

001

**Autologous Olfactory Stem Cells  
Implantation in Stroke Patients:  
A Phase I Study**

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**Background and Rationale:** Intracerebral implantation of olfactory stem cells (OSC) improves functional outcome in rats with chronic cerebral infarction (JCI 2008;118:2482–2495).

**Methods:** A randomized, single blind controlled study was conducted in 6 patients with middle cerebral artery infarction confirmed on T2-weighted MRI 6 months to 5 years after a stroke. Only subjects with neurological deficits of intermediate severity based on the National Institute of Health Stroke Scale (NIHSS) (range: 9–15) that had been stable for at least 3 months were enrolled. Those in the OSC-treated patients received stereotaxic implantation of  $2 \times 10^6$  OSC.

**Results:** All 6 patients completed the 12-month follow-up. No serious adverse events were noted during study period. Improvements in stroke scales (NIHSS, ESS, EMS and FMT) and functional outcome of modified Rankin Scale (mRS) from baseline to the end of the 12-month follow-up period were observed in the OSC-treated patients. The fiber numbers asymmetry (FNA) scores based on diffusion tensor image tractography (DTI) were reduced in every OSC-treated subject. Furthermore, a positive motor evoked potentials (MEP) response by transcranial magnetic stimulation (TMS) appeared in 6 of the 6 subjects in the OSC-treated patients.

**Conclusion:** This phase I study demonstrated that implantation of autologous OSC was safe, feasible, and may be effective in improving stroke-induced neurological dysfunction.

002

**Paracrine Mechanisms of Stem Cell  
Transplantation in Stroke Using Serum  
H-NMR Spectroscopy**

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**Background and Rationale:** Stem cells as regenerative medicine are hope in resistant neurological diseases like Stroke. The current study investigates the paracrine mechanisms of intra-venous stem cell infusion in patients with chronic stroke using invitro H-NMR serum spectroscopy, for measuring the metabolite concentration.

**Methods:** This ongoing randomized controlled trial included 20 stroke patients from 3 months to 2 years of index event. Bone marrow derived mononuclear stem cells (MNC) were infused in 10 patients followed by 8 weeks of physiotherapy and rest served as controls. Serum venous samples were subjected to H-NMR spectroscopy along with assessments with Fugl Meyer (FM), modified Barthel Index (mBI) and MRC for power at baseline, 8, 24 weeks and 1 year. H-NMR spectroscopy was performed with 2D, CPMG spectra using NOESY-based pulse sequence. 340 microlitres of serum, 30 microlitre of trimethylsilylpropionate (TSP) and formate in 200 ml of deuterium oxide (D2O) were added in NMR tubes for analysis.

**Results:** No adverse reactions were observed with stem cells infusion. Mean  $55.3 \times 10^6$  with 0.34% CD34+ mononuclear cells were infused intravenously. There was no significant difference in clinical scores between MNC and control arms at 8 weeks in mBI (65.4 versus 63.2;  $p = 0.72$ ) & FM scores (39.4 vs. 41;  $p = 0.53$ ). Elevated peaks of glutamate, glutamine (2.32 ppm) and acetone (1.9 ppm) compounds in serum of stem cell patients were seen whereas glucose (4.0 ppm) and lactate peaks were observed in all patients ( $p > 0.05$ ).

**Conclusion:** H-NMR spectroscopy provides indirect evidence of release of neurotrophic growth factors by the infused stem cells in patients with chronic stroke.

**Reference:**

Barnaik PR, Devitt TC: Stem cell paracrine actions and tissue regeneration. *Regen Med* 2010;5:121–143.

### Study of Gastrodia on the Recovery of Neurological Function in Rats of Acute Middle Cerebral Artery Occlusion

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**Background and Rationale:** Gastrodia, as a herb of traditional Chinese medicine, is used in treating headaches, dizziness, tetanus, and epilepsy and stroke for thousands years. In this study we investigate the Gastrodia on the recovery of neurological function in rats of acute middle cerebral artery occlusion.

**Methods:** 54 adult male SD rats were randomly divided into sham group (n = 18) and model group (n = 36). Model group rats established by MCAO were randomly divided into control group (n = 18) and dose group (n = 18), respectively. After 24 h, control group were injected the same amount of isotonic saline by intraperitoneal, and dose group were injected Gastrodia by intraperitoneal (4 ml/time, 2 times/d, a total of 14 days). Neurological deficits were evaluated at 2 h, day 1, day 7, day 14, and infarct volume were assessed by hematoxylin and eosin-stained brain sections at day 14 in rats. Cells staining by Brdu were counted as immunopositive stained cells (Brdu) from ischemic subependymal zone (SVZ) and striatum in day 14.

**Results:** Compared with control group, dose group had a significant recovery of neurologic function from 7 days in rats (P = 0.043, P = 0.031). Gastrodin had significantly improved the neurologic functions in rats. The infarct volume of dose group rats was significantly different compared with that of control group (P = 0.044). BrdU positive cells in the SVZ and striatum area of treatment group was significantly higher compared with the control group at day 14 (P = 0.009, P = 0.040).

**Conclusion:** Gastrodia can promote the recovery of neurological function, and has an effect on the proliferation of brain cells after acute infarction in MCAO rats.

### Timing of Initial Mobilisation after Acute Stroke – Relation to 180 Day Outcomes

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**Background and Rationale:** The recent AVERT trial results (Bernhardt, 2015) have increased uncertainty regarding when mobilisation should commence following stroke, and the relative importance of intensity versus timing. We investigated the relationship between timing of initial mobilisation and outcomes using ‘real world’ data from the Australian Stroke Clinical Registry (AuSCR).

**Methods:** Data from AuSCR registrants admitted with stroke to 23 Queensland hospitals between July 2012 and December 2014 were used. Cases of in-hospital stroke and transfers from other hospitals were excluded. Initial mobilisation occurring on the day of admission was defined as Very Early Initial Mobilisation (VEIM), and on the subsequent day as Early Initial Mobilisation (EIM). The relationship between timing of initial mobilisation and death within 180 days was assessed using Cox proportional hazards regression, and Health-related Quality of Life (HR-QoL) outcomes (EQ5D-3L visual analogue scale, deaths coded as 0) using median regression. Models were adjusted for patient demographics, stroke severity, stroke type, and patient clustering.

**Results:** Among 5337 episodes of care (median age 75 years, 54% male, 80% ischaemic stroke, 35% able to walk independently on admission), 36% received VEIM, 35% EIM, 12% were mobilised later, and 17% never mobilised. VAS data were available for 2749 first episodes. Hazard of death within 180 days was significantly lower in the VEIM group when compared to EIM alone (hazard ratio (HR): 0.68, 95% CI: 0.54–0.86, p = 0.001) or to those mobilised later (HR: 0.58, 95% CI: 0.47–0.72, p < 0.001). Registrants receiving VEIM also reported better HR-QoL when compared to EIM alone (EQ5D-3L VAS coefficient 5.16, 95% CI: 3.36–6.97, p < 0.001), or to registrants mobilised later (coefficient 6.29, 95% CI: 4.58–8.01, p < 0.001).

**Conclusion:** In this observational study, VEIM following acute stroke was associated with improved survival and HR-QoL. Amount, rather than timing of mobilisation may explain the poorer outcomes found in the intervention group in the AVERT study.

## Reference:

Bernhardt J, Langhorne P, Lindley RI, Thrift AG, Ellery F, Collier J, Churilov L, Moodie M, Dewey H, Donnan G: Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet* 2015;386:46–55.

005

### SMART Arm Training in Subacute Stroke Survivors with Severe Arm Disability: A Randomised Controlled Trial

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**Background and Rationale:** The SMART Arm is a device designed to promote arm and hand recovery in stroke survivors with severe disability. By enabling practice of reaching, pilot trials of SMART Arm training have demonstrated improved arm function in subacute and chronic stroke. This study aimed to determine the effect of SMART Arm training with or without outcome-triggered electrical stimulation compared with usual therapy in stroke survivors with subacute and severe arm disability undergoing inpatient rehabilitation.

**Methods:** A prospective, multicentre randomised controlled trial, with three parallel groups, concealed allocation, assessor blinding and intention-to-treat analysis was performed. Fifty inpatients within four months of diagnosis of first stroke who had severe arm and hand disability received 20, 1-hour sessions over four weeks of either (1) SMART Arm training with outcome-triggered stimulation (SMART Arm-stim) and usual therapy (n = 16), (2) SMART Arm-alone and usual therapy (n = 17), or (3) usual therapy (control, n = 17). Participants were assessed at baseline, post-intervention, 26- and 52-weeks follow up. The primary outcome measure was Motor Assessment Scale item 6 (upper arm function, MAS-6) at post-intervention, with a score of >1 point change classified as a minimal clinically important difference (MCID).

**Results:** There was no difference in MAS-6 scores between groups at post-intervention, 26 or 52 weeks (p > 0.23). At post-intervention, 65% of SMART Arm-stim, 53% of SMART Arm-alone and 47% of controls achieved a MCID on MAS-6. The SMART Arm-stim group had a greater odds (GenOR 1.47 95% CI 1.23–1.71) of achieving a MCID than controls. At 26-weeks, 69% of the SMART Arm-stim group, 88% of SMART Arm-alone and 59% of controls achieved a MCID on MAS-6. The SMART Arm-alone group had a greater odds than controls of achieving a MCID (GenOR 1.31 95% CI 1.05–1.57).

**Conclusion:** SMART Arm training may increase the likelihood of recovery compared with usual therapy alone.

006

### A Very Early Rehabilitation Trial (AVERT): Outcome at 12 Months

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**Background and Rationale:** We found that a very early intensive out-of-bed mobilisation (VEM) protocol after stroke compared to usual care was associated with a reduction in odds of a favourable outcome at 3 months. We report pre-specified analyses to determine whether VEM post stroke results in better outcomes at 12 months when compared to usual stroke unit care.

**Methods:** We performed a prospective, parallel group, assessor-blinded, multi-centre, clinical trial with the following inclusion criteria: admission within 24 hours of stroke and physiological parameters within pre-set limits. Treatment with rt-PA was allowed. Patients with severe premorbid disability and/or severe comorbidities were excluded. Patients were randomised to VEM or usual care. The intervention, delivered by a physiotherapy/nurse team, started within 24 hours and continued for a maximum of 14 days. Analyses were intention-to-treat. Pre-specified adjusted analyses for 12 month outcomes were: (i) mRS with subgroup analyses for age, stroke severity, stroke type, treatment with rtPA, time to first mobilisation and geographic region; (ii) time days to walking unassisted; (ii) deaths; and (iv) non-fatal serious adverse events.

**Results:** From July 2006 to October 2014, 2104 patients were recruited (Australia, n = 1054; New Zealand, n = 189; Malaysia, n = 123; Singapore, n = 128; UK, n = 610). Patient demographics: age, median (IQR) age: 72.5 (62.9–80.3) years; male: 61.1%; first stroke: 81.8%; ischaemic stroke 87.7%; NIHSS median (IQR): 7 (4–12); rt-PA treated 24.1%. There were 52 (2.5%) patients with missing data for the 12 month mRS. Data lock was completed in December 2015, with analyses underway.

**Conclusion:** Results will provide important information on the 12 month outcomes of a very early intensive rehabilitation protocol following stroke.

## The Changing Trend of Short-Term BP Variability in Patients with Acute Ischemic Stroke and Early Neurologic Outcome

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**Background and Rationale:** In patients with acute ischemic stroke, BP variability (BPV) was characterized into the two steps, which were the 24 hour of short-term time window and its secular trend at first three days. And then, their effects on early neurological outcome were investigated.

**Methods:** Patients who had clear onset time of ischemic stroke and arrived within 24 hour of symptom onset were consecutively identified from prospective stroke registry of Seoul National University Bundang Hospital. All BP information measured from the real clinical practice were summarized into daily standard deviation (SD) and mean during first three days. Primary outcome was the early neurological deterioration (END) during first three days. The associations of daily SDs of SBP and their interactions for END were examined with adjustments for mean of SBP and other predetermined covariates.

**Results:** The enrolled 2545 patients (mean age,  $67.1 \pm 13.5$  years-old and median baseline NIHSS score, 3 (interquartile range, 1–9)) arrived the hospital in  $6.1 \pm 6.6$  h of symptom onset. SD of SBP at day 1 (SD#D1), SD#D2 and SD#D3 were  $14.4 \pm 5.0$ ,  $12.5 \pm 4.5$  and  $12.2 \pm 4.6$  mm Hg, respectively. Each SD#D2 and SD#D3 independently raised the odds of END at day 2 (END#D2) and END#D3, respectively (adjusted odds ratio, 1.08; 95% confidence interval, 1.05–1.12 and 1.06; 1.01–1.12). The interactions between SD#D1 and SD#D2 for SD#D2 and among SD#D1, SD#D2 and SD#D3 for SD#D3 did not changed the effect sizes of event day's SD (P for interactions >0.5).

**Conclusion:** At acute stage of ischemic stroke, short-term BPV would change from first day of stroke onset and high BPV at each day might increase independently the risk of neurological deterioration.

## Inequities in Access to Rehabilitation after Stroke: An International Scoping Review

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**Background and Rationale:** Inequities in accessing inpatient rehabilitation are important and impact on patient outcomes. We sought to compare international rehabilitation assessment recommendations, practices and access to rehabilitation to those of Australia to guide efforts in promoting equitable access to rehabilitation.

**Methods:** International stroke guidelines available in English were examined to identify the recommended rehabilitation selection criteria, when these were reported. Literature was reviewed that provided summary data of rehabilitation selection practices and access to rehabilitation. Descriptive scoping review presented.

**Results:** Data from 13 countries or regions of Europe, North America and Australasia were identified. Seven countries or regions reported inequities in accessing inpatient rehabilitation after stroke. Australian, New Zealand, Canadian and United Kingdom guidelines suggest that all patients with stroke symptoms should access rehabilitation, whereas guidelines from the United States of America (USA) and Europe included reservations or an exclusion criterion for patients with severe stroke. Recommendations frequently did not align with audited practice.

Nine countries or regions reported which health professionals selected patients for inpatient rehabilitation; in 5 reports acute medical professionals assumed sole responsibility for these decisions. The involvement of patients and their families in rehabilitation decisions was only documented in 1 report (USA). Access to inpatient rehabilitation ranged from 17% in Ireland to 31% in Australia and 44% in USA and Switzerland.

**Conclusion:** Clear recommendations regarding how patients with stroke should be assessed for ongoing rehabilitation are inconsistent between countries and regions in North America, Europe and Australasia. Inequity in access to rehabilitation after stroke is an international issue.

## The Changing Opinions of Australasian Health Professionals Regarding Early Mobilisation after Stroke

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**Background and Rationale:** The feasibility, safety and effectiveness of early and intensive mobilisation after stroke has been tested in clinical trials including the large, multi-centre A Very Early Rehabilitation Trial (AVERT) (Bernhardt et al, 2007). The purpose of our study was to determine how the opinions of Australasian health professionals regarding early mobilisation after stroke have changed between 2008 and 2014, over the course, but prior to completion, of the AVERT trial.

**Methods:** Attendees at the two major Australasian stroke conferences in 2008 and 2014 were surveyed for their opinions regarding early and intensive mobilisation after stroke. Participants were asked to rate their level of agreement with 7 statements regarding opinions of the risks and benefits of commencing intensive mobilisation within 24 hours of both haemorrhagic and ischaemic stroke. A 5-point Likert scale was used to rate participants' levels of agreement (Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). Participants in 2014 were also asked about their awareness of, and participation in, the AVERT trial. Logistic regressions were performed to determine whether the time point (2008 vs. 2014) or having heard about AVERT had an influence on opinions about early mobilisation.

**Results:** Surveys were completed by 442 health professionals (2008 n = 202, 2014 n = 241). Respondents were most often nurses (31%), physiotherapists (25%) and medical professionals (22%). The majority of respondents in 2014 reported that early, intensive mobilisation was beneficial and not harmful for people with ischaemic and haemorrhagic stroke. A significantly greater proportion of respondents in 2014 compared to 2008, were in favour of early mobilisation for patients with haemorrhagic stroke (2008 n = 98/202 [49%] vs. 2014 n = 170/241 [71%],  $p < 0.01$ ). Participants in 2014 who were aware of the AVERT trial were significantly more likely to report that early, intensive mobilisation was of benefit and not of harm to patients with stroke ( $p < 0.05$ ).

**Conclusion:** Australasian health professionals' opinions of early and intensive mobilisation after haemorrhagic stroke changed between 2008 and 2014, prior to completion of the AVERT trial. Our results suggest that awareness of the AVERT trial may have influenced health professionals' opinions. This study highlights how familiarity of a research question may lead to changes in opinions, and potentially clinical practice, prior to the efficacy and risk of harm of an intervention being known.

## Reference:

Bernhardt J, Dewey HM, Donnan GA, Thrift AG, Lindley RI, Moodie M: Protocol 06PRT/5424: A Very Early Rehabilitation Trial (AVERT): phase III (Australian Clinical Trials Registry: 1260600185561). *Lancet*, 2007.

## The Impact of Early Mobilisation on Cognition: MoCA Outcomes from AVERT

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**Background and Rationale:** There is evidence that physical activity enhances cognitive and brain function, particularly in older adults (Kramer & Erickson, 2007). Whether increasing the level of physical activity in acute stroke influences subsequent cognitive performance is not known. Despite the high prevalence of post-stroke cognitive impairment, less than 5% of stroke studies include a cognitive outcome measure (Lees et al, 2012).

**Methods:** A Very Early Rehabilitation Trial (AVERT) was a randomised controlled trial conducted across 56 acute stroke units in 5 countries from 2006–2015. Participants were included if they were aged 18+, satisfied physiological limits and presented within 24 hours of symptom onset of a first or recurrent stroke (ischaemic or haemorrhagic). Participants were randomised to receive either usual stroke-unit care alone or very early mobilisation in addition to usual care. The Montreal Cognitive Assessment (MoCA), scored from 0–30, was introduced as a 3-month outcome during 2008.

**Results:** Of the 2104 patients included in AVERT, 317 were assessed prior to the introduction of the MoCA. Of the remaining 1787, 1189 (66.5%) had complete MoCA data, 456 (25.5%) had partial or completely missing data, 136 (7.6%) had died, and 6 (0.3%) were lost to follow-up. In those with complete data, total MoCA scores were very similar in the treatment (n = 595, mean = 21.9, SD = 5.9) and control (n = 594, mean = 21.8, SD = 5.9) groups ( $p = 0.91$ ).

**Conclusion:** Exposure to earlier and more frequent mobilisation in the acute stage of stroke does not appear to influence cognitive outcome at 3 months. This stands in contrast to the primary outcome from AVERT (modified Rankin Scale), where the treatment group had less favourable outcomes than controls.

## References:

Kramer AF, Erickson KI: Capitalizing on cortical plasticity: influence of physical activity on cognition and brain function. *Trends Cogn Sci* 2007;11:342–348.  
Lees R, Fearon P, Harrison JK, Broomfield NM, Quinn TJ: Cognitive and mood assessment in stroke research. *Stroke* 2012;43:1678–1680.

## Circuit Class Therapy Reduces Length of Rehabilitation Stay, But Weekend Therapy Does Not. An Exploratory Secondary Analysis of the CIRCIT Trial

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**Background and Rationale:** The CIRCIT trial (Circuit class therapy or 7-day week therapy for Increasing Rehabilitation Intensity of Therapy) compared two alternative models of physiotherapy service provision to usual care physiotherapy. The aim of this study was to explore the impact of therapy type on length of rehabilitation hospital stay (LoS).

**Methods:** Secondary exploratory analysis of multi-centre, 3-armed randomized controlled trial (n = 283). Eligible participants were randomised to receive either; usual care therapy 5 days a week, usual care therapy 7 days a week or circuit class therapy (CCT) 5 days a week. We examined between group differences in LoS using the Kruskal-Wallis test. We used multivariate regression to explore the independent effect of providing either 7-day week therapy or CCT on LoS.

**Results:** There were no significant between group differences in median LoS (p = 0.64). The multivariate regression model comparing CCT to usual care showed time between stroke onset and admission to rehabilitation, baseline functional independence scale motor score and baseline walking speed contributed significantly to LoS. Age, co-morbidities and type of stroke (Oxfordshire Stroke Classification) did not. Controlling for these variables, randomization to the CCT group was an independent predictor of a shorter LoS in the order of -11.6 days (95% CI -21.3 to -1.9, p = 0.019) and accounted for 37% of the variance in LoS. Comparing 7-day week therapy to usual care, only time between stroke onset and admission to rehabilitation, baseline functional independence scale motor score and baseline walking speed contributed significantly to the model. Randomization to the 7-day week did not have an independent effect on LoS (mean difference -6.5 days, 95% CI -14.8 to 6.6, p = 0.22).

**Conclusion:** Length of rehabilitation stay is influenced by many factors. This exploratory analysis, suggests that group CCT may have a positive, independent impact on LoS, but weekend therapy services do not.

## Analysis of the Barthel Index Using Quantile Regression in the Chinese Medicine Neuroaid Efficacy on Stroke Recovery (CHIMES) Study

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**Background and Rationale:** Barthel Index (BI) is pseudo-continuous and often violates the normality assumption of linear regression. Quantile regression does not depend on such assumptions. We aimed to investigate the BI using quantile regression in a randomized, double-blind, placebo-controlled trial of subjects with stroke of intermediate severity.

**Methods:** We analyzed data from 999 subjects (499 MLC601, 500 placebo) from the CHIMES Study (Chen et al, 2013). 971 patients had BI assessment at month 3. 28 died before final assessment. Multivariable linear, quantile (median, 5th, 10th, 25th percentile), logistic (dichotomized using cutoffs 85, 90, 95) regression models were fitted to BI, which was regressed to allocated treatment, age, sex, baseline National Institute of Health Stroke Scale, time from stroke onset to first dose, and pre-stroke modified Rankin Scale. Adjusted difference in mean and median BI, adjusted odds ratio (OR) were estimated, together with 95% confidence interval (CI). Quantile regression CI was constructed by 10,000 bootstrap resamples.

**Results:** Baseline characteristics were similar between groups. Distribution of BI was heavily skewed with nearly half of the patients obtaining BI of 100, resulting in significant ceiling effect. Linear regression adjusting for baseline prognostic factors showed higher mean BI in MLC601 group by 2.43 points (not statistically significant), while quantile regression revealed statistically higher median BI in MLC601 group than placebo (Difference 1.28, 95% CI 0.04–2.51, p = 0.043). Treatment effect was insignificant in logistic regression models regardless of cutoff used. The 10th percentile of BI was significantly higher in MLC601 compared to placebo by 7.62 points (95% CI 1.55–69, p = 0.014). The MLC601 group had higher 5th and 25th percentile values than the placebo (not statistically significant).

**Conclusion:** Quantile regression demonstrates treatment effect of MLC601 and can be a reliable alternative to linear regression for analyzing BI in stroke trials. It can also model other percentiles of distribution depending on stroke severity.

## Reference:

Chen CH, Young SH, Gan HH, Singh R, Lao AY, Baroque II AC, et al: Chinese medicine neuroaid efficacy on stroke recovery: a double blind, placebo controlled, randomized study. *Stroke* 2013;44:2093–2100.

# Lessons Learnt from Evaluating Interventions for Improving Rehabilitation Assessment Practices for Patients with Stroke in Australia

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**Background and Rationale:** Ten hospitals in New South Wales and South Australia participated in a mixed-methods cluster randomized trial comparing education-only to a multifaceted intervention for improving stroke rehabilitation assessment practices.

**Methods:** The interventions were evaluated using the RE-AIM (Reach, Effectiveness, Adoption, Implementation and Maintenance) framework, developed by Glasgow et al (1999). Data were collected using standardized medical record audits (n = 594) and focus groups with staff (48 participants). Triangulation of the data was used to provide a summary of the findings using this framework.

**Results:** Reach: Interventions had greatest reach with allied health and nursing staff, but negligible reach with acute medical or rehabilitation staff.

Effectiveness: both interventions were effective for increasing proportions of patients assessed for rehabilitation (64% assessed pre-intervention, 73% post-intervention,  $p = 0.01$ ). There was no significant difference in the change in proportions of patients assessed between groups. Minimal impacts on rehabilitation referral practices were found post-intervention. Participants at 6 sites reported that rehabilitation referrals were guided by perceived likelihood of acceptance to a rehabilitation service.

Adoption: 8 sites reported changing some aspect of rehabilitation assessment or referral practices. Adoption at the professional level was led by allied health and nursing staff.

Implementation: Interventions were delivered as intended at 8 of the 10 sites.

Maintenance: Long-term maintenance of rehabilitation assessment practices was not evaluated.

**Conclusion:** This structured evaluation has highlighted where further improvement to rehabilitation assessment could be focused, with modest effects achieved from externally facilitated interventions. Further work is required to ensure that all patients with stroke are referred to rehabilitation if they experience ongoing signs of stroke.

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# Embedding an Enriched Environment in an Acute Stroke Unit Increases Activity in People with Stroke: Results of a Pilot Study

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**Background and Rationale:** An enriched environment (EE) significantly improves functional recovery in animal models of stroke and can increase activity levels in people with stroke in subacute inpatient rehabilitation. We sought to translate an EE into an Acute Stroke Unit (ASU) and determine if our model of enrichment could increase activity levels (primary outcome) and safety (secondary outcome) after stroke.

**Methods:** A before-after pilot study utilising behavioural mapping every 10 minutes between 7.30 am and 7.30 pm was conducted to compare activity levels of stroke patients recovering in an enriched and non-enriched ASU. Patients were observed within 10 days post stroke. The EE was comprised of: communal areas for eating and socialising, group activities and provision of equipment including newspapers, magazines, books, music and iPads. Staff focus towards enabling patient activity was reinforced through interdisciplinary education and appointing nurse champions. Differences between group activity levels were determined using one-way ANCOVA adjusting for age, stroke severity and premorbid function.

**Results:** Sixty stroke patients participated, 30 exposed to an enriched (mean age 76.7; SD 12.1) and 30 to a non-enriched (mean age 76.0; SD 12.8) ASU. Patients in the enriched ASU spent a higher proportion of their day engaged in activity compared to patients in a non-enriched ASU (71% vs. 58%,  $p = 0.005$ ). They were more engaged in physical (33% vs. 22%,  $p < 0.001$ ), social (40% vs. 29%,  $p = 0.007$ ) and cognitive (59% vs. 45%,  $p = 0.002$ ) activity and spent less of their day in a supine position (45% vs. 68%,  $p < 0.001$ ). Fewer patients in the enriched ASU experienced adverse events ( $n = 7$  vs.  $n = 16$ ) and serious adverse events ( $n = 4$  vs.  $n = 11$ ).

**Conclusion:** Use of our model of EE in an ASU increased activity levels in people with stroke. A Phase II trial is needed to determine the feasibility and safety of our model as an important preliminary step to determining functional efficacy in a Phase III Trial.

## Systematic Review of Novel Activity Promoting Strategies to Incorporate into a Model of Environmental Enrichment for Use During Inpatient Stroke Rehabilitation

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**Background and Rationale:** Environmental Enrichment (EE) is an experimental concept based on physical, cognitive and social stimuli and how the brain reacts to this stimuli. EE can also provide for conditions which facilitate physical, cognitive and social activity and has been shown to significantly improve recovery in experimental stroke. We wished to identify potential strategies fitting within the principles of EE which could be included within a broader model of EE for use during stroke rehabilitation.

**Methods:** Systematic review of studies investigating patient- or non-therapist led activities that promoted physical, cognitive and/or social activity. Studies were identified by searching the following databases: MEDLINE, CINAHL, EMBASE and CENTRAL. Two independent researchers screened the studies for eligibility. The quality of randomised controlled trials (RCTs) was assessed against the Physiotherapy Evidence Database (PEDro) Scale. Outcomes were grouped into (i) behavioural outcomes (eg. activity levels) (ii) stroke recovery (eg. function, mood), (iii) patient satisfaction and (iv) adverse events.

**Results:** 3683 citations were retrieved, 78 full text reviewed and 17 studies (581 patients) included in the analysis. Quality of the RCTs (n = 10) was moderate (PEDro = 6/10) and overall study sample sizes were small (median n = 30, range n = 6–103). Strategies included interactive gaming (n = 7), ward models of activity promotion (n = 4), music (n = 3), art (n = 2) and patient exercise booklets (n = 1). Greater patient activity was observed and most patients enjoyed these potential enrichment strategies. Improvement in stroke recovery was reported in the majority of studies and very few adverse events occurred.

**Conclusion:** There is a small amount of evidence in support of novel patient- and non-therapist-led enrichment strategies. The next step is to conduct larger clinical trials which test models of Environmental Enrichment which incorporate a number of these strategies to determine safety, generalisability and efficacy of this approach to activity promotion.

## Elevated Fibrinogen in Diabetes Mellitus Is Associated with Early Neurological Deterioration in Patients with Acute Ischemic Stroke

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**Background and Rationale:** Diabetes mellitus (DM) is a risk factor for early neurological deterioration (END) in acute ischemic stroke (Scott et al. 1999). However, the mechanism of END in DM patients is not clear. Fibrinogen is a prothrombic factor associated with vascular complications in DM (Asakawa et al. 2000). In this study, we evaluate whether fibrinogen is a risk factor of END in diabetic patients with acute ischemic stroke.

**Methods:** We enrolled 3814 acute ischemic stroke patients within 72 hours of onset with available initial National Institutes of Health Stroke Scale (NIHSS) data in a single center database from Jan 2000 to Dec 2015. END was defined as 2 or more increase in the NIHSS within 7 days after admission. After propensity score matching (END, n = 660; nonEND, n = 1320), univariable and multivariable analyses were performed to document fibrinogen as an independent predictor for END. For subgroup analyses, we performed propensity score matching for DM (END, n = 261; non-END, n = 522) and nonDM population (END, n = 399; nonEND, n = 798), respectively. Again, univariable and multivariable analyses were performed to document fibrinogen as an independent predictor for END in each subgroup. Age, sex, initial NIHSS, hypertension and TOAST classification ( $\pm$ DM) were commonly used as covariables for matching and multivariable analyses.

**Results:** Compared to non-END population, END population had higher glycated hemoglobin levels ( $6.42 \pm 1.29\%$  vs.  $6.64 \pm 1.57\%$ ,  $p = 0.035$ ), fasting glucose ( $144 \pm 62$  mg/dl vs.  $151 \pm 66$  mg/dl,  $p = 0.021$ ), and higher fibrinogen levels ( $351 \pm 111$  mg/dl vs.  $367 \pm 156$  mg/dl,  $p = 0.018$ ). In logistic regression analysis, higher fibrinogen levels were associated with END (odds ratio: 1.011 per 10, 95% confidence interval: 1.003–1.019,  $p = 0.010$ ). In subgroup analyses, higher fibrinogen levels were an independent predictor for END in DM population (1.014 per 10, 1.003–1.026,  $p = 0.013$ ) while irrelevant in nonDM population (1.001 per 10, 0.990–1.013,  $p = 0.805$ ).

**Conclusion:** High fibrinogen level is a risk factor for END in diabetic patients with acute ischemic stroke.

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## Relationship between Modified Rankin Scale and Other Stroke-Related Measures in the CHIMES Study

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**Background and Rationale:** The Modified Rankin Scale (mRS) uses a single item to estimate a subject's disability, making decomposition into more basic items unfeasible. National Institutes of Health Stroke Scale (NIHSS) and Barthel Index (BI) contain multiple items related to various aspects of the subject, allowing investigation of factors underlying these measures. We explored the relationship between mRS and the total score and individual items of NIHSS and BI to implicitly examine the factors that constitute the mRS.

**Methods:** We analyzed data from 910 patients (453 placebo, 457 MLC601) who completed month 3 assessments in the CHIMES Study, a double-blind, randomized, placebo-controlled trial of MLC601 in patients with ischemic stroke of intermediate severity. Ordinal logistic regression models were fitted to estimate mRS using the total score and individual items of NIHSS, BI and mini-mental status examination (MMSE).

**Results:** mRS was strongly associated with NIHSS and BI individually. When NIHSS and BI were considered together, 8 items on NIHSS (facial palsy, left arm motor, right arm motor, left leg motor, right leg motor, ataxia, language, dysarthria) and 4 items on BI (dressing, bladder, toilet use, stairs) remained in the final model. The addition of MMSE score or items to the model did not improve the performance. A previous factor-analysis classified the NIHSS items into four factors (Lyden P et al, 1999). The NIHSS items associated with mRS coincided with 3 factors: left motor factor (right arm, right leg and dysarthria), right motor factor (left arm and left leg), and left cortex factor (commands and language). None of the items in the right cortex factor (gaze, visual field, sensory and extinction) was associated with mRS.

**Conclusion:** The mRS is mainly constituted by left and right motor functions and left, but not right, cortical function.

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## Sex Differences in Long-Term Mortality and Disability of Stroke: The INTERNATIONAL STROKE OUTCOMES Study (INSTRUST)

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**Background and Rationale:** It is uncertain why women suffer worse long-term outcomes after stroke than men. We examined sex differences in mortality and disability 1 and 5 years after stroke and identified factors contributing to these differences.

**Methods:** Individual patient data meta-analysis of incident strokes (ischaemic and haemorrhagic) from 1987–2013 were ob-

tained from 13 population-based studies from Australasia, Europe, South America and the Caribbean. Data on socio-demographics, stroke-related factors and pre-stroke health were obtained for each patient and harmonised between studies. Poisson modelling estimated the mortality rate ratio (MRR) for women compared to men at 1 year (13 studies) and 5 years (8 studies) post-stroke. Log binomial regression estimated the relative risk (RR) of poor outcome (modified Rankin scale >2 or Barthel Index <20) for women compared to men at 1 year (9 studies) and 5 years (6 studies) after stroke. Study-specific multivariable models adjusted for all potential confounders were combined using random-effects meta-analysis.

**Results:** A total of 16,957 first-ever stroke patients followed-up at 1 year and 13,216 followed-up to 5 years were included. Crude mortality was greater in women than men at 1-year (pooled MRR 1.34; 95% CI 1.24–1.44) and 5 years (pooled MRR 1.24; 95% CI 1.14–1.35). The factors that explained most of the difference in survival between men and women were age, pre-stroke dependency, stroke severity and a history of atrial fibrillation, with the sex difference reversed after adjustment at both 1 year (MRR 0.90; 95% CI 0.80–1.02) and 5 years (MRR 0.85; 95% CI 0.73–0.98) after stroke. Women were more often disabled after than men at 1 year (RR 1.31; 95% CI 1.17–1.47) and 5 years (RR 1.29 95% CI 1.15–1.44). Similar factors contributed to this sex difference, including age, pre-stroke dependency, stroke severity with adjusted models at showing a much smaller difference in the risk of disability between women and men 1 year (RR 1.08; 95% CI 0.97–1.20) and 5 years (RR 1.06; 95% CI 0.96–1.18) after stroke.

**Conclusion:** Worse outcomes in women were mostly due to age and potentially modifiable factors of stroke severity and atrial fibrillation providing potential targets to reduce the burden of stroke in women.

019

### Long Term Outcomes of First-Ever Stroke in HoChiMinh City, Vietnam

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**Background and Rationale:** There has been limited assessment of the long-term outcomes of patients with stroke in developing countries, such as Vietnam. The aim of this study was to determine mortality, functional status and health-related quality of life (HRQoL) at 2 years after first-ever stroke among a cohort of patients discharged from a major public hospital in HoChiMinh City, Vietnam.

**Methods:** First-ever patients with stroke admitted to the stroke unit of 115 People's Hospital from June to September 2012 were

interviewed for demographic, co-morbid and lifestyle factors. Stroke severity on admission was determined using the National Institutes of Health Stroke Scale (NIHSS). Outcome measurements included functional status, using the modified Rankin Scale (mRS), and HRQoL, using the EuroQoL (EQ-5D), obtained during face-to-face interview at 3 months and by telephone at 2 years.

**Results:** We recruited 450 consecutive patients (99.6% participation, 47.9% female, mean age 62.5 [SD 14.0] years, 76.2% ischaemic stroke). Mortality at 2 years was 17.1%. Telephone follow-up of survivors was completed in 276 patients (97% eligible). At 2 years, the mean mRS score of survivors was 2.1 (SD 1.6) with 38% classified as 'dependent' (mRS≥3). Of those, who were 'dependent' at 2 years, 68.9% were also 'dependent' at 3 months. Among patients with 'independent' functional status at 2 years, 76.2% were 'independent' at 3 months. One quarter of patients who were 'independent' at 3 months were either 'dead or dependent' at 2 years. The mean EQ5D utility score was 0.79 (SD 0.12) at 2 years. Compared to 3 months after stroke, one quarter of survivors had a clinically meaningful reduction in EQ5D utility score by 2 years.

**Conclusion:** The proportion of patients with poor functional status and HRQoL at 2 years suggests a high continuing burden on patients and their families at 2 years after stroke onset.

020

### Do CT Perfusion Imaging Profiles Impact Response to Endovascular Reperfusion? A Pooled Analysis of Randomized Trials of Endovascular Stent Thrombectomy

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**Background and Rationale:** The role of CT-perfusion imaging in selection of patients for endovascular thrombectomy has been controversial. We pooled data to investigate the association of CT-perfusion imaging profiles in 5 recent randomized trials of endovascular stent-thrombectomy.

**Methods:** Patient-level imaging data from the MR CLEAN, ESCAPE, EXTEND-IA, SWIFT PRIME and REVASCAT trials were pooled (HERMES Collaboration). CT-perfusion data were uniformly reprocessed using RAPID software (non-commercial research version, Stanford University) as used in the EXTEND-IA and SWIFT PRIME trials. Irreversibly injured ischemic core was defined using a relative cerebral blood flow threshold <30% of normal brain. Tissue at risk of infarction (ischemic penumbra) was estimated using a Tmax threshold >6 seconds. The association between pre-treatment ischemic core and mismatch volumes and the 90 day modified Rankin scale (mRS) was examined by treatment status and reperfusion status. The number needed to treat (NNT) to achieve at least 1 unit improvement in the mRS with endovascular treatment versus control was calculated as a function of ischemic core volume as a continuous variable. A similar analysis was performed for the NNT to achieve an extra patient with independent outcome (mRS0–2).

**Results:** The results will be presented at the conference and are expected to include over 400 patients with pre-treatment CT-perfusion imaging.

**Conclusion:** This analysis will comprise the largest series examined to date with CT-perfusion imaging prior to endovascular therapy using current technology. The resulting insights into whether CT-perfusion parameters are prognostic, treatment effect modifying or both will be highly relevant to clinical practice.

021

### Clinical Utility of Whole-Brain 4D-CTA Using 320-Detector Row CT in the Evaluation of Spontaneous Lobar Intracerebral Hemorrhage

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**Background and Rationale:** The recently introduced 320-detector row computed tomography (CT) enables whole-brain perfusion imaging and CT angiography (CTA) in one examination, allowing cerebrovascular diseases to be evaluated less invasively. The purpose of this retrospective study was to evaluate the clinical utility of 320-detector row CT, particularly with whole-brain four-dimensional CT angiography (4D-CTA), in the detection of underlying vascular abnormalities causing spontaneous lobar intracerebral hemorrhage (SLICH).

**Methods:** Subjects were patients admitted to our hospital emergency room between April 2011 and January 2016 and were diagnosed with SLICH by non-contrast CT. Contrast-enhanced CTA (including 4D-CTA) was performed for all patients with a 320-detector row CT scanner soon after confirmation of a hemorrhagic lesion. Patients with bleeding in common sites of hypertensive intracerebral hemorrhage (basal ganglia, thalamus, brain stem, or cerebellar dentate nucleus) were excluded.

Evaluation items included the location and size (estimated bleeding volume) of the hematoma, and the number and frequency (%) of cerebrovascular lesions detectable with 4D-CTA. In patients who also underwent cerebral angiography (CAG), the con-

cordance rate between 4D-CTA and CAG results was calculated, Spetzler-Martin grade for cerebral arteriovenous malformations (AVMs) and Cognard classification for dural arteriovenous fistulas (dAVFs). Images were evaluated by two expert neuroradiology readers in consensus.

**Results:** In total, 136 consecutive patients matched our criteria (78 men (57.4%); mean age, 56.4 ± 15.7 years; range, 20–88 years; mean estimated bleeding volume, 16.5 ± 11.6 ml). With 4D-CTA, a vascular lesion was detected as the source of bleeding in 16 (11.8%) of the 136 patients: 6 had AVMs, 5 had dAVFs, 3 had aneurysms, and 2 had Moyamoya disease. In patients who underwent CAG, 4D-CTA and CAG offered nearly identical diagnostic performance.

**Conclusion:** Whole-brain 4D-CTA using 320-detector row CT was useful for diagnosing SLICH, particularly in the detection of cerebrovascular lesions.

022

### Whole Brain CT Perfusion in Suspected Transient Ischemic Attack and Minor Stroke

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**Background and Rationale:** There is limited data on the usefulness of CT Perfusion (CTP) imaging in the evaluation of transient ischemic attack (TIA) and minor stroke. We aimed to characterise the spectrum of perfusion abnormalities in TIA and minor stroke with whole brain CTP.

**Methods:** Patients presenting to John Hunter Hospital with suspected TIA were scanned by multi-modal CT (320-detector scanner) including non-contrast CT (NCCT), CT angiography (CTA), and CTP, with later MRI. A pixel based analysis was undertaken to determine perfusion abnormalities on CTP which were correlated with diffusion MRI (DWI) and clinical characteristics.

**Results:** Of 129 patients who underwent whole brain CTP (median 38 hours after symptom onset) and MRI (median 139 hours), 103 had perfusion abnormalities, and 39 had DWI abnormality. Perfusion abnormality included: hypoperfusion (57 of 129) and hyperperfusion (46 of 129). CTP had a high sensitivity (89.7%) but low specificity (24.4%) in predicting DWI abnormality. Only 2 of 39 (5.1%) patients with DWI abnormality were CT Perfusion negative. Both hypo- and hyperperfusion were associated with extracranial CTA disease ( $p = 0.014$ , OR 8.5, 95% CI 1.55–46.40), hypoperfusion alone was associated with prior smoking ( $p = 0.01$ , OR 5.46, 95% CI 1.34–22.1) and hyperperfusion with prior migraines ( $p = 0.04$ , OR 5.14, 95% CI 1.17–14.67).

**Conclusion:** CTP is sensitive in detecting cerebrovascular ischemia and is comparable to MRI in the evaluation of acute neurovascular syndromes. Despite its low specificity, a negative CTP would be helpful in early risk stratification particularly in centres with limited access to early MRI.

### Longitudinal Network-Wide Cortical Thickness Changes after Ischaemic Stroke

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**Background and Rationale:** Investigation of brain atrophy after stroke, a key indicator of neurodegeneration, is typically limited to localised atrophy and cross-sectional studies. We examined correlations in the rate of longitudinal cortical atrophy in stroke patients, compared to healthy age-matched controls, in order to investigate whether patterns of neurodegeneration resembled healthy functional networks as seen in aging and dementia syndromes (Zhou et al. 2012).

**Methods:** Fifty-three patients (mean age 67, SD 11) were scanned 3 months and 1 year after ischaemic stroke. Fourteen healthy age-matched controls (mean age 68, SD 5) were scanned at the same time points. High-resolution structural images were acquired as part of a longer imaging protocol (Brodtmann et al. 2014). Images were processed using the longitudinal stream in Freesurfer (Reuter & Fischl 2011). We calculated vertex-wise Pearson's correlations in the rate of cortical atrophy relative to a posterior cingulate region of interest.

**Results:** One year after ischaemic stroke, there were significant correlations in the rate of atrophy between the posterior cingulate, medial prefrontal cortex, parahippocampal gyrus and superior frontal gyrus, all key regions of the default mode network. Compared to the healthy control group, atrophy was more widespread in stroke patients including the middle temporal gyrus and the insula. This suggests atrophy after stroke extends beyond that typical of normal aging. Future work will examine the specificity of network atrophy after stroke in relation to healthy network function in aging.

**Conclusion:** The effects of stroke are widespread and neurodegenerative. We examined longitudinal atrophy after stroke and provide evidence of network-wide neurodegeneration above that seen in healthy aging. Examining the rate of cortical atrophy has the potential to clarify the vulnerability of networks to degeneration after stroke.

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### Anterior versus Posterior Stroke: No Difference in Cognitive Impairment

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**Background and Rationale:** To compare the incidence and nature of cognitive impairment three months post-stroke in subtypes of ischemic stroke patients, classified according to Oxfordshire criteria.

**Methods:** Participants were assessed three months post-stroke as part of CANVAS, a study which examines changes in brain volume and cognition after stroke. The cognitive test battery comprised measures of executive function, language, memory, attention, and visuospatial ability. Impairments were defined as domain z-scores more than 1.5 standard deviations below normative values. Stroke location was divided into anterior circulation infarction (ACI), either total (TACI) or partial (PACI), posterior circulation infarction (POCI), and lacunar infarction (LACI), based on Oxfordshire criteria. All participants underwent high resolution 3D MPRAGE MRI. Infarct size was quantified via manual tracing of FLAIR images.

**Results:** 126 patients were assessed, including 61 ACIs, 43 POCIs, and 15 LACIs. Seven patients with anterior and posterior circulation infarcts were excluded from the analyses. The groups did not differ with respect to age, sex or education level. Incidence of cognitive impairment was 45% in the anterior group, 44% in the posterior group, and 33% in the lacunar group ( $p = 0.717$ ). Incidence of impairment was 35% for the executive function domain, 8% for language, 8% for memory, 9% for attention, and 15% for visuospatial function. There was no language impairment in the lacunar group. Mean infarct volumes were significantly different in the anterior ( $11.8 \pm 3.8 \text{ mm}^3$ ) and lacunar ( $0.4 \pm 0.3 \text{ mm}^3$ ) groups ( $p = 0.043$ ), and in the posterior ( $9.6 \pm 16.9 \text{ mm}^3$ ) and lacunar groups ( $p = 0.003$ ). Despite these differences in infarct volume between groups, associations between stroke subtype and frequency of impairment in each cognitive domain were not significant ( $p > 0.05$  for all domains).

**Conclusion:** Executive function was most commonly impaired on testing in all groups three months after stroke. Cognitive profiles were not different in patients with anterior and posterior circulation strokes.

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## The Screening for Post Stroke Dementia among Stroke Survivors Residing at Home in the Community: Findings from the iCaPPS Trial in Peninsular Malaysia

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**Background and Rationale:** Detection of post stroke dementia in developing countries is challenging as post stroke care is mostly uncoordinated. Cognitive impairment and dementia may be delayed or missed. The Integrated Care Pathway for Post Stroke (iCaPPS) patients advocates primary care team to regularly screen for cognitive decline during follow up visits. This project aimed to estimate the prevalence of dementia among patients who reside at home and receive long term care from public primary care healthcentres.

**Methods:** A cross sectional study was conducted at ten selected public primary care healthcentres in Peninsular Malaysia, as part of a larger study to assess post stroke care services in the community in 2012. Post stroke patients were identified and recruited. Patients were screened for depression before subjected to screening with the Elderly Cognitive Assessment Questionnaire (ECAQ,  $\geq 60$  years) and Malay Mini Mental State Examination (M-MMSE,  $< 60$  years, cut off score 17). M-MMSE was also used to quantify severity of cognitive decline in patients who scored  $< 5$  on ECAQ.

**Results:** Total of 151 patients were recruited. Mean age of patients was 60.2 (SD9.5), with mean age at stroke presentation 55.8 (SD9.8) years. The median duration post stroke was 2.25 (IQR 5.1) years, with 50.3% at more than 2 years post stroke. Most common cause for stroke was ischaemia (70.9%). ECAQ was used on 74 patients where 6.8% scored  $< 5$ . Five patients were not tested due to aphasia. Total of 84 patients were tested using M-MMSE, with 8.3% (7/84) having scores  $< 17$ . Altogether, the total number of patients who screened positive for dementia was 4.8%.

**Conclusion:** The prevalence of post stroke dementia among patients residing at home in the community at 2 years post stroke was low at 4.8%.

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Chong MS: Making the diagnosis of dementia. Singapore Family Physician. 2008;35:66-72.

## Cognition Is Associated with Brain Volumes Early after Ischaemic Stroke

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**Background and Rationale:** Cognitive impairment is common in the weeks after ischaemic stroke. Yet, the relationship between cognition and brain volume, cortical thickness, and white matter hyperintensity (WMH) volume has not been examined in detail early post-stroke.

**Methods:** Cognition And Neocortical Volume After Stroke (CANVAS) is an ongoing longitudinal study. Ischaemic stroke patients without dementia are assessed within six weeks of stroke and compared to healthy age-matched controls. All participants complete a high-resolution 3T MPRAGE MRI to evaluate brain volume (total, hippocampal, WMH) and cortical thickness. Cognitive tasks include the Hopkins Verbal Learning Test-Revised (HVLRT-R) to measure short- and long-term memory, and the Detection, Identification, and One-Back subtests of the computerised CogState battery to measure processing speed, attention, and working memory, respectively.

**Results:** We recruited eighty-two stroke patients (age =  $67.32 \pm 12.87$  years; 60 men; education =  $12.85 \pm 3.98$  years; NIHSS =  $3.48 \pm 3.05$ ; days post-stroke =  $25.45 \pm 9.45$ ) and 40 healthy controls (age =  $68.65 \pm 6.64$  years; 25 men; education =  $15.42 \pm 4.53$  years). Adjusting for age and education, stroke patients performed worse than controls in all cognitive domains ( $p < 0.01$ ). In stroke patients, greater cortical thickness was associated with better short- and long-term memory ( $p < 0.05$ ), faster processing speed ( $p = 0.004$ ), and better attention ( $p < 0.001$ ). Larger hippocampal volume was associated with better short- and long-term memory ( $p < 0.05$ ). Larger total brain volume was associated with better working memory ( $p = 0.03$ ), while larger WMH volume was associated with poorer working memory ( $p = 0.005$ ).

**Conclusion:** Impairments in memory (short-term, long-term, and working), processing speed, and attention were observed in patients early after stroke. Cognition was associated with greater cortical thickness, larger hippocampal volume, and to a lesser degree, with total brain and WMH volume. Tracking of cortical thinning and hippocampal atrophy over time after stroke may provide important information about long-term cognitive decline and risk of dementia.

## Quality of Life of Stroke Survivors and Their Informal Caregivers: A Prospective Study

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**Background and Rationale:** Healthcare improvements have led to increased survival among stroke patients; however, the disability level remains high. These patients require assistance from caregivers, mostly informal caregivers. Quality of life (QoL) changes for both patients and their caregivers, particularly first year after stroke. Objectives of this study were to describe the changes in QoL and determine the factors associated with QoL for stroke patients and their informal caregivers in the first year after stroke.

**Methods:** Multi-centered prospective study was conducted in public hospitals in Mongolia. In this study, 155 first-time stroke patients and their 88 informal caregivers were followed up for 1 year. The WHOQOL-BREF questionnaire was used to assess QoL. The Barthel Index (BI) was administered to the patients at the baseline and after 1 year. A generalized estimating equation analysis was used to determine the factors associated with QoL.

**Results:** The QoL of the stroke patients in the physical health and environment domains significantly ( $p = 0.014$ ) improved after 1 year; however, QoL in the social relationship and psychological health domains declined, but the decline was not significant. Among the caregivers, QoL in the psychological health ( $p = 0.003$ ) and social relationship ( $p < 0.001$ ) domains improved; however, physical health declined ( $p = 0.47$ ), but this decline was not significant. Among the stroke patients, the factors associated with low QoL were older age ( $\beta = -0.21$ ,  $p = 0.04$ ) and being single ( $\beta = -12.27$ ,  $p < 0.001$ ). The female gender ( $\beta = 6.5$ ,  $p = 0.01$ ) and great improvement in the BI score ( $\beta = 14.84$ ,  $p < 0.001$ ) had higher QoL. Among the caregivers, these factors were poor physical health ( $\beta = -9.11$ ,  $p = 0.013$ ) and financial difficulties ( $\beta = -9.73$ ,  $p = 0.008$ ).

**Conclusion:** Efficient rehabilitation therapy for poststroke patients can improve their QoL. Disability training and financial support for caregivers of poststroke patients might be helpful; however, further research is required.

## CT Perfusion as a Predictor of Diffusion-Weighted-Imaging Lesions in Transient Ischemic Attack and Minor Stroke

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**Background and Rationale:** TIA and minor stroke patients with Diffusion Weighted Imaging (DWI) lesions have worst prognosis than those without (Sato, 2014; Merwick, 2010). Clinical features associated with DWI lesions in this population are well described (Kono, 2014), but whether CT Perfusion (CTP) can predict subsequent DWI-evident tissue injury is unclear. We sought to study the prevalence of DWI lesions in TIA and minor stroke patients according to CTP result, and whether thrombolysis (IV-tPA) alters this association.

**Methods:** Consecutive patients presenting with NIH Stroke Scale 0–3 were identified from a prospective single tertiary-centre TIA/Stroke database over a 4.5-year period (2011–2015). Radiological outcome of patients who underwent CTP on presentation and had follow-up DWI studies were analyzed according to CTP results and treatment received (thrombolysed vs. non-thrombolysed).

**Results:** A total of 145 TIA and minor stroke patients were included. Overall, the mean age was 71.7 years (SD 13.3). 62 patients had an ischemic abnormality on CTP. Among these, DWI lesions on follow-up were present in 90.3% ( $n = 56$ ). All non-thrombolysed patients with ischemic CTP abnormalities had DWI lesions (35/35), compared to 77.8% (21/27) in patients who received thrombolysis. IV-tPA was associated with a normal follow-up DWI study (22.2% vs. 0%;  $p = 0.005$ ).

Among non-thrombolysed patients overall ( $n = 113$ ), DWI lesions were present in 63.7% ( $n = 72$ ). In this population, the presence of an ischemic CTP abnormality was associated with DWI lesions (100% vs. 47.4%;  $p \leq 0.001$ ). CTP had high specificity (100%, 95% CI 89.3%–100%) and positive predictive value (100%, 95% CI 87.7%–100%) for DWI lesions on follow-up. There was a trend for patients with ischemic CTP abnormalities to have higher modified Rankin score at discharge ( $p = 0.078$ ).

**Conclusion:** Ischemic CTP abnormalities in patients presenting with TIA or mild stroke is a strong predictor of DWI lesions on follow-up. The use of IV-tPA is associated with normal DWI results and represents successfully averted stroke.

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**You've Got to Ask Yourself One Question: Do I Feel Lucky? A Mixed Methods Analysis of an Open Ended Question in the Psychosocial Outcomes in Stroke (POISE) Study**

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**Background and Rationale:** There have been very few studies examining health outcomes in young stroke survivors (18 to 64 years of age), despite this group accounting for one-third of strokes in Australia. Our aim was to examine the experience of life after stroke and highlight concerns important to this population.

**Methods:** 405 stroke survivors (or proxy responders) from the POISE (Psychosocial Outcomes In Stroke) study were asked to (1) classify the effect of stroke on their lives into strongly positive, positive, no effect, negative, or strongly negative, and (2) describe in their own words how stroke had affected their lives. This was done at 28 days (baseline) and 12 months following stroke. Responses were coded by multiple researchers and inductive analysis was used to identify core themes.

**Results:** Forty seven percent of participants reported an overall positive or neutral effect of stroke at one month and 40% at 12 months. When describing the specific details, five over-arching themes emerged which could be positive or negative: restrictions, emotions, lifestyle changes, social changes, awareness of lifestyle changes and global effects (in decreasing order of frequency). While many assessed the overall effect of stroke as positive or neutral at baseline, their specific comments were largely negative when describing physical and cognitive disabilities (the dominant theme at baseline), followed by emotional and lifestyle changes. At one year, restrictions continued to dominate, however emotional and lifestyle comments had reduced considerably.

**Conclusion:** In this innovative large-scale qualitative analysis we were able to demonstrate that an overall positive experience of stroke did not preclude negative aspects from being evoked, or vice versa. We were also able to highlight novel areas of interest specific to the young stroke population such as loss of a driver's license, feeling 'lucky' and adoption of health behaviours, all of which are potential tools to optimising the management and outcome of younger stroke survivors.

**Contrast Peak Density in Collateral Vessels May Be an Important Factor in Tissue Fate in Acute Ischemic Stroke**

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**Background and Rationale:** Collateral circulation in patients with acute ischemic stroke (AIS) may sustain hypoperfused tissue at-risk. However, the best method to quantify collateral status on acute CT images is uncertain. We aimed to determine the relationship between visual collateral status, quantitative collateral assessments, baseline perfusion CT measures, and tissue outcomes on follow-up imaging.

**Methods:** Sixty-six consecutive AIS patients clinically eligible for reperfusion therapy and with MCA occlusion (M1 or M2 segments) were enrolled. We compared the visual collateral scoring with measures of contrast peak time delay, and contrast peak density. Visual collateral scoring was divided into 'good' and 'reduced' based on degree of reconstitution to MCA up to the distal end of the occlusion on CTA (Miteff et al, 2009). We also compared these collateral measures for their ability to predict perfusion lesion and infarct core volumes, final infarct volume, and infarct growth volume.

**Results:** Higher contrast peak density ( $p = 0.002$ ) and shorter contrast peak time delay ( $p = 0.041$ ) were associated with good collateral status. Shorter contrast peak time delay correlated with higher contrast peak density ( $\beta = -0.413$ ,  $p = 0.037$ ). In logistic regression analysis after adjustment for age, sex, onset-CT time and occlusion site, higher contrast peak density was independently associated with good collateral status ( $p = 0.009$ ). Multiple regression analysis showed that higher contrast peak density was an independent predictor of smaller perfusion lesion volume ( $p = 0.029$ ), smaller ischemic core volume ( $p = 0.044$ ), smaller follow-up infarct volume ( $p = 0.005$ ), and smaller infarct growth volume ( $p = 0.010$ ).

**Conclusion:** Visual collateral status, contrast peak density, and contrast peak time delay were interrelated. Notably, contrast peak density in collateral vessel may be an important factor in tissue fate in AIS.

**Reference:**

Miteff F, et al: The independent predictive utility of computed tomography angiographic collateral status in acute ischaemic stroke. *Brain* 2009; 132:2231-2238.

# Quantitative Measurement of Physical activity and Sleep Behaviour Longitudinally After Stroke

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**Background and Rationale:** Observational studies have demonstrated people are inactive after stroke. But there is very little longitudinal evidence on changes in physical activity and sleep behaviour in the months after stroke. We aimed to quantify these variables using validated activity monitoring devices within a week of stroke and at 3 months post-stroke.

**Methods:** This sub-study formed part of the larger 'A Very Early Rehabilitation Trial' (AVERT). Participants were patients with confirmed stroke recruited within 24 hours of symptom onset. SenseWear, a triple axis accelerometer attached to a band worn on the upper arm, was worn for  $\leq 7$  days in the acute hospital and for 7 days at 3 months after stroke. Data from this device were used to calculate percentage of the waking day spent active (using a 1.5 METs threshold), energy expenditure, sleep time and sleep efficiency.

**Results:** Eighteen participants were assessed acutely, with 14 of these followed up at 3 months post-stroke. Marked increases were seen between the acute stage and 3 months in percentage of the day active (median 4.6% to 18.1%;  $p < 0.001$ ), daily energy expenditure (median 7123 to 9167 joules;  $p = 0.001$ ), nightly sleep time (median 440 to 519 minutes;  $p = 0.04$ ) and sleep efficiency (median 73.6% to 85.1%;  $p = 0.002$ ).

**Conclusion:** This is the first study to longitudinally and objectively measure the activity and sleep behaviours of stroke survivors. We have shown stroke survivors are primarily inactive early after stroke, and even when accounting for time spent asleep, there remain long periods of the day when stroke survivors are inactive. These periods could be targeted for further physical activity and rehabilitation.

# Participation in Unpaid Work in the First Year after Stroke: The Psychosocial Outcomes in Stroke (POISE) Cohort Study

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**Background and Rationale:** Twenty five per cent of strokes occur in people under the age of 65 (Intercollegiate Stroke Working Party, 2012). While returning to paid work is a crucial marker of stroke recovery (Hartke, 2011), little is known about return to unpaid work in the 12 months following stroke.

**Methods:** POISE (Psychosocial Outcomes In Stroke) was a prospective, multicentre observational study that recruited individuals, 18–64 years, within 28 days of stroke from New South Wales, Australia. Unpaid work was classified as: unpaid domestic work for the household; unpaid care of others; looking after own child(ren) without pay; looking after someone else's child(ren) without pay; voluntary work; graded as  $<5$ , 5–14; 15–29 and 30 hours or more per week. Data were collected on pre-stroke, 28 day, 6 and 12 month follow-up. The primary outcome was rate of return to unpaid work.

**Results:** Of 441 consented individuals, 143 (32%) participated in unpaid work immediately before their stroke while 271 (61%) participated in paid and unpaid work before stroke. Prior to stroke, of those who participated in unpaid work only, 38% performed 5–14 hours of domestic unpaid work per week; 8% completed  $<5$  hours of unpaid care, help or assistance to others per week; 15% looked after their own children and 6% did voluntary work 5–14 hours per week. At 28 days after stroke, the proportion reduced to 20%, 6%, 10% and 2% respectively. By 6 months, the rate of return to unpaid work had mostly gone back to pre-stroke levels: 38%, 5%, 14% and 4% respectively. Additional analyses on factors predicting return will be presented by conference date.

**Conclusion:** Participation in unpaid work returns to pre-morbid levels within six months of stroke indicating that unpaid work may be a necessity of day to day life rather than a marker of recovery for younger stroke survivors.

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# Determining the Number of Ischemic Strokes Potentially Eligible for Endovascular Thrombectomy: A Population-Based Study

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**Background and Rationale:** Endovascular Thrombectomy (ET) is standard-of-care for ischemic stroke patients with large vessel occlusion, but estimates of potentially eligible patients from population-based studies have not been published. Such data are urgently needed to rationally plan hyper-acute services. Retrospective analysis determined the incidence of ET-eligible ischemic strokes in a comprehensive population-based stroke study (Adelaide, Australia 2009–2010).

**Methods:** Stroke patients were stratified via a pre-specified eligibility algorithm derived from recent ET trials comprising: stroke subtype, etiology, severity, premorbid modified Rankin Score (mRS), presentation delay, large vessel occlusion and ‘target mismatch’ penumbra. Recognizing centers may interpret recent ET trials either loosely or rigidly, two eligibility algorithms were applied: restrictive (key criteria mRS 0–1, presentation delay <3.5 h and ‘target mismatch’ penumbra) and permissive (mRS 0–3 and presentation delay <5 h).

**Results:** In a population of 148,027 people, 318 strokes occurred in the one year study period [crude attack rate 215 (192–240) per 100,000 person-years]. The number of ischemic strokes eligible by restrictive criteria was 17/258 (7%; 95% CI 4–10%) and by permissive criteria an additional 16 were identified, total 33/258 (13%; 95% CI 9–18%). Two of 17 patients (and 6/33 permissive patients) had thrombolysis contraindications. Using the restrictive algorithm there were 11 (95% CI 4–18) potential ET cases per 100,000 person-years or 22 (95% CI 13–31) using the permissive algorithm.

**Conclusion:** In this cohort, approximately 7% of ischemic strokes were potentially eligible for ET (13% with permissive criteria). In similar populations, the permissive criteria predict up to 22 strokes per 100,000 person-years may be eligible for ET.

# Prehospital Stroke Scale to Predict Large Vessel Occlusion: FACE2-AD Scale

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**Background and Rationale:** Patients with ischemic stroke due to large vessel occlusion (LVO) would be better to be transferred to comprehensive stroke centers to shorten the delay from symptom onset to endovascular therapy. We aimed to develop a simple prehospital stroke scale for paramedics to identify patients with LVO.

**Methods:** We examined consecutive 5504 patients who were transferred to our hospital by ambulance because of suspicion of stroke or disturbance of consciousness between April 2012 and February 2015. Among them, we extracted 1444 patients (71 ± 14 years, 876 men) who arrived within 24 hours from the onset with sufficient ambulance records. LVO was defined as occlusion of internal carotid artery, middle cerebral artery (M1 or M2), or basilar artery, diagnosed by vascular imaging on admission.

**Results:** 436 patients were diagnosed as acute ischemic stroke (AIS), and LVO was identified in 130 patients. In ambulance records, factors associated with LVO were age, facial palsy, arm palsy, speech disturbance, impaired consciousness (cannot answer own name), eye deviation, atrial fibrillation (Af) and diastolic blood pressure (DBP). In logistic regression analysis, facial palsy (odds ratio 2.04, [95% confidence interval 1.28–3.26]), arm palsy (1.65 [1.02–2.66]), impaired consciousness (1.71 [1.08–2.72]), eye deviation (12.61 [7.54–21.50]), Af (2.54 [1.57–4.48]) and DBP ≤85 mm Hg (2.47, [1.60–3.88]) were related to LVO. Based on these results, we developed the FACE2-AD scale formed by assigning 1 point each for the presence of facial palsy, arm palsy, impaired consciousness, Af, and DBP ≤85 mm Hg, and assigning 2 points for the presence of eye deviation. A FACE2-AD scale ≥3 had sensitivity 0.88, specificity 0.76, positive predictive value 0.27 and negative predictive value 0.98 for detecting LVO.

**Conclusion:** FACE2-AD scale is a simple and accurate tool for triage of AIS patients with LVO. Validation of FACE2-AD scale is needed on a prospective prehospital cohort.

### Establishing Administration Practices of Intravenous Thrombolysis for Patients with Acute Ischaemic Stroke

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**Background and Rationale:** Strict criteria for the eligibility for intravenous thrombolysis (rt-PA) for acute stroke are available, yet a recent United States of America (USA) survey revealed 81% of stroke centres added local criteria to the patient selection stipulated by the USA licence. This raises issues for other countries and their approach to patient eligibility.

**Aim:** To examine the criteria used by clinicians in Australia in the selection of patients for rt-PA.

**Methods:** Designed based on the USA survey, a questionnaire was mailed to Stroke Unit Co-ordinators of Australian hospitals (n = 87) known to provide rt-PA as identified by the National Stroke Foundation. From a list of 48 indications, contraindications and warnings specified by the Australian rt-PA licence and 15 additional criteria not stipulated by the licence (non-standard criteria) also were included, participants were asked to indicate their local criteria for rt-PA eligibility.

**Results:** Response rate 72.4%. Mean number of inclusion criteria was 5 (SD 1.7); 28.6% of hospitals selected  $\geq 2$  non-standard inclusion criteria. The most common stated non-standard criteria was *NIHSS score*  $> 4$  (49.2%). Mean number of exclusion criteria selected was 26 (SD 8.5); 66.7% of hospitals selected  $\geq 2$  of the non-standard exclusion criteria. The most common stated non-standard exclusion criteria was *level of consciousness severely depressed* (61.9%). Associations between non-standard criteria and rt-PA administration will be reported.

**Conclusion:** Similar to the USA, our findings suggest that Australia's low rt-PA rates could, in part, be due to the altering of licence stipulated in/exclusion criteria and adding of non-standard criteria.

### Tandem Intracranial Internal Carotid Arterial Disease in Patients with Carotid Endarterectomy: Reversible Characteristics after Surgery and Their Clinical Implication

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**Background and Rationale:** Tandem intracranial internal carotid artery disease (TICID) may affect clinical outcome of patients undergoing carotid endarterectomy (CEA). Some components of TICID may be distinct in their dependence on the patency of proximal carotid artery, and reversibility upon revascularization. We aimed to investigate prevalence, characteristics, and clinical implication of reversible components of TICID in CEA patients.

**Methods:** Pre- and post-operative 3D time-of-flight magnetic resonance angiography (MRA) on 304 consecutive CEA patients were assessed to identify preoperative TICID as determined by presence of non-exclusive characteristics such as focal stenosis (FS), diffuse stenosis (DS), reduced signal intensities (SI), and luminal irregularities/mild stenosis (LI). Those components were evaluated for their relationships and reversibility. Baseline and clinical outcome variables were analyzed according to the presence of TICID with/without reversible components.

**Results:** Preoperative TICID was identified in 142 (46.7%) cases, of which  $>30\%$  (48 cases) had reversible components. The presence of DS and of SI were correlated ( $P < 0.001$ ), and  $>93\%$  of them were reversed after CEA. Only less than 10% of FS and of LI were normalized. TICID patients with DS/SI were more likely to have severe degree of carotid stenosis ( $P < 0.001$ ), and post-operative new ischemic lesions ( $P < 0.001$ ) than other patients. The presence of TICID with DS/SI was independently associated with postoperative new ischemic lesions (odds ratio: 2.74; 95% confidence interval: 1.22–6.12).

**Conclusion:** A subset of TICID components on preoperative MRA, correlated with severe proximal hemodynamic compromise, can be normalized after proximal revascularization. Those hemodynamic characteristics of TICID may contribute to the occurrence of postoperative new ischemic lesions.

# Change in Strategies Significantly Improves Door to Needle Time in Acute Stroke Fast Track Service

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**Background and Rationale:** The benefit of intravenous tissue plasminogen activator (IV rtPA) for acute ischemic stroke (AIS) treatment is highly time dependent. We aim to assess if the implementation of change in strategies to the system of delivering IV rtPA can significantly improve door to needle (DTN) time.

**Methods:** The new 'Stroke Fast Track Call' (SFTC) protocol has been implemented in Siriraj hospital, Mahidol University, Thailand since April 2015. The new SFTC protocol consisted of three changes: 1) The use of virtual private network telephone (VPN) for stroke team notification; 2) Code stroke was activated by the hospital call center in which neurologists, radiologists, interventional neuroradiologists and porters were called simultaneously; and 3) Administering IV tPA in the CT scanner. DTN time was compared before (January 2014 – March 2015) and after (April – December 2015) the implementation of the new SFTC protocol. DTN time was analyzed using Kaplan-Meier curves, the Log-rank test and Cox proportional hazards regression.

**Results:** There were 76 patients treated with IV rtPA between January 2014 and March 2015. Median DTN time was 52 minutes [95% CI: 48–58]. During the new SFTC protocol implementation (April 2015–December 2015), there were 36 patients treated with IV rtPA with a median DTN time of 39.5 minutes [95% CI: 37–45]. Cox regression analysis revealed that the change of the SFTC protocol resulted in a significant reduction in DTN time [HR = 1.6; 95% CI: 1.07–2.39;  $p < 0.05$ ].

**Conclusion:** The implementation of changes in strategies of the new SFTC protocol was proved to reduce DTN time. This can benefit health care providers as another initiative to improve quality of acute stroke care.

# Accuracy of Clinical Risk Scores in Predicting Post-rtPA Intracerebral Hemorrhage in a Thai Cohort

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**Background and Rationale:** Symptomatic intracerebral hemorrhage (SICH) is the most feared complication in acute ischemic stroke (AIS) treated with IV recombinant tissue plasminogen activator (rtPA). Several risk prediction scores were developed based on Caucasians datasets. Previous studies showed a higher risk of SICH post-rtPA in Asians. We aim to compare the accuracy of eight existing clinical risk scores to predict post-rtPA SICH in the Thai population.

**Methods:** We applied 8 existing risk scores to a retrospective cohort of AIS patients who received IV rtPA between 2005–2015 in a tertiary care center (Siriraj Hospital, Mahidol University, Thailand). Those risk scores collectively represented 37 predictors of SICH post IV rtPA. The main outcome was SICH defined according to the European-Australian Acute Stroke Study II (ECASSII) and the National Institute of Neurological Diseases and Stroke (NINDS) definitions. All risk scores were then compared using ROC, sensitivity, specificity, negative and positive predictive values, and the negative and positive likelihood ratios.

**Results:** A total of 405 patients were included. The rates of SICH-ECASSII and SICH-NINDS were 7.1% and 11.1%, respectively. Among the eight risk scores, the Dense cerebral artery pre-stroke modified Rankin scale Age Glucose Onset-to-treatment time NIHSS (DRAGON) score, the Hemorrhage After Thrombolysis (HAT) score, and the Glucose Race Age Sex Pressure Stroke Severity (GRASPS) score were the three best scores for predicting SICH according to the ECASSII definition. The DRAGON score achieved 66% sensitivity and 58% specificity (AUC = 0.59, PPV = 11%, NPV = 96%, LR+ = 1.56, LR– = 0.59), the HAT score had 72% sensitivity, 50% specificity (AUC = 0.65), while GRASPS score reached 79% sensitivity, but only 40% specificity (AUC = 0.63).

**Conclusion:** This study demonstrated that existing SICH risk scores did not perform well in the Thai population. We proposed to develop a new model to better predict SICH post IV rtPA among Asian race.

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039

## Two-Year Outcome of Anticoagulant Therapy for Acute Ischemic Stroke with Nonvalvular Atrial Fibrillation – SAMURAI-NVAF Study

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**Background and Rationale:** Stroke Acute Management with Urgent Risk-factor Assessment and Improvement-NonValvular Atrial Fibrillation (SAMURAI-NVAF) registry is a prospective, multicenter, observational study in Japan, enrolling acute stroke/TIA patients having NVAF. We determined the long-term risk-benefit profile in patients receiving warfarin or non-vitamin K antagonist oral anticoagulants (NOACs).

**Methods:** Among 1,192 patients enrolled in 18 stroke centers between September 2011 and March 2014, we studied 1116 patients (480 women, 77 ± 10 y.o) taking anticoagulants at acute hospital discharge. Warfarin was administered for 650 (313 women) patients and NOACs for 466 (167 women): dabigatran, 203; rivaroxaban, 238; and apixaban 25. We examined the influence of anticoagulant choice for ischemic and bleeding events and mortality in 2-year follow-up period.

**Results:** NOAC users were younger (75 ± 9 vs. 79 ± 10 y.o), heavier (60 ± 12 vs. 54 ± 12 kg), and had better renal function (Ccr 66 ± 23 vs. 51 ± 26 ml/min), lower NIHSS (median 4 vs. 10), CHADS<sub>2</sub> (4 vs. 4), CHA<sub>2</sub>D<sub>2</sub>-VASc (5 vs. 6), HAS-BLED (3 vs. 3) score on admission, and mRS (1 vs. 4) at discharge than warfarin users (p < 0.001, respectively). An estimated event rate of ischemic events was 4.5%/y in NOAC users vs. 6.4%/y in warfarin users {crude hazard ratio (HR) (NOACs/warfarin) 0.70 (95% CI 0.44–1.09)}; major bleeding, 1.6%/y vs. 3.3%/y {HR 0.48 (0.22–0.96)}; ischemic stroke/TIA, 3.9%/y vs. 4.7%/y {HR 0.82 (0.49–1.35)}; intracranial bleeding, 0.6%/y vs. 1.6%/y {HR 0.41 (0.11–1.17)}; all stroke, 4.4%/y vs. 5.6%/y {HR 0.77 (0.48–1.23)}; and all-cause death, 1.7%/y vs. 12.5%/y {HR 0.13 (0.07–0.24)}. After adjust-

ment by propensity score, intracranial bleeding {HR 0.28 (0.07–0.90)} and death {HR 0.37 (0.18–0.68)} occurred in significantly lesser frequency in NOAC users.

**Conclusion:** Stroke/TIA patients choosing NOACs for secondary prevention were younger and had milder symptom and risk indices than warfarin. A cumulative rate of ischemic events and stroke within 2 year after index stroke was similar between two groups, while those of intracranial bleeding and death were lower in NOAC users.

040

## Changes in Post-Stroke Survival Over Time: New Evidence form the Australian Stroke Clinical Registry

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**Background and Rationale:** The Australian Stroke Clinical Registry (AuSCR) was established to monitor the quality of acute care and outcomes for patients admitted to hospital following stroke or transient ischaemic attack (TIA). We aimed to identify sub-groups in which there were temporal improvements in survival at 180 days after admission.

**Methods:** We used a historical controlled, matched design utilising episodes from hospitals contributing data from 2012 to 2014. Mortality data from the National Death Index was linked to relevant cases within the AuSCR. Comparisons over time were made using random effects Cox proportional hazards regression analysis with adjustment for demographic and clinical factors and clustering by hospital.

**Results:** There were 25 hospitals that contributed data for all 3 years (14438 episodes; mean age 73 years; 54% male). Compared to patients admitted in 2012, those admitted in 2014 had a 13% reduced risk of death at 180 days after admission (adjusted hazard ratio [aHR]: 0.86, 95% confidence interval [CI] 0.77–0.97, p = 0.011). In patients aged >65 years there was reduced 180 day

mortality in those admitted in 2014 compared to those admitted in 2012 (aHR: 0.88, 95% CI 0.78–0.99,  $p = 0.035$ ). In patients treated on stroke units, those who were admitted in 2014 had an 16% reduced risk of death at 180 days compared to those admitted in 2012 (aHR: 0.84, 95% CI 0.73–0.95,  $p = 0.008$ ). There was no difference in mortality between 2012 and 2014 for those not treated on a stroke unit (aHR: 1.01, 95% CI 0.79–1.29,  $p = 0.941$ ). Temporal improvements in survival were not observed for any stroke subtype.

**Conclusion:** The temporal improvements in survival observed may be attributable to improvements in the quality of care provided on stroke units, and to better treatment and secondary prevention in those aged >65 years.

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#### 041

### BMI and Stroke Mortality: Is There an Obesity Paradox among Asians?

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**Background and Rationale:** Overweight and obesity were progressively associated with increased ischemic stroke, in a meta-analysis pooling 25 studies. However, ‘obesity paradox’ was also reported for stroke in that obesity or overweight was protective of stroke. Across the spectrum of Body Mass Index (BMI), ‘who has the most risk’ remains unclear, when major risk factors were controlled.

**Methods:** A large cohort from Taiwan,  $N = 469,088$ , successively recruited during 1994–2008 with comprehensive health screening data, was followed up with National Death file. Stroke risks for underweight (BMI <18.5), overweight (BMI 25–29) and obesity (BMI  $\geq 30$ ) were expressed as hazard ratios (HR) by Cox model with BMI 23–24 as reference. Stroke as a whole or ischemic and hemorrhagic stroke separately were analyzed.

**Results:** Underweight had the highest stroke mortality (HR = 1.90, 95% CI: 1.35–2.67), followed by next underweight with BMI at 18.5–22 (HR = 1.25, 95% CI: 1.03–1.52), while overweight (HR = 0.95, 95% CI: 0.78–1.16) and obesity (HR = 1.00, 95% CI: 0.70–1.43) showed no stroke increase. Among three age groups with underweight, age 40–64 had highest risk with HR = 2.71 (95% CI: 1.5–4.8). Significant results for underweight were similar for smokers (HR = 1.83, 95% CI: 1.02–3.27) or nonsmokers (HR = 2.03, 95% CI: 1.33–3.09), for hypertension (HR = 1.76; 95% CI: 1.13–2.72) or no hypertension (HR = 3.37; 95% CI: 1.88–6.06), and for ischemic stroke (HR: 1.82; 95% CI: 1.15–2.89) or for hemorrhagic stroke (HR = 1.90; 95% CI: 1.15–3.14).

**Conclusion:** In this large Asian cohort, for stroke mortality, all groups with underweight (BMI <18.5) had the highest risk, particularly at middle-aged adults (40–64). Obesity, defined as BMI  $\geq 30$ , showed no increase in risk nor protective power against stroke.

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#### 042

### Googling Map of Service Boundaries for Endovascular Clot Retrieval (ECR) Hubs in Metropolitan Melbourne

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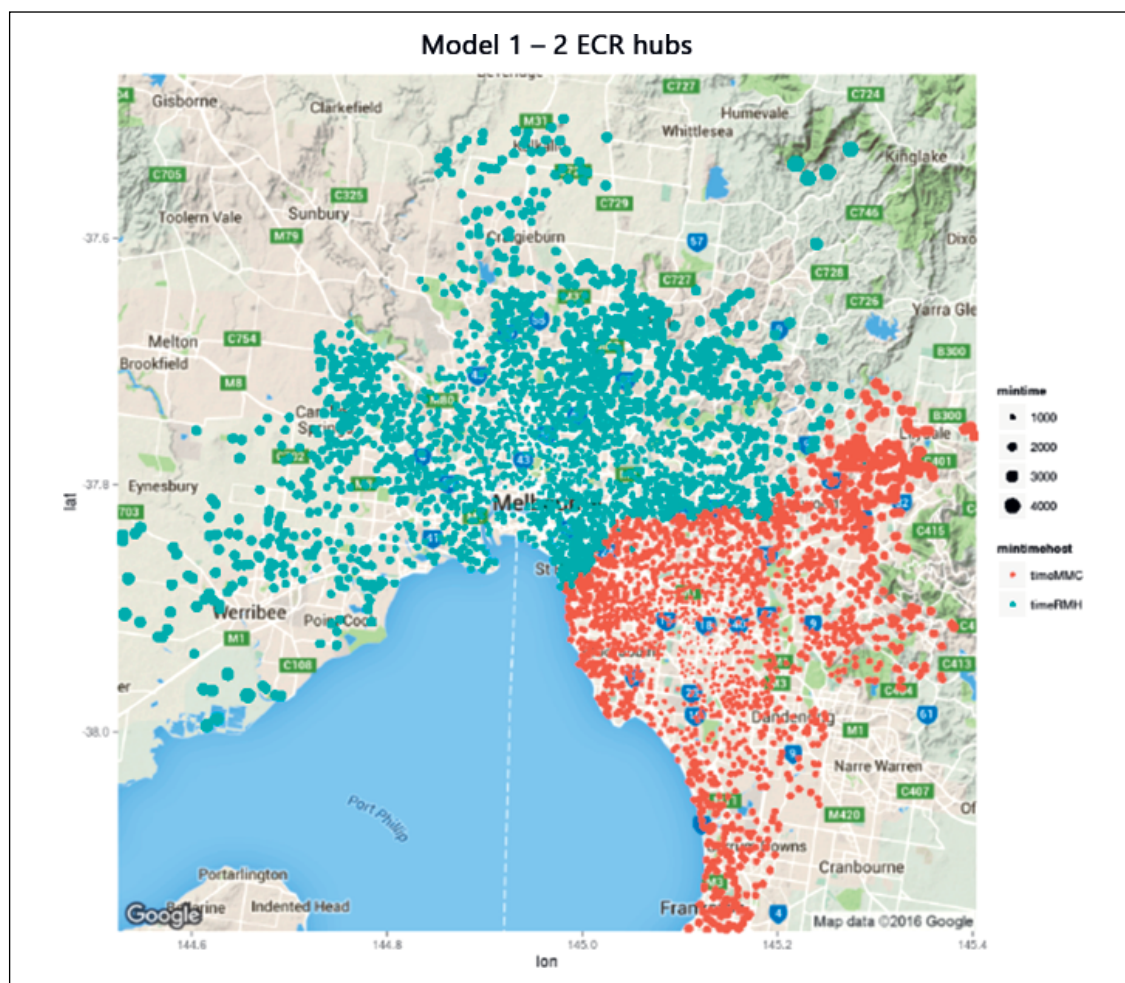
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**Background and Rationale:** In the era of endovascular clot retrieval (ECR), there is immense interest in how ECR hub hospitals can collaboratively provide services to other metropolitan and rural hospitals. The aim of this study is to establish the potential boundary of service (as defined by traveling time to hub) between the ECR hubs.

**Methods:** Stroke incidence data in metropolitan Melbourne was merged with population census data in each suburb. Randomly chosen coordinates were generated in each suburb and converted to addresses using reverse geocoding. The times to travel from each address to four ECR capable hospitals (A–D) were estimated using a ggmap package (available from R) which accesses data from the Google Map application program interface (API). Boundary maps were performed for two ECR (A and B) sites (model 1) and 3 ECR sites (ABC and ABD, model 2) using logical comparison of traveling time.

**Results:** The total catchment area simulated in this experiment was 2910 km<sup>2</sup>. For Model 1 the median travel times to hospitals A and B were 1325s (IQR = 1054, 1621) and 1202s (IQR = 887, 1482) respectively from maps created. For Model 2, times to hospitals A, B and C were 1355s (IQR = 1042.5, 1659), 1188s (IQR = 841.5, 1553), 537.5 (IQR = 761, 942), and times to A, B and D were 898s (IQR = 1229, 1509), 821s (IQR = 1106, 1321), 825s (IQR = 1099, 1404).

**Conclusion:** We have developed a computational method for estimating the metropolitan boundary for ECR hubs which may help to identify the ideal hub for patient transfer (given their locations). This method can be applied to other metropolitan areas in Australia when designing ECR services.



**Fig. 1.** (for Abstract 042).

043

### Effectiveness of Acute Stroke Team in a Regional Primary Health Care Hospital

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**Background and Rationale:** In 2012, the total financial costs of stroke in Australia were estimated to be \$5 billion (Australian Stroke Foundation). Studies have shown significant benefit of an acute stroke team in improving thrombolysis rates, reducing door-to-CT, door-to-needle and in-hospital mortality (Nazir et al.2009, Hamidon et al.2007), but this model has largely been adopted by metropolitan tertiary health care hospitals. The benefit of implementing an acute stroke service in a primary care hospital is not known.

**Methods:** We undertook an internal audit to evaluate the effectiveness of acute stroke team in improving thrombolysis rates, door-to-CT, door-to-needle, length of stay (LOS) and mortality in a regional primary health care hospital. Data from 6 months pre and post commencement of acute stroke team and stroke unit was collected retrospectively.

**Results:** We identified 152 and 160 patient's pre and post commencement of services. There was a 3 fold increase in the number of stroke calls and thrombolysis rates increased from 3.7% to 12.9%. A reduction of 44 mins and 20 mins was seen in door-to-CT and door-to-needle times respectively. The mean LOS reduced from 8 to 4 days while in-hospital mortality dropped from 12.5% to 6.25%. Failure rate of admission swallow screening improved from 51% to 5%. Cost-benefit analysis showed a \$600 saving per patient.

**Conclusion:** Our study highlights the advantage of an acute stroke team in improving thrombolysis rates, door-to-CT and door-to-needle times, and swallow screen assessment. It reduces LOS and in-hospital mortality and resulted in an annual saving of

\$96,000 in our centre. We plan to expand our service after hours and perform a larger prospective study to confirm our findings with the long-term aim of providing service to a wider catchment area.

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044

### Determinants and Prognostic Significance of Hematoma Sedimentation Level in Acute Intracerebral Hemorrhage

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**Background and Rationale:** This study aimed at identifying the determinants and prognostic significance of a sedimentation level (fluid-blood level) in the hematoma among patients with acute intracerebral hemorrhage (ICH) who participated in the second Intensive Blood Pressure Reduction in Acute Cerebral Haemorrhage Trial (INTERACT2) (Anderson et al., 2013).

**Methods:** Post-hoc analysis of the INTERACT2 dataset, a randomized controlled trial of patients with acute ICH with elevated systolic blood pressure (BP), randomly assigned to intensive (target systolic BP <140 mm Hg) or guideline-based (<180 mm Hg) BP management. Patients with a sedimentation level at baseline assessment on computed tomography (CT), and modified Rankin Scale score at 90-day, were included in these analyses. Factors associated with sedimentation level and its significance in relation to 90-day clinical outcomes were assessed in univariable and multivariable logistic regression models.

**Results:** Of 2065 participants, 19 (1%) had sedimentation level on baseline CT, which was independently associated with warfarin use ( $p = 0.006$ ) and lobar ICH ( $p = 0.025$ ). Sedimentation level was also associated with death or major disability at 90-day in both crude (84% vs. 53%;  $p = 0.014$ ) and multivariable analyses adjusted for age, sex, Chinese region, warfarin use, baseline National Institutes of Health Stroke Scale score, onset to CT time, volume and location of ICH, intraventricular extension, and randomized intensive BP lowering (odds ratio, 3.94; 95% CI, 1.01–15.37;  $p = 0.049$ ).

**Conclusion:** The presence of hematoma sedimentation level on baseline CT is associated with warfarin use and lobar location of ICH, and predicts a worse outcome. Although uncommon, sedimentation level is an easily detectable prognostic factor in acute ICH.

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045

### Determinants of Hyperglycemic Response in Intracerebral Hemorrhage: INTERACT2 Results

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**Background and Rationale:** Hyperglycemia is common after acute intracerebral hemorrhage (ICH) and is associated with adverse outcomes. We aimed to identify the determinants of hyperglycemic response among participants of the INTERACT2 study.

**Methods:** INTERACT2 was an international, multicenter, prospective, open, blinded endpoint, randomised controlled trial of 2839 ICH patients (<6 hr) with elevated systolic blood pressure



(SBP) assigned to intensive (target SBP <140 mm Hg) or guideline-based (SBP <180 mm Hg) BP management. Determinants of baseline hyperglycemia were identified in multivariable logistic regression models.

**Results:** Available baseline data on blood glucose in 2653 (93%) patients showed significant predictors of hyperglycemia were female sex, recruitment outside China, high SBP, high NIHSS score, history of diabetes mellitus, cortical location of ICH, large hematoma volume, and intraventricular extension (all  $P < 0.001$ ). Independent predictors of hyperglycemia in non-diabetic patients ( $n = 2361$ ) were female sex, recruitment outside of China, high NIHSS score, cortical location of ICH, large volume hematoma and intraventricular extension (all  $P < 0.001$ ).

**Conclusion:** Hyperglycemic reaction in acute ICH reflects a combination of physiological stress related to the severity of underlying disease and associated dysglycemia from associated diabetes mellitus.

046

### Prevalence and Characteristics of Cerebral Microbleeds in Atrial Fibrillation Patients on Oral Anticoagulants

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**Background and Rationale:** MRI detection of cerebral microbleeds (CMB) is a recently recognized marker which predicts future intracerebral haemorrhage (ICH) [1]. For stroke prevention in atrial fibrillation (AF), new strategies with less ICH risk (e.g. left atrial appendage occlusion) have recently emerged. Understanding the prevalence and clinical significance of CMB in AF patients can help evaluate if CMB can help identify patients at high risk of ICH, and better personalize stroke prevention strategies [2, 3].

**Methods:** The aim of this study is to evaluate the prevalence of CMB and their correlation with CHA<sub>2</sub>DS<sub>2</sub>-VASc score, HAS-BLED score and stroke history in patients with AF on oral anticoagulants. We prospectively recruited AF patients on oral anticoagulants (both warfarin and direct oral anticoagulants) from Prince of Wales Hospital since April 2014. Major exclusion criteria were concurrent anti-platelet therapy; patients with underlying bleeding tendencies and contra-indications for MRI scan (e.g. patients with metallic heart valves, pacemaker, aphasic patients who could not follow commands etc). 3T MRI brains were performed using a standardized stroke protocol which included susceptibility-weighted image for evaluation of CMB. Demographic and clinical information were collected for calculation of CHA<sub>2</sub>DS<sub>2</sub>-VASc score and HAS-BLED scores.

**Results:** A total of 267 patients were recruited. There were 143 patients on warfarin and 124 patients on direct oral anticoagulants (including Dabigatran, Rivaroxaban and Apixaban). CMB were identified in 88 patients (33.0% of patients), with 48 patients on warfarin and 42 patients on direct oral anticoagulants. Concern-

ing lesion load of CMB, there were 37 patients with 1 CMB, 35 patients with 2 to 4 CMB and 16 patients with  $\geq 5$  CMB. Quantity of CMB correlated positively with CHA<sub>2</sub>DS<sub>2</sub>-VASc score (Spearman's correlation coefficient  $r = 0.152$ ,  $p = 0.013$ ) and HAS-BLED scores ( $r = 0.155$ ,  $p = 0.011$ ). CMB were significantly more commonly observed in patients with HAS-BLED score of 3 or above (38.8% vs. 22.7%,  $p = 0.007$ ).

Presence of any CMB tends to be more commonly observed in patients with history of stroke compared to those without (36.1 vs. 23.4%,  $p = 0.060$ ). Only patients with history of stroke were noted to have  $\geq 5$  CMB (7.9% vs. 0.0%,  $p = 0.02$ ).

**Conclusion:** CMB were commonly observed in AF patients, particularly in those with history of stroke. The positive correlations of CMB quantity with CHA<sub>2</sub>DS<sub>2</sub>-VASc and HAS-BLED scores suggest that AF patients at high risk of stroke are also at increased risk of anticoagulant-related ICH. Further prospective studies are urgently warranted to see if incorporating CMB findings can better personalize stroke prevention strategies for high-risk patients who may benefit from new strategies with lower ICH risk.

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047

### The Natural History of Peri-Haematomal Oedema and Impact on Outcome after Intracerebral Haemorrhage – Data Derived from the Helsinki Intracerebral Haemorrhage Study

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**Background and Rationale:** Oedema is associated with outcome after intracerebral haemorrhage (ICH). We assessed the natural history, factors influencing growth and association with outcome and oedema.

**Methods:** We estimated oedema volumes in ICH patients from the Helsinki ICH study using semi-automated planimetry. We excluded patients with pure ventricular haemorrhage, brain-



stem location, those undergoing surgical evacuation, lack of planimetric data, or baseline imaging performed >1 week from onset. We assessed the correlation between oedema extension distance (EED) growth and time from ICH onset, creating an oedema growth trajectory model using all available scans. We identified clinical and imaging characteristics associated with more than expected EED growth. Association between high EED with mortality was assessed using logistic regression adjusting for known predictors of ICH outcome.

**Results:** From a series of 1013 consecutive patients, 861 were included. There was a strong inverse correlation between EED growth rate (cm/day) and time from onset (days): EED growth =  $0.162 \times \text{days}^{-0.927}$ ,  $R^2 = 0.82$ . Baseline factors associated with larger than expected peak EED were older age (74 vs. 69,  $p = 0.007$ ), higher NIHSS (16 vs. 9,  $p < 0.001$ ) and lower GCS (13 vs. 15,  $p < 0.001$ ), larger ICH volume (33.5 vs. 12.7 ml,  $p < 0.001$ ), larger initial EED (0.46 vs. 0.31,  $p < 0.001$ ) and higher glucose (7.7 vs. 6.9 mmol/l,  $p = 0.001$ ). Patients with larger than expected EED were more likely to have midline shift (58% vs. 32%,  $p < 0.001$ ), herniation (14% vs. 5%,  $p < 0.001$ ), higher 3 month (51% vs. 26%,  $p < 0.001$ ) and 6 month (54% vs. 28%,  $p < 0.001$ ) mortality. In the logistic regression model higher than expected EED was associated with mortality at 6 months (OR 1.81 95% CI 1.12–2.92,  $p = 0.015$ ) adjusted for age, male gender, warfarin use, NIHSS, GCS, ICH volume and ventricular extension.

**Conclusion:** Oedema growth can be readily monitored and is an important independent determinant of outcome after ICH. It is strongly correlated with time from stroke onset and is associated with larger baseline haematoma volume. Oedema growth is an important treatment target for strategies to improve patient outcome.

048

### Comparison of Aboriginal and Non-Aboriginal Stroke in Central Australia: A Retrospective Cohort Study

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**Background and Rationale:** Preliminary evidence suggests stroke in Aboriginal and Torres Strait Islander (Aboriginal) Australians occurs more frequently and at younger ages than in non-Aboriginal people. This is mostly derived from State hospital databases, preventing investigation of stroke subtypes and risk factors. The greater Alice Springs area has a high proportion of Aboriginal people (27%), and provides an ideal region for compar-

ing subtypes of stroke and risk factors between Aboriginal and non-Aboriginal people.

**Methods:** We examined the medical records of all stroke admissions to Alice Springs Hospital (2011–2014, ICD010 codes I 60, 61, 62.9, 63 and 64). Data were extracted using a pre-specified template, including demographics, risk factors, investigations and management of stroke. Clinical and radiological information was examined to assign a final diagnosis of stroke or non-stroke and aetiological classification of stroke.

**Results:** 255 patients were discharged with an ICD10 code of stroke. 27 files were non-obtainable or incomplete. Of the remaining 228 cases, 200 (88%) were correctly coded as stroke. Of 200 people discharged with stroke, 108 identified as Aboriginal (54%). Aboriginal people with stroke were younger (median age 54 [interquartile range (IQR) 46–66] than non-Aboriginal patients (median 67 [IQR 57–79,  $p$  value <0.001]). Intracerebral and subarachnoid haemorrhage comprised a non-significantly greater proportion of stroke in Aboriginal patients (31 vs. 29%). In-hospital mortality appeared higher in Aboriginal patients (21 vs. 9%,  $p$  value = 0.04). There were no significant differences in smoking, alcohol and atrial fibrillation between the two groups.

**Conclusion:** Although not a population-based study, we confirm that hospitalisation rates for stroke in Aboriginal patients appear excessive, and in-hospital mortality higher. Aboriginal people with stroke are younger than their non-Aboriginal counterparts. The reasons are unclear from this study, and a larger prospective population-based study is needed to further illuminate the cause of these disparities.

049

### Damage to the Left Precentral Gyrus Is Associated with Buccofacial Apraxia

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**Background and Rationale:** The responsible lesion for buccofacial apraxia (BFA) in ischemic stroke patients still remains unclear. The aim of this study is to address this issue in consecutive patients with acute stroke.

**Methods:** We retrospectively studied consecutive 2146 ischemic stroke patients who were admitted to our department within 7 days after onset from April 2007 through March 2012. According to the inclusion criteria of first-ever stroke onset, right-handed, not complicated with dementia, isolated non-lacunar infarcts in the left middle cerebral artery (MCA) territory, and neuropsychological evaluation by speech-language pathologists, consecutive 136 patients (70.5 ± 12.9 years old, 79 male) were enrolled in this study. Lesions were delineated on T2-weighted images or fluid-attenuated inversion recovery images obtained during hospital stay. We generated a statistic map of lesions contribution related to BFA using voxel-based lesion symptom mapping (VLSM).

**Results:** The median interval between stroke onset and neuropsychological evaluation was 7 days [5–10, interquartile range]. The median NIHSS on admission was 5 [2–10]. Of the 136 pa-

tients, 20 patients (15%) showed BFA. There was no patient with pure form of BFA. The median time from onset to MRI was 9 days [7–12.75]. The VLSM analysis revealed areas associated with BFA in regions centered at the left precentral gyrus.

**Conclusion:** In patients with acute left MCA stroke, damage to the left precentral gyrus is the most likely site causing BFA.

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050

### Topographical Distribution of Cerebral Infarction Associated with Transcatheter Aortic Valve Implantation (TAVI)

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**Background and Rationale:** TAVI is associated with one of the highest incidences of stroke of any medical or surgical procedure (Fanning *et al.*, 2014). Such clinically apparent events represent but the 'tip-of-the-iceberg' of TAVI-associated cerebrovascular events (CVEs). Cerebral MRI provides an objective marker for characterising the full burden of perioperative CVEs, which is pivotal to both understanding their aetiology and functional consequences in this setting, and developing effective neuroprotective strategies.

**Methods:** Forty-one patients undergoing TAVI with the Edwards SAPIEN-XT™ at The Prince Charles Hospital in Australia, were enrolled prospectively. Participants underwent brain MRI, including diffusion weighted imaging (DWI) sequences, pre-procedure, and 4 (±2) days post-procedure. Clinical assessment included completion of the National Institute of Health stroke scale (NIHSS), modified Rankin Score (mRS), Montreal Cognitive Assessment (MoCA), Confusion Assessment Method (CAM), and the rapid assessment test for delirium (4-AT), all administered at baseline, 4 (±2) days post-procedure and again at six weeks.

The primary endpoint was new DWI-positive lesions on the post-procedural scan versus baseline MRI using previously published definitions (Fanning *et al.*, 2015), quantified both by number and volume (μL). Secondary endpoints were clinically apparent neurological injuries, including strokes (major or minor), transient ischemic attacks, postoperative cognitive dysfunction, and delirium.

**Results:** Mean (± standard error) participant age was 82.3 (±1.1) years. Patients were of an intermediate-to-high risk with a Society of Thoracic Surgeons (STS) score of 6.3 (±0.09) and Euro-

SCORE II of 6.5 (±1.1). MRI assessments identified 83 new DWI lesions in 19/31 patients (59.26%), a mean 2.6 (±0.77) lesions/patient and 138 (±0.08) μL/lesion. Anatomical characterisation of these lesions revealed 63% and 81% in the right versus left hemisphere by number (p = 0.06) and volume (p < 0.0001), respectively. Corresponding values, considering the brain parenchyma involved, were 60% and 80% for cortical grey matter; and considering vascular distribution, 59% and 91% for the posterior circulation (p < 0.0001 for both when weighted for blood flow). Of these lesions, the standardised clinical assessments identified 1 minor stroke, 2 episodes of postoperative cognitive dysfunction and 1 episode of delirium.

**Conclusion:** Subclinical neurological injury is common post TAVI. Lesion distribution suggests vulnerability of the cortical grey matter, the right hemisphere and posterior circulation. Our findings reveal unique considerations for neuroprotective strategies in TAVI, and, highlight the need for further investigation into the prognostic significance of subclinical CVEs, all of which is likely to be of increasing significance as TAVI utilisation is extended into lower-risk patients (Fanning *et al.*, 2016).

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051

### Citalopram on Acute Ischemic Stroke Outcome: A Randomized Clinical Trial

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**Background and Rationale:** Ischemic stroke (IS) is one of the main causes of death and disability in the adult population and recovery from it is considered by many researchers. The aim of the present study was to evaluate the efficacy of citalopram on 3-month outcome of non-depressed acute IS patients.

**Methods:** In a randomized, placebo controlled clinical trial, 144 patients with acute IS were studied for 3 months. In one group, the patients received oral citalopram 20 mg (once daily) and in the other group, they received placebo. All patients received standard care including physiotherapy. Patients with depression were excluded from the study. Primary outcome was set

to a 50% reduction in the 3-month National Institutes of Health stroke scale (NIHSS) compared to the baseline scores. Clinical Trial Registration-URL: <http://www.irct.ir>; Unique identifier: IRCT201203192150N2.

**Results:** The mean age of patients was 66.39. Of 144 eligible patients, 15 patients died (4 in citalopram and 11 in placebo groups) and 21 patients did not complete the study follow up period (10 in citalopram and 11 in placebo groups). The primary outcome of the study was achieved in 57 patients (79%) of citalopram and 39 patients (54%) of placebo groups ( $p < 0.000$ ) with the risk ratio and number needed to treat of 1.9 (CI: 1.2–3) and 3.6 (CI: 2.5–8.6), respectively. No major adverse events were found in either group.

**Conclusion:** Citalopram is a safe and tolerable medication in patients with acute IS and could improve the outcome in these patients.

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## 052

### Stroke Telemedicine in Australia: Preliminary Findings on Building the Case for Financial Sustainability

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**Background and Rationale:** With limited specialist physicians available in regional hospitals, telemedicine may help improve access to time critical acute stroke treatments. The Victorian Stroke Telemedicine (VST) project is being established in 16 regional hospitals across Victoria, Australia (Bladin et al., 2015). This program enables access to neurologists at any time for decision support related to reperfusion therapies. We present preliminary data on whether the VST program is cost-effective.

**Methods:** Patients presenting to a participating hospital with suspected stroke <4.5 hours from symptom onset were eligible using 2011–2012 administrative data for Victoria. A simulated, incremental cost-effectiveness analysis was conducted to assess the potential costs and benefits of the VST program compared with (a) usual care or (b) an alternate ‘counterfactual’ option of directly employing stroke specialists to service one or more regional hospitals for delivering reperfusion therapy to patients in regional Victorian hospitals. Interim data from the VST program and the literature were sourced to populate the economic model. Assumptions were verified by an expert working group. Incremental costs were compared to incremental benefits measured as ‘healthy years (HY)’ gained. Scenario modelling and sensitivity analyses were undertaken to account for uncertainty in the point estimates.

**Results:** Using a willingness-to-pay threshold of AUD50,000/HY gained, the VST program was cost-effective compared to usual care (net cost per HY gained AUD38,000; 95% uncertainty in-

terval [UI] AUD22,000, AUD60,000) with ~66 more patients being treated with intravenous thrombolysis. The counterfactual scenario of employing stroke specialists at regional hospitals was not cost-effective (AUD73,000 [95% UI AUD42,000, AUD118,000; 9% iterations <\$50,000] per HY gained).

**Conclusion:** Stroke telemedicine is a feasible model to improve stroke outcomes in rural and regional areas. Our preliminary, economic evaluation of the VST program provides important information to guide the business case for ongoing sustainability and funding of the program.

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053

### The Experience of Integrating Remote Acute Stroke Telemedicine Consultations with Local Practice: A Comparison of United Kingdom and Australian Specialist Providers

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**Background and Rationale:** By increasing access to stroke specialists, telemedicine can reduce healthcare inequities in rural areas. However, the successful implementation of telemedicine services requires specialists' adapting their usual practice to provide consultations remotely. Yet how specialists' experiences vary between different countries is unknown. The aim of this study was to compare perceptions of United Kingdom (UK) and

Australian specialists providing remote acute stroke telemedicine consultations.

**Methods:** Participants were identified using purposive sampling of remote specialists of these new telestroke networks: Australia's Victorian Stroke Telemedicine Program (n = 6; 2010–2013) and UK's Cumbria and Lancashire telestroke network (n = 5; 2010–2012). Semi-structured interviews were conducted pre- and post-implementation; recordings were subsequently transcribed verbatim and analysed in NVivo.

Deductive analysis was undertaken by two independent coders using the Normalisation Process Theory framework designed for assessing integration of interventions into usual practice. Interrater reliability analyses revealed 78–100% (M = 92%, SD = 8%) agreement, weighted average k = 0.69.

**Results:** Analysis to date (n = 6 Australia, n = 4 UK) revealed cross-cultural similarities and differences. In both countries, specialists described old and new consulting practices, and the purpose and value of the new telemedicine system. Both UK and Australian specialists reported not knowing rural colleagues' assessment and diagnostic skills as a concern. Australians discussed how remote consultations impacted on their usual role and future improvements, while UK specialists discussed system governance and policy and procedures. Full results will be presented.

**Conclusion:** Although concerns were identified, specialists from both Australia and the UK were actively involved in aspects of implementation to facilitate telemedicine consultations being available for regional patients with acute stroke. The variation identified may reflect different models of care used in Australia and the UK, requiring further exploration.

054

### Lessons from Implementing a Regional Acute Stroke Telemedicine Service and How It Promotes Access to ECR Capable Hospitals

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**Background and Rationale:** While acute telemedicine programs can increase the use of stroke thrombolysis in regional hospitals, it can also support rapid access to new advanced therapies such as endovascular clot retrieval (ECR). This presentation will take a theory-informed approach, outlining barriers and enablers to the implementation of the Victorian Stroke Telemedicine (VST) program and how it has facilitated access to ECR.

**Methods:** The VST program commenced in one regional hospital in 2011, and is expanding to a further 15 hospitals in a staggered approach from 2013–2017. This virtual system links regional hospitals to a network of metropolitan-based neurologists who provide 24/7 on-call support for patients presenting with acute

stroke symptoms. Implementation strategies were selected to address likely barriers and enablers to telemedicine, identified through published literature, pilot site work and action research methods (e.g. key informant interviews, program governance documentation analysis). These included employment of local site coordinator, site visits, education and integration of VST service into local processes and systems.

**Results:** From February 2014 – January 2016, the VST program provided 393 initial consultations in 10 hospitals and 80 received thrombolysis. From mid-2015, VST commenced facilitating access to ECR, resulting in 10 being transferred for treatment. The median time from initial site visit to site coordinator commencement was 9.3 months. ‘Go-live’ status took a further 4.8 months to achieve. Common barriers to implementation were local technology issues, site coordinator recruitment challenges and lack of buy-in from senior management. Enablers were effective working relationships with organisations, leadership and ability to adapt quickly to new technologies and stroke therapies.

**Conclusion:** The rollout of a regional statewide stroke telemedicine project is complex and requires significant planning. Successful implementation involves a multi-faceted approach to address organisational and technological barriers. Telemedicine enablers can be leveraged to rapidly translate new evidence into practice, such as access to ECR.

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055

### Using a Tailored Health Information Technology Driven Intervention to Improve Health Literacy and Medication Adherence in a Pakistani Population with Vascular Disease

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**Background and Rationale:** We aimed to develop, test and evaluate the effectiveness of a tailored health information technology driven intervention: ‘Talking Prescriptions’ (Talking Rx) to improve medication adherence.

**Methods:** We conducted a parallel, randomized, controlled, assessor-blinded, superiority trial at the Aga Khan University Hospital Karachi, Pakistan. Adults with diagnosis of Cerebrovascular accident (CVA) or Coronary artery disease (CAD) for at least one month, on anti-platelets and statins and had access to a cell phone were enrolled. The intervention group received a) Daily Interactive Voice Response (IVR) call services b) Daily tailored medication reminders and c) weekly lifestyle modification messages. Usual care consisted of regular follow-up appointments. Medication adherence was assessed by a validated version of Morisky Medication Adherence scale (MMAS). (Saleem et al., 2012) Analysis was conducted by intention-to-treat (ITT). Independent t-test statistics were used for outcome.

**Results:** The Talking Rx study was conducted from April 2015 till December 2015. In total 197 participants were enrolled, out of which 99 were in the intervention and 98 in the usual care group. The drop-out rate was 9.6%. Baseline group characteristics were similar. At baseline, MMA was 6.68 (0.12) in the intervention group and 6.77 (0.13) in usual care group. At end of follow-up the MMAS increased to 7.40 (0.08) in the intervention compared with 7.38 (0.06) in usual care group with mean difference of 0.03 (95% C.I for the difference = -0.23, 0.29,  $p = 0.404$ ). In further sub-group analysis on CVA participants, 50 participants in the intervention group and 47 in the usual care group, the MMAS increased to 7.29 (0.11) in the intervention as compared to 7.07 (0.18) in usual care group with mean difference of 0.22 (95% C.I for the difference = -0.20, 0.65,  $p = 0.152$ ).

**Conclusion:** mHealth technology driven intervention was feasible in a busy LMIC setting. It increased medication adherence in those who received intervention although the results did not achieve statistical significance.

**Trial Registration:** Clinical Trials. gov NCT02354040 <https://clinicaltrials.gov/ct2/show/NCT02354040>.

### Reference:

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### Acute Stroke Therapy

P001

#### Iodinated Contrast Administration for Computed Tomography in Stroke Does Not Cause Acute Kidney Injury: A Retrospective Single-Centre Review of 340 Patients

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**Background and Rationale:** The significance of contrast-induced nephropathy following computed tomography (CT) is questionable (McDonald et al., 2013), making stroke treatment delays introduced in determining renal function prior to CT angiography (CTA) unwarranted. This study aimed to analyse the incidence of acute kidney injury (AKI) amongst patients undergoing acute stroke evaluation, to guide local practice.

**Methods:** We conducted a retrospective analysis of patients from our stroke registry between April 2014 and January 2016. All patients underwent non-contrast CT brain, followed by CTA arch-to-vertex unless contraindicated. Baseline renal function, based on blood results at or prior to presentation, was compared to renal function after 48 hours of hospital admission; with AKI defined using KDIGO criteria.

**Results:** Data was available for 340 patients, of whom 248 (72.9%) underwent CTA. Mean patient age (68.6 vs. 75.0 years;  $p < 0.001$ ) and presence of chronic kidney disease (CKD) stage 3–5 (22.6% vs. 35.9%;  $p = 0.02$ ) were significantly greater in the non-contrast group. Mean serum creatinine significantly improved over the first 48 hours of admission in both CTA (82.3 vs. 76.2 mmol/l;  $p < 0.001$ ) and non-contrast groups (95.4 vs. 90.0 mmol/l;  $p = 0.03$ ).

The overall incidence of AKI was 2.65% (9 patients), with no significant difference between the CTA and non-contrast groups (1.61% vs. 5.43%; OR 0.29, 95% CI 0.075–1.09;  $p = 0.078$ ). No patient required dialysis. Amongst patients who underwent CTA, neither age  $>80$  years (0% vs. 2.3%;  $p = 0.263$ ) nor baseline CKD 3–5 (1.9% vs. 1.5%;  $p = 0.793$ ) significantly increased the risk of developing AKI.

**Conclusion:** The incidence of AKI post-CTA is low and consistent with that reported in another recent Australian study (Ang et al., 2015). Contrast administration in acute stroke imaging does not appear to increase the risk of AKI, affirming our practice of not routinely awaiting renal function prior to CTA in the setting of acute stroke.

### References:

Ang T, et al: Multi-modal CT in acute stroke: wait for a serum creatinine before giving intravenous contrast? No! *Int J Stroke* 2015;10:1014–1017.

McDonald JS, et al: Frequency of acute kidney injury following intravenous contrast medium administration: a systematic review and meta-analysis. *Radiology* 2013;267:119–128.

P002

#### Extending the Time for Thrombolysis in Emergency Neurological Deficits – The Extend Trial

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EXTEND<sup>1</sup>

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**Background and Rationale:** Current clinical application of intravenous thrombolysis in stroke is limited by the 4.5 hour time window and not applicable to patients with wake up stroke (WUS). Patient selection using advanced penumbral imaging criteria may allow extension of the therapeutic window.

To test the hypothesis that perfusion-diffusion mismatch can be used to select patients with favourable response to thrombolysis beyond conventional time windows and in WUS patients.

**Methods:** EXTEND is an investigator initiated, randomised, double-blind, placebo controlled trial of intravenous alteplase vs. placebo in patients with ischemic stroke 4.5–9 hours from stroke onset and WUS.

Patients with ischemic stroke within 4.5–9 hours from stroke onset and WUS patients, (WUS defined as the midpoint between time to sleep and awakening with the stroke symptoms  $<9$  hours), are eligible for recruitment ( $n = 400$ ). Criteria for entry into the trial include perfusion-ischemic core mismatch using a perfusion threshold of  $T_{max} >6$  sec and a perfusion-ischemic core lesion volume ratio of  $>1.2$  and absolute mismatch  $>10$  ml. Ischemic core lesion volume must be  $<70$  ml. This will be assessed using a fully automated software package (RAPID, Stanford University). Reperfusion/recanalization will be assessed at 24 hours. Safety endpoints include symptomatic intracerebral haemorrhage and death.

**Results:** The primary endpoint is mRS 0–1 at 90 days. Secondary endpoints will include mRS ordinal analysis, reperfusion, recanalization, quality of life and depression scales.

**Conclusion:** Recruitment is underway in Australasia, Taiwan and Finland. As of January 2016, 134 patients were randomised and a prospective pooled analysis with ECASS4 is planned which is called EXTEND-AE.

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## P003

### Tenecteplase versus Alteplase for Stroke Thrombolysis Evaluation Trial (TASTE)

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**Background and Rationale:** In phase II studies, tenecteplase (TNK) has been shown to result in more complete reperfusion. We are conducting a phase III trial to compare TNK with Alteplase in acute ischemic stroke with onset <4.5 hours in patients clinically eligible for intravenous alteplase who fulfil additional imaging criteria.

**Methods:** Multicentre, prospective, randomised, open-label, blinded endpoint (PROBE) phase III study. Patients are randomised 1:1 to standard dose intravenous alteplase (0.9 mg/kg) or TNK (0.25 mg/kg as a single bolus). There are two randomisation strata: first, randomisation is stratified by the presence or absence of internal carotid artery occlusion (ICAO) on baseline CT or MR angiography (capped at a maximum of 25% of the sample size); second, randomisation is stratified by size of infarct core (above or below 25 ml) on baseline CTP or diffusion-weighted MRI (DWI). We aim to include 1024 participants.

**Results:** Patients aged ≥18 years presenting with acute hemispheric ischemic stroke within 4.5 hours of stroke onset who are clinically eligible for IV alteplase. Multimodal CT or MRI including perfusion imaging must be performed before randomization.

Infarct core and penumbral volumes will be calculated by automated software, RAPID or MISTar.

**Primary Outcome:** Modified Rankin Scale (mRS) 0–1 at 3 months.

**Secondary Outcomes:**

Reperfusion at 24 hours post stroke.

Early clinical improvement (reduction in acute – 24 hour NIHSS score)

Modified Rankin Scale (mRS) 0–1 at 3 months (adjusted for baseline age and NIHSS).

Modified Rankin Scale 0–2 at 3 months.

Categorical shift in mRS at 3 months.

Infarct growth at 24 hours.

Recanalization at 24 hours.

**Conclusion:** Since the trial commenced in August 2014, 56 patients have been recruited. Fifteen centres now open in Australia and a further 17 sites are opening in 2016 across Taiwan, Canada, Spain, the UK and Belgium. Interim analysis is planned after inclusion of the first 50 patients.

## References:

- Trial PI: Mark Parsons.
- Trial Registry Number ID: ACTRN12613000243718.
- Trial Sponsor: National Health and Medical Research Council Australia.
- Trial Website: <http://taste.webmistar.com/>.

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## P004

### New Zealand Stroke Thrombolysis: Comprehensive National Data from a Newly Implemented Mandatory National Registry

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**Background and Rationale:** Stroke thrombolysis is a time sensitive and potentially harmful therapy. To ensure quality assurance and continuous service improvement the New Zealand National Stroke Network introduced a mandatory National Stroke Thrombolysis Register in 2015. Here we present the first six months of data capturing every patient thrombolysed in New Zealand during this time frame.

**Methods:** All New Zealand hospitals collect data around stroke thrombolysis and submit this for central collation quarterly. Data is analysed and linked with data from the Ministry of Health National Minimum Dataset. Stata 12.1 is used for all statistical analysis.

**Results:** In the first six months, there were 179 [75 women, mean (SD) age 69.9 (14) years] treated with stroke thrombolysis out of a total of 2796 ischaemic stroke patients, giving a national thrombolysis rate of 6.4%. Of thrombolysed patients 6 (3.4%) had strokes as inpatients, 53 (29.6%) were over the age of 80, 122 (68%) were treated within 3 hours of symptom onset, and 105 (58.6%) were treated out of hours. The median [Inter-quartile range (IQR)] onset-to-treatment time was 154 (125–190) minutes

and the median (IQR) door-to-needle time was 74.5 (55.7–105.0) minutes. The rate of symptomatic intracranial haemorrhage following thrombolysis was 4.4%. There was variation depending on geographic location with a thrombolysis rate of 4.7% in small rural centres, 6.1% in mid-sized districts, and 8.4% at large urban centres. Tertiary hospitals treated patients faster with a median (IQR) door-to-needle time of 67.5 (47–95) minutes compared to 81 (62–110) minutes at non-tertiary centres ( $p = 0.014$ ).

**Conclusion:** Overall these results are similar to other international centres and indicate an approximate doubling of the proportion of stroke patients treated with stroke thrombolysis since a 2009 national audit. There is need for on-going efforts to improve treatment rates and process efficiency as well as reduce geographic variation.

#### P005

### Is Bigger Better? Improving National Access to Vital Stroke Unit Care and Thrombolysis by Focusing Our Efforts on Just a Handful of Larger Stroke Unit Sites? Data from the 2015 National Stroke Audit

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**Background and Rationale:** Stroke unit care (SUC) and thrombolysis are well established recommended elements of acute stroke care as outlined in the Clinical Guidelines for Stroke Management and the Acute Stroke Clinical Standard. Compared to international benchmarks Australia has considerable room for improvement. Access to SUC and thrombolysis increase with larger hospital volumes but improvement in a few larger sites (admitting >350 strokes annually) in particular could significantly improve access rates nationally.

**Methods:** As part of the National Stroke Audit clinicians at each participating hospital completed a self-reported survey regarding organisational aspects of stroke services including SUC and thrombolysis provision. Standardized training and a data dictionary were provided. Analysis of aspects of care was undertaken based on hospital volume. Potential impact of improving care in large hospitals was calculated.

**Results:** 18 acute hospitals participated completed the survey, 25 of whom reported admitting >350 stroke patients annually. These 25 sites account for 50% of all reported stroke admissions and all have SUC available. However, 3928 (26%) of patients at these sites failed to receive SUC and seven sites (all admitting >450 strokes annually) reported <57% access to SUC. Total thrombolysis rates (all stroke admissions) ranged from 2.5%–14.9% (median nationally all hospitals: 6.5%, median hospitals with 350+ admissions: 9.0%). Improving access to 80% in seven large sites with low SUC rates would lead to 1444 more patients accessing SUC. Improving rates of thrombolysis to the current median for large volume sites (9.0%) could lead to an additional 270 patients receiving thrombolysis.

**Conclusion:** Focused efforts at a small number of large volume sites would substantially improve access to SUC and thrombolysis across Australia.

#### P006

### Transforming Stroke Research in South Australia – A Management Program to Support Change

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**Background and Rationale:** Administrators need to improve support for stroke management transitions (Alexandrov et al, 2015). The vision of the South Australian (SA) Advanced Health and Research Translational Centre at the SA Health and Medical Research Institute (SAHMRI) is to continuously enhance the rate of translation of research into healthcare. In a milieu of change, CALHN provides a 16-week multidisciplinary program to support clinical and corporate middle-level managers as change leaders. A program objective is to plan, implement and evaluate a practical hospital departmental change project; we selected quantification and overcoming barriers to stroke unit access as part of our project.

**Aim:** To describe and report on the program method to achieve the project objective in an environment of transition.

**Methods:** The program included an information session, pre-reading, 4 daylong interdisciplinary workshops, project scoping and action learning set meetings, a buddying system and final project presentation. The main change model underlying the program content is the ADKAR model (Awareness, Desire, Knowledge, Ability, Reinforcement) (Hiatt, 2006) supported by Bridges' model of transition (Bridges, 1991). Program tools include stakeholder mapping and engagement, staff engagement in change and communication strategies, and action planning.

**Results:** The change project within the program was scoped, stroke unit access impact and quality indicators were identified, and the project was initiated. The transition support program and our project are described, including upskilling, interdisciplinary work undertaken, monitoring and managing resilience and change fatigue risks, as well as planning, implementing and evaluating the practical change project with direct report stroke indicator outcomes.

**Conclusion:** The method, impact and outcomes of a management support program, with an embedded project on change in stroke unit access, for stroke management transition are described.

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## P007

### Quantifying and Overcoming Barriers to Stroke Unit Access

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**Background and Rationale:** Stroke unit admission has been shown to be beneficial for treatment and survival of stroke patients (Jauch et al, 2013). The 2015 National Stroke Foundation (NSF) audit of 185 hospitals reported that in Australia 67% of people with stroke are admitted to a stroke unit (NSF, 2015). In order to receive the benefits of stroke unit care, patients should be on a stroke unit and barriers to access need to be overcome.

**Aim:** To determine stroke unit access in the Central Adelaide Local Health Network (CALHN) pre and post the merger of two separate hospital stroke units, examine the impact of organisational change and recommend strategies to increase stroke unit access.

**Methods:** We analysed stroke unit access in CALHN from 2014–2015. Stroke services underwent structural change in August 2015 to better facilitate stroke unit access, continuing improvements to stroke services in South Australia (Moey et al, 2015). Prior to this date stroke unit access was discretionary. Following reorganization, stroke unit admission was mandated for all appropriate patients. The impact of organisational change on stroke unit access was assessed. Further barriers to stroke unit access will be examined by casenote review.

**Results:** In the 14 months pre-merger, i.e. prior to August 2015, there were 1,250 stroke admissions to the two separate hospitals (average of 89.3 per month), with 61.6% of these admissions receiving treatment within their stroke units. Following the merger of stroke units and streamlining of services, the admissions increased to 90.75/month with a much-improved 72.5% of all admissions receiving treatment in the stroke unit. Results of the casenote audit will be reported at the meeting.

**Conclusion:** Following structural reorganization, the percentage of patients receiving stroke unit care at CALHN improved. The main barriers to improvement and the strategies to overcome them will be reported at the meeting.

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## P008

### Evaluation of Scores for Ischemic Risk Stratification in Stroke Patients with Atrial Fibrillation: The SAMURAI-NVAF Study

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**Background and Rationale:** There are some scores for predicting ischemic stroke risk in patients with non-valvular atrial fibrillation (NVAF). We investigated the availability of 6 reported scores in evaluating ischemic stroke/transient ischemic attack (TIA) recurrence in the acute stroke patients with NVAF enrolled in the multicenter observational SAMURAI-NVAF study.

**Methods:** Between September 2011 and March 2014, 1192 patients with acute ischemic stroke/TIA having NVAF were enrolled. The median follow-up periods were 482 days. We categorized each score for ischemic risk stratification into low/intermediate- and high-risk group: CHADS<sub>2</sub> (low/intermediate risk 0–1, high risk 2–6); CHA<sub>2</sub>DS<sub>2</sub>-VASc (0–1, 2–6); Framingham (0–15, 16–31); NICE; ACC/AHA/ESC; and Eighth ACCP (in the latter three scores, risk level was assessed by combination of each risk factor). Ischemic stroke/TIA recurrence was compared between low/intermediate-risk and high-risk group in each risk score.

**Results:** Eighty-nine ischemic stroke and 6 TIA were occurred. The incidence of recurrence was significantly higher in high risk group in all risk scores: the crude hazard ratio of high-risk group in each score was 1.7 (95% CI 1.0–2.8), 3.0 (1.1–12), 1.5 (1.0–2.3), 1.9 (1.2–3.1), 1.8 (1.1–3.0), and 1.6 (1.0–2.7), respectively.

**Conclusion:** All scores (CHADS<sub>2</sub>, CHA<sub>2</sub>DS<sub>2</sub>-VASc, Framingham, NICE, ACC/AHA/ESC, Eighth ACCP) are useful for predicting recurrence of stroke/TIA in the stroke patients with NVAF.

P008

### A Case of Acute Encephalitis Presented with Aphasia, Confusion Mimicking Cerebral Infarction

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**Background and Rationale:** Several CNS infections have been confused with the ischemic stroke. We should consider vague symptoms confused with ischemic infarction as other causes for example encephalitis.

**Methods:** A 65-year-old man was delivered to emergency room with sudden onset of confusion mentality and language disturbance, right hemiparesis. He had been well before admission. He had a history of hypertension and diabetes mellitus. Vital sign was stable at admission. He was afebrile and routine laboratory findings were normal. On the neurological examination at admission, he was alert and sensory aphagic. Right hemiparesis was Medical Research Council (MRC) grade 4. Diffusion weighted imaging showed hypertense signal at left periventricular white matter. 2nd day on admission, mentality changed to stupor state and right hemiparesis to MRC G1. he developed fever of 38.4. 3rd day on admission, 1st CSF exam was performed with no white blood cell. But we diagnosed encephalitis and started antiviral agent. 6th day on admission, WBC(5) are founded in CSF exam. During the admission days after antiviral therapy, the patient gradually improved to right hemiparesis MRC G4.

**Results:** Based upon initial radiologic findings and clinical manifestations, we diagnosed acute cerebral infarction. But his clinical condition aggravated to stupor mentality, right hemiplegia with fever. Repeated CSF exam revealed elevated WBC. After antiviral therapy, his clinical condition gradually improved.

**Conclusion:** This case presented herein is characterized by an association between acute cerebral infarction and CNS infection. So we should be curious of other causes except cerebral atherosclerosis with patients diagnosed as ischemic stroke.

### References:

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P010

### The Influence of Organisational Context on Delivery of Thrombolysis and Stroke Unit Care

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**Background and Rationale:** Organisational context can influence the translation of evidence into practice, but how it affects delivery of acute stroke care from an interdisciplinary perspective is unknown. We aimed to describe variations in the organisational context of hospitals responsible for delivering acute stroke care and identify aspects correlated specifically with thrombolysis delivery and stroke unit care.

**Methods:** Data from 20 Queensland hospitals (Australia) that participated in the Stroke123 quality improvement project were used. Clinicians' perception of their work context was collected at baseline using the Alberta Context Tool (ACT) (Copyright, Estabrooks 2007). The tool covers ten dimensions including leadership, culture, evaluation and interactions. Hospital adherence to providing stroke unit care and thrombolysis was calculated using data from the Australian Stroke Clinical Registry for the 12-months prior to the study (2013). One-way analysis of variance was used to assess differences between sites for each ACT dimension and correlations between ACT dimension scores and adherence levels to the care processes investigated were calculated.

**Results:** 216 clinicians completed the survey (47% nursing, 36% allied health, 11% medical). Overall scores (possible range: 1–5) were greatest for the social capital (mean [SD]: 4.1[0.6]) and culture dimensions of the ACT (mean [SD]: 4.0[0.5]). Significant variation between hospitals was observed for the dimensions of: culture ( $p = 0.03$ ); evaluation ( $p = 0.04$ ); social capital ( $p = 0.04$ ); excess staff capacity ( $p = 0.01$ ); and excess space capacity ( $p < 0.001$ ). Hospitals providing greater access to stroke unit care had significant correlations with the dimensions of: culture ( $r = 0.6$ ,  $p < 0.001$ ); social capital ( $r = 0.6$ ,  $p < 0.001$ ); and informal interactions ( $r = 0.5$ ,  $p < 0.001$ ). Achieving higher rates of thrombolysis was correlated with: social capital ( $r = 0.4$ ,  $p < 0.001$ ); culture ( $r = 0.3$ ,  $p < 0.001$ ); and excess time capacity ( $r = 0.3$ ,  $p < 0.001$ ).

**Conclusion:** Aspects of organisational context such as culture and social capital may influence delivery of evidence-based stroke care, offering insights to potential mechanisms for improving implementation of evidence.

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**P011****Risk Factors, Characteristics and Outcomes of Recurrent Ischaemic Stroke in Hospital Seberang Jaya**

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**Background and Rationale:** Despite the institution of evidence-based secondary prevention treatment, stroke recurrence remains prevalent in our population. The clinical characteristics and outcomes of recurrent stroke patients are not well studied as most research efforts in Malaysia involve patients with first ever stroke. In this cross-sectional study, we investigate the various differences between first-ever stroke and recurrent stroke.

**Methods:** Hospital Seberang Jaya (HSJ) participates in Acute Stroke Registry Malaysia and stroke patients are enrolled prospectively. Data of stroke patients between 1st January 2015 to 31st December 2015 were extracted and their demographics, co-morbidities, stroke severity and outcomes were analysed. Patients with non-ischaemic stroke and missing data were excluded.

**Results:** We found a total of 248 stroke patients were admitted during the study period and after excluding 45 patients, 161 (79.3%) were first-ever stroke events and 42 (20.7%) were recurrent stroke. Using multivariate analysis, recurrent stroke was significantly associated with female gender and history of diabetes mellitus but not with age, ethnicity, underlying smoking history, hypertension, ischaemic heart disease, hyperlipidemia or atrial fibrillation. First-ever stroke and recurrent stroke patients did not differ in terms of stroke severity (NIHSS and MRS), length of stay or in-hospital mortality.

**Conclusion:** Our hospital data uniquely showed stroke recurrence was more common in females and diabetics with both recurrent and first-ever strokes were similar in severity and outcomes. However, this is a single centre study with limited sample size. Future studies with multicentre involvement and prospective data are indicated to further confirm these findings. Acute Stroke Registry is a good platform and important tool to provide such insightful data.

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**P012****Reversible Cerebral Vasoconstriction Syndrome: An Important Differential for Thunderclap Headache and Infarction**

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**Background and Rationale:** Reversible cerebral vasoconstriction syndrome (RCVS) is an uncommon cause of stroke in young people. It usually presents with a thunderclap headache and variable neurological signs and therefore can mimic a subarachnoid haemorrhage (SAH). The clinical course is heterogeneous and RCVS can lead to development of intracerebral haemorrhage (Ducros A. 2010) and reversible cerebral edema. Up to a third of patients with RCVS present with ischaemic strokes.

**Methods:** We present a case of a young woman presenting with an occipital stroke due to reversible cerebral vasoconstriction syndrome.

**Results:** A 31 year old woman presented to our emergency department with a thunderclap headache and associated blurred vision, photophobia and left hand tingling that occurred whilst drinking alcohol and smoking. She denied concurrent illicit drug use. Her neurological examination showed a right homonymous hemianopia.

She was thrombolysed after a normal CT brain and CT angiogram. Subsequent MRI brain on Day 1 showed diffusion restriction in the right occipital cortex.

Her admission was characterized by an ongoing severe headache and repeat CT brain excluded haemorrhage. Day 2 of admission patient developed vertigo and a second MRI showed extension of the infarct in the right posterior cerebral artery (PCA) territory. Focal narrowing and spasm of the right PCA was noted on the MR angiogram (MRA). The patient received nimodipine. After six days, repeat MRA showed partial resolution of right PCA narrowing consistent with reversible cerebral vasoconstriction syndrome. She was discharged on verapamil.

**Conclusion:** RCVS should be considered in patients that present with thunderclap headache and neurological deficit once SAH has been excluded. Serial angiograms may be required to demonstrate RCVS and this diagnosis has important therapeutic implications.

**Reference:**

Ducros A: Hemorrhagic manifestations of reversible cerebral vasoconstriction syndrome: frequency, features, and risk factors. *Stroke* 2010;41:2505–2511.

## P013

### A Very Early Rehabilitation Trial (AVERT): Safety in the First 14 Days after Stroke

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**Background and Rationale:** In the international trial AVERT (A Very Early Rehabilitation Trial), patients commencing intensive out-of-bed activity within 24 hours of stroke (intervention) showed less favourable outcome (mRS0–2) compared to usual care (UC), but no significant differences in death or serious adverse events (SAEs) at 3 months. We now report the pre-specified safety analysis of deaths and non-fatal SAEs during the first 14 days (intervention period).

**Methods:** SAEs were either events that resulted in deaths or were non-fatal (life threatening, admission or prolonged hospitalisation, or resulted in significant disability). All events were independently adjudicated by clinical experts who were masked to treatment assignment and classified as stroke related (progression or recurrent stroke), immobility related (pulmonary embolism, deep-vein thrombosis, urinary tract infection, pressure sores, pneumonia), falls or other. 14 day outcomes: Deaths and numbers of non-fatal SAEs for individual patients adjusted for age and stroke severity, with pre-specified subgroup analyses, and time to death at 14 days were compared using appropriate regression models.

**Results:** 2104 patients were recruited from five countries, 80 died within 14 days. Patients who died were older (age median (IQR): 80.2 (73.0–84.0) v 72.2 (64.6–80.0),  $p < 0.001$ ) and had more severe strokes (NIHSS median (IQR): 21 (16–24) v 6 (4–11),  $p < 0.001$ ). More intervention patients (48/1048, 4.5%) died than UC (32/1050, 3.0%); adjusted Odds Ratio [aOR] 1.76, 95% CI 1.06–2.92,  $p = 0.029$  with deaths earlier (aHR 1.59 95% CI 1.01–2.48,  $p = 0.044$ ). Death was most commonly associated with stroke progression or recurrence (29/48 intervention; 16/32 UC). Intervention patients aged  $>80$  (OR 2.38, 95% CI 1.12–5.08) and with haemorrhagic stroke (OR 4.17, 95% CI 1.06–16.43) had greater odds of death. No significant differences in non-fatal SAEs were found.

**Conclusion:** Although deaths and SAEs rates were low overall, intervention patients had increased odds of death compared to UC.

## P014

### Victorian Strategies for Reperfusion: Creating Potential for Statewide Access

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**Background and Rationale:** In 2010, rapid access to stroke thrombolysis centres in some rural regions of Victoria (Australia) was limited (Bray et al. 2011). These results, and planning for Endovascular Clot Retrieval (ECR), resulted in the development of strategies for statewide access. This study aims to examine the impact of the implementation of these strategies by the Victorian Stroke Clinical Network (VSCN), the Victorian Stroke Telemedicine Program (VST) and local health services.

**Methods:** The study used Ambulance Victoria (AV) data from 2015 for all patients attended by AV with suspected stroke. The location of the patient was mapped and drive-times to reperfusion centres (thrombolysis and ECR) were calculated using MapInfo (MapInfo Drivetime®, Pitney Bowes Inc.). Statistical comparison were made to the 2010 data.

**Results:** Between 2010 and 2015, five rural health services commenced treatment with IV thrombolysis. Compared to 2010, a greater proportion of rural cases in 2015 were within 60-minutes transport time of a thrombolysis centre (77% to 95%,  $p < 0.001$ ). A 3-hour travel time to two endovascular clot retrieval (ECR) centres is possible for 88% of rural cases (96% for the entire state).

**Conclusion:** A strategic, region-specific approach has seen rapid access to stroke thrombolysis improve across Victoria. Access to ECR by road transport is currently viable for the vast majority of patients with the addition of a second centre in 2016. This data demonstrates access to reperfusion therapies is possible for the majority of stroke patients in Victoria.

## Reference:

Bray JE, Coughlan K, Mosley I, Barger B, Bladin C: Are strokes patients identified by emergency medical services transported to appropriate stroke centres? IMJ 2014;44:515–518.

P015

# **The Impact of Public Stroke Awareness Campaigns: Is There an Association between Calls to Ambulance for Stroke and Awareness of Campaign Advertising?**

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**Background and Rationale:** Separate studies have reported increases in Australian's stroke knowledge and calls to ambulance for stroke since the National Stroke Foundation's (NSF) awareness campaigns began in 2004 (Bray et al 2013; Bray et al 2015). This study aims to assess the potential relationship between calls to ambulance for stroke and 1) awareness of campaigns and 2) unprompted recall of symptoms in Melbourne (Australia) residents.

**Methods:** This study combined data from two sources collected between 2003 and 2014: 1) stroke calls to Ambulance Victoria and 2) annual NSF survey data (collected by telephone 2003–2010 and online 2001–2014).

**Results:** The reported awareness of the NSF advertising among Melbourne residents increased between 2005 and 2010 (17% to 56%), but declined rapidly when data collection changed to online in 2011 (40% to 19%). Both the proportion of people who recalled any stroke symptom, particularly FAST symptoms, as well as the number of calls to ambulance for stroke have steadily increased since campaigns commenced ( $p < 0.001$ ). Calls for stroke and symptom recall were highly correlated ( $r = 0.87$ ); a 10% increase in the proportion of respondents aware of any symptom was associated with a 0.4% absolute increase in the proportion of calls to ambulance due to stroke ( $p = 0.001$ ).

**Conclusion:** These findings suggest that the NSF campaigns have been effective in improving stroke knowledge and health seeking behaviour for suspected stroke. Our study also highlights the need to explore alternate methods of advertising (e.g. online) to improve reach. The next phase of this study is underway and will explore the impact of campaigns on emergency department utilisation and ambulance use among stroke patients.

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- Bray JE, Straney L, Barger B, Finn J: The effect of public awareness campaigns on calls to ambulance across Australia. *Stroke* 2015;46:1377–1380.

P016

# **Establishment of National Performance Benchmarks for Acute Stroke Care: New Evidence from the Australian Stroke Clinical Registry**

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**Background and Rationale:** The Australian Stroke Clinical Registry (AuSCR) is used to monitor and improve several important national clinical quality indicators. To date, national averages have been used for reporting performance, but this crude method for benchmarking promotes conservative performance targets. We used data from top performing hospitals in AuSCR to establish achievable benchmarks to promote greater performance targets, and describe the potential benefits to patients if these targets were achieved.

**Methods:** Data from 2014 were used. Benchmarks were calculated based on the Achievable Benchmarks of Care (ABC™) method (Weissman et al., 1999, Hall et al., 2013) from hospitals with >6 months of data and ≥50 cases ( $n = 34$ ). The achievable benchmark was the average of top performing hospital results that collectively contributed at least 15% of the data. The gap between national average adherence (total number of patients that received the recommended process indicator divided by the total number eligible) and the benchmark was then calculated.

**Results:** In 2014, 8625 episodes of care (54% male, mean age 73 years) were registered. Care gaps between the average performance and benchmark ranged from 9% to 33%. If benchmarks were achieved by these hospitals then, relative to the average performance, the number of additional patients to receive four key stroke processes of care would have been: stroke unit care  $n = 1463$ , (average 79%; benchmark 96%); intravenous thrombolysis for ischemic events  $n = 490$  (average 11%, benchmark 20%); secondary prevention antihypertensives,  $n = 1090$  (average 74%; benchmark 88); and a care plan on discharge  $n = 1429$  (average 53%, benchmark 86%). Collectively, resulting in potentially 185 more patients with reduced death/disability.

**Conclusion:** We present new Australian benchmarks from the top performing hospitals participating in the AuSCR, all rele-

vant to monitoring care against the Australian Acute Stroke Clinical Care Standards (ACSQHC, 2015). These data should facilitate greater impetus for quality improvement.

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### P017

#### Endovascular Stroke Therapy in Internal Carotid Occlusions – Outcomes in a 'Real World' Study

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**Background and Rationale:** Endovascular therapy in acute ischaemic stroke involving proximal occlusions in the anterior cerebral circulation within 6 hours of stroke onset is highly beneficial. Recent NEJM trials studied more patients with middle cerebral artery than internal carotid artery occlusions (Berkhemer et al, 2015). Few endovascular studies have determined outcomes in patients with internal carotid occlusions. This lesion has a very poor prognosis with a historical mortality rate of >50% (Orton et al, 2014).

**Methods:** This study is a retrospective audit of outcomes and recanalization rates in acute ischaemic stroke patients undergoing endovascular clot retrieval in patients with internal carotid occlusions at Liverpool Hospital over 24 months (2014–2015). Patients were selected for clot retrieval on the basis of medical need and after discussion between the patient's treating neurologist and neurointerventional radiologist. Informed consent was obtained prior to the procedure in accordance with hospital policy. We evaluated patient functional outcomes (mRs), mortality at 90 days and recanalization rates.

**Results:** 19 patients with internal carotid involvement (either tandem lesions, carotid bulb lesions or terminal internal carotid lesions) and median initial NIHSS 21 were treated with suction thrombectomy and/or solitaire stent retrievers. Of this group 12 (63%) received intravenous thrombolysis prior to endovascular therapy. Recanalization rates included TICI 3 or TICI 2b reperfusion scores in 15 patients (79%). Mean time to recanalization was 4.5 hours from stroke onset (range 2.5–6 hours) Good functional

outcome (mRs 0–2) was achieved in 6 (32%) with mortality in 5 patients (26%).

**Conclusion:** This study shows similar rates of good outcomes in patients with internal carotid occlusions as seen in recently published acute intervention trials involving the anterior circulation. This study translates endovascular stroke therapy in a severe subgroup of patients to a 'real world' situation.

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### P018

#### Identifying Origin in a Case of Recurrent Stroke by <sup>18</sup>F-Sodium Fluoride Positron Emission Tomography/Computed Tomography

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**Background and Rationale:** The thromboembolic origin is unclear in approximately 60% of patients with embolic cerebral infarction. Many of these cryptogenic cerebral infarctions are considered to be caused by rupture of aortic atherosclerotic plaques which are not easy to confirm in clinical practice. <sup>18</sup>F-Sodium Fluoride Positron Emission Tomography/Computed Tomography (<sup>18</sup>F-NaF PET/CT) has been shown the potential of identifying vulnerable atherosclerotic plaques and facilitating the establishment of infarction origin.

**Methods:** A 61-year-old woman had suffered from ischemic stroke three times during the past 4 years. The first ischemic stroke involved to Rt. portion of pons at 56 years old. The second striato-capsular infarction involved Rt. corona radiata at 59 years old. The third ischemic stroke was multiple embolisms in bilateral middle cerebral artery territory at 60 years old. Although her previous medical history including hypertension, dyslipidemia and diabetic mellitus for 10 years was under control, recurrent stroke attacked in spite of antiplatelet therapy. Her electrocardiography (ECG), 24-hour Holter monitoring and echocardiography did not reveal atrial fibrillation or cardiogenic etiology. For assessing possible ruptured plaques in carotid or aortic arch, <sup>18</sup>F-NaF PET/CT was performed after informed consent signed and approved by institutional review board.

**Results:** The PET/CT image showed increased NaF uptake in the atherosclerotic plaque of the aortic arch, abutting the orifice of

left subclavian artery. The target-to-background ratio for this NaF-avid plaque was 3.08. It was considered to be the culprit lesion for the three times ischemic strokes.

**Conclusion:** According to the findings of  $^{18}\text{F}$ -NaF PET/CT, it is very likely that the rupture of atherosclerotic plaques in aortic arch results in thromboembolisms of downstream unilateral or bilateral common carotid or vertebral arteries. We believe that this is the first report that  $^{18}\text{F}$ -NaF PET/CT may be a useful tool for identifying vulnerable aortic arch atheroma.

## Reference:

Hung GU, Hung CH, Chen TY, Kung WM, Wei CY, Kao CH, Uchiyama S: Identification of Suspected Ruptured Atherosclerotic Plaque in Acute Ischemic Stroke on  $^{18}\text{F}$ -Sodium Fluoride Positron Emission Tomography-Computed Tomography. *Circ J* 2015;79:1855–1857.

## P019

### Risk Factors Causing Hemorrhagic Transformation in Acute Stroke Patients Treat with Recombinant Tissue Plasminogen Activator: A Different Model Result

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**Background and Rationale:** Recombinant tissue plasminogen activator (rt-PA) is an effective treatment for acute ischemic stroke (AIS) patients. But hemorrhage transformation (HT) is a severe complication that affects efficacy and prognosis. The aim of this is to evaluate the risk of HT after accept rt-PA by different analysis model.

**Methods:** From Jan. 2011 to Dec 2014, we enrolled 98 AIS patients treated with rt-PA. HT was definite by brain image (CT or MRI) and confirmed by neuro-radiologist. We recorded all of epidemiological data, laboratory data, NIHSS score of admission, and rt-PA dosage. Two-sample t-test, Chi-Square test, and different multiple logistic regression analysis model were performed to confirm the risk of HI.

**Results:** Up-to 28.6%(28/98) patients had HI identified by follow-up brain CT. Atrial fibrillation (Af), heart disease, NIHSS score  $\geq 12$ , INR  $\geq 1$ , and standard dosage of rt-PA (0.9 mg/Kg) were significant risk factors of HI. After multiple logistic regression analysis: Af (OR,3.6;95% CI, 1.2–10.8;  $P = 0.023$ ) and standard dosage of rt-PA (OR,5.5;95% CI, 1.5–19.8;  $P = 0.009$ ) were significant associated with HT after rt-PA therapy, We also combined

different risk factors, the different outcomes were displayed by different analysis model.

**Conclusion:** Our results may show the respective risk factors of HI in AIS Patients after treat with rt-PA. And, when can understand the different risk factors merge, it will also increase the risk of HI.

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## P020

### Impact of the Difference between Serum Levels of Glucose at Admission and Fasting State on the Functional Outcome in Hyperglycemic Patients with Acute Ischemic Stroke

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**Background and Rationale:** The previous studies have demonstrated that elevated serum levels of glucose at admission or fasting state increase the risk of worse outcome in patients with ischemic stroke. In this study, we investigated the impact of the difference between serum levels of glucose at admission and fasting state on the functional outcome in hyperglycemic patients with acute ischemic stroke.

**Methods:** From January 2011 to December 2014, we retrospectively reviewed the patients who had acute ischemic stroke and hyperglycemia at admission, which was defined as serum glucose level greater than 140 mg/dl. Blood samples for the fasting glucose level were taken in the next morning following admission. We dichotomized the patients into low glucose difference (LGD) and high glucose difference (HGD) groups, which were assessed by measuring the percent decrease of the serum glucose level from admission to fasting state. Demographic profiles, risk factors, laboratory results, and functional outcomes were compared between the two groups. We performed multivariate analysis to determine whether the glucose difference was an independently associated with the functional outcome.

**Results:** Of the 274 patients recruited, 177 (64.6%) were male and the mean age was  $67.5 \pm 11.4$  years. Compared with the HGD group, significantly higher baseline National Institutes of Health Stroke Scale (NIHSS) score ( $p = 0.005$ ), and proportions of early neurological deterioration ( $p = 0.002$ ) and unfavorable outcome at 3 months ( $p < 0.001$ ) were found in the LGD group. After adjusting the confounders, multivariate analysis showed older age (OR 1.047, 95% CI 1.006–1.090,  $p = 0.012$ ), higher baseline NIHSS score ( $p < 0.001$ ), higher fasting glucose level ( $p = 0.022$ ), and lower glucose difference ( $p = 0.038$ ) were significant and independent predictors of unfavorable outcome.

**Conclusion:** This study showed that the lower difference between the serum levels of glucose at admission and fasting state was independently associated with unfavorable outcome in hyperglycemic patients with acute ischemic stroke. We suggest that not only a single glucose measurement but also the pattern of change should be addressed in the prediction of stroke outcome.

## P021

### Lipoic Acid Use and Functional Outcome after Tissue Plasminogen Activator Treatment in Patients with Acute Ischemic Stroke and Diabetic Polyneuropathy

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**Background and Rationale:** Alpha-lipoic acid (aLA) is a strong antioxidant commonly used for treatment of diabetic polyneuropathy (DPNP). Previously, we demonstrated the neurorestorative effects of aLA after cerebral ischemia in rats. However, its effects on stroke patients remain unknown. This study investigated whether patients treated with aLA for acute ischemic stroke (AIS) after reperfusion therapy have a better functional outcome than aLA-naïve patients.

**Methods:** In a prospective observational cohort study of 172 patients with DPNP and AIS treated with tissue plasminogen activator (tPA), we investigated the relationship between aLA use and functional outcome at 3 months and 1 year, the occurrence of hemorrhagic transformation (HT), early neurological deterioration (END), and early clinical improvement (ECI). The functional outcomes of patients were categorized as favorable (modified Rankin Scale [mRS] score 0–2) or unfavorable (mRS score 3–6). We defined END as an increase of  $\geq 1$  point in motor power or an increase of  $\geq 2$  points in the total National Institute of Health Stroke Scale (NIHSS) score and ECI as a decrease of  $\geq 4$  points in NIHSS score within 7 days. Ischemic stroke subtypes were defined according to the TOAST classification.

**Results:** Of the 172 AIS with DPNP patients included, 47 (27.3%) used aLA for DPNP. In the entire cohort, those treated with aLA had a significantly higher rate of a favorable outcome at 3 months (55.3 vs. 33.6%,  $p < 0.01$ ) and 1 year (57.4 vs. 34.4%,  $p < 0.01$ ) compared with their counterparts. The risks of END and HT were significantly lower and the percentages of ECI were significantly higher in those treated with aLA. In the multivariable analysis, aLA use was associated with favorable outcome at

3 months (OR = 2.13, 95% CI = 1.01–4.51,  $p = 0.048$ ) and 1 year (OR = 2.26, 95% CI = 1.06–4.84,  $p = 0.036$ ). Age, HT, and increasing NIHSS scores were negative predictors of favorable outcome.

**Conclusion:** aLA use for AIS with DPNP patients treated with tPA is associated with favorable outcome. These results indicate that aLA could be a useful intervention for the treatment of AIS after reperfusion therapy.

## P022

### Stroke Characteristics in the Patients with Non-Sustained Atrial Tachycardia and Enlarged Left Atrium

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**Background and Rationale:** Stroke patients with atrial fibrillation (AF) have a higher stroke recurrence rate than those without AF. Non sustained atrial tachycardia is known to appear more frequently in patients with paroxysmal atrial fibrillation. Enlarged left atrium is considered to be independent risk factor for newly diagnosed atrial fibrillation. We aimed to document characteristics of diffusion MRI findings of cryptogenic stroke patient with non-sustained atrial tachycardia (NSAT) and enlarged left atrium.

**Methods:** We investigated the infarction pattern in diffusion weighted MRI in the patients with non-sustained atrial tachycardia and left atrium enlargement (LAE). To exclude atherothrombotic stroke, we exclude the patients with relevant arterial stenosis or occlusion on vascular imaging. Non sustained atrial tachycardia was defined as 3 or more consecutive APBs with a rate more than 100 beats/min and lasting less than 30 seconds. Enlarged left atrium was determined as  $>28 \text{ mm}^3/\text{m}^2$ .

**Results:** In total, 716 patients with acute ischemic stroke and documented NSAT in 24-hour Holter monitoring were enrolled. Among them 602 patients underwent echocardiography (84%). After exclusion of the patients with arterial lesion or normal left atrial volume, total 210 patients were finally investigated (107 women, mean 73 years). Of 210 patients, 79 patients showed the infarction of perforating artery occlusion (37.6%). Forty six patients (21.9%) revealed single cortical infarction or multiple infarcted lesions within single arterial territory. Eighty five patients (40.5%) showed multiple infarctions involved multiple arterial territories.

**Conclusion:** Of 210 acute stroke patients with NSAT and LAE, 131 patients (62.4%) presumed embolic pattern because there was no relevant arterial pathology. Those patients may be considered as candidates for further evaluation of undocumented paroxysmal atrial fibrillation and anticoagulation.



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**P023****Acute Cerebral Infarction Following Pyrethroid Ingestion**

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**Background and Rationale:** Pyrethroid exposure induces various symptoms. Herein, we report the case of a patient who ingested pyrethroid to commit suicide and was admitted to the hospital in a stuporous state. Intermittent atrial fibrillations and ultimately cerebral infarction were detected. In conclusion, pyrethroid ingestion can modify the cardiac rhythm. This effect should be considered during treatment because it can be responsible for cerebral infarction.

**Methods:** A 61-year-old man with no particular disorder was found lying on the floor in his house. It was reported that he was under excessive stress with no problem in the 12 hours that preceded the event, but 100 cc of pyrethroid was found beside him, which he might have ingested. He usually smoked, but never drank nor took any other medications.

When he reached the hospital, he was in a stuporous state with no response to verbal commands, no prominent hemiparesis, and no observed seizure-like movement. He presented stable vital signs and no abnormal findings such as muscle enzyme from a laboratory test. Atrial fibrillation was observed from the electrocardiogram (ECG) at his visit.

Based on overall improvement after 3 days, mild dysarthria and sensory aphasia were observed. From the brain MRI with doubt of cerebral infarction, multiple acute infarctions scattered in the left MCA territory were detected, while no abnormal finding was observed by MR angiography.

**Results:** Pyrethroids are commonly used commercial and domestic insecticides that infrequently result in human intoxication. As reported in 2002, the most typical symptoms from 48 pyrethroid poisoned patients were gastrointestinal (73%), followed by CNS involvement (33%), which mainly included confusion, seizure, and coma. While arrhythmia was observed in 2 patients (4%), the types of arrhythmia were not specified in the report. Pyrethroid-induced arrhythmia is caused by the effect of pyrethroid directly on the myocardium. Considering the mechanism of occurrence of cerebral infarction, atrial fibrillation, which was not previously found, was observed and multiple scattered lesions were detected without stenosis or occlusion on the left MCA. Thus, there was a high probability that the cerebral infarction was due to the occurrence of embolism induced by cardiac arrhythmia, resulting from pyrethroid ingestion.

**Conclusion:** We speculate that this patient presented cardiac arrhythmia after ingesting pyrethroid, which caused cardiogenic embolism and cerebral infarction. Therefore, the fact that pyrethroid may cause temporary arrhythmia, which can induce cerebral infarction should be taken into consideration when treating patients who ingested pyrethroid.

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**P024****Evolution of Intraparenchymal Hyperdensity after Intra-Arterial Therapy in Patients with Ischemic Stroke**

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**Background and Rationale:** Non-contrast CT scan is obtained immediately after intra-arterial thrombolysis to assess for hemorrhagic complication. But sometimes it is difficult to distinguish iodinated contrast extravasation from hemorrhage. The aim of this study is to determine the incidence, appearance, and clinical significance of lesions mimicking hemorrhages.

**Methods:** Forty-six patients were treated with intra-arterial (IA) thrombolysis between January 2012 and April 2015. All patients underwent noncontrast CT scans immediately after IA thrombolysis, and follow-up CT scan or MRI scan were obtained after 24 hours. Contrast enhancement was defined as a hyperdense lesion that disappeared on a 24-hour follow up CT scan or as negative finding on MRI gradient echo. The lesions were categorized into three types according to their volume, shape and density: round shape (soft HD: hounsfield unit <80 unit, metallic HD: hounsfield unit >80 unit) and diffuse shape HD.

**Results:** Hyperdense lesion was found in 26 of 46 patients (56.5%). 16 of 26 patients (61.5%) showed hemorrhage of their lesion. All of the soft HD lesions (n = 10, 38.5%) showed spontaneous resolution and no hemorrhagic transformation. All of the metallic HD resulted in hemorrhagic transformation. All of the soft HD lesions showed spontaneous resolution and no hemorrhagic transformation. All of the metallic HD lesions (n = 16) resulted in hemorrhagic transformation; among them, four cases (15.4%) with a maximum CT value more than 150 HU (Hounsfield unit) subsequently but was not prognostic factor (p = 0.186). And in our study, regardless of the CT density or the location of hyperdense lesions, the volume of the hyperdense lesion could be considered as a prognostic factor (p = 0.035). The patients' prognosis, which volume of hemorrhage was more than 10cc, was worse than other patients. Contrast extravasation was not prognostic factor (p = 0.572).

**Conclusion:** The parenchymal hyperdense lesions observed on the CT obtained immediately after IA thrombolysis in ischemic stroke patients exhibited varying features and they were not always hemorrhagic transformation. Most of the soft HD lesions were not became hemorrhagic transformation, and large proportion of the metallic HD lesions became hemorrhagic transformation. And the volume of hyperdense lesions could be considered as a prognostic factor.

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**P025****An Efficacy Comparison between Trevo and Swift in Acute Ischemic Stroke: Preliminary Result**

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**Background and Rationale:** Recent reports have indicated that mechanical thrombectomy may have potential to treat acute ischemic stroke. However, few comparative studies of thrombectomy devices are reported. We compared the safety and effectiveness between Trevo and SWIFT devices in acute ischemic stroke patients.

**Methods:** A retrospective study comparing the clinical, radiological, and functional outcome of 34 patients with an angiographically verified occlusion. Patients were treated either with Trevo Retriever (Stryker, Kalamazoo, Michigan, USA) or Solitaire Stent (ev3/Covidien, Irvine, California, USA) according to the neurointerventionalist preference. Successful recanalization was defined as TICI grade 2b to 3 and clinical outcome was defined as a NIHSS score.

**Results:** Revascularization was tried in 12 patients with Trevo and in 22 with Solitaire. The mean age of all patients was 65.5 years. The lesions were MCA occlusion 23, ICA 7 and BA 4 patients. Successful recanalization was achieved in 92% of patients treated with Trevo compared with 77% of patients treated with Solitaire. Average number of passage was 1.67 with Trevo and 2.36 with Solitaire. And especially, first passage was superiorly showed in 58.3% of Trevo rather than 36.4% of Solitaire and patients treated with Trevo had a shorter treatment time. In the clinical outcome, most of patients treated with stent retrievers (58% and 59% in each) had achieved improved scores of NIHSS in both groups without significant differences (F/U NIHSS <7). Rate of symptomatic ICH was 27.3% for Trevo versus 31.8% for Solitaire.

**Conclusion:** Stentriever achieve a high rate of recanalization and functional independence in acute ischaemic stroke and have a relatively good safety profile. No significant differences in functional outcomes and symptomatic ICH could be demonstrated between Trevo and Solitaire. In this study, patients treated with Trevo had a better revascularization rate, lower number of passage and a shorter treatment time than patients treated with Solitaire. Further studies will be needed.

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**P026****Technology Solutions to Encourage Participation in the Australian Stroke Clinical Registry**

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**Background and Rationale:** The value of clinical registries depends on the quality and completeness of their data (Arts et al, 2007) [1]. The Australian Stroke Clinical Registry (AuSCR) uses an online tool to collect data from participating hospitals. Responding to clinician feedback, the Victorian Stroke Clinical Network (VSCN) sought to reduce manual data entry to improve data completeness and encourage participation in the AuSCR as part of the VSCN Registry Initiative.

**Methods:** The VSCN was awarded \$450,000 via the 2014 Victorian Innovation fund to enable interested metropolitan and regional hospitals to develop an electronic data collection system that can: (1) automatically extract demographic and contact variables from their patient information management systems, (2) enable live entry of clinical variables measuring quality of stroke care, and (3) export the data for upload into the AuSCR web-based tool. An expression of interest (EOI) process was used to determine successful hospitals. A technical (information technology) lead and a clinical lead were required to govern each local project.

**Results:** Six hospitals, collectively managing close to 3,000 stroke admissions annually, were initially awarded funds and commenced their projects in 2015. Only one of these sites was already contributing data to the AuSCR. Two hospitals have commenced sending automated extracts to the AuSCR with a further four to begin by June 2016. A second EOI process is currently underway, with applications from a further five hospitals (that collectively manage an additional 2,000 patients with stroke annually) being considered.

**Conclusion:** The VSCN Registry Initiative will enable up to 11 Victorian acute care hospitals to develop technology solutions to reduce their data collection burden and, in turn, facilitate enhanced participation in the AuSCR. This initiative is producing new technology solutions that will lead to more complete clinical quality data that can be used to reliably monitor and improve patient care.

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P027

### **'Red Flags' to Thrombolysis Treatment in Acute Stroke – Reducing the Risk of Harm**

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**Background and Rationale:** Acute stroke is a time-critical medical emergency and in the rush to initiate thrombolysis treatment quickly, potential 'red flags' to treatment may go unheeded. 'Red flags' post-treatment may be inappropriately attributed to stroke without due consideration of alternative causes.

**Methods:** This case report will describe a patient who presented with a missed spontaneous cervical spine epidural haematoma (SSEH) who was thrombolysed for presumed stroke and subsequently deteriorated.

**Results:** Mrs X, a 70-year-old woman with a history of well-controlled neck pain, presented with sudden onset of severe right arm and leg hemiplegia with facial sparing, dysarthria and worsening neck pain, requiring pre-hospital narcotic analgesia. The patient was thrombolysed with a presumptive diagnosis of left lacunar infarct; no abnormalities were detected on multimodal CT imaging. Over the following 12-hours, the patient developed left-sided weakness, urinary retention and hypotension, with ongoing narcotic requirements for neck pain. An MRI was performed following the development of quadraparesis, and showed a C2-C7 epidural haematoma. In retrospect, a subtle cervical hyperdensity consistent with SSEH was present on initial CT. The onset of new symptoms following thrombolysis were considered in isolation; the possibility of spinal cord compression was not considered until quadraparesis developed.

**Conclusion:** Dense hemiplegia with facial sparing is an uncommon stroke presentation, but neck pain and normal CT imaging ('red flags') did not prompt re-evaluation for alternative diagnoses. Post-treatment 'red flags' were examined and dismissed in isolation. Initial stroke assessments must always consider any 'red flags' for stroke mimic presentations and new symptoms following thrombolysis should trigger prompt medical and diagnostic review.

P028

### **Identifying a Set of Priority Barriers to Facilitate Successful Implementation of a Triage, Treatment and Transfer (T<sup>3</sup>) Intervention in Acute Stroke Care**

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**Background and Rationale:** Understanding barriers that inhibit adoption of evidence-based stroke care processes has an integral role in implementation trials. Since not all barriers have equal importance, standardised methods for their prioritisation are needed.

**Aim:** To identify the major barriers to target as part of the implementation of an evidence-based triage, treatment and transfer intervention in Emergency Departments (ED) within an acute stroke care trial (T<sup>3</sup> Trial).

**Methods:** A questionnaire listing each T<sup>3</sup> trial intervention (n = 9) was completed by a convenience sample of Australian stroke opinion leaders. Participants produced two ranked lists: the first based on how influential the barrier is in preventing clinicians from adopting each T<sup>3</sup> intervention; and the second based on how difficult the barrier is to overcome. Using simultaneous analysis of the two attributes, priority barriers were identified.

**Results:** Response rate 100% (n = 17). For each T<sup>3</sup> intervention a set of priority barriers were identified. *Patients presenting with resolving symptoms* and *no hospital protocol for rapid stroke care* were priority barriers to overcome in relation to appropriate triage. *Lack of leadership* and *delays in obtaining computed tomography (CT) scans* were priority barriers to overcome for assessing eligibility for thrombolysis. *Prolonged patient stay in ED* and *lack of fever protocols* were priority barriers to overcome in relation to taking temperature on arrival to ED.

**Conclusion:** This standardised, efficient method for identifying and classifying the importance of barriers for implementation interventions is novel within a stroke trial. This could be used in future stroke implementation trials and ensure greater success.

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P029

**Identifying the Barriers and Enablers for a Triage, Treatment and Transfer (T<sup>3</sup>) Intervention to Manage Acute Stroke Patients in the Emergency Department**

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**Background and Rationale:** Clinical guidelines recommend that the assessment and management of patients with stroke should commence early. The evaluation of the effectiveness of a multidisciplinary supported, nurse-initiated, organisational intervention to improve the triage, treatment and transfer of acute stroke patients in Emergency Departments (ED) is currently underway (T<sup>3</sup> Trial).

**Aim:** To identify barriers and enablers to inform the development of an intervention focused on improving the management of triage, treatment and transfer of stroke patients.

**Methods:** Systematic review identified studies that reported barriers and/or enablers for the triage, treatment and/or transfer of stroke patients. Biomedical databases were searched using comprehensive search strategies. Barriers and enablers were categorised using the theoretical domains framework (TDF).

**Results:** Nine studies met the selection criteria. All reported barriers and enablers were classified to a TDF domain. The majority of barriers reported corresponded with the TDF domains of 'environmental, context and resources' (such as *stressful working conditions* or *lack of resources*), and 'knowledge' (such as *lack of guideline awareness* or *familiarity*). The majority of enablers corresponded with the TDF domains of 'knowledge' (such as *education for physicians on the calculated risk of intracranial haemorrhage following thrombolysis*), and 'skills' (such as *providing opportunity to treat stroke cases of varying complexity*).

**Conclusion:** These findings have been used to inform the development of an implementation intervention that targets these barriers. It is recommended that findings from similar future reviews are reported within the context of a theoretical framework to facilitate the comparison and synthesis of barrier and/or enabler data.

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P030

**Eight-and-A-Half Syndrome Plus Dissociated Dysaesthesia Complicating with Hypertensive Emergency**

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**Background and Rationale:** Eight-and-half-syndrome is a rare and unique presentation of brain stem stroke. This condition includes the ipsilateral facial paresis-lower motor neuron type with one-and-a-half syndrome. Interestingly, our patient presented with dissociative dysaesthesia coincided with hypertensive crisis.

**Methods:** A 57-year-old man, a Thai boxing trainer, presented with acute binocular diplopia while awakening 12 hours before arriving the hospital. One day prior, he complained of acute left fronto-parietal headache and then developed dissociated dysaesthesia of the left face and right body. At emergency department, he was alert and oriented with the blood pressure of 250/140 mm Hg. Ophthalmoscopic findings, motor power, coordination, swallowing, and speech were normal. Because of the hypertensive crisis resulting in rising creatinine level, he was treated with antihypertensive injection.

**Results:** On examination, abnormal lateral horizontal gazes were detected bilaterally with obvious right lateral gaze palsy. The right eye was fixed while performing the left lateral gaze and the left eye showed abducting nystagmus which was suggestive of one-and-a-half syndrome. Right facial paresis-lower motor neuron type was noted on the first day in stroke unit.

The brain computerized tomography showed bilateral pontine infarction with small left thalamic hemorrhage.

This presentation with the unique one-and-a-half syndrome and an ipsilateral seventh cranial nerve palsy which has been little-known as eight-and-a-half syndrome. In addition with dissociated dysesthesia, eight-and-a-half syndrome plus were coined. Left thalamic infarct was most likely caused by hypertensive crisis. After optimal blood pressure control, acute kidney injury was resolved.

**Conclusion:** The eight-and-a-half syndrome plus dissociative dysaesthesia is one unique presentation of parapontine infarction resulting in hypertensive crisis in this case report.

**References:**

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## P031

### Quality of Care Over-Time: New Evidence from the Australian Stroke Clinical Registry

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**Background and Rationale:** Variations in quality of care exist for patients with stroke. Since 2009, the Australian Stroke Clinical Registry (AuSCR) has been providing clinical quality indicator data for participating hospitals to use to drive quality improvement. We investigated whether there was evidence of improvement in quality of care over time in hospitals using AuSCR.

**Methods:** A historical controlled design, matched by hospital, was used such that only hospitals that contributed data from 2012–2014 were included (n = 25). AuSCR data for 4 national and 8 Queensland stroke care indicators for consecutive patients admitted to contributing hospitals were analysed. Comparisons were made using descriptive statistics and random effects logistic regression. Each indicator was the dependent variable and models were adjusted for audit year, hospital and known confounders.

**Results:** 15508 episodes of care were analysed (39% 2014; mean age 73 years; 54% male). In 2012 compared to 2014, the crude proportion of patients admitted to a stroke unit (77% vs. 78%, p = 0.13) or receiving intravenous thrombolysis (12% vs. 11%, p = 0.23) was similar. In contrast, improvements in patients discharged with a care plan (45% vs. 55%, p < 0.001) or with antihypertensive medications (62% vs. 74%, p < 0.001) were observed. In adjusted analyses, evidence of improved access to stroke units (aOR: 1.31 95% CI 1.18, 1.47), provision of discharge care plans (aOR: 1.95 95% CI 1.69, 2.25) and prescription of antihypertensive medications at discharge (aOR: 2.01 95% CI 1.81, 2.23) was observed. In Queensland hospitals, improvements in the provision of aspirin within 48 hours (aOR: 1.34 95% CI 1.11, 1.63) and discharge on antithrombotic medications (aOR: 6.20 95% CI 4.93, 7.80) were also found.

**Conclusion:** Use of a clinical quality registry in Australia for monitoring acute stroke care has provided evidence of improvements in the quality of care at participating hospitals. Support for AuSCR should be a priority.

## P032

### Environmental Barriers and Facilitators to Communication Activity on Acute and Rehabilitation Wards during Early Stroke Recovery

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**Background and Rationale:** Stroke patients with aphasia spend less than 28% of their day communicating with others during early stroke recovery (Godecke et al., 2014) which increases their risk of developing maladaptive communication behaviours (Murphy and Corbett, 2009). The aim of this study was to identify barriers and facilitators to communication interactions on acute and rehabilitation stroke wards to inform a model which will aim to address patient inactivity and utilise neuroplasticity after stroke.

**Methods:** Stroke patients with (n = 4) and without aphasia (n = 4) admitted to acute and rehabilitation stroke wards were video recorded and observed for 12 hours over two weekdays and two weekend days. Behavioural mapping was used to determine language and communication activity as a proportion of total observed activity. Patient interviews and staff focus groups (n = 5) identified environmental barriers and facilitators to communication on the ward.

**Results:** Qualitative and quantitative data was triangulated to explore the ward environment from multiple perspectives. Interviews and focus groups were analysed using a qualitative description approach. A one-way ANOVA determined the difference in communication and language activity for patients with and without aphasia.

**Conclusion:** Results from this study reveal the environmental, cultural and individual factors influencing communication activity of stroke patients during their inpatient rehabilitation. This will inform the development of a Communication Enhanced Environment model which is a feasible and safe multi-disciplinary ward based intervention to enable patients to engage in higher levels of language and communication activity with the aim to maximise post-stroke recovery and quality of life.

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P033

### **Safety and Feasibility of Intravenous Tissue Plasminogen Activator (IV-tPA) in Acute Ischemic Stroke Patients, Update on Tabriz Thrombolytic Therapy on Acute Ischemic Stroke (T3AIS) Project**

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**Background and Rationale:** Intravenous thrombolysis (IVT) with tissue plasminogen activator (IV-tPA) improves outcome of acute ischemic stroke patients if given within the first 4.5 hours of symptoms onset. At this study our goal was to assess safety and feasibility of IVT at our center.

**Methods:** Prospectively, over a 58 months period, all patients who were treated with IV-tPA were recruited. Inclusion and exclusion criteria were based on updated American Heart Association/American Stroke Association (AHA/ASA) guideline for stroke. Outcome were measured based on National Institutes of Health Stroke Scale (NIHSS) changes between admission and after 3 months and MRS on 3 month follow up. Any hemorrhagic complications including symptomatic or non-symptomatic, intra or extra cranial were recorded for safety assessment. In addition, prospectively, in-hospital stroke time targets during the diagnostic process preceding thrombolysis were recorded. The results are presented as median and interquartile range.

**Results:** During the study period, a total of 180 patients were treated with IV-tPA. Median age was 65 (54–72) years; Median baseline NIHSS score was 14 (10–19). Thrombolysis was started at an average time of 145 (120–170) minutes after symptom onset. Ten non symptomatic (5.5%) and 8 (4.4%) symptomatic cerebral hemorrhages occurred. There were two urinary bleeding and two cases of angioedema. At three months, favorable Outcome (MRS 0 or 2) was seen in 44.9%. The median door-to-CT time was 20 (11–30) minutes and the door-to-needle time was 55 (40–75) minutes.

**Conclusion:** Intravenous thrombolysis with IV-tPA for acute ischemic stroke patients was safe and feasible in our center in Tabriz, Iran.

P034

### **Risk and Benefit of Anticoagulant Therapy in Stroke Patients with Chronic Kidney Disease**

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**Background and Rationale:** Chronic kidney disease (CKD) is well known as a risk factor for stroke. In CKD patients, bleedings are not rare in stroke patients treated with anticoagulant agent. Recently, non-vitamin K antagonist oral anticoagulant (NOAC) therapy has been introduced<sup>1–4</sup>, and expected to reduce bleeding. The purpose of the present study was to investigate the risk and benefit of anticoagulant therapy in stroke or TIA patients with CKD and atrial fibrillation.

**Methods:** Among the consecutive 10116 stroke or TIA patients who were admitted within 7 days after the onset, 636 ischemic stroke and TIA patients with atrial fibrillation, CKD, and modified Rankin scale of 3 or less were included into the present study. CKD patients with creatinine clearance of less than 30 ml/min were excluded. All of them were treated with anticoagulant agents at discharge. According to the anticoagulant agents, 636 patients were divided into 2 groups; Warfarin-group (W-group) and non-vitamin K antagonist oral anticoagulant (NOAC) -group (N-group). We observed stroke recurrence, all death, and cardiovascular event during 2 years and investigated predictive factors for those events.

**Results:** Among the 636 patients, 141 patients were treated with NOAC (N-group) and 395 patients were treated with warfarin (W-group). Prior stroke and concomitant use of antiplatelet agents were less frequent, estimated GFR was higher, NIH stroke score at discharge was lower in N-group patients than W-group patients. There was no significant difference in all stroke recurrence (12.1% vs. 17.5%,  $p = 0.1328$ ) and ischemic stroke recurrence (12.1% vs. 16.2%,  $p = 0.2380$ ) between N-group and W-group patients. All death (3.6% vs. 15.7%,  $p = 0.0002$ ) and stroke recurrence or all death (14.9% vs. 27.9%,  $p = 0.0021$ ) were observed less frequently in N-group than W-group patients. There was no hemorrhagic stroke in N-group. Composite events (stroke, all death, and cardiovascular events) were less frequent in N-group than W-group patients (20.1% vs. 32.4%,  $p = 0.0080$ ). On the multivariate analysis, NOAC tended to be superior to warfarin in preventing composite events (OR 0.63, 95% CI 0.39–1.01).

**Conclusion:** NOAC might be superior to warfarin in long-term effect and safety in patients with stroke, atrial fibrillation, and CKD. No hemorrhagic stroke was observed in N-group patients.

### **References:**

- 1 Connolly, 2009.
- 2 Patel, 2011.
- 3 Granger, 2011.
- 4 Giugliano, 2013.

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**P035****Incidence and Predictors of Recurrent Stroke in Acute Stroke Patients with Active Cancer**

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**Background and Rationale:** Some study have reported that patients with acute ischemic stroke in the setting of active cancer face a substantial short-term risk of recurrent ischemic stroke and other types of thromboembolism. However, the risk of early recurrent stroke remained unclear in patients with active cancer. The aim of this study was to elucidate the incidence and predictors of early stroke recurrence in ischemic stroke patients with active cancer.

**Methods:** We retrospectively enrolled acute ischemic stroke patients with active malignancy visited to our hospital between 2006 and 2014. Active cancer was defined as cancer diagnosed within 1 year of stroke occurrence or before stroke with incomplete treatment. Primary clinical outcome was recurrent ischemic stroke within 1 month. Patients who died within 1 month after stroke onset were excluded in our study.

**Results:** A total of 68 subjects (45 men, mean age 70.4 years) were registered. The cancers were mostly located in the pancreas in 11 patients (16.2%), followed by stomach (14.7%) and lung (11.8%). Metastases to other organs were found in 33 patients (48.5%). The median plasma D-dimer value was 4.95  $\mu\text{g/ml}$  (IQR 1.35–13.53  $\mu\text{g/ml}$ ). Recurrent stroke occurred in 8 patients (11.8%) within 1 month after initial stroke. As compared to patients without recurrent stroke, those with recurrent stroke were more younger (mean age 64 vs. 71;  $p < 0.01$ ), more likely to have metastases (87.5% vs. 43.3%;  $p = 0.02$ ) and higher plasma D-dimer levels (24.65 vs. 4.35;  $p = 0.02$ ).

**Conclusion:** Among ischemic stroke patients with active cancer, 11.8% had recurrent stroke within 1 month. Recurrent stroke was associated with young age, metastases, and high plasma D-dimer levels.

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**P036****Statin Effect on Progression of Symptomatic Basilar Artery Stenosis and the Risk of Clinical Recurrent Stroke**

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**Background and Rationale:** Symptomatic basilar artery stenosis is associated with high risk of stroke recurrence. We aimed to investigate whether statin therapy prevent progression of symptomatic basilar artery stenosis and reduce the rate of stroke recurrence.

**Methods:** We retrospectively analyzed data from patients with symptomatic basilar artery disease. All patients were per-

formed MRA at admission day and the day of clinical event or 1 year later. The clinical endpoints were recurrent ischemic stroke and composites of recurrent ischemic stroke, transient ischemic attack, coronary disease and vascular death.

**Results:** In 153 patients with symptomatic basilar artery stenosis, 114 (74.5%) patients were treated by statin after stroke. During the follow-up period, there were 31 ischemic strokes, and 38 composite vascular events. There were significantly low stroke recurrence (14.9% vs. 35.9%; OR [odds ratio] = 0.31; 95% CI [odds ratio], 0.13–0.72) and composite vascular event (18.4% vs. 43.6%; OR = 0.29; 95% CI, 0.13–0.64) in patients with statin therapy versus no treatment. Statin therapy significantly prevented the progression (7.0% vs. 28.2%) and induced the regression (22.8% vs. 15.4%) of symptomatic basilar artery stenosis compared with patients without statin ( $p = 0.002$ ). Recurrent stroke in basilar territory and composite vascular events were more common in progressed group than the other group (OR = 5.16; 95% CI, 1.63–16.25, OR = 4.2; 95% CI, 1.56–11.34).

**Conclusion:** Our study suggests that statin therapy may decrease the risk of recurrent ischemic stroke and prevent progression of symptomatic basilar stenosis.

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**P037****The Longitudinal Length of Infarcted Lesion Predicts Neurological Deterioration in the Single Subcortical Infarctions Without Relevant Artery Stenosis**

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**Background and Rationale:** The aim of our study is to investigate the image biomarker of early neurological deterioration in single small subcortical infarctions (SSSIs) without relevant artery stenosis.

**Methods:** Between June 2005 and December 2009, 215 consecutive patients with SSSIs within 24 hours of symptom onset were enrolled. Magnetic resonance angiography (MRA) of brain and neck were performed on all patients to exclude the stenosis of the relevant artery ( $n = 10$ ). Neurological deterioration (ND) was defined as worsening by  $\geq 2$  points from the initial NIHSS score during the first week after admission. Multiple logistic regression analysis was used to evaluate the independent predictors for neurological deterioration in SSSIs.

**Results:** The final subjects consisted of 205 patients (109 males;  $63.9 \pm 11.0$  years; ranged 39 to 90) of whom 158 (77%) remained stable or improved and 47 (23%) showed neurologically worsening. Univariate analysis showed that significant differences were noted between patients with and without ND in term of infarcted axial size and DWI slice number. Multiple logistic regression analysis revealed that only slice number  $\geq 3$  on DWI was an independent predictor of ND in SSSIs without parent artery stenosis (1 vs. 3; OR 14.281; 95% CI 1.76 – 115.8;  $p = 0.013$ , 1 vs. 4; OR 14.04; 95% CI 1.65 – 119.57;  $p = 0.016$ ).

**Conclusion:** The longitudinal length of infarcted lesion predicts ND in the acute SSSIs without relevant artery stenosis.

### Contrast-Induced Nephropathy Is Rare and Clinically Insignificant after Computer Tomography Arteriography and Perfusion Studies among Taiwanese Patients with Acute Ischemic Stroke

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**Background and Rationale:** In the era of endovascular clot retrieval, computed tomography arteriography (CTA) and perfusion study (CTP) are essential for the management of patients with acute ischemic stroke. Asian stroke patients have higher incidence of renal impairment and may be prone to contrast-induced nephropathy (CIN). We aimed to study the effect of contrast on alteration of renal function in this group of patients in Taiwan.

**Methods:** We conducted a retrospective study on consecutive patients who presented within 6 hours of stroke onset and received CTA+CTP at a tertiary centre. Patients with end-stage renal disease undergoing dialysis were excluded. The dosage of Omnipaque (300 mg/ml) was 120 ml/person for CTA+CTP. Renal function was compared on arrival, 2–5 days and 6–14 days after contrast CT. Renal confounders including diabetes, hypertension, dehydration, urinary tract infection, pneumonia, rhabdomyolysis, shock, acute coronary syndrome, death and large stroke were recorded. CIN was defined as elevation of creatinine level >25% or >0.5 mg/dl.

**Results:** 325 out of 954 patients fulfilled the criteria with median age of 72.0 years (interquartile range 61.0, 81.0) and 46.0% male. The median serum creatinine level was 0.98 mg/dl (0.81, 1.21) on admission, 0.92 mg/dl (0.73, 1.11,  $p = 0.001$ ) on day 2–5, and 0.85 mg/dl (0.68, 1.06,  $p = 0.035$ ) on day 6–14. The estimated GFR were 68.7 ml/min/1.73 m<sup>2</sup> (56.8, 88.2) on admission, 73 (56.0, 93.0,  $p < 0.001$ ) on day 2–5, and 81.19 (66.2, 107.3,  $p < 0.001$ ) on day 6–14. After exclusion of patients with renal confounders, the incidence of CIN was <1.0% (2/325) and none required dialysis. None of the cofounders were significant predictors of CIN.

**Conclusion:** The incidence of CIN was rare and without any clinical significance in Taiwanese patients. Overall, renal function was not deteriorated after CTA+CTP. There is no evidence to support checking eGFR or creatinine before contrast despite any pre-existing renal impairment and related confounders.

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### Safety of Thrombolysis in the Acute Ischemic Stroke Patient with Aortic Dissection; Care Report and a Systematic Review

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**Background and Rationale:** There had been concerns regarding a risk of rupture, cardiac tamponade and mortality due to the use of thrombolytic agent in aortic dissection (AoD) (Fessler et al., 2000, Hong et al., 2009, Rodriguez-Luna et al., 2011). Here, we describe a case of a hyperacute stroke patient who was treated by intravenous tissue-plasminogen activator (rt-PA), and was later diagnosed with painless Stanford type B AoD.

**Methods:** A 73-year-old man complained left side weakness, which was abruptly occurred thirty minutes ago. He denied any other symptoms, including chest pain, nausea, vomiting or transient loss of consciousness. Neurological examination revealed the National Institute of Health Stroke Scale (NIHSS) of 7. As there were no contraindications, intravenous rt-PA was administered within 1 hour from the onset of stroke. Thirty minutes after the start of the infusion, his neurologic status improved (NIHSS 2). Brain CT angiography (CTA) was performed while his rt-PA continued. When we found that he had a Stanford type B AoD from CTA, rt-PA infusion was already finished. Because medical therapy is recommended for uncomplicated type B AoD, he was managed with medical therapy.

**Method:** Using multiple comprehensive databases (MEDLINE, EMBASE and KoreaMED), we searched for case reports or case series. Key words were included 'thrombolysis', 'thrombolytic agent', 'ischemic stroke,' and 'aortic dissection'.

**Results:** Fifteen patients were treated with IV thrombolytic agent. Diagnosis of AoD was delayed, especially in cases without pain and all cases were diagnosed with Stanford type A or DeBakey type I AoD except our case. Among them, a rupture in dissection site or subsequent cardiac complications developed in 2, although 6 were treated with partial dose of thrombolytic agent.

**Conclusion:** This case report and systematic review showed that the safety of thrombolysis in acute ischemic stroke and aortic dissection could depend on dissection type, although the use of thrombolytic agent in AoD would be fatal.



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## P040

### Carotid Artery Web as the Aetiology of Embolic Ischaemic Stroke in Two Patients

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**Background and Rationale:** Carotid artery webs are a type of neointimal proliferation that may be isolated or part of a generalised disorder, including fibromuscular dysplasia. The isolated forms are rarely implicated in ischaemic strokes. The prevalence of carotid webs is unknown and population studies are not available. Nonetheless, it remains an important consideration in the potential aetiology of cerebral ischemia or infarction, especially in patients otherwise labelled as having ‘cryptogenic’ stroke.

**Methods:** We present two cases where carotid webs were considered the aetiology of cerebrovascular ischaemia. We describe the clinical features, imaging findings and management strategies employed in each case.

**Results:** Case 1 is a 41 year old male who presented with acute onset aphasia and right hemiparesis. He had no significant past medical history and was not on any regular medications. Non-contrast CT demonstrated dense left MCA confirmed as a left M1 embolus on CT angiogram. He received intravenous tPA and underwent mechanical thrombectomy. Digital subtraction angiography revealed a posterior carotid web at the left ICA bulb, associated mild stenosis, and florid contrast stagnation. No other aetiology for stroke was found.

Case 2 is a 64 year old male who presented with transient aphasia and right upper limb weakness. He had left carotid endarterectomy for TIA’s 14 years earlier. Non contrast CT brain showed focal hyperdensity in the left MCA M2/3 segments. CTA and targeted ultrasound doppler revealed multiple underlying carotid webs. No other aetiology for stroke found.

**Conclusion:** Carotid webs are a potential nidus for thrombus formation and an important aetiology for embolic stroke, particularly if they cause flow disturbance and blood stagnation. Due to its rarity as a cause of stroke, there is no definite consensus on optimal management (medical vs. carotid stenting or endarterectomy). Increasing awareness of this diagnosis will lead to a more evidence-based approach.

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## P041

### Outcome of IV Thrombolysis in Acute Cardioembolic Stroke

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**Background and Rationale:** Background: Cardioembolic strokes account for 25–30% of strokes and are severer with larger clot burdens. Outcome in valvular disease is not well described. Objectives: 1. Determine efficacy of intravenous thrombolysis in acute cardioembolic stroke and 2. To determine recanalisation rates with IV rtPA.

**Methods:** Patients with acute cardioembolic strokes enrolled prospectively from the PGIMER Acute stroke registry from Jan 2011 to Jun 2015 and thrombolysed IV rtPA (0.9 mg/kg) were analysed. Rates of symptomatic ICH (SICH) as per SITS MOST

definition, proportion of patients with good outcome (mRS 0–2) and complete recanalization at 3 months were determined.

**Results:** 47 patients were enrolled in the study with 26 males (55.3%) and 21 females (44.7%) with a Median age 68 (IQR 48–74). AF was the commonest cause (68%). Valvular heart disease was seen in 32%. Baseline median NIHSS was 9 (IQR 7–18) and median window period for thrombolysis was 145 min (IQR 120–220). 0.39 (83%) patients had major artery occlusions at baseline. 4 patients (8.5%) developed SICH. An excellent recovery (>9 points NIHSS improvement) at 24 hours occurred in 17.2%. Good outcome at 3 months was seen in 25 (53.2%) while complete recovery (mRS 0–1) occurred in 36.2%. Mortality was 27.7% (15% stroke related and 8.5% related to SICH). Recanalisation data was available for 29 patients (61.7%). TICI 2b–3 recanalisation was seen in 19 (62.7%). Good outcomes were associated with lower NIHSS at baseline (Median 9, IQR 5.5–15.5) and 24 hours (Median 4, IQR 2–8) and good recanalisation ( $p = 0.013$ ).

**Conclusion:** 1. IV thrombolysis is safe and efficacious in Cardioembolic strokes of both valvular and nonvalvular nature. 2. Cardioembolic strokes are associated with a high rate of recanalization with IV r-tPA.

#### P042

### Recurrent Ischaemic Watershed Cerebral Infarction in a Patient with Mobile Extracranial Internal Carotid Thrombus-Role of Anticoagulation in Secondary Prevention of Ischaemic Stroke

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**Background and Rationale:** 65 year old gentleman who has significant underlying cardiovascular risk factors (diabetes mellitus, hyperlipidaemia and hypertension), was diagnosed with right middle cerebral artery (MCA) and right posterior cerebral artery (PCA) watershed infarction secondary to right internal carotid artery occlusion from a mobile thrombus. He had been having total 3 ischaemic stroke from the same vascular territories despite optimum medical therapy. Warfarin was started for secondary stroke prevention.

**Methods:** Patient had 3 episodes of ischaemic stroke in one month during the hospital stay. Ultrasound carotid showed subtotal occlusion of right internal carotid artery at bifurcation by an echogenic mobile mass. Transthoracic echocardiogram showed no intracardiac thrombus and no valvular lesions. 24 hour holter showed no atrial fibrillation. He was started with aspirin for secondary stroke prevention, which then escalated to dual antiplatelet therapy (aspirin and clopidogrel) when he sustained another episode of recurrent stroke over the same vascular territory. Repeated MRI Brain showed interval worsening and extension of acute infarction over right MCA/PCA infarction. Repeated ultrasound carotid showed stable right internal carotid mobile echogenic mass with subtotal internal carotid artery occlusion. Warfarin was started after third episode of ischaemic stroke over the same territory

despite optimum medical therapy with dual antiplatelet, atorvastatin and good blood pressure control.

**Results:** Warfarin was started in this patient in view of multiple, recurrent ischaemic events over the same vascular territories, despite optimized medical therapy and vascular risk factors. He was then followed up with repeated ultrasound carotid that was done at 6th and 12th month after discharge, which showed stable subtotal right internal carotid artery occlusion with mobile echogenic mass. Since he was started with warfarin, there is no further ischaemic event, and he has been recovering well neurologically. Warfarin therapy in secondary prevention of stroke has been decided for life long in view of persistent stable mobile echogenic mass within the right internal carotid artery.

**Conclusion:** Mobile thrombus within carotid artery demands immediate attention. Symptomatic internal carotid artery occlusion from a mobile thrombus increase risk of recurrent ischaemic stroke, which is better preventable by oral anticoagulation.

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#### P043

### Brain Natriuretic Peptide, Left Atrial Size, P Wave Terminal Force in Lead V1 in Embolic Stroke of Undetermined Source

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**Background and Rationale:** Embolic stroke of undetermined source (ESUS) was recently proposed to explore optimum antithrombotic prophylaxis for cryptogenic stroke (Hart et al, 2014). In this study, we aimed to clarify the associations between biomarkers for cardioembolic stroke and ESUS patients.

**Methods:** In our single-center stroke registry (ClinicalTrials.gov: NCT02251665), ischemic stroke patients were divided into three groups, cardioembolic stroke (Group C), ESUS referred to the criteria (Group E), and other types of ischemic stroke (Group O). The possible biomarkers including brain natriuretic peptide (BNP), as well as left atrial size with echocardiogram, and P wave terminal force in lead V1 (PTFV1) in 12-lead ECG, were assessed while admission.

**Results:** Among 415 first-ever ischemic stroke (166 women, 75 ± 12.6 y.o.) admitted between Jan 2014 and Dec 2014, 130 (59 women, 80 ± 11.0 y.o.) belong to Group C, 51 (26 women, 76 ± 10.6

y.o.) to Group E, and the other 234 (81 women,  $72 \pm 9.0$  y.o.) to Group O. Median serum levels of BNP [218.9 pg/ml (IQR 110.0–534.1), 65.5 pg/ml, (35.0–132.2), 38.4 pg/ml (23.0–80.2), respectively;  $p < 0.0001$ ] was the highest and median sizes of left atrium [42.0 cm, (38.0–47.0), 37.0 cm, (33.0–40.5), 35.0 cm, (32.0–39.8), respectively;  $p < 0.0001$ ] was the largest in Group C, followed by Group E, Group O in descending order. Concerning 328 in sinus rhythm (59, 47, and 222, respectively), median PTFV1 [2296  $\mu\text{V}\cdot\text{ms}$ , (765–3759), 2284  $\mu\text{V}\cdot\text{ms}$ , (741–3407), 1900  $\mu\text{V}\cdot\text{ms}$  (761–3401), respectively;  $p = 0.6857$ ] was not significantly different.

**Conclusion:** Serum level of BNP and size of left atrium in patients with ESUS were not as high and large, respectively, as compared to those with cardioembolic stroke, but these were somewhat higher and larger, respectively, as compared to those with other types of ischemic stroke. PTFV1 was similar among the three groups.

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## P044

### Stroke Care and Outcomes for Patients Who Require an Interpreter: Evidence from the Australian Stroke Clinical Registry (AuSCR)

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**Background and Rationale:** In multicultural Australia, many patients with stroke cannot speak, or fully understand, English. This may impact on their quality of care or outcomes, but few such data exist for people with stroke who require an interpreter during hospitalisation.

**Methods:** We used data from 45 hospitals participating in the Australian Stroke Clinical Registry between 2010 and 2014. HRQoL was assessed using the EQ-5D-3L at 90–180 days. We undertook propensity score matching of patients using age, sex and ability to walk on admission (2 without interpreters matched to 1 requiring interpreters, with replacement) to reduce selection bias associated with observational data. Between group comparisons were analysed using multilevel, multivariable regression.

**Results:** Among 25,531 registrants, 1,049 (4.1%) required an interpreter. Compared to patients without interpreters, patients with language barriers were more often female (52% vs. 46%), aged  $\geq 75$  years (68% vs. 51%) and unable to walk on admission (71% vs. 62%; all  $p < 0.001$ ). Patients needing interpreters had greater access to stroke unit care (84% vs. 77%;  $p < 0.001$ ) and were more often discharged with a care plan (55% vs. 48%;  $p = 0.004$ ) and on antihypertensive medication (72% vs. 69%;  $p = 0.03$ ). 1,944 without interpreters were matched to 1,049 with interpreters (median age 79 years, 49% male). After accounting for patient characteristics and stroke severity, patients requiring interpreters had comparable discharge outcomes (e.g. mortality, discharged to rehabilitation) to patients not needing interpreters, but reported poorer HRQoL (Coefficient  $-0.10$ ; 95% CI  $-0.13, -0.07$ ) including more problems with self-care (OR 2.08, 95% CI 1.55, 2.79), activity (OR:1.52; 95% CI 1.12, 2.07) and pain (OR:1.78, 95% CI 1.32, 2.38).

**Conclusion:** Patients requiring interpreters reported poorer HRQoL 90–180 days after stroke despite receiving recommended care more often than those not needing an interpreter. Determination of the underlying reasons for these differences may assist in providing better support for these patients.

## P045

### Triple Antiplatelets and High-Intensity Statin Treatment May Regress Middle Cerebral Artery Stenosis: A Study Using Repeat Transcranial Doppler

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**Background and Rationale:** Atherosclerotic intracranial artery stenosis (ICAS) is a common cause of ischemic stroke, and prevention of its recurrence is a key objective in these patients. The purpose of this study was to evaluate the efficacy of medical treatment in patients with atherosclerotic middle cerebral artery stenosis (MCAS) by using Transcranial Doppler (TCD).

**Methods:** Patients diagnosed with MCAS between June 2001 to April 2014 were recruited in this retrospective study. Patients in whom initial TCD, as well as repeat TCD was performed between 180 and 730 days after initial TCD, were included. Patients not evaluated with TCD due to poor temporal window, and those diagnosed with moyamoya disease or dissection, were excluded from the study. Patients were categorized into stenosis regression and stenosis non-regression groups based on TCD findings. Regression was defined as a  $\geq 10\%$  decrease in mean velocity on repeat TCD compared to that observed on initial TCD. History of

antiplatelet and statin therapy and various clinical variables were included in the analysis.

**Results:** A total of 60 patients were classified into either the regression group ( $n = 26$ ) or non-regression group ( $n = 34$ ). Age, sex, and initial National Institutes of Health Stroke Scale score did not differ between groups. Initial mean velocity on TCD was  $164 \pm 68$  cm/s and  $110 \pm 64$  cm/s in the regression and non-regression groups, respectively ( $p = 0.004$ ), while follow-up mean velocity was  $94 \pm 40$  cm/s and  $147 \pm 73$  cm/s, respectively ( $p = 0.001$ ). A combination of three antiplatelet drugs including aspirin, clopidogrel, and cilostazol was more frequently prescribed for secondary prevention in the regression group (7 [26.9%] vs. 2 [5.9%],  $p = 0.024$ ). Rosuvastatin was also more frequently prescribed in the regression group (12 [46.2%] vs. 6 [17.6%],  $p = 0.017$ ).

**Conclusion:** In conclusion, regression was more commonly observed in atherosclerotic MCAS patients treated with triple antiplatelet therapy and rosuvastatin. Aggressive medical therapy such as triple antiplatelet drugs and high-intensity statin therapy may prevent recurrent stroke in ICAS patients.

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#### P046

### Comparison of Effectiveness and Safety between Angioplasty and Usual Endovascular Treatment for Patients with Anterior Circulation Acute Ischemic Stroke: A Propensity Score-Matched Analysis

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**Background and Rationale:** Endovascular treatment (ET) is now recommended methods for achieving successful recanalization and good clinical outcome in acute ischemic stroke (AIS). Different techniques can be employed as a method for ET. We assessed whether the angioplasty as an endovascular technique was safe and effective method for achieving successful recanalization and good clinical outcome compared with other usual ET in AIS patients.

**Methods:** Between 2011 and 2015, one hundred fifty-nine patients from an original pool of 183 patients that underwent ET were included in the study. Patients were divided into two groups depending on whether they had received angioplasty as part of ET. From 159 non-matched patients treated with angioplasty ( $n = 39$ ) and without angioplasty ( $n = 120$ ), 33 propensity score-matched case pairs were selected. The baseline characteristics, stroke risk factors, recanalization rates, safety profiles and clinical outcomes at 3 months were analyzed.

**Results:** Mean age was  $71 \pm 12$  in Angioplasty group and  $69 \pm 13$  in usual ET group. Median baseline NIHSS score was 14 (9–17) points in Angioplasty group and 14 (9–17) in usual ET group. Successful recanalization (TICI 2b and 3) was achieved in 22 patients (66.7%) of the Angioplasty group and in 21 (63.6%) of the usual ET group ( $p = 0.796$ ). Good clinical outcome (modified Rankin Scale score  $\leq 2$ ) was showed in 18 patients (54.5%) of the Angioplasty group and in 17 (51.5%) of the usual ET group ( $p = 0.805$ ). The complications after ET were not different between two groups.

**Conclusion:** Angioplasty group showed similar successful recanalization rates and good clinical outcomes at 3 months compared with usual ET group. Even the most cases of angioplasty were used to rescue method and took more time to achieve successful recanalization, angioplasty showed similar effectiveness and safety compared with usual ET. We think that angioplasty is effective and safe ET method for achieving successful recanalization and good clinical outcome in AIS patients.

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#### P047

### Antidepressants Use and Short-Term Functional Outcomes in Acute Ischemic Stroke

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**Background and Rationale:** Recovery after stroke has long been a unresolved problem for clinicians. However, antidepressants enhanced the functional recovery via neuroplasticity beyond the treatment of depression.

**Methods:** From March 2010 to May 2013, a total of 775 patients participated in this study. We analyzed binary logistic regression analysis for prescription of antidepressants. For the short-term functional outcomes, we conducted regression adjustment method using propensity score as a variable for prescription of antidepressants.

**Results:** Among the 775 participants, a total of 39 patients (5.03%) were prescribed SSRIs (escitalopram). When compared with non-antidepressants user, duration of hospital stay (OR, 1.07; 95% CI, 1.04–1.10) and use of mechanical ventilation were significantly related to antidepressants user (OR, 5.15; 95% CI, 1.53–17.40). In a propensity score adjusted model, AU was not significantly associated with short-term functional outcome (OR, 1.27; 95% CI, 0.50–3.25).

**Conclusion:** The effects of escitalopram on short-term functional outcomes were limited in our study. However, considering low rate of prescription of antidepressants in Korea, we suggest that modulation of cerebral neuroplasticity by using SSRIs is a promising treatment in patients with ischemic stroke.

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**P048****Nocturnal Desaturation Is a Possible Risk Factor for Early Neurological Deterioration Following Ischemic Stroke***Kim T.J., Mo H., Ko S.B., Yoon B.W.*

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**Background and Rationale:** The mechanisms of early neurological deterioration (END) in patients with acute stroke remain unclear. Despite that systemic hypoxia is associated with stroke and poor outcome following stroke, the relationship between nocturnal desaturation and END remains to be elucidated. We assessed the relationship between nocturnal oxygen desaturation (NOD) in the stroke unit (SU) and END in patients with acute stroke.

**Methods:** A total of 298 patients with acute ischemic stroke who were admitted to the SU between July 2013 and June 2014, and between January 2015 and May 2015 were recruited. The ODI was calculated from pulse oximetry data sampled every 1 minute during 9 hours on the first night (10:00 PM-7:00 AM) of SU admission and nocturnal desaturation was defined as an ODI of at least 5 per hour. We compared the clinical characteristics and NOD between patients with and without END.

**Results:** Among the total patients (age, 67.7; male, 54.4%), thirty-eight (12.8%) patients experienced END after stroke onset. The proportion of NOD was significantly greater in the END group (47.4% vs. 12.3%,  $P < 0.001$ ). Moreover, END in small-vessel occlusion was associated with NOD ( $P < 0.001$ ). The stroke lesion locations did not significantly differ between the two groups. After adjustment for covariates, we found that NOD was independently associated with END (Odds ratio, 8.21; 95% confidence interval, 3.02–22.32).

**Conclusion:** This study demonstrated that nocturnal desaturation in the SU was associated with END in patients with acute stroke. This suggests that intensive monitoring of nocturnal desaturation in the SU could be an important factor in preventing END following acute stroke.

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**P049****Antiphospholipid Syndrome in Young Aged Stroke***Kim S., Kim J.S., Kim S.*Department of Neurology, Kangwon National University  
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**Background and Rationale:** Antiphospholipid syndrome (APS) is a systemic autoimmune disorder characterized by clinical manifestations of arterial or venous thrombosis and recurrent spontaneous abortions with the presence of antiphospholipid antibodies. The patients with primary APS in the absence of other well-defined autoimmune disease are usually presented in the form of stroke or transient ischemic attacks. Indeed, other clinical features such as seizure and psychosis, are also observed similar to the secondary APS.

**Methods:** We retrospectively studied 90 patients with acute ischemic stroke aged between 18 to 55 years who were admitted to kangwon regional cerebrovascular center. All patients underwent brain CT/MRI and, echocardiography and laboratory studies for coagulopathy and vasculitis, PFO study with TCD. Stroke subtypes were classified according to TOAST criteria.

**Results:** In our study, prevalence of young age stroke was 5.4% in all stroke patients in our registry. Men (86.3%) was significantly more than women. Stroke subtypes were: large artery atherosclerosis 22.7%, small artery occlusion 22.7%, cardioembolism 18.1%, undetermined causes 27.2%, and other determined etiologies 9.0%. Five patients had antiphospholipid antibodies in of stroke in other determined etiologies (5.5%). Mechanism of stroke were thrombosis in 4 patients and venous infarction in 1 patient. Recurrent thrombosis was identified in on patients despite of anticoagulation therapy. Recurrence was stopped after steroid pulse treatment.

**Conclusion:** APS is one of the most frequent acquired thrombophilia. The primary APS can be present to recurrent stroke, seizure, psychotic feature and other neurologic symptoms. Many past studies showed only anticoagulation as secondary stroke prevention. Immunosuppression therapy are known to no effect on primary APS. But, our study show benefit of immunomodulation or immunosuppression in case of anticoagulation failure. Further randomized controlled trial will be required in management of APS.

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**P050**

**Three Cases of Paradoxical Embolism via An Atrial Septal Defect**

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**Background and Rationale:** Atrial septal defect (ASD) is a rare cause of paradoxical brain embolism, compared with the more common causes of patent foramen ovale and pulmonary arterio-venous fistula. The prevalence of ASD in the general population is relatively low, and the risk of paradoxical embolism among patients with ASD has therefore not been established. We report three cases of paradoxical embolism via an ASD.

**Methods:** Case report.

**Results:** Case 1: A 62yo man suddenly developed dyspnea on defecation. Contrast-enhanced CT showed pulmonary embolism, deep vein thrombosis, and renal infarctions. After admission, right hemiparesis was revealed and brain MRI demonstrated multiple infarctions involving bilateral cerebral hemispheres. Transthoracic echocardiography revealed a large ASD (17 mm). Case 2: A 61 yo woman felt clumsy with her right hand when she woke up. Brain MRI revealed an acute infarction in the left insular cortex. Transesophageal echocardiography (TEE) showed an ASD (8.5 mm) and a right-to-left shunt was documented by Valsalva maneuver. Case 3: A 68 yo woman experienced transient motor aphasia and weakness of her left hand while washing her face. A brain MRI showed acute infarctions in the right MCA territory. TEE revealed an ASD (6.3 mm) and a right-to-left shunt was documented by Valsalva maneuver.

Paradoxical brain embolism was suspected in all three cases because of the lack of other embolic sources.

**Conclusion:** ASD can be a risk factor for paradoxical embolism. Right-to-left shunting might occur during transient elevations in right-atrial pressure due to pulmonary embolism or Valsalva maneuver.

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**P051**

**Posterior Cerebral Artery Infarction Due to Dissection Treated with Intravenous Thrombolysis**

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**Background and Rationale:** Infarction in the posterior cerebral artery (PCA) is relatively common. However, stroke in the PCA territory due to dissection is relatively rare. The main clinical features of PCA infarction are contralateral visual field defects and sensorimotor symptoms. Thrombolysis is usually restricted in patients with dissection because of bleeding risk such as subarachnoid hemorrhage.

**Methods:** We present a young woman who had PCA territory infarct due to dissection and was successfully treated with intravenous recombinant tissue plasminogen activator (r-tPA).

**Results:** A 26-year-old woman admitted to our hospital complaining of visual disturbance and hemiparesis & hypoesthesia in the right side of sudden onset. She had severe headache in the occipital area 1 day ago. Her symptom was developed within 4.5 hours and brain CT showed no hemorrhage. She was treated with r-tPA. MR angiography revealed no definite occlusion. Transfemoral cerebral angiography showed dissection in the left PCA. Herein, we describe the mechanism and outcome.

**Conclusion:** In conclusion, dissection in the PCA is the cause of stroke in young adults and intravenous r-tPA thrombolysis can be the feasible treatment option.

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**P052**

**Patterns of Antithrombotic Prophylaxis in Ischemic Stroke Patients with Atrial Fibrillation**

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**Background and Rationale:** Atrial fibrillation is one of the most common rhythmic disorders with a prevalence of 0.5% to 1% in general population and a major risk factor of cardioembolic cerebral infarction. We retrospectively investigated the patterns of antithrombotic premedication in ischemic stroke patients with atrial fibrillation and the effect of premedication on initial stroke severity.

**Methods:** We reviewed consecutive cerebral infarction patients who admitted from January 2012 to December 2013. Then we selected patients with atrial fibrillation which was diagnosed on this admission or already known. The antithrombotic medication history, initial NIHSS, and initial prothrombin time international normalized ratio (PT-INR) were gathered to analyze the premedication pattern and effect of premedication on stroke severity. The therapeutic anticoagulation was defined as 2.0–3.0 of PT-INR.

**Results:** Of the total 533 patients, atrial fibrillation was detected in 100 (newly diagnosed in 34). Among the 66 patients with known atrial fibrillation, 48 patients had 2 or more CHADS<sub>2</sub> score. Medication history showed only 4 patients received therapeutic range anticoagulation, 18 sub-therapeutic range anticoagulation, 22 antiplatelet agent, and 22 no antithrombotic medication. Mean NIHSS score was lowest in patients with therapeutic range anticoagulation ( $1.5 \pm 1.00$ ) compared to no medication ( $9 \pm 8.249$ ), antiplatelet ( $6.07 \pm 6.772$ ), and subtherapeutic range anticoagulation ( $8.11 \pm 8.963$ ), even though there was no statistical significance.

**Conclusion:** Large portion of atrial fibrillation patients do not receive proper anticoagulation, although have higher risk of embolization. Therapeutic anticoagulation can prevent cerebral infarction and may reduce the severity of neurologic deficit in case of cerebral infarction.

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P053

**Using a Simplified 4-Item NIHSS to Predict Stroke Outcomes – A Tool for Rapid Assessment**

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**Background and Rationale:** Time efficient clinical assessment of acute stroke is crucial in the era of thrombolysis and thrombectomy. Pre-notification from ambulance officer to designated hospital can reduce the delay of treatment. We aimed to develop a simpler version of the National Institutes of Health Stroke Scale (NIHSS) with minimal items but practical to predict mortality and functional outcomes with comparable value as the full scores.

**Methods:** We identified prospectively 23,702 patients with ischemic stroke from the Taiwan Stroke Registry and randomly divided them into derivation (n = 17,420) and validation (n = 6,282) cohorts. Hazard ratios (HRs) of death and poor functional outcome with a modified Rankin Scale >3 within 6 months after the stroke associated with NIHSS items were identified by 5 stepwise models.

**Results:** Simple models with only four NIHSS items (1b consciousness, gaze, motor arm, dysarthria) were performed for predicting mortality and functional outcome. The areas under receiver operating characteristic curves (AUCs) for both the full and simple models were similar in predicting 6-month mortality (0.83 vs. 0.83,  $p = 0.51$ ) and poor functional outcomes (0.83 vs. 0.81,  $p = 0.51$ ) after adjusting for age, gender and vascular risk factors. Compared to the full score, the coefficients for simple models in the derivative and validation cohorts were 0.89 and 0.89 to predict the 6-month mortality, and 0.59 and 0.60 to predict the poor functional outcome, respectively. The model coefficients for men and women were similar to those for whole population in both derivation and validation cohorts.

**Conclusion:** A simple and quick assessment with a 4-item NIHSS can be used to predict mortality and functional outcomes in patients with acute stroke with comparable predictive value as the full NIHSS score.

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P054

**Risk of Stroke in Patients with Chronic Urticaria – A Population-Based 12-Year Follow-Up Study**

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**Background and Rationale:** Chronic inflammation has been associated with cardiovascular disease and progression of atherosclerosis. Chronic urticarial (CU) is a common skin inflammatory disease which may be associated with chronic inflammation, autoimmune and systemic inflammatory diseases. How-

ever the link between CU and the risk of stroke has not been well investigated. We aim to examine the putative link between CU and stroke risk, using a large claims data set of the National Health Insurance of Taiwan.

**Methods:** This study identified a cohort of 13,065 newly diagnosed CU patients from year 2000 to 2010, and a comparison cohort comprising 52,260 randomly selected subjects without CU, frequency matched by age, sex and diagnosis year. Both cohorts were followed from the date of inclusion until the end of 2011.

**Results:** The overall stroke incidence was 37.0% higher in the CU patients than in comparison cohort (6.76 vs. 4.95 per 1000 person-years) with a Cox model measured adjusted hazard ratio of 1.22 (95% confidence interval 1.11–1.33). The incidence rate of stroke was highest within the first five years of diagnosis. Ischemic stroke accounted for the majority of cases, with the cumulative incidence 2.6% higher in CU patients than in comparisons (7.1 vs. 4.5%;  $p < 0.0001$ ) by the end of 2011. There was no significant difference in the incidence of haemorrhagic stroke between the two groups. No significant interactions between urticaria and comorbidities were found for the stroke hazard.

**Conclusion:** This is the first study investigated the link between CU and stroke which has demonstrated a moderate increase risk of ischemic stroke in patients with CU over a 12 year period independent of cardiovascular comorbidities with higher risk in the first five years of diagnosis. Further studies are warranted to investigate the pathophysiology of the association.

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P055

**Surgical Timing of Ruptured Intracranial Aneurysm – Rebleeding, Treatment Modality, Outcome**

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**Background and Rationale:** Rebleeding after aneurysmal subarachnoid hemorrhage (SAH) dramatically decreases the chances of good recovery and nowadays early surgery, treatment within 3 days after the onset of symptoms is usual. We assessed the impact of surgical modality and surgical timing, associated with rebleeding, to the clinical outcome of the patients with aneurysmal SAH.

**Methods:** Between August 2010 and September 2015, 346 patients with spontaneous SAH were admitted. Among them 244 patients (70.5%) had been diagnosed with ruptured cerebral aneurysms and treated. Two hundred and forty one patients excluding three, in which surgery was delayed 30 days more due to specific reasons, were candidates for this study. The mean age is 52 years and the sex ratio is 113: 128 (M:F). Microsurgical clippings were performed in 198 people (82.2%) and 43 patients underwent endovascular coiling. According to the timing of surgery after the onset of symptoms, we classified the patients into four groups. We investigated clinical outcome and lots of factors affecting prognosis such as preoperative rebleeding, delayed cerebral ischemia, etc.

**Results:** The mean surgical timing after the onset of symptom was 1.2 days on average. Eighty-eight patients (36.5%) underwent surgery on the day of symptom, 86 (35.7%) on one day after symp-

tom, 33 (13.7%) on two days, 24 patients (10.0%) on three days, and 10 (4.1%) on more than four days, respectively. In each group, Hunt-Hess grade of the patients was not significantly different. Six patients showed preoperative bleedings and those all happened on the day of symptoms. The incidence of delayed cerebral ischemia showed no significant difference in groups and there was no significant difference in treatment outcome. ( $P < 0.05$ ) In patients admitted on weekends, including Friday, surgery was delayed compared to that of ones admitted on weekdays, especially admitted on Saturday (2.2 days). But clinical outcome was not significantly different ( $P < 0.05$ ).

**Conclusion:** Our results shows that we can get the same clinical result with the early surgery for the aneurysmal SAH, regardless of ultra early surgery. The surgical timing is inevitably affected by the status of the patients, the condition of the hospital, and the surgeon factors. We think this study may be helpful for cerebrovascular surgeons to decide the surgical timing of aneurysmal SAH.

## P056

### **KNIT (Know Stroke Symptoms, Use Hotline Number, Intervene at Stroke Unit Support System, Act on Time) Study: Evaluate Running of a Co-Ordinated (Well-KNIT) Stroke Unit Support System in Kerala, India**

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**Background and Rationale:** There are nearly 6.5 m disability adjusted life years from stroke in India with 73% of those affected living in rural India with severe disability. This is due to fragmented stroke care with only a few stroke units (SUs) in urban and private hospitals, limited physiotherapists, multidisciplinary approaches and patient/carer involvement. Advanced literacy and healthcare in Kerala aids us to determine the impact of support system improvement on a public sector SU in a developing nation.

**Methods:** KNIT is an investigator-initiated, prospective, open, non-randomized, pilot study of a consecutive sample of stroke patients admitted to an established SU in a public sector, tertiary care hospital in Kerala, India. Outcomes will be evaluated before and after implementing structural and process changes to the SU support system.

We will recruit 50 stroke patients before (control group) and 50 patients after (intervention group) implementing the changes. The intervention over 2 months will include educating the public and paramedical staff about FAST and our hotline, and streamlining access to acute stroke care and rehabilitation.

Outcomes include levels of relevant awareness among nurses, house doctors, ambulance staff and community representatives; time to imaging; proportion of patients coming within thromboly-

sis window; proportion thrombolysed; iv thrombolysis rate; door to needle time; mortality; physiotherapy time; modified Rankin Scale (mRS) at 3 months; 3rd month quality of life.

**Results:** The study is currently recruiting control patients in the site of Medical College Thiruvananthapuram. An awareness generation intervention kit is being developed composed of advertisements, brochures and educational materials for our intervention.

**Conclusion:** SUs are evolving in low and middle income countries (LMICs), but lack of formal infrastructural and functional guidelines are hampering their quality and functioning. Fast access to standard care is not being met even with SUs, unlike in advanced nations where support system standards pre-exist. Hence, the study helps us learn how a co-ordinated SU through increased all-round awareness can be a model to developing accreditation/standardized guidelines for SUs in LMICs.

## P057

### **Pre-Hospital Acute Stroke Detection – Can We Do Better?**

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**Background and Rationale:** It is well established that higher education, didactic feedback and a structured assessment tool for the identification of acute stroke, improves pre-hospital identification of stroke emergencies (Smith et al., 1999, Kothari et al., 1997). With transition to tertiary education of paramedics in Australia, and recent successes of endovascular clot retrieval trials, opportunity for more robust assessment tools to identify reperfusion eligible patients has been highlighted (de la Ossa et al., 2014).

**Methods:** An electronic survey was distributed to all operational paramedics employed by the Queensland Ambulance Service, Queensland, Australia. The survey consisted of a series of questions assessing: knowledge, experience and opinions of paramedics towards currently used, and alternative, acute stroke assessment items; and, their application to clinical vignettes to determine patient eligibility for acute stroke referral. Chi-squared analysis was applied with an alpha level of 0.05 and a confidence level of 95%.

**Results:** Critical Care Paramedics (CCP) were more likely to select a severe headache with no previous migraine history for stroke referral ( $\chi^2(1)=8.72$ ,  $p = 0.003$ ), whilst less experienced paramedics tended to avoid stroke referral in a young patient (17 years) with clear stroke symptoms ( $\chi^2(1)=13.1$ ,  $p = 0.005$ ). Paramedics with >6 years experience were less likely to use current stroke tools ( $\chi^2(1)=12$ ,  $p = 0.035$ ), however non-utilisation of a stroke tool made prenotification of receiving facilities, by paramedics, less likely ( $\chi^2(1)=16.22$ ,  $p < 0.001$ ). No other significant effects in referral patterns were found.

**Conclusion:** Along with the use of structured tools, there is an interplay between experience and level of education in



the identification and prenotification of acute stroke, with CCPs most likely to have more years of experience as well as higher levels of education. However, it was found the majority of individual factors did not significantly alter stroke referral patterns.

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## P058

### The Risk of Perioperative Complications in the Patients with Chronic Subdural Hematoma Treated with Anticoagulants and Antiplatelet Agents

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**Background and Rationale:** In the patients with chronic subdural hematoma (CSDH), there are various reports about the risks of perioperative complications including cerebral infarction, intracranial hemorrhage and recurrences associated with anti-thrombotic therapy.

**Methods:** Eighty-eight patients with CSDH were treated in our hospital between April 2011 and March 2013. Twenty-five patients were treated with preoperative antithrombotic therapy.

Eleven patients were taking anticoagulants, seventeen patients were antiplatelet agents, and three patients were both drugs.

**Results:** In the patients taking anticoagulants, all 11 patients discontinued them in the perioperative period. Eight of 11 resumed them during post-operative day 4–10. In the patients taking antiplatelet agents, 12 of 17 discontinued them in the perioperative period. Ten of 12 resumed them during post-operative day 5–15. In the patients taking both antithrombotic drugs, one of 3 patients suffered from cerebral infarction at post-operative day 10. In the patients taking antithrombotic drugs, three patients required for second operation, while 5 of 63 patients not taking them did. There were no significant differences between these two groups.

**Conclusion:** There is no relationship between peri-operative interruption of antithrombotic therapy and recurrence rate. It is

beneficial for reducing the risk of hemorrhagic complication to interrupt of antithrombotic therapy. These results suggest that it is important to resuming of antithrombotic therapy as soon as possible for reducing ischemic complication.

## P059

### Endovascular Treatment of Intracranial Atherosclerotic Carotid Artery Stenosis with Stenting

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**Background and Rationale:** Endovascular stenting for intracranial atherosclerotic lesion is still high risk. We will report retrospective analysis of intracranial carotid artery stenosis patients treated with endovascular stenting in our institute.

**Methods:** Between April 2011 and February 2016, intracranial carotid artery stenting was performed in 13 consecutive patients. Characteristic of the 13 patients was 10 men, 54–82 years old (mean 67.7), 7 with symptomatic (50%); and severe intracranial carotid artery stenosis (>70%). We divided these patients into two groups (S group and P group). S group: 4 patients, treated with standard technique (between April 2011 and July 2013). P group: 8 patients, treated under (complete reversal flow) Parodi anti-embolic system (between October 2013 and February 2016). We evaluated technical success and, stroke, postoperative MR (DWI), and prognosis between two groups.

**Results:** In both group, technical success rate was 100%. In S group, one patient presented minor stroke cause of shower embolism (stroke rate: 25%), and DWI-positive rate was 75%. On the other hand, in P group, there is no neurological complications and DWI-positive rate was 0%.

**Conclusion:** Endovascular stenting with Parodi anti-embolic system is effective and safe, for intracranial atherosclerotic carotid artery stenosis.

## P060

### Association between Neurological Symptoms at Stroke Onset and Use of Ambulance – The Fukuoka Stroke Registry

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**Background and Rationale:** Although stroke patients are recommended to use ambulance, it is still uncertain whether stroke symptoms affect the use of ambulance. This study aimed to elucidate the association between neurological symptoms at stroke onset and the use of ambulance.

**Methods:** Using a database of multicenter hospital-based stroke registry, the Fukuoka Stroke Registry, 5751 patients with ischemic stroke within 24 hours after onset were included in this study. Patients were classified into two groups: ambulance-use group (n = 3643) and non-use group (n = 2108). The neurological symptoms were estimated by using National Institute of Stroke Scale (NIHSS) and categorized as follows: consciousness disorder, gaze palsy, visual disturbance, facial palsy, upper limb palsy, lower limb palsy, ataxia, sensory disorder, disturbance of speech, and inattention. The association between neurological symptoms and the use of ambulance were evaluated by multivariate-adjusted logistic regression model.

**Results:** In overall patients, all neurological symptoms except ataxia were significantly associated with the use of ambulance even after adjusting for multiple confounding factors. In patients with minor stroke (NIHSS <5), facial palsy (multivariate-adjusted OR 1.47, 95% confidence interval 1.25–1.73), upper limb palsy (1.10, 0.93–1.30), disturbance of speech (1.60, 1.37–1.86), consciousness disorder (2.55, 1.80–3.69), gaze palsy (1.90, 1.23–2.99), visual disturbance (0.98, 0.68–1.41), lower limb palsy (1.22, 1.03–1.45), ataxia (1.78, 1.33–2.39), sensory disorder (1.01, 0.85–1.19), and inattention (1.97, 1.07–3.72) were significantly associated with the use of ambulance. However, no significant association was found with upper limb palsy, visual disturbance, or sensory disorder in minor stroke patients.

**Conclusion:** All neurological symptoms but ataxia were associated with use of ambulance in overall patients. However, in patients with minor stroke, visual disturbance, upper limb palsy, and sensory disorder were not associated with the use ambulance. These findings may be of use in a public campaign for stroke awareness.

#### P061

### Can a Nurse-Initiated Intervention to Manage Fever, Hyperglycaemia and Swallowing Post Stroke Reduce Long-Term Mortality? Follow-Up Results from the QASC Trial

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**Background and Rationale:** The Quality in Acute Stroke Care (QASC) CRCT (2005–2010) conducted in 19 NSW acute stroke units demonstrated that management of fever, hyperglycae-

mia and swallowing dysfunction decreased death and disability 90-days post-stroke.

**Aim:** To assess the impact of the QASC intervention on longer term all-cause mortality.

**Methods:** All-cause mortality was ascertained through linkage with Australia's National Death Index. Cox proportional hazards regression was used to compare time to death adjusting for correlation of outcomes within stroke units. Primary analyses included treatment group only, with secondary analyses also adjusting for age, sex, marital status, education, and Los Angeles Motor stroke severity Scale (LAMS). All analyses were adjusted for correlation of patient outcomes within hospitals. Multiple imputation was used to account for missing covariate data.

**Results:** A total of 1,076 participants (Intervention n = 600; control n = 476) were followed for a median of 4.1 years (range 0.3–70 months), of whom 264 (24.5%) had died. Preliminary analyses showed that those in the QASC intervention group, relative to the control group, had better overall survival, although this was only statistically significant in adjusted analyses: unadjusted hazard ratio (HR): 0.79, 95% CI 0.58–1.07, P = 0.13; adjusted HR: 0.73, 95% CI 0.56–0.95, P = 0.019. Increasing age and higher LAMS were associated with poorer survival, while being married was marginally associated with better survival.

**Conclusion:** Multidisciplinary supported evidence-based protocols initiated by nurses for the management of fever, hyperglycaemia, and swallowing dysfunction may have the potential to reduce long-term mortality after discharge from stroke units.

#### P062

### Systolic Blood Pressure as a Prognostication of Hemorrhagic Transformation in Patients after Receiving Intravenous or Intraarterial Thrombolytic Therapy

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**Background and Rationale:** In hyperacute stroke patients, hemorrhagic transformation is a major complication of intravenous and intraarterial thrombolytic therapy. We assessed prognostic factors in symptomatic hemorrhagic transformation after intravenous or intraarterial (or both of them) thrombolytic therapy.

**Methods:** Data were collected retrospectively at the Seoul National University Hospital. A total of 127 patients with hyperacute ischemic stroke who received intravenous or intraarterial (or both of them) thrombolytic therapy between March 2012 and March 2015 were enrolled. Among the hemorrhagic transformation in brain imaging (CT or MRI), we defined symptomatic hemorrhagic transformation as a symptom aggravation of more than 4 in NIHSS.

**Results:** Among the total patients, 57.5% were male, with a mean age of 68.9 years. Eighteen (14.2%) patients experienced symptomatic hemorrhagic transformation after IV or/and IA thrombolysis therapy. The patients with hemorrhagic transforma-

tion tended to be obese ( $P = 0.064$ ), more likely to have coronary heart disease ( $P = 0.014$ ), lower eGFR (59.3 versus 84.5,  $P = 0.016$ ). In patients with symptomatic hemorrhagic transformation, mean systolic blood pressure during 24 hours after thrombolysis was higher (146 versus 136,  $p = 0.035$ ).

**Conclusion:** Higher mean systolic blood pressure were related to symptomatic hemorrhagic transformation in patients with intravenous or/and intraarterial thrombolytic therapy.

In this context, our data suggest strict blood pressure control can be important to avoid symptomatic hemorrhagic transformation after intravenous or intraarterial (or both of them) thrombolytic therapy.

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#### P063

### Reducing Door-to-Needle Time in Acute Ischaemic Stroke: A Single Centre Experience in a Large Tertiary Hospital in Singapore

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**Background and Rationale:** The benefits of administration of intravenous tissue plasminogen activator (IV tPA) in patients with acute ischemic stroke (AIS) are time dependent. AHA/ASA 2013 guidelines have recommended a door-to-needle (DTN) duration of  $\leq 60$  mins. However, IV tPA administration is a complex process that requires coordination between various departments within the hospital. Thus, the aim of our study was to reduce inpatient hospital delays so that IV tPA can be administered in a timely fashion.

**Methods:** A multi-departmental acute stroke workgroup comprising of Emergency Department (ED), Neurology and Neuroradiology was formed to review our hospital's performances and processes for IV tPA for acute ischaemic stroke. Gaps were identified and several measures were implemented. Workflow process was structured and refined accordingly. IV tPA was made readily available in the Computed Tomography (CT) scan room for immediate administration after plain CT brain. A standardised form for acute stroke activation was created so as to reduce documentation time. Enhanced workflow was disseminated to the relevant stakeholders in various departments. DTN times were closely monitored and monthly audit were conducted with feedback to relevant parties. Advanced Practice Nurse (APN) trained in stroke was included in the acute stroke activation team and implementation of pre-hospital notification commenced in November 2015.

**Results:** The median DTN time progressively decreased from 80 minutes in year 2012 to 60 minutes in 2015. 17.2% ( $N = 58$ ) of acute stroke patients achieved DTN of less than 60 minutes in year 2012. After implementation of measures, 51% ( $N = 98$ ) of AIS achieved DTN time of less than 60 minutes in 2015. Further analysis is required after the implementation of APN participating in acute stroke activation process and pre-hospital notification.

**Conclusion:** Door-to-needle time for AIS can be reduced with a dedicated stroke team working towards a common goal. A

structured workflow process, continuous monitoring and audit with opportunity for feedback are useful measures to reduce DTN time.

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#### P064

### Hyperperfusion on Perfusion CT in Seizure Patient Mimicking Acute Stroke

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**Background and Rationale:** Intravenous thrombolysis (IVT) is limited due to a narrow therapeutic time window. So, clinicians need to hurry to select eligible patients for IVT. However, sometimes it may be difficult to differentiate ischemic stroke from stroke mimics, such as seizure, migraine, or functional deficits.

**Methods:** In this case, neuroimaging study, such as perfusion CT (PCT), could be helpful for a differentiation of the stroke mimics. We have recently been able to distinguish a seizure patient from ischemic stroke based on PCT findings and report here the case.

**Results:** A 53-year-old man was brought to an emergency department. He presented with sudden onset dysarthria and left hemiparesis. Initial neurological examination revealed dysarthria, left facial palsy, gaze preference to right side, left hemiplegia, asomatognosia of left extremities and anosognosia for hemiplegia (NIHSS score of 9). The history taking was limited due to his symptoms. An initial brain CT was normal (ASEPCT score of 10). CT angiography did not show any occlusion of extracranial and intracranial arteries. PCT showed reduced time-to-peak, increased cerebral blood flow and cerebral blood volume in right frontal lobe (medial, dorsolateral, and orbitofrontal area), basal ganglia and thalamus, which did not correspond to a territory of middle cerebral artery. IVT was withheld and a diagnosis of seizure was confirmed by further history taking and evaluation.

**Conclusion:** In our case, the hyperperfusion on PCT which did not correspond to vascular territory was helpful in differential diagnosis between seizure and stroke. Our case shows that careful PCT interpretation and history taking could help to avoid the unnecessary IVT.

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#### P065

### Optimal Heparin Therapy for Patients with Acute Cardioembolic Stroke

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**Background and Rationale:** The optimal timing and dose of heparin as anticoagulation for secondary prevention of acute ischemic stroke remains unclear. This multicenter prospective observational study aimed to elucidate the effects and safety of heparin infusion in patients with acute cardioembolic stroke in the middle cerebral artery territory.

**Methods:** The characteristics, neurological severity, volume of infarct on CT, the timing and dosage of heparin infusion, other antithrombotic agents, and clinical events during the course and 90-day outcomes were prospectively collected from 22 NHO centers by electronic data capture.

**Results:** We enrolled 167 patients (male,  $n = 60$ ; mean age,  $77 \pm 11$  years) by April 1, 2015. About 60% of them were started on heparin (10,000 U/day) from day 2 (median) after admission and continued for a median of six days. Hemorrhagic transformation occurred in 22% of the patients on heparin therapy. Outcomes tended to be better among patients with medium-to-large infarctions treated with, than without heparin.

**Conclusion:** Low-dose heparin therapy for acute cardioembolic stroke may be effective and safe when used for medium-large infarct during the acute period.

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#### P066

### Cerebral Dural Arteriovenous Fistula Secondary to Bilateral Sigmoid Sinus Thrombosis

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**Background and Rationale:** Dural arteriovenous fistula (DAVF) is an infrequent variety of cerebrovascular disease and accounts for 10 to 15% of all brain arteriovenous malformation. While the cause of a DAVF is not always clear, the common predisposing factor appears to be cerebral venous thrombosis (CVT). The surgical and endovascular techniques have proven efficacy for symptomatic DAVF.

**Methods:** We report a patient of DAVF secondary to bilateral sigmoid sinus thrombosis who had fluctuating neurologic symptoms.

**Results:** A 69-year-old woman with a history of hypertension admitted to hospital due to a transient left hemiparesis and dysarthria 1 day ago. On admission, she was well oriented but complained of a headache and tinnitus of left ear. On neurologic examination, she had mild dysarthria, left central type facial palsy and hemiparesis, and papilledema on both eye. Brain MRI showed multifocal high signal intensity lesions in left occipital and bilateral frontal cortex areas on diffusion-weighted image. She sequentially had confusional mentality and a conventional cerebral angiography confirmed a thrombosis of the bilateral sigmoid sinus and DAVF at bilateral occipital area causing retrograde flow within superior sagittal sinus and bilateral cortical veins (Borden type 2). She was treated with anticoagulation for the venous thrombosis and her headache was marked improved. However, she experienced the fluctuation of neurologic symptoms.

**Conclusion:** There are two possible mechanisms to contribute for fluctuating neurologic symptoms in this patient. First, regardless of the initial anticoagulation therapy, insufficient venous recanalization might not solve venous hypertension. Second, fluctuating neurologic symptoms also might be the result of the retrograde venous reflux. These two mechanisms should not be seen as being in competition but rather they seem to be same pathomechanisms; Venous hypertension.

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#### P067

### A Case of Internal Jugular Vein Thrombosis Due to Tuberculosis Pericarditis

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**Background and Rationale:** Internal Jugular vein (IJV) thrombosis is a rare entity and usually secondary to various etiologies such as catheter, malignancy, trauma, infection and hyperco-

aguable status. It can be a serious event with potentially fatal outcome, where the clinical symptoms may be vague or absent.

**Methods:** We reported IJV thrombosis which initial chief complaint was left arm discomfort and revealed with ultrasound scan.

**Results:** A 41-year-old woman presented with left arm discomfort. Chest radiography showed a normal sized heart, bilateral pleural effusion. Brain MRI revealed no abnormality in brain parenchyma. Doppler ultrasound of neck showed non-compressible intraluminal echoes inside the left internal jugular vein consistent with an intravenous thrombosis, partly adherent to the vessel wall. A chest and neck computed tomography (CT) scan showed mild wall thickening of pericardium (pericarditis) and filling defect in left IJV with internal minimal enhancing soft tissue density material (from C3 body level~ left brachiocephalic vein) which mean to imply thrombus. Serum levels of antitrombin III, protein S and protein C were normal. Cytology of mediastinal mass revealed Tuberculosis. This patient was treated low-molecular-weight heparin and was referred to pulmonology department for further treatment.

**Conclusion:** Early diagnosis and appropriate management is important to prevent potentially fatal complications from internal jugular vein thrombosis. Among the patient who complain chest discomfort and neck distension, jugular vein thrombosis must be considered as one of the differential diagnosis.

#### P068

##### **Impact of Intervention with Stroke Specialist on Reducing In-Hospital Delay in Reperfusion Therapy**

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**Background and Rationale:** Efficacy of reperfusion therapies for acute ischemic stroke patients diminishes with the delay of time from symptom onset. However, the effect of systemized intervention with highly-skillful stroke specialists throughout the acute stroke treatment process on reducing the time delays in the hospital has not been evaluated yet.

**Methods:** From a total of 7358 patients who admitted to Seoul National University Bundang Hospital between July 2007 and September 2015, we selected the subjects who arrived at hospital within 4.5 hours from symptom onset (N = 2100) with image-documented ischemic stroke cases (N = 1360). We excluded cases who received reperfusion therapy at local hospitals and transferred to our hospital (N = 10). In addition to Stroke Critical Pathway protocol that has been used for quality improvement for treatment in our hospital, a stroke specialist was arranged to the patient for immediate assessment and acceleration of whole process for stroke treatment from January 2008, after designation of our hospital as a regional cardiocerebrovascular center by the Ministry of Health and Welfare of Korea. Included patients were divided into two groups according to the admission date [before 2008 (B2008) versus from 2008 (F2008)].

**Results:** Among the 1350 included subjects, 546 (40%) cases were treated with any reperfusion therapy [230 for intravenous thrombolysis (IVT), 73 for endovascular therapy (EVT), and 243 for combined IVT and EVT (CMT)]. Compared to the B2008 group, each median times of door-to-needle in IVT (50 [40–73] vs. 31 [25–47]) and CMT (50 [38–61] vs. 29 [24–39]), door-to-puncture in EVT (116 [89–151] vs. 85 [66–110]) and CMT (113 [95–133] vs. 82 [68–98]), and needle-to-puncture in CMT (65 [48–81] vs. 51 [30–65]) were significantly shorter in F2008 group (all p-values <0.01).

**Conclusion:** With systemized intervention via immediate arrangement of stroke specialist and acceleration of the treatment process, it is possible to reduce the in-hospital waste of time.

#### P069

##### **Nonbacterial Thrombotic Endocarditis and Adenocarcinoma in Acute Stroke**

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**Background and Rationale:** Nonbacterial thrombotic endocarditis is a complication of mucin-producing adenocarcinoma. Aseptic valvular vegetations formed on valves are friable and frequently result in stroke. Immune mediated valvular endothelial damage and hypercoagulability have a role to play. Mucin, is also likely to increase the formation of intravascular thrombi. Treatment is difficult and requires use of anti-coagulant. Evidence of superiority of unfractionated heparin over low molecular wt heparin will be discussed.

**Methods:** We conducted a retrospective review of the hospital stroke registry to identify patients diagnosed with embolic stroke secondary to Nonbacterial thrombotic endocarditis (NBTE). Individual patient records were then examined for patients' demographics, imaging and confirmation of underlying malignancy.

**Results:** Three patients were identified from the registry data for the period January to December 2015. All the patients were male and magnetic resonance imaging showed evidence of multiple ischemic infarcts across arterial territories, suggestive of an underlying embolic mechanism. All patients were confirmed to have disseminated malignancy and histopathology confirmed adenocarcinoma based on biopsies of isolated pulmonary lesions. In all patients, echocardiography (ECHO) and carotids ultrasound (CUS) showed no evidence of thrombi. Coagulation studies were normal.

**Conclusion:** We describe three patients with NBTE and underlying adenocarcinoma. Blood investigations showed no evidence of hypercoagulability based on conventional assessments of coagulation. The diagnosis of ischemic stroke secondary to emboli was based on the MRI findings and despite normal ECHO, which is common in NBTE. Patients were treated with Low molecular weight heparin (LMWH) and suffered recurrent stroke. Unfortunately all three patients succumbed to their illness.

## Frequency and Detection of Stanford Type A Aortic Dissection in Hyperacute Stroke Management

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**Background and Rationale:** Acute Stanford type A aortic dissection (AAD) is a devastating aortic disease, and prompt diagnosis is sometimes difficult. Identification of AAD among suspected acute stroke is especially challenging. Nevertheless, frequencies and predictive factors of AAD in suspected acute stroke patients are not well investigated. We aimed to elucidate prevalence of and predictors for AAD in patients suspected acute stroke.

**Methods:** From January 2012 through January 2013, consecutive patients who visited our hospital due to suspected acute stroke were retrospectively enrolled. Clinical characteristics and laboratory data were collected. Frequencies of AAD in patients suspected acute stroke were evaluated, and clinical characteristics were compared between subjects with AAD and those with acute ischemic stroke (AIS) not due to AAD within 4 h from onset. Receiver operating characteristic (ROC) curve analyses were also conducted.

**Results:** A total of 1,637 patients were included in the study period. Five (0.31%) patients were diagnosed as having AAD. AAD accounted for 1.70% of AIS patients presenting within 4 h from onset. In cases with AIS due to AAD, SBP were lower in both arms ( $p = 0.001$  in the right and  $p = 0.007$  in the left arm), and NIHSS score ( $p = 0.020$ ), glucose level ( $p = 0.026$ ), and D-dimer level ( $p < 0.001$ ) were higher than those with AIS without AAD arrived to hospital within 4 h from onset. On ROC analyses, low SBP in the right arm (cut-off value  $\leq 110$  mm Hg, sensitivity 100%, specificity 94.4%) and high D-dimer level (cut-off value  $\geq 5.0$   $\mu\text{g/ml}$ , sensitivity 100%, specificity 91.7%) had high predictive values for detecting AAD among patients with AIS within 4 h from onset.

**Conclusion:** Frequencies of AAD in suspected acute stroke patients and in AIS within 4 h from onset were 0.31% and 1.70%, respectively. Low SBP in the right arm and high D-dimer level could predict AAD in AIS patients.

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## Dabigatran Concentration in Acute Ischemic Stroke Patients and Later Bleeding/Ischemic Events

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**Background and Rationale:** The safety and efficacy of early initiation of anticoagulation with dabigatran in the setting of acute stroke have not been fully investigated. The aim of this study was to evaluate the anticoagulation intensity of dabigatran among acute stroke patients and bleeding/ischemic events after initiation of dabigatran.

**Methods:** We studied acute ischemic stroke/TIA patients admitted to our hospital and started dabigatran from 2012 to 2015. The blood samples were drawn just before (0 h) and 4 hours after taking dabigatran on median 5 days of initiation to measure dabigatran concentration ( $C_{0h}$ ,  $C_{4h}$ ) based on thrombin clotting time assay (Hemoclot<sup>®</sup>), as well as APTT. APTT was expressed as a ratio to the baseline value (APTT-ratio).

**Results:** Of a total 52 patients (44 men,  $69 \pm 10$  y), 12 started dabigatran after TIA, and 40 started after ischemic stroke in median 5 day after onset.  $C_{0h}/C_{4h}$  was  $54 \pm 34/107 \pm 77$  ng/ml in total,  $67 \pm 30/135 \pm 78$  ng/ml in 24 patients taking 150 mg BID, and  $40 \pm 30/83 \pm 63$  ng/ml in 28 patients taking 110 mg BID; they were relatively low as compared to those from the RE-LY (Reilly PA, et al: JACC 2014).  $\text{APTT-ratio}_{0h}/\text{APTT-ratio}_{4h}$  was  $1.38 \pm 0.26/1.49 \pm 0.33$ ,  $1.45 \pm 0.27/1.60 \pm 0.34$ , and  $1.31 \pm 0.25/1.37 \pm 0.29$ , respectively.  $\text{APTT-ratio}_{0h/4h}$  was correlated well to dabigatran  $C_{0h}/C_{4h}$  ( $R^2 = 0.24/P = 0.0004$ ,  $R^2 = 0.35/P < 0.0001$ , respectively). No bleeding or ischemic event occurred during acute hospitalization (median 14 days). However, for median 418 (IQR128–717)-day follow-up in 52 patients who continued dabigatran after discharge, one developed GI bleeding ( $C_{0h}/C_{4h}$  5/5 ng/ml), one developed ischemic stroke ( $C_{0h}/C_{4h}$  10/50 ng/ml), and another developed acute myocardial infarction ( $C_{0h}/C_{4h}$  40/40 ng/ml).

**Conclusion:** In acute ischemic stroke/TIA patients, plasma dabigatran concentration was lower than that of the participants in the RE-LY. The concentration was correlated well with APTT-ratio. The concentration did not seem to be predictive of future bleeding events.

P072

**Should Mild Stroke Be Considered for Thrombolysis If There Is Significant Penumbra on CT Perfusion Imaging? A Case Series Demonstrating Advanced Imaging Guided Patient Selection for Intervention**

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**Background and Rationale:** In an analysis of a North American stroke database mild stroke accounted for over 50% of total ischaemic stroke presentations [1]. Determining the correct management approach for this significant number of stroke patients continues to be a challenge. This is due to the fact that those with mild stroke presentations may have a clinical course marked by deterioration before discharge from hospital or with the longer term outcome of loss of function [2, 3].

**Methods:** This series will present three cases in which Computed Tomography perfusion studies (CT perfusion) was utilised in the clinical decision making process to administer intravenous recombinant tissue-type plasminogen activator in acute ischaemic stroke with mild initial presentation (National Institute of Health Stroke Scale <5).

**Results:** In each of the cases a significant penumbra was demonstrated on CT perfusion imaging and in each case the total area of brain affected by ischaemia (as per the follow-up imaging) was far less than the penumbra initially seen.

**Conclusion:** These cases raise the clinical and research question of whether the exclusion criteria for thrombolysis in minor stroke be changed so that those patients with mild deficits are no longer excluded on severity grounds if a significant ischaemic penumbra is seen.

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P073

**Short Term Outcome after Acute Ischemic Stroke with Atrial Fibrillation Which Was Unidentified Prior to Stroke**

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**Background and Rationale:** Atrial fibrillation (AF) is often asymptomatic and undetected until the occurrence of embolic events. The short term outcome after ischemic stroke with AF which was unidentified prior to stroke is not clear. We aimed to clarify the 90-day outcome in patients with acute ischemic stroke and AF which was unidentified prior to stroke.

**Methods:** This study used a multicenter, prospective, observational database including consecutive patients with acute ischemic stroke admitted to 3 hospitals with stroke unit within 7 days from the onset. We extracted patients with AF-related cardioembolic stroke. The frequencies of modified Rankin Scale (mRS) of  $\geq 3$ , stroke recurrence, or death after 90 days from the onset were compared between patients with AF which was identified and unidentified prior to stroke.

**Results:** Two hundred and fifty three patients (130 men,  $79.5 \pm 10.0$  years) with identified AF and 196 patients (92 men,  $79.4 \pm 9.9$  years) with unidentified AF were included. Patients with unidentified AF had lower pre-morbid mRS (0 [0–3] vs. 0 [0–2],  $p = 0.024$ ), more frequent paroxysmal AF (55.9% vs. 27.3%,  $p < 0.001$ ), and less frequent history of stroke (14.4% vs. 31.6%,  $p < 0.001$ ), congestive heart failure (13.3% vs. 25.3%,  $p = 0.002$ ), diabetes mellitus (15.4% vs. 24.1%,  $p = 0.023$ ), ischemic heart disease (7.2% vs. 15.0%,  $p = 0.010$ ), and prior anticoagulant therapy (2.6% vs. 53.0%,  $p < 0.001$ ). Stroke recurrence was more common in patients with unidentified AF (6.2% vs. 1.6%,  $p = 0.011$ ), but frequencies of mRS of  $\geq 3$  (63.6% vs. 59.7%,  $p = 0.400$ ) or death (16.4% vs. 13.4%,  $p = 0.379$ ) were not different between the groups. Cox proportional hazard model showed unidentified AF was an independent predictor for stroke recurrence after adjustment with other factors (hazard ratio 5.59, 95% confidence interval 1.34–31.43).

**Conclusion:** In patients with acute ischemic stroke and newly diagnosed AF, higher risk of short term stroke recurrence should be kept in mind.

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**P074****Low Pulse Pressure on Admission Is Associated with Unfavorable Outcome in Acute Ischemic Stroke Patients: Results from Taiwan Stroke Registry**

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**Background and Rationale:** Pulse pressure (PP) has been related to the cardiac function, arterial stiffness and fluid status. The impact of PP on stroke outcome remains to be delineated. The present study aimed to explore the prognostic role of admission PP in patients with acute ischemic stroke (IS) based on Taiwan Stroke Registry.

**Methods:** We evaluated the association between PP on admission and outcome at 3 months after stroke in acute IS patients registered in the Taiwan Stroke Registry from August 2006 to August 2013. Unfavorable outcome was defined as modified Rankin Scale of 3 to 6 at 3 months after stroke.

**Results:** Of 33,530 acute ischemic stroke patients, PP on admission had a 'reversed J-curve' association with unfavorable outcome. After adjustment for IS subtypes, the NIH Stroke Scale, systolic and diastolic blood pressure (BP) on admission, the PP lower than 50 mm Hg was an independent unfavorable outcome predictor. Compared to the patients with a PP of 60–69 mm Hg, the adjusted odds ratio of unfavorable outcome increased gradually along with every 10 mm Hg decrease in PP [1.29 (1.13–1.46) with PP of 40–49 mm Hg and 3.03 (1.85–5.05) with PP <20 mm Hg]. The association between PP on admission and outcome was still persistent after the stratification of systolic BP. Furthermore, the prognostic impact of admission PP was similar across the IS subtypes except for the other determined etiologies.

**Conclusion:** Results from the present study establish a significant impact of PP on stroke outcome with lower PP carrying an unfavorable outcome in patients with acute IS.

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**P075****Barriers to Reducing Door to Needle Times**

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**Background and Rationale:** Door to needle time is an important factor in improving outcome in stroke. Following on the results of the Helsinki study (Meretoja, et al, 2012) we developed and implemented a new acute stroke protocol aimed at reducing the door to needle time at our hospital. A barriers analysis was done prior to the writing of the protocol.

**Methods:** Data collected over 5 years were analysed using the Theoretical Domains Framework (Cane, et al 2012) to determine the human and systematic barriers and facilitators to achiev-

ing the desired door to needle time and how they changed during the time period of the study.

**Results:** The protocol had an immediate and sustained effect on the time taken for performing a CT scan after it was ordered. The main driving force for this was the education of radiographers who were keen to improve patient care and did not have rapid staff turnover. A sustained reduction in time between prescription and administration of the thrombolytic drug was facilitated by the acute stroke CNC coordinating and educating the nursing staff. One of the persistent barriers to thrombolysis is the time taken for the treating neurologist to decide on thrombolysis. The barriers in this respect include both consultant seniority and knowledge of stroke as well as registrar experience and clinical acumen.

**Conclusion:** Implementation of improvements in care and sustainability of these changes are challenging in units with high staff turnover. Education remains a cornerstone in maintaining improvements in care but attitudes of emergency physicians to thrombolysis will continue to be a hindrance if the efficacy of the treatment is not accepted by this fraternity.

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**P076****Detection of Acute Aortic Dissection Using Carotid Ultrasonography in Acute Ischemic Stroke or Transient Ischemic Attack**

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**Background and Rationale:** Diagnosis of acute Stanford type A aortic dissection (AAD) in patients with acute ischemic stroke or TIA is sometimes challenging. Urgent detection of AAD is important to avoid intravenous thrombolysis and have an appropriate surgical treatment. We clarified the features of carotid ultrasonography findings in AAD patients with acute ischemic stroke or TIA.

**Methods:** Consecutive AAD patients with acute ischemic stroke or TIA who were admitted to our institute from Jan 2012 to Dec 2014 were reviewed. We retrospectively assessed the carotid ultrasonography findings which was performed in AAD patients



with acute ischemic stroke or TIA before emergency surgery on admission.

**Results:** We identified 13 AAD patients with acute ischemic stroke or TIA. Of them, 9 patients (5 women,  $68 \pm 12$  y.o.) received carotid ultrasonography examination. Abnormal findings due to the extension from an aortic dissection were detected in 8 patients (89%). The affected arterial segment was the right common carotid artery (CCA) in 8, the left CCA in 2, the right vertebral artery (VA) in 4 and the left VA in 0. We classified abnormal findings into 3 patterns as follows; flap with communicating false lumen pattern, flap with non-communicating false lumen pattern and occlusion pattern (no flow, zero end-diastolic flow velocity, or to and fro pattern). These patterns were detected in the right CCA in 4, 1 and 3 patients, respectively, and in the left CCA in 2, 0 and 0, respectively, and in the right VA in 0, 0, and 4, respectively. All 9 patients underwent an emergency surgery and none died during hospitalization.

**Conclusion:** Carotid ultrasonography is useful to detect abnormal findings mainly in the right CCA in AAD patients with acute ischemic stroke or TIA. AAD patients sometimes have a carotid artery occlusion rather than a typical carotid dissection flap.

#### P077

##### **Comparable IV-tPA Treatment Outcomes between Patients Treated On-Hours vs. Off-Hours – Taiwan Stroke Registry**

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**Background and Rationale:** Patients with acute ischemic stroke presenting during off-hours have higher mortality and greater neurological disability (Sortita et al, 2014). However, the differences in short-term and long-term outcomes after IV-tPA therapy between patients who arrived on- versus off-hours are still controversial in previous studies.

**Methods:** We compared IV-tPA treatment outcome between patients with acute ischemic stroke who presented off-hours vs. those on-hours in a retrospective analysis of the prospectively collected data in Taiwan Stroke Registry (Hsieh et al, 2010) from May 2006 to Aug 2013. Patients in the off-hours cohort presented to emergent departments on Monday through Friday from 5 pm to 8 am and on weekends and holidays. The door-to-CT time, door-to-needle time, incidence of symptomatic intracranial haemorrhage (sICH) and mRS at 3 months post stroke were compared between patients presenting during on- and off-hours.

**Results:** Among 1,749 patients receiving IV-tPA, 1,135 (64.9%) presented during the off-hours period. The off-hours presentation was associated with shorter door-to-CT time as compared to on-hours presentation ( $16 \pm 14$  vs.  $18 \pm 16$  min,  $p = 0.005$ ), but the door-to-needle time was not different between groups ( $67 \pm 39$  vs.  $69 \pm 44$  min,  $p = 0.73$ ). The incidences of sICH (1.9% vs.

1.1%,  $p = 0.26$ ) were comparable between groups. In addition, the risk of death (8.0 vs. 8.6%; adjusted hazard ratios, 0.95; 95% confidence intervals, 0.65–1.40) and good neurological outcome (mRS 0–2) (39.6% vs. 40.9%; adjusted odds ratio, 0.93; 0.69–1.24) at 3 months after stroke were comparable between groups.

**Conclusion:** The outcomes were comparable between on- and off-hours stroke patients after receiving IV-tPA in Taiwan, indicating the quality of IV-tPA therapy is not compromised during the off-hours period. The longer door-to-CT time in the on-hours group implies greater CT demand during regular work hours suggesting a need to streamline emergent CT imaging protocol during on-hours especially in the era of thrombectomy.

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- 2 Sortita A, et al: Off-hour presentation and outcomes in patients with acute ischemic stroke: a systematic review and meta-analysis. *Eur J Intern Med* 2014;25:394–400.

#### P078

##### **Durability of Beneficial Effect of MLC601 (NeuroAiD) on Functional Recovery among Stroke Patients from the Philippines in the CHIMES and CHIMES-e Studies**

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**Background and Rationale:** A pre-specified country analysis of subjects from the Philippines (PH) in the CHINESE Medicine NeuroAiD Efficacy on Stroke recovery (CHIMES) Study showed significantly improved functional and neurological outcomes on MLC601 at month (M) 3 (Navarro et al, 2015). We aimed to assess the effect of MLC601 on long-term functional recovery in the PH cohort.

**Methods:** The CHIMES-E (extension) Study evaluated the long-term effects of MLC601. Subjects were allowed to receive standard stroke care and rehabilitation. Modified Rankin Score (mRS) and Barthel Index (BI) were assessed in-person at M3 and by telephone at M6, M12, M18, M24. Treatment effect was calcu-

lated as odds ratios (OR) with corresponding 95% confidence intervals (CI) for functional recovery (by mRS ordinal analysis) and for achieving functional independence (mRS 0–1 or BI  $\geq$ 95) at each time point. ORs were adjusted for age, sex, baseline National Institute of Health Stroke Scale (NIHSS), onset to treatment (OTT) and pre-stroke mRS.

**Results:** The 378 subjects (MLC601 = 192, placebo = 186) included in CHIMES-E from PH (mean age  $60.2 \pm 11.1$ ; 46% female) had more women ( $p < 0.001$ ), worse baseline NIHSS ( $p < 0.001$ ) and longer OTT ( $p = 0.002$ ) compared to other countries. Baseline characteristics were similar between groups. The ORs for mRS and BI in favor of MLC601 previously seen at M3 peaked at M6 with cumulative ORs of 1.53 (1.05–2.22) on mRS ordinal analysis, 1.77 (1.10–2.83) on mRS dichotomy 0–1, and 1.87 (1.16–3.02) for BI  $\geq$ 95. The beneficial effect persisted at M12, 18, and 24. There were 2 recurrent strokes and 16 deaths (7 vascular) in the MLC601 group compared to 1 recurrent stroke and 14 deaths (4 vascular) in the placebo group. Other illnesses were similar between treatment groups.

**Conclusion:** The beneficial effect of MLC601 on functional recovery seen at M3 in the PH cohort is durable up to 2 years after stroke.

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## P079

### Both High and Low Serum Cholesterol Levels Are Associated with Higher 30-Day Mortality from Ischemic Stroke in Patients with End-Stage Renal Disease Undergoing Dialysis

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**Background and Rationale:** End-stage renal disease (ESRD) patients on dialysis are at elevated risks of stroke and death from stroke. Whether serum cholesterol level is associated with the prognosis of stroke in ESRD patients has not been systematically studied. We used the Taiwan Stroke Registry (TSR) data [1] to explore the association between serum cholesterol and 30-day mortality after ischemic stroke in dialysis patients.

**Methods:** From the TSR data, we identified 1312 ischemic stroke patients with ESRD undergoing dialysis between 2006 and 2013. The control group consisted of 53226 ischemic stroke pa-

tients without ESRD in the same period. Patients' demographic data, subtypes of stroke, location, comorbidity, blood pressure, laboratory data, GCS score on admission, and medications prior to admission were documented. Serum cholesterol levels on admission were divided into 4 ranges:  $<120$  mg/dl, 120–159 mg/dl, 160–199 mg/dl, and  $\geq 200$  mg/dl. The primary outcome of the study was 30-day mortality after ischemic stroke. The multivariate Cox proportional hazards regression was used to assess stroke mortality in 4 different ranges of cholesterol level.

**Results:** The 30-day mortality rate after the acute ischemic stroke was 2.57 per 1000 person-days ( $n = 83$ , 6.33%). The mortality rates were 1.66, 0.63, 2.86, and 2.26 per 1000 person-days in patients with serum cholesterol of  $<120$  mg/dl, 120–159 mg/dl, 160–199 mg/dl, and  $\geq 200$  mg/dl, respectively. The corresponding hazard ratio was 2.61 (95% CI = 0.87–7.81), 4.48 (95% CI = 1.49–13.5), and 3.57 (95% CI = 1.17–11.0) for patients with serum cholesterol level of  $<120$  mg/dl, 160–199 mg/dl, and  $\geq 200$  mg/dl, respectively, compared to patients with serum cholesterol of 120–159 mg/dl after adjustment of age, comorbidities and stroke severity. On the other hand, there is no difference in the risk of stroke mortality among 4 different ranges of cholesterol level in patients without ESRD.

**Conclusion:** ESRD patients with serum total cholesterol level of  $\geq 160$  mg/dl or  $<120$  mg/dl on admission are at an elevated hazard of 30-day mortality after ischemic stroke.

## Reference:

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## P080

### Identification of Red Clot in Posterior Circulation Large Artery Occlusion

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**Background and Rationale:** There is no evidence-based therapy available for patients with acute posterior circulation large artery occlusion. Intra-arterial red clot is composed of red erythrocyte-fibrin thrombus, which could be detected by Magnetic Resonance Imaging (MRI). The aim of this study was to identify red clot in patients with posterior circulation large artery occlusion.

**Methods:** All patients hospitalized with intracranial posterior circulation occlusion from January 2003 to September 2013 were included. MRI and Computed Tomography Angiography (CTA) were reviewed to determine the presence of arterial occlusion and identify red clot. The clinical and imaging characteristics associated with the red clot were explored.

**Results:** Eighty-one patients with intracranial posterior circulation large artery occlusion were analyzed. We identified 21 of 63

(33.3%) patients with red clot in symptomatic patients, and 1 of 18 (5.6%) with red clot in the asymptomatic group with significant difference ( $P = 0.019$ ). Red clot was found in 6 of 10 (60.0%) patients with cardioembolism, 5 of 13 (38.5%) with dissection, 9 of 34 (26.5%) with large artery atherosclerotic disease, 1 of 6 (16.7%) with undetermined cause.

**Conclusion:** Identifying the red clot composition may be useful in judging the mechanism of stroke and planning optimal therapy based on clot presence and clot burden.

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## P081

### Wake-Up Stroke in India: The Indo-US Stroke Project

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**Background and Rationale:** Nearly one third of all strokes occur during sleep or without witnessed onset (unclear onset time, UoT). A subset of UoT patients may benefit from thrombolysis. There is little knowledge about risk factors, clinical profile, thrombolysis and outcome of UoT patients from India.

**Methods:** The Indo-US Stroke Project included five Indian academic hospitals with stroke teams. Consecutive inpatient data was collected from January 1, 2012 to December 31, 2014. Outcome was assessed using the modified Rankin Scale (mRS) at 3 months; mRS 0–2 was considered good outcome.

**Funding:** This study was jointly funded by NINDS and Indian Department of Biotechnology (NIH-NINDS R21NS077442).

**Results:** Of 2066 patients enrolled, 555 (26.86%) had UoT. When compared to known onset time group, UoT patients were younger (57.2 vs. 58.7 years,  $p = 0.03$ ), had more prior TIAs (10.45% vs. 6.6%,  $p = 0.005$ ), smokers (current, 22.7% vs. 15.1%,  $p = 0.002$ ; past, 8.46% vs. 4.9%,  $p = 0.001$ ), severe deficits (baseline median NIHSS 11 vs. 9,  $p = 0.001$ ), more MCA-territory infarcts (80% vs. 78%,  $p = 0.03$ ), more complications like urinary tract infection (16.6% vs. 6.8%,  $p < 0.001$ ) and pneumonia (20.2% vs. 10%,  $p < 0.001$ ). In UoT, 36 patients received IV tPA. Of these, 30 patients had last seen well time  $< 4.5$  hours and 6 received tPA based on imaging findings suggesting hyperacute stroke. An additional 12 patients received IV+IA (bridging) therapy and 23 received IA clot retrieval. Overall, fewer patients with UoT received either IV or IV-IA tPA (8.4% vs. 12.6%,  $p < 0.001$ ). There were no significant differences in recanalization rates, 3-month mRS scores, and return to work status.

**Conclusion:** In India, stroke patients with UoT are younger, have more stroke risk factors and develop more in-hospital com-

plications but have similar 3-month outcomes. Opportunities exist to increase the rates of thrombolysis using advanced imaging for selection, and to reduce in-hospital complications.

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## P082

### A Case of Recurrent Thromboembolic Stroke from Mitral Myxoma with Mechanical Thrombectomy Therapy: Case Report

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**Background and Rationale:** In many previous case reports of acute stroke from cardiac myxoma revealed no clinical improvement after administration of rt-PA. This case is report of mechanical thrombectomy in patient with acute thromboembolic stroke caused by mitral myxoma.

**Methods:** This case is report of mechanical thrombectomy in patient with acute thromboembolic stroke caused by mitral myxoma.

**Results:** Case: A 51 year-old man had history of deep vein thrombosis and previous thromboembolic stroke 4 months ago with MRI brain showed shower embolic phenomenon at bilateral hemisphere, his medication was continue enoxaparin subcutaneous injection everyday. He presented with acute onset right hemiparesis and global aphasia for 30 minutes. His MRA showed occlusion at mid to distal M1 of left MCA. Following successful mechanical thrombectomy (TICI 3), the clot and fibrin tissue was removed from left MCA and his NIHSS score improved from 18 to 6. Then, transesophageal echocardiogram showed myxomatous mitral valve disease and determine the surgical approach to valve repair or replacement. In this case had contraindication for rt-PA from on low molecular weight heparin.

**Conclusion:** The mechanical thrombectomy was appropriate option therapy for this interesting case.

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- Vanda ML, 1995.
- Vega RA, 2015.

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**P083****DC007: A Novel Triple Function Small Molecule for the Treatment of Acute Ischemic Stroke (AIS)**

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**Background and Rationale:** Short treatment time window and haemorrhagic transformation comprise the major limitations of IV recombinant tissue plasminogen activator (tPA) in the treatment of AIS. DC007 is a novel small molecule designed to have thrombolytic, anti-platelet aggregation and free radical scavenging activities with a superior safety profile. Reported here are the antiplatelet and thrombolytic efficacy of DC007 observed in vitro and in vivo.

**Methods:** Effects of intravenous tPA (10 mg/kg) versus DC007 (7.5 mg/kg) were compared using a model of focal embolic cerebral ischemia in rats. Rats were randomized to be administered with saline, tPA or DC007 at 3 hours after embolization.

Platelet aggregation was monitored after the addition of aggregation agonist in platelet-rich plasma (PRP) and platelet suspensions (PS) pre-treated with DC007.

Tail vein bleeding time was measured in mice injected with PBS, tPA (10 mg/kg), or DC007 (7.5 mg/kg).

**Results:** Compared to saline or tPA treatments, DC007 significantly reduced brain infarction and hemispheric swelling in the stroke rats when given at 3 hours after stroke onset. 24 hours after stroke, infarction volumes were 49.36%, 31.98%, and 40.66% for saline, DC007 and tPA group, respectively; while brain swelling rates were 17.67%, 13.20% and 22.58% for saline, DC007 and tPA group, respectively.

DC007 inhibited collagen- and thrombin-induced platelet aggregation in PS and PRP in a dose-dependent manner. IC<sub>50</sub> values for collagen- and thrombin-induced platelet aggregation were 10.47  $\mu$ M and 14.44  $\mu$ M in PS and 114.20  $\mu$ M and 77.08  $\mu$ M in PRP, respectively.

The tail bleeding time of mice treated with DC007 (60.80s) was comparable to mice treated with normal saline (54.40s), while rt-PA extended the bleeding time to longer than 1800s.

**Conclusion:** DC007 appears to be a better thrombolytic with superior safety profile than IV rt-PA when given at 3 hours after the stroke onset and unaffected bleeding time. Further investigation is warranted for its potential in the treatment of AIS.

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**P084****Embolic Sources and 1-Year Outcome in Patients with Embolic Stroke**

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**Background and Rationale:** Cardioembolic stroke is considered as a subtype related with high recurrence rate and bad outcome [1]. Aortic arch atheroma is well known as an embolic

source for repeatable brain embolism [2]. We investigated an association between embolic sources and stroke recurrence or mortality.

**Methods:** Among patients with acute stroke or transient ischemic attack within 7 days after the onset, 661 consecutive patients who were diagnosed as having brain embolism without significant occlusive lesions in the cerebral arteries and underwent transesophageal echocardiography for evaluating embolic sources were included. All patients were classified into 5 groups: patients only with cardiogenic embolic sources (C-Group), patients only with right-to-left shunt diseases, such as atrial septal defect, patent foramen ovale, or pulmonary arteriovenous fistula (R-Group), patients only with aortogenic embolic sources (aortic atheroma  $\geq 4.0$  mm) (A-Group), patients with multiple embolic sources (M-Group), and patients without any embolic sources (N-Group). In accordance with the etiology-related groups, 1-year stroke recurrence and mortality were compared. We also investigated risk factors for stroke recurrence and death.

**Results:** Stroke recurrence or all death was observed in 16.5% of C-group, 18.0% in A-group, 6.9% in R-group, 20.9% in M-group, and 10.9% in N-group, respectively ( $p = 0.0651$ ). Cardio-genic embolic sources, aortic atheroma, hypertension, and diabetes mellitus were significantly more frequent in patients with than without 1-year stroke recurrence and all death. In the multivariate analysis, stroke recurrence and all death was significantly more frequent in M-group in comparison with N-group patients (OR 2.12, 95% CI 1.21–4.08). Hypertension was also an independent risk factor for 1-year stroke recurrence and all death (OR 1.71, 95% CI 1.00–3.07).

**Conclusion:** In embolic stroke, stroke recurrence or death was frequent in cardioembolic stroke or aortogenic stroke patients. Patients with multiple embolic sources was especially at high risk state for stroke recurrence or death.

**References:**

- 1 Yokota et al, 1998.
- 2 Fujimoto et al, 2004.

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**P085****Evaluation of Acute Ischemic Stroke Patients with rt-PA Intravenous Therapy by Age**

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**Background and Rationale:** Ischemic stroke is known for the different disease type and severity by age. We examined relationship between the effectiveness of rt-PA intravenous therapy and age.

**Methods:** We studied 133 consecutive ischemic stroke patients treated by rt-PA intravenous therapy between October 2005 to June 2015 from our hospital. We divided these patients into 5 groups according to age (i.e., 35–44, 45–54, 55–64, 65–74, and

75–84 years old). We analyzed National Institute of Health Stroke Scale (NIHSS) on admission, modified Rankin Scale (mRS) at discharge, complications and so on.

**Results:** The ratio of cardiogenic embolism and NIHSS on admission were higher in elderly groups. Duration from onset to the hospital visit was shorter in younger patients. mRS at discharge was higher over 85 years old. Prognosis was getting worse by age in both cardiogenic embolism and atherothrombotic infarction patients, but cardiogenic embolism was tended to be worse than atherothrombotic infarction in younger patients. mRS at discharge was higher in patients treated over 180 min than within 180 min. There was no significant difference in ratio of symptomatic intracranial hemorrhage depending on age or the start of treatment.

**Conclusion:** Prognosis at discharge was tended to be poor in elderly groups. Concerning cardiogenic embolism, it tended to be worse in younger patients in comparison to atherothrombotic infarction. Symptomatic intracranial hemorrhage was not affected by age nor whether within 180 min or not.

#### P086

### The Cost Effectiveness of a Stroke Unit in Providing Enhanced Patient Outcomes in an Australian Teaching Hospital

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**Background and Rationale:** Stroke is one of the leading causes of disability and mortality (Lozano et al. 2012; Murray et al. 2012). Patients who receive organised inpatient care in a stroke unit (SU) have better clinical outcomes (Stroke Unit Trialists' Collaboration 2013). However evidence on the cost analysis of a SU is lacking. The objective of this study was to assess the performance and analyse the cost effectiveness of a SU.

**Methods:** We conducted a retrospective observational study comparing the acute stroke patient care in a 6-month period before and after the establishment of an acute SU at Calvary Hospital in 2013–2014.

**Results:** In this study, 103 and 187 patients were included in the pre-SU and post-SU periods respectively. There was a significant trend suggesting better morbidity and mortality in the post-SU group using ordinal analysis of modified Rankin Scale at 90 days ( $p = 0.013$ ). The average length of stay for stroke patients was reduced from 9.7 days in the pre-SU group to 5.2 days in the post-SU group ( $p = 0.001$ ). There was a concurrent reduction of cost per admission which totalled \$6936 Australian Dollars (AUD) with conventional ward care compared to \$6383 AUD with SU care. In the post-SU period there was major improvement in the adherence to best medical management which included the ordering of investigations and the implementation of therapeutics.

**Conclusion:** This study has confirmed that the establishment of a stroke unit not only improves treatment outcomes but also shortens length of stay, thereby achieving cost effectiveness.

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## Acute TIA

#### P087

### Incidence, Risk Factors, and Prognosis of Transient Ischemic Attack in a General Japanese Population: The Hisayama Study

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**Background and Rationale:** Very few studies have reported incidence, risk factors, and prognosis of transient ischemic attack (TIA) in a general Japanese population.

**Methods:** A total of 2,646 stroke-free community-dwelling Japanese individuals aged  $\geq 40$  years in 1988 were followed up for 24 years. The incidence of TIA was calculated by the person-year method. The association between risk factors and the development of TIA was estimated by the Cox proportional hazards model. The 10-year cumulative risks of cardiovascular disease and all-cause mortality were estimated by the Kaplan-Meier product limit method and compared by the log-rank test between the subjects with TIA events and age- and sex-matched control subjects.

**Results:** During the follow-up, 34 TIA events occurred. The crude incidence of TIA was 0.67 per 1,000 person-years in total. The incidence of TIA was significantly higher in men than in women (0.99 vs. 0.46 per 1,000 person-years,  $P = 0.03$ ), and increased with aging in both sexes (both  $P$  for trend  $< 0.01$ ). The subjects with hypercholesterolemia had a significantly higher risk of TIA than those without it (age- and sex-adjusted hazard ratio, 2.76; 95% confidence interval, 1.36–5.54;  $P = 0.005$ ). The 10-year cumulative incidences of total stroke, ischemic stroke, and coronary heart disease were higher in 28 TIA cases than in 84 age- and sex-matched control subjects (51.9% vs. 16.9%,  $P < 0.001$  for total stroke; 44.8% vs. 10.1%,  $P < 0.001$  for ischemic stroke; 20.3% vs. 7.3%,  $P = 0.05$  for coronary heart disease). In contrast, the 10-year risk of all-cause mortality did not show a clear difference between the two groups (59.2% vs. 49.0%,  $P = 0.25$ ).

**Conclusion:** In a general Japanese population, the incidence of TIA was 0.67 per 1,000 person-years in total. Men, older age, and hypercholesterolemia were significant risk factors for the development of TIA. The subjects with TIA had a higher risk of subsequent cardiovascular events.

#### P088

### Strokes, TIAs, Mimics: A Comparison of Emergency Department and Discharge Diagnosis Coding

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**Background and Rationale:** There are potentially cost, quality of care and quality of life implications (e.g., extended length of stay, inappropriate investigations, poorer patient outcomes) for discrepancies between admission and discharge diagnoses. However, few data are available regarding the agreement between Emergency Department (ED) and final diagnosis for patients presenting with stroke/stroke-like symptoms. The aim of this study was to compare the diagnosis of patients presenting to ED with the final diagnosis.

**Methods:** Medical records for a 12 month period (between 2010 and 2014) in seven regional Victorian hospitals were reviewed. Patients allocated one or more of 16 International Statistical Classification of Diseases and Related Health Problems, Australian Modification 10th revision (ICD-10) codes related to stroke or stroke-like symptoms in either Emergency or at Discharge were included: recognised stroke (I619, I620, I621, I629, I639, I64), TIA (G459) or stroke symptoms – disorientation (R410), loss of consciousness (S0600, S0601), visual field defects (H534), other visual disturbances (H538), dysphagia (R13), dysphasia and aphasia (R470), other specified disorders of brain (G938), and dysarthria and anarthria (R471).

**Results:** Of 2776 patient records identified, 1005 had an ED and final diagnosis code recorded. While there was only 36% exact concordance between ED and discharge coding, there was 72% agreement at the stroke prefix level (i.e., I codes) or TIA code (i.e., G459). Specifically, 62% of TIAs and 85% of strokes diagnosed at the ED were concordant with the discharge diagnosis. A final diagnosis of stroke was allocated for 87 of the 271 (32%) patients receiving an ED TIA diagnosis.

**Conclusion:** In regional Victoria, approximately one-third of TIAs diagnosed in the ED are subsequently diagnosed as stroke. This limits the provision of time-critical stroke therapies (e.g., thrombolysis) and further education may be warranted. Predictors of discrepancies shall be identified.

#### P089

### Acute Transient Vestibular Syndrome: Stroke Prevalence and Efficacy of Bedside Information

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**Background and Rationale:** The aim of this work was to determine the stroke prevalence and efficacy of bedside information in acute transient vestibular syndrome (ATVS).

**Methods:** We prospectively recruited 86 patients with ATVS. All patients received constructed examination including four-item HINTS ‘plus’ (head impulse test, nystagmus pattern, test of skew, and hearing loss), and brain MRI. Patients without an obvious causes further received perfusion-weighted imaging (PWI). Multivariable logistic regression was used to determine clinical parameters to identify stroke in ATVS.

**Results:** Overall stroke prevalence in ATVS was 27%. HINTS plus could not be applied to the majority of patients due to the resolution of vestibular symptoms, and MRI was falsely negative in 12%. In patients with vestibular symptoms and nystagmus, the specificity (75%) of the HINTS plus was also low. There was a significantly higher hazard risk of developing stroke in ATVS associated with craniocervical pain (OR = 8.4, 95% CI = 2.0–34.3) and focal neurologic symptoms/signs (OR = 12.2, 95% CI = 2.4–60.7). Ten patients (12%) showed unilateral cerebellar hypoperfusion on PWI, and eight of them had a focal stenosis or hypoplasia in the corresponding vertebral artery.

**Conclusion:** Our results show that ATVS has a diagnostic challenge simply based on bedside examination and routine MRI. Associated craniocervical pain and neurological symptoms or signs may be clinical clues for the prime consideration of neuroimaging. Cerebellar hypoperfusion in ATVS provides an evidence that isolated vertigo actually occur in vertebrobasilar transient ischemic attack requiring broader diagnostic criteria.

#### P090

### Lambl's Excrescences Associated with Ischemic Stroke

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**Background and Rationale:** Lambl's excrescences are thin filiform strands that attached to the edges of cardiac valves. Embolic stroke associated with these valvular strands has rarely been reported [1, 2]. We present a case of ischemic stroke associated with Lambl's excrescences.

**Methods:** Case: A 53-year-old man with a history of hypertension and smoking presented with dysarthria and mild left hemiparesis. Neurologic examination showed mild dysarthria, mild left facial weakness, and anosognosia for left hemiparesis.

**Results:** Brain MRI showed acute multiple infarctions in the right middle cerebral artery (MCA) territory and old small infar-

tions in the subcortical frontal area. MR angiography showed focal significant stenosis of the right proximal internal carotid artery and occlusion of the right distal MCA. Transesophageal echocardiogram showed oscillating linear material at aortic valve. He was treated with aspirin and clopidogrel. The patient was discharged seven days after admission with residual mild dysarthria.

**Conclusion:** Although the causal relationship between ischemic stroke and Lambl's excrescences remains unclear in this patient due to ipsilateral proximal carotid artery stenosis, cerebral infarctions in other vascular territory suggest that Lambl's excrescences are might be associated with embolic ischemic stroke.

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## P091

### Effectiveness and Safety of a Coordinated Transient Ischaemic Attack Program in the Princess Margaret Hospital (PMH) in Hong Kong

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**Background and Rationale:** A coordinated transient ischaemic attack (TIA) program was established in PMH, Hong Kong in April, 2014. This program targets on early diagnostics and aggressive treatment to prevent stroke. It involves early TIA recognition, neuroimaging and cerebrovascular diagnostic workup, protocol based treatment with antiplatelet treatment according to the ABCD2 score, unless contraindicated, direct discharge from A&E and early review of patients by neurologist in a fast track TIA clinic within two weeks.

**Methods:** Objective: Part I: To study the 30-day stroke risk in TIA patients being treated in this program. Part II: To evaluate any adverse effects associated with 'over-treatment' with antiplatelet agent(s) if patients were finally confirmed to be TIA mimics upon review in the fast tract TIA clinic.

**Methods:** We reviewed all potential TIA patients who were treated under this TIA program from April, 2014 to Dec 2015. A total of 56 patients were referred from A&E department during this period. Except one defaulted patient, we analyzed 55 patients.

**Results:** Part I: A total of 35 patients (64%) and 6 patients (11%) were diagnosed of TIA and minor stroke, respectively. One patient developed a non-disabling minor stroke within 30 days of TIA diagnosis. The 30-day stroke risk was 2.9%. Part II: Fourteen patients (25%) were diagnosed of TIA mimics. Two of them had dyspepsia after antiplatelet treatment. No bleeding complication was recorded.

**Conclusion:** The TIA program model is effective and safe in treating the potential TIA patients and avoids unnecessary hospital admissions.

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## P092

### Limb Shaking Transient Ischemic Attack as a Manifestation of Cerebral Venous Thrombosis in the Superior Sagittal Sinus

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**Background and Rationale:** Limb shaking TIA is rarely observed in stenosed/occlusive carotid disease. Hemodynamic failure in the anterior circulation is considered as a possible etiology. We report a case of cerebral venous thrombosis in the superior sagittal sinus initially manifested limb shaking TIA.

**Methods:** Case report.

**Results:** A 60-year-old man was admitted to our service with complaints of a sudden weakness of the right extremities, verbal disturbance and sensory deficit of his right-sided body. He had been suffering one year-lasting limb shaking TIA before admission. Initial MRI and MR angiography revealed no responsible lesions. On day 5, the right paralysis was deteriorated. MRI showed dilatation of vessels, from deep medullary veins toward superficial medullary veins on the left frontal/parietal lobe and on the right frontal/parietal lobe. MR venography indicated cerebral venous thrombosis in sagittal sinus. Since both limb shaking and TIA can be induced by hemodynamic failure in the anterior circulation, hypoperfusion in the left dorsolateral frontal cortex was suggested as a cause of repetitive limb shaking TIA in the present case.

**Conclusion:** To our knowledge, this is the first report describing the cerebral venous thrombosis manifesting one-year lasting limb shaking TIA. We have to be cautious that cerebral venous thrombosis can cause limb-shaking TIA.

#### P093

### Factors Relating to an Early Visit to a Stroke Center in Patients with Transient Ischemic Attack: Analyses of Data from a Multicenter Prospective Study

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**Background and Rationale:** The purpose of this study was to investigate factors relating to an early visit to a stroke center in patients with TIA.

**Methods:** The study subjects were patients within 7 days of TIA onset who were enrolled in a prospective register from 57 hospitals between June 2011 and December 2013. We compared baseline characteristics between patients visiting a stroke center within 3 hours of TIA onset (early visit, EV group) and those after the initial 3 hours (late visit, LV group). 1365 patients (882 men, mean age of 69.4 years) were registered. Of them, 732 patients (53.6%) belonged to the EV group.

**Results:** Patients in the EV group were older than those in the LV group (70.1 vs. 68.6 years,  $p = 0.029$ ). Patients in the EV group more commonly had hemiparesis (77.1% vs. 68.9%,  $p < 0.001$ ), speech disturbance (58.9% vs. 42.8%,  $p < 0.001$ ), and symptom duration of  $\geq 10$  minutes (76.5% vs. 71.3%,  $p < 0.001$ ). Patients in the EV group were more likely to have atrial fibrillation (17.6% vs. 13.6%,  $p = 0.041$ ) and less likely to have a history of TIA (15.0% vs. 33.8%,  $p < 0.001$ ). Patients were more frequently men in the EV group than in the LV group, but not significant (66.8% vs. 62.1%,  $p = 0.069$ ). The ABCD<sup>2</sup> score was significantly higher in the EV group than in the LV group (median [IQR], 5 [3–6.75] vs. 4 [2–5],  $p < 0.001$ ). Multiple regression analysis revealed men (OR: 1.30, 95% CI: 1.03–1.65,  $p = 0.026$ ), hemiparesis (OR: 1.55, 95% CI: 1.22–2.00,  $p < 0.001$ ), speech disturbance (OR: 1.87, 95% CI: 1.50–2.34,  $p < 0.001$ ), and no history of TIA (OR: 2.85, 95% CI: 2.17–3.75,  $p < 0.001$ ) were associated with an early visit.

**Conclusion:** We identified several factors relating to an early visit to a stroke center after TIA onset.

## Intracranial Disease

#### P094

### Strategy for Adequate Blood Pressure Lowering in the Patients with Intracranial Atherosclerosis (STABLE-ICAS)

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**Background and Rationale:** Appropriate target BP level is uncertain especially for the patients with intracranial atherosclerotic stenosis (ICAS). We investigated the safety and efficacy of aggressive BP control in the patients with symptomatic ICAS.

**Methods:** This single-blinded randomized trial studied the patients with symptomatic intracranial ICA or MCA steno-occlusion ( $>50\%$ ) from 7 to 42 days after index stroke. Subjects should have screening SBP  $\geq 140$  mm Hg or be on anti-hypertensive medications. Primary hypothesis is that aggressive BP control (target SBP 110–120 mm Hg) will not increase the ischemic lesion volume compared to modest lowering (130–140 mm Hg) in the patients with symptomatic ICAS. Primary outcome is the ischemic lesion volume change in the whole forebrain on FLAIR MRI between baseline and 24 weeks.

**Results:** Among 132 patients, follow-up FLAIR MRI were available in 111 (59 in aggressive and 52 in moderate control group). Achieved BP level at 24 weeks were  $124.64 \pm 10.50$  mm Hg in aggressive and  $132.27 \pm 10.55$  mm Hg in modest control group. The ischemic lesion volume change in the whole forebrain on FLAIR MRI between baseline and 24 weeks was  $4.9 \pm 18.3$  cc in aggressive and  $2.2 \pm 8.2$  cc in modest control group. The ischemic lesion volume change difference between the aggressive and modest control group was  $2.8 \pm 14.5$  cc with the one-sided 95% upper confidence limit of 7.2 cc, which exceed the non-inferiority margin of the 3 cc. Frequency of new ischemic lesions on 24-week FLAIR MRI was not different in two groups [10 (16.9%) in aggressive vs. 5 (9.6%) in moderate group ( $p = 0.2594$ )]. Only 1 recurrent stroke developed during the study period in each group.



**Conclusion:** We could not prove that aggressive BP reduction in ICAS patients was non-inferior to modest control in terms of ischemic lesion change. Greater variation in lesion volume change in aggressive control group suggests more cautious and large-sized clinical study should be needed. (clinicaltrials.gov: NCT01104311).

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#### P095

### **Risk Factors for Newly-Developed Cerebral Infarction after Surgical Revascularization for Adults with Moyamoya Disease**

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**Background and Rationale:** It is important to recognize the incidence and risk factors for ischemic complications after surgical revascularization for moyamoya disease (MMD). However, most studies focus on pediatric MMD or both pediatric and adult MMD. Our study identified the incidence and risk factors of newly-developed cerebral infarction after surgical revascularization for adult MMD.

**Methods:** Ischemic complications were defined as newly-developed cerebral infarction within 15 days following surgery, as identified by imaging studies. To identify the incidence and these risk factors for adult patients 18 years or older, we retrospectively reviewed our experience with 194 adult MMD patients with 241 surgical revascularizations.

**Results:** The incidence of symptomatic infarction after surgical revascularization was 5.8% (14 cases) and 30 cases (12.4%) experienced silent infarction. For univariate analysis, initial presentation as infarction, initial presentation as hemorrhage, transient ischemic attacks (TIAs) >3 times/month, involvement of posterior cerebral artery (PCA), combined bypass, and using muscle for revascularization were variables related to newly-developed cerebral infarction. Multivariate analysis revealed that the following factors were independently associated with newly-developed cerebral infarction after surgery: cerebral infarction as initial presentation (OR 1.150; 95% CI 1.038–1.273;  $p = 0.0073$ ), TIAs >3 times/month (OR 1.188; 95% CI 1.058–1.335;  $p = 0.0035$ ) and PCA involvement (OR 1.095; 95% CI 1.005–1.194;  $p = 0.039$ ).

**Conclusion:** Our findings demonstrate that newly-developed, silent cerebral infarction developed more frequently than symptomatic cerebral infarction in adult patients. Cerebral infarction as initial presentation, frequent TIA before surgery, and PCA involvement were also independent risk factors for newly-developed cerebral infarction after surgical revascularization for adult MMD.

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#### P096

### **The Characteristics of Stroke in Homeless Patients**

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**Background and Rationale:** Our hospital has been assigned the medical care of homeless people belonging to the Tokyo Prefecture, and we have experienced many homeless patients with stroke. Most of these people have little access to medical care; therefore, they often neglect arteriosclerotic risk factors. In addition, it often takes long time to reach the hospital after stroke occurs; therefore, they rarely receive optimal treatment in the acute period. Here we examined the characteristics of stroke in homeless patients.

**Methods:** We examined 20 patients with stroke admitted to wards reserved for homeless patients from January 2012 to December 2013. As controls, we examined 271 patients with stroke admitted to general wards.

**Results:** The mean age in the homeless group was 69.5 years, and all cases were men. Five patients were hospitalized for other diseases in our as well as other hospitals. Except for these 5 patients, only 1/15 presented within 1 day of stroke onset. 17/20 patients showed cerebral infarction (7 atherothrombotic infarction, 3 cardioembolic infarction, and 3 lacunar infarction) and the remaining 3/20 showed cerebral hemorrhage. Many untreated patients were recognized even if they showed the presence of hypertension, diabetes, and dyslipidemia. Moreover, 10/20 patients were current smokers. Of the 7 patients with atherothrombotic infarctions, 4 involved the middle cerebral arteries, 1 involved the intracranial internal carotid artery, and 2 involved the extracranial internal carotid arteries. ADL at discharge, mRS was 0–2 in 8 and 3–6 in 12. Only 5 patients could be transferred to acute rehabilitation hospitals.

**Conclusion:** Majority of the homeless patients with stroke showed cerebral infarction, particularly of the atherothrombotic type. The stenotic arteries among the middle cerebral arteries were recognized to be the cause in more number of homeless patients in comparison with the controls. In the homeless group, the arteriosclerotic risk factors were often untreated and the number of smokers was high. Finally, transfer to an acute rehabilitation hospital was difficult in this group.

P097

### Carotid Arterial Dissection Originated from Asymptomatic Long Segmental Aortic Dissection

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**Background and Rationale:** Cerebral arterial dissection is a main cause of young-age stroke, especially frequent in cervical carotid artery and vertebral artery. Cerebral arterial dissection can occur after trauma or spontaneously. In some cases, arterial dissection can be originated from aorta. We report a case of ischemic stroke from ipsilateral carotid artery dissection, which was originated from aortic dissection.

**Methods:** A 59-year old female visit to our emergency department with sudden left sided hemiparesis. Her limbs weakness suddenly started spontaneously with sudden right neck sharp pain. Neck pain were terminated spontaneously 30 minutes after. Neurologic examination on her revealed drowsy mental status, left hemiparesis MRC grade 3, forced right sided eyeball deviation, slurred speech and left facial palsy. Her vital signs were nonspecific findings. And other generalized symptoms were none. Brain MRI revealed multifocal diffusion restriction lesions in left hemisphere, mainly in left middle cerebral artery territory in diffusion weighted images (DWI-MRI). In MRA, double lumen and true lumen narrowing was noticed in from common carotid artery to proximal internal carotid artery. After MRI/A was done, her neurologic symptoms showed mild improvement. Her motor power recovered to MRC grade 4+ and forced eyeball deviation was neutralized.

**Results:** After patient's neurologic symptoms were stabilized, we tried extended-carotid MRA because end point of dissection was not founded in routine MRA. Extended carotid MRA revealed long segmental dissection of carotid artery, which reached to aortic arch with dissecting aneurysm. In series, we performed vascular CT in chest and abdomen in emergency. In CT, focal intimal tear at ascending aorta and double lumen extension from ascending aorta to iliac bifurcation level was noticed, suggesting diffuse aortic dissection. And right renal infarction due to right renal artery involved in dissected false lumen was revealed. But her vital signs and laboratory findings were normal and she complained only focal neurologic symptoms, left sided hemiparesis. For emergency operation of her aortic dissection and renal infarction, she was transferred to other hospital which can perform cardiothoracic surgery.

**Conclusion:** Our patient showed only focal neurologic symptoms and did not complained of any other medical symptoms even though aortic dissection had occurred. Therefore, in carotid arterial dissection, even in spontaneous mode, the possibility of aortic dissection should be considered when long segmental dissection was found in MRA.

P098

### Vertebral Artery Terminating in Posterior Inferior Cerebellar Artery: A Normal Variation with Clinical Significance

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**Background and Rationale:** Vertebral artery (VA) terminating in posterior inferior cerebellar artery (PICA-terminate) was considered a normal variation associating with VA hypoplasia (VAH). Our aim is to elucidate its the relationship with VAH clinical significance.

**Methods:** A total of 80 patients with cerebral infarct or dizziness/vertigo were examined with Duplex sonography and magnetic resonance angiography (MRA). 80 healthy subjects were recruited as controls. The PICA-terminate was defined as the VA not communicating with basilar artery but ending in PICA on MRA. We compared the prevalence of PICA-terminate and its associated hemodynamic parameters between patients and controls, and investigated its relationship with VAH.

**Results:** The prevalence of PICA-terminate was higher in patient group than in control (18.7% vs. 6.5%,  $p = 0.015$ ). Most of the PICA-terminate did not fit the criteria of VAH. In comparison with the non-PICA-terminate group, the diameter in PICA-terminate VA was smaller ( $3.0 \pm 0.5$  mm v.s  $3.7 \pm 0.7$  mm,  $p < 0.0001$ ); mean velocity was lower ( $164 \pm 88$  mm/sec v.s  $241 \pm 100$  mm/sec,  $p < 0.01$ ); pulsatility index of VA was higher ( $1.87 \pm 0.55$  v.s  $1.32 \pm 0.52$ ,  $p < 0.0001$ ); and flow volume was lower ( $1.21 \pm 0.83$  ml/min v.s  $2.76 \pm 1.64$  ml/min,  $p < 0.0001$ ). Moreover, the diameters of basilar artery and left PCA were smaller in in PICA-terminate group ( $2.52 \pm 0.89$  vs.  $3.18 \pm 0.49$  mm,  $p = 0.0036$  and  $1.57 \pm 0.07$  mm vs.  $1.96 \pm 0.07$  mm,  $p = 0.0064$  respectively).

**Conclusion:** The fact that prevalence of PICA-terminate was high in patient group reflects it is not a merely normal variation. PICA-terminate VA has detrimental impact on the cerebral hemodynamics.

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## P099

### Tuberculous Meningitis Complicated with Hemorrhagic Infarction: A Case Report

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**Background and Rationale:** The largest number of Tuberculosis (TB) cases are found in Southeast Asia, Western Pacific, and African regions.<sup>12</sup> In the Philippines, Tuberculosis ranks sixth among the top causes of morbidity and mortality.<sup>2</sup> Tuberculous meningitis accounts for 28.9% of all cases of primary CNS infections in the country, with a case fatality rate of 20%.<sup>2</sup> Stroke is a dangerous complication of tuberculous meningitis.<sup>1</sup> It is the purpose of this paper to present a seemingly rare complication.

**Methods:** We present a 43-year-old woman with Tuberculous Meningitis who developed hemorrhagic infarction and underwent autopsy.

**Results:** A 43 year old housewife, no known co-morbidities, was referred to our institution due to 3-week history of headache, fever, vomiting and confusion. Examination revealed oculomotor nerve palsy and nuchal rigidity. Cranial CT scan showed left basal ganglia infarct with communicating hydrocephalus. CSF study revealed pleocytosis, lymphocytic predominance, elevated pro-

tein and decreased glucose. Anti-Kochs and dexamethasone were started. On the 3rd hospital day, she had decreased sensorium, anisocoria and decrebration. Repeat scan revealed left basal ganglia hemorrhagic transformation with intraventricular extension. She expired on the 4th hospital day. Autopsy revealed exudates at the base of the brain and gray matter infarct stippled with areas of hemorrhage. Histology showed meningeal lymphocytic infiltrates and Langhans giant cells. Arteries showed fibrinoid necrosis of the vessel walls, with lymphocytic infiltrates suggestive of vasculitis.

**Conclusion:** Tuberculous Meningitis has a high mortality and morbidity. Although the simultaneous presence of meningitis and hemorrhagic infarction is rare, prompt identification and treatment of each is essential to maximize the outcome.

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## P100

### Reversible Cerebral Vasoconstriction Syndrome Triggered by Intra-Operative Co-Phenylcaine Forte®: Case Report and Literature Review

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**Background and Rationale:** Reversible cerebral vasoconstriction syndrome (RCVS) is a clinico-radiological diagnosis with an underlying pathophysiology related to dysfunction of cerebrovascular tone (Ducros et al).

**Methods:** We describe a case of RCVS four days post tracheal balloon dilatation surgery with use of intra-nasal Co-phenylcaine forte® (Lignocaine 5% and Phenylephrine 0.5%). Vasoactive substances are well known triggers of RCVS (Ducros et al). Intra-operative administration of intra-nasal Co-phenylcaine forte® likely leading to RCVS has not been previously described to our knowledge.

**Results:** A 61 year old female presented 4 days after operative tracheal balloon dilatation with recurrent thunderclap headaches associated with Valsalva manoeuvre. Subsequently the patient developed cognitive deficits followed by focal neurological deficits associated with areas of watershed infarction on MRI and minor subarachnoid haemorrhage. Formal cerebral angiography revealed minor blood vessel abnormalities in the distribution of the right middle cerebral artery. Prednisolone was commenced and the patient was given a single pulse of IV cyclophosphamide for presumed cerebral vasculitis.

Extensive drug history revealed use of Co-Phenylcaine Forte® intra-operatively. A diagnosis of RCVS was made based on the clinical and radiological findings. Prednisolone was ceased and the patient improved without further clinical intervention. A literature review performed revealed 9 other case reports with varying association between phenylephrine and RCVS.

**Conclusion:** This case highlights the importance of extensive drug history for RCVS triggers extending into drugs used during operations by surgeons and anaesthetists for patients with recurrent thunderclap headaches.

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## P101

### Clinical Usefulness of Ankle Brachial Index and Brachial-Ankle Pulse Wave Velocity in Patients with Ischemic Stroke

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**Background and Rationale:** Ankle brachial index (ABI) and brachial-ankle pulse wave velocity (baPWV) are widely used noninvasive modalities to evaluate atherosclerosis. Recently, evidence supporting the use of ABI and baPWV as markers of cerebrovascular disease has increased. This study sought to examine the relationship between ABI and baPWV with ischemic stroke. And this study also aimed to determine which pathogenic mechanism, large artery disease (LAD) or small vessel disease (SVD), is related to ABI or baPWV.

**Methods:** Retrospectively, 119 patients with ischemic stroke and 40 subjects with no obvious ischemic stroke history were re-

cruited. First, ABI and baPWV were compared between the groups. Then, within the stroke group, the relevance of ABI and baPWV with regard to SVD and LAD, which was classified by brain magnetic resonance image (MRI) and magnetic resonance angiography (MRA) or computed tomography angiography (CTA) findings, was assessed.

**Results:** The baPWV was higher in the stroke group than non-stroke group ( $1944.18 \pm 416.6$  cm/s vs.  $1749.76 \pm 669.6$  cm/s,  $p = 0.0079$ ). Regarding LAD, we found that mean ABI value was lower in the group with extracranial large artery stenosis ( $p = 0.005$ ) and there was an inverse linear correlation between ABI and the grade of extracranial large artery stenosis ( $p = 0.001$ ). For SVD, there was a significant correlation between SVD and baPWV ( $2057.6 \pm 456.57$  cm/s in SVD(+) group vs.  $1491 \pm 271.62$  cm/s in SVD(-) group;  $p = 0.001$ ). However, the grade of the abnormalities detected in SVD did not correlate linearly with the baPWV value.

**Conclusion:** These findings show that baPWV is a reliable surrogate marker of ischemic stroke. Furthermore, baPWV and ABI can be used to indicate the presence of small vessel disease and large arterial disease respectively.

## P102

### Branch Atheromatous Disease in the Saiseikai Stroke Database

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**Background and Rationale:** Branch Atheromatous Disease (BAD) refers to infarcts caused by occlusions at the origin or proximal portion of the perforators (Caplan, 1989). In lenticulostriate artery territory (LSA), BAD is larger than 20 mm along the perforator. In paramedian pontine artery territory (PPI), BAD has a characteristic shape that extends to the base of the pons. In Japan, BAD is a common subtype of infarct. Using data from a large Japanese stroke database, the features of BAD are analyzed.

**Methods:** Twenty-five Saiseikai hospitals in Japan prospectively registered acute stroke patients within 7 days of onset in the Saiseikai Stroke Database. Using this database, the background and the clinical outcomes of BAD were evaluated.

**Results:** Of the 2658 ischemic stroke patients, 216 (8.1%) were diagnosed with BAD. The distribution of BAD was 74% in the LSA and 26% in the PPI. The patients with BAD had the following characteristics and medical background:  $73.4 \pm 12.9$  years of age, hypertension 71.4%, dyslipidemia 47.9%, and diabetes mellitus 26.3% which was similar to the background in atherothrombotic (ATI) and lacunar (LI) infarction. Previous TIA/ischemic stroke had occurred 22.1% of patients, which was less than that in AT and LI patients. The percentage of patients with disturbance of conscious at admission was similar to that in LI. BAD patients showed worse modified Rankin Scale values at discharge and longer hospital stays compared with ATI and LI patients. Dia-

betes mellitus was more prevalent in patients with BAD in the PPI compared with those with BAD in the LSA (36.4% vs. 23.1%).

**Conclusion:** BAD is common in Japanese stroke patients. The medical backgrounds of BAD patients were similar to those of patients with other thrombotic infarctions, except in the case previous stroke, the prevalence of which was lower in BAD patients. Diabetes mellitus was more common in patients with BAD in the PPI than in those with BAD in the LSA. The clinical outcome of BAD was worse than those of other thrombotic infarctions.

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## P103

### Recurrent Posterior Circulation Infarct Secondary Symptomatic Intracranial Vessel Stenosis: The Role of Stenting

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**Background and Rationale:** 50 year old chinese male, background history of hypertension and dyslipidemia, had recurrent posterior circulation infarct secondary symptomatic intracranial vessel stenosis in July and November 2014 with successful thrombectomy respectively.

**Methods:** The patient was admitted for recurrent posterior circulation stroke In July and november 2014, On both admission, MRI brain showed new posterior circulation ischaemic strokes and MRA showed complete lack of flow signal of posterior intracranial vessel.

The patient underwent successful thrombectomy on both admissions, clinically improved subsequently. Dual antiplatelet were initiated on second admission and planned for outpatient stenting.

The patient was admitted for recurrent posterior circulation stroke In July and November 2014, On both admissions, MRI brain showed new posterior circulation ischaemic strokes and MRA showed complete lack of flow signal of vertebrobasilar system. The patient underwent successful thrombectomy on both admissions, clinically improved subsequently. Post thrombectomy MRI showed good restoration of flow in the vertebrobasilar system and bilateral PCAs. Dual antiplatelet were initiated on second admission and planned for outpatient stenting.

**Results:** The patient underwent stenting and angioplasty of basilar artery on 08/01/2015. Post stenting angiography showed good flow. Since then there is no more clinical event.

**Conclusion:** Significant basilar artery stenosis increase risk of recurrent ischemic stroke. This case illustrated that stenting of basilar artery stenosis help to prevent recurrent stroke better than medical therapy alone.

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## P104

### Combined Deficiency of Protein S and Antithrombin Iii in a Patient with Recurrent Deep Vein and Cerebral Sinus Thrombosis

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**Background and Rationale:** Protein S and antithrombin III (AT-III) deficiency are rare blood disorder which can lead to hypercoagulable state and recurrent thromboembolism. However, combined deficiency of protein S and AT-III has rarely been reported.<sup>1,2</sup> We present a case of combined deficiency of protein S and AT-III associated with recurrent deep vein thrombosis (DVT) and cerebral sinus thrombosis (CVT).

**Methods:** Case: A 31-year-old man with a history of smoking presented with severe headache for 3 months. Neurologic examination showed no deficits. Brain MRI showed thrombosis of the straight sinus. Diagnostic cerebral angiography showed obstruction of the right jugular bulb and thrombosis of the right transverse sinus, sigmoid sinus, and torcular herophili. Total protein S antigen was 0.9 mg/dl (normal 1.35–2.41) and protein S activity was 43% (normal 65–140%). AT-III was 27.3% (normal 83–128%) and lupus anticoagulant was positive.

**Results:** He was treated with warfarin and the headaches gradually improved. Thirteen months later, he was readmitted to our hospital because of recurrent CVT. Protein S activity was 50%. Follow-up cerebral angiography showed obstruction of the left sigmoid sinus and jugular bulb. He was then treated warfarin plus aspirin. However, his prothrombin times were maintained between international normalized ratio of 1.11 and 1.17. Four months after his second admission, DVT developed in the right superficial femoral vein and treated by the insertion of an inferior vena cava (IVC) filter. Two months after his third admission, he was readmitted with lower abdominal pain. CT angiography of the abdomen showed DVT extending from the bilateral common femoral vein into just above the level of the IVC filter. And then the patient was transferred to other hospital for further therapy.

**Conclusion:** We report the case of recurrent CVT and DVT, which was probably due to a hypercoagulable state caused by combined deficiency of protein C and AT-III.

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## P105

### An Interesting Case of Eight and a Half Syndrome

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**Background and Rationale:** We present an interesting case of a 49 year old man who was admitted with right sided weakness and visual disturbance.

**Methods:** 49 year old man presented to his local hospital with right sided facial droop, visual disturbance and feeling unsteady while walking. He had a past medical history of type 2 diabetes mellitus. On examination he was noted to have impaired horizontal eye movement on both sides in right eye and impaired adduction of left eye with nystagmus on abduction and lower motor neuron facial nerve weakness on right side. He also had paraesthesia on the left upper and lower limbs. There was no cerebellar signs or any limb weakness.

**Results:** Initial CT brain scan was normal. He subsequently had a MRI brain scan which was normal too. He was transferred from his local hospital to our hospital for further investigation and management. He was reviewed by the neurologist and was given a clinical diagnosis of probable pontine ischaemic stroke. A repeat MRI scan was requested which showed acute pontine infarct which confirmed the diagnosis. The ophthalmoplegia (one and a half syndrome) along with ipsilateral lower motor neuron facial nerve weakness fits with a diagnosis of eight and a half syndrome.

**Conclusion:** Eight and a half syndrome is a combination of one and a half syndrome and lower motor neuron facial nerve palsy. It can be easily missed if we are not aware of this rare syndrome. Being aware of this syndrome will help us in localising the lesion and also in diagnosing it. In our case the initial MRI was reported as normal. It's good practice to review the old scans again or repeat the scan if there is high clinical index of suspicion.

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## P106

### Considerations for the Transfemoral Cerebral Angiography in Patients with the First and Second Decades

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**Background and Rationale:** To investigate the anatomical and technical considerations of the transfemoral cerebral angiography (TFCA) in patients with the first and second decades.

**Methods:** We have done 5,404 TFCA procedures from Jan. 2004 to Dec. 2014. The 166 TFCA which were performed in patients who were under the twenty year old were included in our case series study. We analyzed the demography, diagnosis, anatomical characteristics, anesthesia, catheter type, contrast amount, dye infusion method, hemostasis and complications.

**Results:** Only 3.1% (166/5404) TFCAs were done in 127 patients with the first and second decades. Male to female ratio was 1.2:1. Twenty seven and 139 procedures were performed in the first and second decades, respectively. To perform the TFCA, the first decade required general anesthesia more frequently compare to the second decade (58.8% (10/27), vs. 2.9% (4/139),  $p < 0.05$ ). The final diagnosis of 166 procedures were AVM in 71, moyamoya disease (MMD) in 57, brain tumor in 12, intracerebral hemorrhage in 8, cerebral infarction in 6, subarachnoid hemorrhage in 6, and others in 6. Instead of the internal carotids, the common carotids and external carotid arteries were selected in patients with MMD. The catheters were used; Davis in 123, Headhunter in 42 and another type in remaining patient. Four French diagnostic catheter was used more frequently in first decade than in the second decade (70.3% vs. 10.1%). No catheter angiography related complications were occurred in our series.

**Conclusion:** TFCA is a safe procedure in patients with the first and the second decades. However, the operators may consider the vascular anatomical characteristics of the pediatrics and keep cautions for the catheter diameters, dye amounts, possibility of general anesthesia to perform it without complications.

## P107

### Lipoprotein-Associated Phospholipase A2 in Acute Ischemic Stroke Is Associated with Intracranial Atherosclerosis in Patients with Acute Ischemic Stroke

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**Background and Rationale:** Despite increasing evidence of lipoprotein-associated phospholipase A<sub>2</sub> (Lp-PLA<sub>2</sub>) as a risk factor of ischemic stroke, there is little information about relationship between Lp-PLA<sub>2</sub> and the occurrence of atherosclerotic stroke. We investigated the relationship between Lp-PLA<sub>2</sub> level and the stroke subtype, and the association of Lp-PLA<sub>2</sub>

level with initial stroke severity in patients with acute ischemic stroke.

**Methods:** Lp-PLA<sub>2</sub> levels were measured in 200 patients who were admitted due to first-ever ischemic stroke confirmed by diffusion-weighted MRI, within 7 days of symptom onset. Vascular risk factors, stroke subtypes, and angiographic findings were assessed. Stroke severity was measured by initial national institutes of health stroke scale (NIHSS).

**Results:** Lp-PLA<sub>2</sub> levels of large artery atherosclerotic (LAA) stroke were significantly higher than those of non-LAA stroke ( $208.1 \pm 69.8$  vs.  $165.8 \pm 68.1$ ,  $p < 0.001$ ). After adjustment for confounders, Lp-PLA<sub>2</sub> levels (OR 1.007, 95% CI 1.001–1.012) were significantly associated with the presence of atherosclerotic steno-occlusion. Lp-PLA<sub>2</sub> levels of moderate to severe stroke (initial NIHSS  $\geq 6$ ) were significantly higher than those of mild stroke (mild  $165.6 \pm 60.5$  vs. moderate to severe  $210.2 \pm 85.9$ ,  $p < 0.001$ ).

**Conclusion:** Our study indicates that elevated Lp-PLA<sub>2</sub> levels in the acute stroke setting are associated with LAA stroke, burden of cerebral atherosclerosis, and initial stroke severity.

#### P108

##### The Relation between Intracranial Aneurysm and Coronary Calcium Score

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**Background and Rationale:** Coronary artery disease (CAD) is a risk factor for abdominal aortic aneurysm, but the association with intracranial aneurysm was not clearly known. In this retrospective study we assessed the relationship between intracranial aneurysm and coronary artery disease which was predicted by the coronary calcium score.

**Methods:** Subjects who underwent brain magnetic resonance angiography and cardiac computed tomography as part of a health check-up were enrolled. We investigated the existence of intracranial aneurysm and coronary calcium score. Patients were classified into two groups by the coronary calcium score: under minimal evidence of CAD (calcium score  $< 100$ ) and mild to extensive evidence of CAD (calcium score  $\geq 100$  or history of carotid artery stenosing or coronary artery bypass graft surgery).

**Results:** Among 21,985 subjects who received health check-up, 686 underwent brain MRA and cardiac CT simultaneously. Intracranial aneurysms were found in 27 patients (3.9%). Mild to extensive evidence of coronary artery disease were found 11.7% (79/656) of subjects without intracranial aneurysm and 7.4% (2/27) of subjects with intracranial aneurysm ( $P = 0.758$ ).

**Conclusion:** Coronary artery calcification seems to be not associated with the presence of intracranial cerebral aneurysm.

#### P109

##### Low Flow Velocity Predict Postoperative Infarction after Bypass Surgery in Adult Moyamoya Disease

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**Background and Rationale:** Direct and indirect bypass surgeries are recognized as the most effective treatments for preventing further stroke in adult moyamoya disease (MMD). However, the risk factors of postoperative infarction after bypass surgery for MMD are not well established. The objective of this study was to investigate risk factors of postoperative infarction, especially whether the results of transcranial doppler (TCD) predict postoperative infarction.

**Methods:** Patients with MMD who underwent direct bypass surgery between July 2012 and April 2015 were reviewed. Mean flow velocity (MFV) of the middle cerebral artery (MCA) was measured by transcranial Doppler and categorized as high ( $> 80$  cm/sec), medium (40–80 cm/sec), and low ( $< 40$  cm/sec).

**Results:** Of the 43 enrolled cases, 11 cases showed post revascularization infarction. Ten cases were in the low MFV group and one case was in the medium flow velocity group. Low MFV was associated with post revascularization infarction in both univariate and multivariate analysis (adjusted odds ratio = 109.158, 95% confidence interval 1.908–6245.302). The proportion of low MFV increased with advanced stage of MMD ( $p = 0.002$ ).

**Conclusion:** Low MFV of the ipsilateral MCA may be a predictor of post revascularization infarction. Bypass surgery for MMD appears to be safe in early stage MMD.

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P110

### Imaging Features and Outcomes of Acute Vertebrobasilar Dissection

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**Background and Rationale:** Imaging findings for the improvement of prognosis are not well established in patients with posterior circulation dissection. We aim to identify the vascular imaging features and imaging outcomes of the dissection in patients with acute vertebrobasilar dissection.

**Methods:** Demographic characteristics, putative risk factors, and vascular imaging findings of consecutive patients with vertebrobasilar dissection on baseline vascular images were collected. Imaging findings on the baseline were obtained within 7 days after onset of the ischemic symptoms and/or headache, and follow-up vascular images were performed 6 months or 1 year. We compared the vascular imaging features and the degrees of recovery between baseline and follow-up vascular images.

**Results:** A total of 50 patients who underwent baseline and 6-month or a year vascular imaging were compared for these analyses. The site of a dissection was more common in the intracranial vertebral artery (V4 segment, 48% [34–62%]). The baseline vascular images identified an aneurysm in 42%, stenosis or occlusion in 74% and occlusion in 22%. Follow-up images showed complete improvement of the dissected vessels in 22% (40–96%) and partial or complete improvement in 50% (36–64%). Patients who had an occlusion the baseline images ( $n = 11$ ) had partial or complete resolution in 27% (7–60%), but none of patients showed complete resolution. The odds ratio for complete or partial improvement on the follow-up vascular images from the lesion in the distal vertebral artery (V3 or V4 segment) was 0.20 ([0.06–0.73],  $p = 0.015$ ) and from dyslipidemia was 0.1 ([0.06 to 0.73],  $p = 0.044$ ) by the multivariate analysis including age, gender, and lesion in the posterior inferior cerebellar artery.

**Conclusion:** The rate of complete or partial recanalization on the 6-month or 1-year follow-up images was over 50% in patients with vertebrobasilar dissection. Dyslipidemia and distal vertebral arterial dissection are poor prognostic factors for the recovery of the vascular lesion after vertebrobasilar dissection.

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P111

### Intracranial Arterial Stenosis and Related Clinical Risk Factors in Acute Stroke Patients

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**Background and Rationale:** Intracranial arterial stenosis are relatively common findings of stroke patients in Asia area. We reviewed stroke database to investigate clinical risk factors related to intracranial arterial stenosis, including carotid disease, and peripheral arterial disease which reflects advanced atherosclerosis.

**Methods:** Acute stroke patients at the National Health Insurance Corporation Ilsan Hospital from January 2012 to December 2014 with available transcranial Doppler (TCD) examination, carotid ultrasound and ankle-brachial indexes (ABI) formed the analysis cohorts. Retrospective review was performed.

**Results:** A total of 642 patients were included during that period, 212 patients with incomplete TCD study due to poor insonation windows were excluded (33%). According to TCD criteria, 3 groups of intracranial arterial stenosis are defined: 0 vessel stenosis is in 220 patients (51%), 1–2 vessels in 125 patients (29%), more than 3 vessels in 85 patients (20%). As the arterial number of intracranial stenosis increased, ABI is decreased ( $P = 0.013$ ) and the size of carotid artery plaque is increased ( $P = 0.011$ ). Among the risk factors, Diabetes, age, past stroke history are increased ( $P = 0.0000$ ,  $P = 0.006$ ,  $P = 0.05$ ) and HDL cholesterol showed tendency of decrease ( $P = 0.033$ ). However hypertension, smoking, total cholesterol, LDL cholesterol, triglyceride and sex are not correlated with intracranial arterial stenosis.

**Conclusion:** Among the acute stroke patients, about a half of them have intracranial arterial stenosis and these patients tend to have higher burden of advanced atherosclerosis as evidenced by a higher prevalence of Diabetes, large sized plaques of carotid artery and peripheral arterial occlusive disease.

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P112

### Experience of Protocol-Based Treatment Decision for Carotid Artery Stenosis

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**Background and Rationale:** There are two established interventional treatment options for carotid artery stenosis. Both carotid endarterectomy (CEA) and carotid artery stenting (CAS) have been used in case of severe arterial stenosis based on the guideline. Each treatment option has advantages and disadvantages for the treatment outcomes. We developed a protocol for selection of a proper treatment option for carotid artery stenosis and validate it in clinical practice.

**Methods:** A total of 192 published articles on management of carotid artery stenosis were reviewed. Preoperatively considerable factors which had been repeatedly noted in those articles for the risk/benefits of CEA or CAS were selected. According to these selected factors, a protocol with four categories was established.

**Results:** CEA or CAS is indicated when the patient has a symptomatic stenosis  $\geq 50\%$ , or when the patient has an asymptomatic stenosis  $\geq 80\%$ . Each treatment option has absolute indications and favorable indications. Each absolute indication is scored with three points, and each favorable indication, one point. Based on the highest scores, a proper treatment option (CEA or CAS) is decided. From October 2013 to December 2015, total 43 patients were treated by this protocol, 12 CEA and 31 CAS.

**Conclusion:** CEA This protocol is feasible in clinical practice and might be helpful in assessing the risk/benefit for each treatment option in patients with carotid artery stenosis. More experience will be needed to analyze the result and refine this protocol.

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P114

### Clinical Utility of an Automated Pupillometer in Patients with Acute Brain Lesion

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**Background and Rationale:** The purpose of this study was to evaluate the clinical utility and validity of using a pupillometer to assess patients with acute brain lesions.

**Methods:** Pupillary examinations using an automated pupillometer (NeuroOptics®NPi™-100 Pupillometer) were performed every 4 hours and were simultaneously assessed using the Glasgow coma scale (GCS) and for intracranial pressure (ICP), when possible. Manual pupillary examinations were also recorded for comparison. By comparing these data, we evaluated the validity of using automated pupillometers to predict clinical outcomes.

**Results:** The mean values of the Neurologic Pupillary index (NPi) were different in the groups examined manually. The GCS correlated well with NPi values, especially in severe brain injury patients (GCS below 9[오전1]). However, the NPi values were weakly correlated with intracranial pressure (ICP) when the ICP was lower than 30 cm H<sub>2</sub>O. The NPi value was not affected by age or intensity of illumination. In patients with a 'poor' prognosis who had a Glasgow outcome scale (GOS) of 1 or 2, the mean initial NPi score was  $0.88 \pm 1.68$ , whereas the value was  $3.89 \pm 0.97$  in patients with a 'favorable' prognosis who had a GCS greater than 2 ( $p < 0.001$ ). For predicting clinical outcomes, the initial NPi value of 3.4 had the highest sensitivity and specificity.

**Conclusion:** An automated pupillometer can serve as a simple and useful tool for the accurate measurement of pupillary reactivity in patients with acute brain lesions.

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P115

### Long-Term Outcome Following Lesion-Specific Wingspan-Stent Treatment for Intracranial Arterial Diseases

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**Background and Rationale:** Clinical and angiographic outcome (CAO) following balloon angioplasty (bA) for an intracranial artery stenosis (iAS) depends on its angiographic characteristics. Mori's type B or C lesions are refractory to bA, because abrupt occlusion or restenosis after pBA is anticipated. The aim of this study was to investigate if Wingspan-stent treatment (W-st) can improve CAO of type B or C lesions.

**Methods:** Included were patients who underwent elective W-st for symptomatic intracranial type B or C lesions between July and November 2014. Evaluated were success rate, procedural complications, angiographic restenosis (aR) rate at 3 months after stenting, recurrent ischemic symptoms (riS) within 6 months or repeat bA or stenting rate within 6 months.

**Results:** Seven patients matched our criteria. Two patients underwent W-st for the middle cerebral artery (MCA), three for the intracranial carotid artery (ICA) and two for the vertebro-basilar artery (VBA). Four patients had type B and three patients type C lesions. All patients underwent transbrachial W-st. Gateway balloon in 6 cases and Shiden in one case were used for initial dilatation. Successful W-st was achieved in all cases. No procedural complications occurred. Asymptomatic aR occurred in 4 cases (57%), but no riS. No repeat angioplasty was done.

**Conclusion:** Wingspan provided safe dilatation even in type B or C lesions and prevented riS. However, asymptomatic restenosis remains problematic.

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## P116

### Homocysteine Is Associated with Cerebral Artery Stenosis and Calcification

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**Background and Rationale:** Elevated serum homocysteine level is known to be associated with increased risk of vascular event due to endothelial senescence. We investigated the association between homocysteine level and cerebral artery stenosis and calcification.

**Methods:** We identified 1193 consecutive patients (mean age =  $68.6 \pm 12.7$ , 537 female patients) who were admitted with acute cerebral infarction or transient ischemic attack. Cerebral artery calcification was assessed in the cavernous portion of both internal carotid arteries and intracranial arterial stenosis burden was derived as the sum of stenosis degree of major intracranial arteries on brain CT angiography. The patients were categorized into three groups according to serum homocysteine level.

**Results:** The mean homocysteine level was  $14.1 \pm 6.2 \mu\text{mol/L}$ , and intracranial cerebral artery calcification was present in 974 patients (81.6%) with 339 advanced calcification (28.4%). Intracranial cerebral arterial stenosis was detected in 819 (68.7%). The prevalence of cerebral artery calcification, advanced cerebral artery calcification and intracranial arterial stenosis burden showed increasing tendency throughout homocysteine tertile. Multivariate logistic regression analysis showed that the highest serum homocysteine tertile was an independent factor predicting advanced cerebral artery calcification (odds ratio = 1.47, confidence interval = 1.04–2.07) and advanced intracranial atherosclerosis (odds ratio = 1.50, confidence interval = 1.08–2.08) than the lowest group.

**Conclusion:** Elevated serum homocysteine level was independently associated with intracranial cerebral arterial calcification and stenosis burden.

## P117

### Epilepsy Associated with Increased Risk of Stroke: Analysis of the Tasmanian Epilepsy Register

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**Background and Rationale:** Recent data indicate that epilepsy is associated with an increased risk of stroke. However, there is limited understanding of the underlying pathophysiological processes. In this study, data from the Tasmanian Epilepsy Register (TER) were analysed in order to further characterise associations between seizures and stroke.

**Methods:** TER is a unique dataset compiled from a community-based cohort of patients with treated epilepsy. Cases were ascertained from the Australian National Prescription Database between July 2001 and June 2002 and methods have been previously reported.<sup>1</sup> Residents supplied antiepileptic medication for 'blank spells, seizures or epilepsy' were invited to participate. Stroke and seizure occurrence were reported by both patients and witnesses. Seizure classification was determined by an epileptologist, using standardised validated criteria. Proportion denominators were censored for missing data with confidence intervals obtained using Wilson's method.

**Results:** Data were available for 997 registry participants (male:50.4%, mean age:  $44.9 \pm 19.7$ ). Stroke was reported by 13.7% of participants (95% CI 11.4–16.4%; witness agreement  $\kappa = 0.66$ ). In participants with stroke, a pre-stroke diagnosis of epilepsy was reported in 39/90 (43.3%; 33.6–53.6%). Median age of first seizure in those with pre-stroke epilepsy was 21 (IQR 12–44) with median age of stroke lower than the national average (51; 44–59). Idiopathic Generalised Epilepsy (IGE) was diagnosed in 8/39 (20.5%; 10.8–35.3%). There was no difference in stroke incidence or age of stroke for participants with IGE compared with non-IGE. Overall incidence of diabetes in TER was 6.4% (4.8–8.4%). Incidence of diabetes was higher in pre-stroke epilepsy participants (15.4%; 7.2–29.7%) than those without stroke (5.1%; 3.6–7.2%;  $p < 0.001$ ) but similar to those with post-stroke seizures (14.0%; 7.0–26.2%).

**Conclusion:** This is the first community based study to evaluate the association between seizures and stroke. In TER, Stroke occurred at a younger age and higher frequency than expected. Epilepsy is associated with an increased risk of early lifetime stroke and may represent a modifiable risk factor.

## Reference:

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P118

### The Best Treatment in the Cerebrovascular Atherosclerosis: A Point of Debate

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**Background and Rationale:** Atherosclerotic stenosis of the major intracranial arteries is the most common cause of ischemic stroke worldwide and seems to have a more role in the Asian and Iranian patients. The risk of recurrent cerebrovascular accident is high in these patients and the method of choice for secondary stroke prevention for them remains a point of debates.

**Methods:** In the current review, the latest and Influential articles about this topic were reviewed. Three major strategies are evaluating for this concept: Aggressive medical management of vascular risk factors, endovascular management of intracranial stenosis and surgical approaches.

**Results:** Most studies revealed a higher incidence of intracranial atherosclerosis in Asians and African Americans compared with white Americans (33–57% vs. 1–11%). Aggressive management of vascular risk factors might substantially reduce the risk of stroke in these patients. Also Aggressive medical therapy using dual antiplatelet drugs, is safe and effective for most high risk patients with symptomatic significant stenosis, but the role of endovascular and surgical therapies still remain uncertain.

**Conclusion:** Although some of the recent studies are trying to suggest a more effective bench for endovascular approaches in symptomatic intracranial arterial stenosis but current evidences weight on aggressive medical treatment of these patients. Further studies are needed to find the better approaches.

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P119

### Relationship between Carotid Plaque Surface Regularities and Stroke Risk Factors in Patients with Acute Ischemic Stroke

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**Background and Rationale:** The presence of atherosclerotic carotid plaque is a well-established risk factor for ischemic stroke. Irregular or ulcerated plaque surface morphology has also been correlated with advancing stenosis and is independently associated with ischemic stroke. The purpose of this study was to evaluate the relationship between plaque surface irregularities in the extracranial carotid artery measured by B-mode ultrasound, risk factors, and the stroke prognosis in patients with acute ischemic stroke.

**Methods:** Extracranial carotid plaque irregularities were evaluated bilaterally with B-mode ultrasonography in 98 patients

who visited Chungbuk National University Hospital due to acute ischemic stroke from September 1, 2013 to August 30, 2014. The correlation between carotid plaque irregularities, risk factors for ischemic stroke, and 90-day functional outcome was assessed.

**Results:** Among the 98 patients, 34 had irregular carotid plaques, and 64 had smooth plaques. The irregular group was older ( $p < 0.001$ ) and had a higher incidence of hypertension ( $p = 0.030$ ) and higher blood glucose levels ( $p = 0.046$ ) than those in the smooth group. The 90-day modified Rankin scale scores for the irregular and smooth groups were  $1.3 \pm 1.3$  and  $0.9 \pm 1.0$  ( $p = 0.136$ ).

**Conclusion:** Our results show that surface carotid plaque irregularities measured by ultrasound are associated with older age, hypertension, and blood glucose levels among the stroke risk factors. However, carotid artery surface irregularities did not affect 90-day functional outcome compared to that of a smooth carotid artery surface.

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P120

### Asymmetric Skin Temperature after a Pure Motor Stroke

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**Background and Rationale:** Vasomotor changes and sympathetic dysfunction may occur after acute ischemic stroke. Some patients complain of distressing coldness of the hemiplegic arm and leg, and most of them had a hemispheric or brain stem infarction.

**Methods:** Here, we report a patient with acute hemiparesis and decreased skin temperature after basal ganglia infarction. 62-year-old man suddenly developed dysarthria and right-sided hemiparesis. He did not have any significant medical histories. On admission, his vital signs were stable. Neurologic examination demonstrated a central type facial palsy on the right side and grade 3 and 4 weakness of the right upper and lower extremities, respectively. Initial NIH stroke scale was 5.

**Results:** Brain MRI with diffusion-weighted image (DWI) showed an acute lacunar infarction involving basal ganglia, and no vascular abnormality was seen in MRA. Two days after onset, he also felt coolness in his right hemibody, especially in right hand. He did not have any somatosensory dysfunction consisting of light touch, pain, thermal sensation, and position and vibration sense. Skin temperatures in both side were measured at rest, and the temperature on the right arm was only decreased to 35.7°C. Infrared thermography showed a decrease (about 2°C) in the skin temperature of the right hemibody rather than opposite side, especially in arm and leg. As his motor power was improved, his feeling coolness of right hemibody was slowly improved together. The difference of temperatures between both sides was slightly decreased after 2 weeks.

**Conclusion:** A decrease in the subcortical inhibitory effect on the vasomotor neurons can result in increased vasoconstrictor tone with decreased cutaneous blood flow and skin temperature on the side opposite to the infarction.

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## P121

### Spatial Distribution of Middle Cerebral Artery Plaque and Its Relevance with Infarction Pattern: A High-Resolution MRI Study

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**Background and Rationale:** The role of intracranial artery morphology in stroke pathophysiology is largely unknown. This study aimed to demonstrate the relationship between the plaque spatial distribution and morphology of middle cerebral artery (MCA) M1 segment (M1), and their clinical relevance.

**Methods:** Consecutive patients with MCA territory stroke within 1 month were collected from 2009 to 2014. On high-resolution magnetic resonance imaging (HRMRI), the plaque distribution was recorded as one or multiple quadrants that a plaque involved the M1 (Xu et al. 2011, Li et al. 2009). The M1 shape was classified into straight, single curve and double curve (Kim et al. 2015). The M1 curve direction was determined by the direction of the inner wall of a single curve. The quadrant consistency was evaluated by whether the plaque and direction of the curved M1 shared the same quadrant. The location of infarct lesion in relation to plaque (medial, lateral and undifferentiated type) was assessed on sagittal HRMRI images (Marinkovic et al. 1985).

**Results:** One hundred and three patients were analysed in this study. The plaque distribution was consistent with the M1 curve direction ( $P < 0.05$ ). The M1 curve direction was the independent predict factor of the plaque distribution ( $P < 0.05$ ). The infarct pattern (penetrating artery infarction vs. embolic infarction) was associated with the location of infarct lesion in relation to plaque, infarct lesion volume and plaque length ( $P < 0.01$ ). Only the loca-

tion of infarct lesion in relation to plaque was the independent predict factor for infarct patterns ( $P < 0.05$ ).

**Conclusion:** The M1 shape and direction play an important role in the plaque distribution and stroke mechanisms.

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## Basic Sciences

## P122

### Exercise Improves Learning and Increases Neurogenesis after an Endothelin-1-Induced Hippocampal Stroke in Adult Mouse

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**Background and Rationale:** Smaller hippocampal volume in humans with cortical or subcortical lesions is associated with impaired cognition (Blum et al., 2012, Schaapsmeeders et al., 2015). Hippocampal neurogenesis continues throughout life. Reduced neurogenesis is associated with impaired cognition, whereas exercise stimulates neurogenesis and improves learning in aged animals. The impact of exercise-induced neurogenesis on cognitive functions following stroke is uncertain (Yagita et al., 2006, Luo et al., 2007).

**Methods:** Mice underwent unilateral intrahippocampal injection of the vasoconstrictor Endothelin-1 to induce stroke, followed by 21 days of free access to a running wheel. Exercise-induced neurogenesis was disrupted by ablating immature neurons in a cohort of animals using a transgenic approach at the end of the running period. Spatial learning was tested before and after stroke, and again after running, using the hippocampal-dependent Active Place Avoidance (APA) task. Immunohistochemistry and cell counts were performed to evaluate levels of neurogenesis.

**Results:** Endothelin-1-induced stroke resulted in a localised hippocampal lesion with damage primarily to the dentate gyrus, reduced numbers of immature neurons, and an observable spatial learning deficit in APA. Post-stroke voluntary running resulted in

increased levels of neurogenesis and improved APA learning performance when compared to stroked animals that did not run. Furthermore, systemic ablation of the immature neurons arising following running prevented this exercise-induced cognitive recovery.

**Conclusion:** Voluntary running following hippocampal stroke improves cognitive recovery and this is dependent on increased neurogenesis.

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## P123

### Prefrontal Cortex Stroke Disrupts Cholinergic Pathways and Impairs Learning

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**Background and Rationale:** Cholinergic pathways have been shown to play a critical role in visual attention tasks and motor learning. Furthermore, disruption in cholinergic signaling has been linked to both dementia and impaired stroke recovery. We have recently reported that stroke to the prefrontal cortex (PFC) results in delayed onset impairment in spatial memory<sup>1</sup> similar to what is observed in human stroke patients.

**Methods:** Focal cerebral ischemia was induced in 3-month old C57Bl/6J male mice using photothrombotic stroke (PT; 22-minutes light exposure). Using this model of stroke, we aimed to further investigate the extent of cognitive impairments using the reaching task (separate cohorts tested at either 1 or 4 weeks post-stroke) for motor learning and the five-choice serial reaction time task (5-CSRTT) for assessing visual attention using operant-based touchscreens. For assessment on the 5-CSRTT all mice were pre-trained down to baseline (1.4sec) before being randomly assigned to either stroke or sham surgery. Following surgery, animals were exposed to different probe variables (1) delaying when the image is displayed (inter-trial interval: 1, 3, 5, 7 or 9sec), (2) changing how long the image is displayed (altered stimulus duration: 0.4, 0.8, 1, 1.4 or 1.8sec) or (3) displaying the image in the presence of a white noise distractor (distractor).

**Results:** Assessment of mice following PFC stroke revealed a significant and progressive impairment in motor learning on the reaching task at 1 and 4-weeks post-stroke ( $P \leq 0.05$ ;  $n = 15$  per treatment group). In addition, data from the 5-CSRTT indicated that the PFC-stroke mice were not visually impaired yet they displayed significant impairments in accuracy for all 5-CSRTT paradigms (distractor, altered stimulus duration and inter-trial interval) tested ( $n = 11$  per treatment group).

**Conclusion:** As motor learning and visual attention requires intact cholinergic signaling, we hypothesize that a disruption in cholinergic signaling is contributing to these impairments. Therefore, further studies are currently investigating changes in cholinergic cell populations and fibre densities. We suggest that this model will lead to a better understanding of stroke-induced cognitive impairments and can be used to investigate therapeutic interventions for translation into the clinic.

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## P124

### Mitochondria-ROS Threshold Distinguishes Vascular Occlusion from Chemotoxicity Induced Oxidative Stress

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**Background and Rationale:** Production of reactive oxygen species is a major effect of cyanide toxicity (CN) and vascular occlusion (VO). In cyanide toxicity, oxygen is present but its conversion is blocked in the mitochondria, while in vascular occlusion, oxidative stress is induced via reduction of oxygen-blood circulation to the occluded brain region. We hypothesize that differential oxygen concentration in both forms of ischemia affect ROS production rate in the mitochondria thus distinguishing the cytotoxicity pattern.

**Methods:** Male, adult Wistar rats ( $N = 30$ ) were separated into three groups. A set of  $n = 12$  animals were treated with orally administered potassium ferricyanide. Global vascular occlusion was induced in a second set of animals ( $n = 12$ ) using neck cuffs to occlude the common carotid arteries and brachiocephalic vein. The control group ( $n = 6$ ) received normal saline for the total duration of the treatment (10 days). Glutathione (GSH), superoxide dismutase (SOD), glutathione peroxidase (GPx), malondialdehyde (MDA) and acid phosphatase (ACP) levels were assayed in tissue homogenate using colorimetric techniques while cathepsin D

(CAD+) was demonstrated by antigen retrieval immunohistochemistry. Statistical analysis was done in ANOVA with significance set  $*P < 0.05$ .

**Results:** Cyanide treatment and vascular occlusion recorded a significant rise in SOD. This confirms that ROS formation is involved in both forms of ischemia. However, an increase in GSH levels demonstrates *mitochondria-ROS* production in cyanide treatment while no significant change in GSH was observed in vascular occlusion versus the control (reduced mitochondria-ROS production). In addition, CN recorded a significant increase in GSH when compared with the control and VO ( $P < 0.001^{***}$ ). The level of ROS also correlated with the degree of lipid peroxidation (GPx) and autophagic cell response (ACP/CAD+) and was more significant in cyanide toxicity than vascular occlusion.

**Conclusion:** Although cyanide toxicity and vascular occlusion involves the induction of oxidation stress and ROS production. Findings suggest a difference in the threshold of ROS production and cytotoxicity for both forms of ischemia. In addition, this threshold is dependent on the availability of oxygen to fuel mitochondria-ROS production in oxidative stress. Finally, such availability determines the significance of lipid peroxidation, calcium-shift and autophagic cell response associated with the ischemia.

#### P125

##### **CXCL14 Promotes Regulatory T Cell-Mediated Neuroprotection in Stroke**

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**Background and Rationale:** Inflammatory processes have a detrimental role in the pathophysiology of ischemic stroke. However, little is known about the endogenous anti-inflammatory mechanisms in ischemic brain.

**Methods:** Here, we identify CXCL14 as a critical mediator of these mechanisms. CXCL14 levels were upregulated in the ischemic brains of humans and rodents. Moreover, hypoxia inducible factor-1 $\alpha$  (HIF-1 $\alpha$ ) drives hypoxia- or cerebral ischemia (CI)-dependent CXCL14 expression via directly binding to the CXCL14 promoter. Depletion of CXCL14 inhibited the accumulation of dendritic cell precursors (DCPs) or regulatory T cells (Tregs) and increased the infarct volume, whereas the supplementation of CXCL14 had the opposite effects. CXCL14 promoted the adhesion, migration, and homing of circulating CD11c<sup>+</sup> DCPs to the ischemic tissue via the upregulation of the cellular prion protein (PrP<sup>C</sup>), PECAM-1, and MMPs.

**Results:** The accumulation of Tregs in ischemic areas of the brain was mediated through a cooperative effect of CXCL14 and DCP-secreted IL-2-induced Treg differentiation. Interestingly, CXCL14 largely promoted IL-2-induced Treg differentiation.

**Conclusion:** These findings indicate that CXCL14 is a critical immunomodulator involved in the stroke-induced inflamma-

tory reaction. Passive CXCL14 supplementation provides a tractable path for clinical translation in the improvement of stroke-induced neuroinflammation.

#### P126

##### **Glycated ApoA1 on High-Density Lipoprotein Is Highly Expressed in Stroke Patients**

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**Background and Rationale:** The Glycation of ApoA1 on HDL can cause inflammation through the receptor for advanced glycation endproducts (RAGE) to increase neutrophil infiltration. Furthermore, glycated ApoA1 can impair cholesterol efflux and leads to cholesterol plaque accumulation. In this study we investigated the glycated ApoA1 and lipoprotein compositions on HDL in stroke subjects and other disease controls to find HDL-associated biomarkers for stroke.

**Methods:** Plasma samples from healthy (n = 50), diabetes (n = 50), hyperlipidemia (n = 50), uremia (n = 50), chronic stroke and acute stroke subjects (n = 100) were collected. HDL was purified with salt density ultracentrifugation. The glycation level and lipoprotein expression were analyzed with Bis-Tris gradient gel, nanoLC-MS/MS (nanoflow liquid chromatography-tandem mass spectrometry) and MALDI-TOF (matrix-assisted laser desorption/ionization-time of flight).

**Results:** The expression levels of major lipoproteins on HDL were analyzed with intact protein profiling and proteomics strategy. The results showed that the expression level of major lipoproteins are similar among all disease groups. Based on the Bis-Tris gradient gel analysis and MS analysis, uremia and chronic/acute stroke subjects displayed more intense glycated-ApoA1 bands compared to healthy, diabetes, and hyperlipidemia subjects. The glycated sites were found to be at VSFSALEEYTK(238)K or QLNK(45)LLDNWDSVTSTFSK.

**Conclusion:** Lipoprotein composition on HDL may not altered significantly and specifically to stroke disease. However, we found that glycated ApoA1 on HDL is specifically appeared in stroke and uremia (easily developed to atherosclerosis) and may be used to evaluate HDL dysfunction, atherosclerosis development and stroke risk.

## Are the Anomalous Vertebral Arteries More Hypoplastic? Analysis of CT and 3-Dimensional MR Angiography

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**Background and Rationale:** To assess whether various types of anomaly of the vertebral artery (VA) contribute to its diameter.

**Methods:** This was a retrospective analysis of patients who underwent neck computed tomography (CT) and magnetic resonance (MR) angiography within 1 month. A V1 anomaly was defined as the abnormal origin of the VA on a three-dimensional MR angiogram and a V2 anomaly was defined as the VA not passing through the C6 transverse foramen on an axial CT image. A linear mixed model was used to evaluate the determinants of VA size with the side of the VA as a within-subject variable.

**Results:** The present study included 238 patients; 24 (10.1%) exhibited an anomalous VA and, of the 476 VAs examined, 11 (2.3%) had an aortic origin and 27 (5.7%) had an abnormal entrance into the C6 transverse foramen. The V1 anomaly was positively associated with the V2 anomaly (chi-squared test,  $p < 0.001$ ) and a linear mixed model revealed that being male (0.2 mm larger,  $p = 0.015$ ), having a right VA anomaly (0.4 mm smaller,  $p < 0.001$ ), having a V1 anomaly (0.9 mm smaller,  $p < 0.001$ ), and having a V2 anomaly (0.8 mm smaller,  $p < 0.001$ ) were significant determinants of VA diameter.

**Conclusion:** The diameters of VAs with an anomalous aortic origin or a transverse foramen were significantly smaller than those of normal VAs. These findings suggest that anomalies of the VA on CT and MR angiograms may aid in the definition of VA hypoplasia (VAH).

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## Detection of Abnormal Cerebral Hemodynamic Change by Intravoxel Incoherent Motion (IVIM) Analysis in Bilateral Carotid Artery Occlusion (BCAO) Rat

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**Background and Rationale:** Cerebral blood volume (CBV) elevation is deeply associated with development of ischemic events in chronic ischemic patients (Kuroda et al 2006). Diffusion MRI (DWI) can quantify CBV as a volume fraction  $f_{ivim}$  of perfusion compartment in intravoxel incoherent motion (IVIM) as well water diffusivity in the brain (Le Bihan et al 1988). Here, we investigated whether IVIM-DWI could detect hemodynamic changes in a rat after bilateral carotid artery occlusion (BCAO) including nearly ‘misery perfusion’.

**Methods:** We performed surgical treatment to 10 Wistar rats (3 females, 7–9 week-old, initial body weight =  $178.4 \pm 19.2$  g) as follows: first, a unilateral common carotid artery (CCA) was occluded by ligation with a 4–0 surgical thread; second, another CCA on the contralateral side was occluded 4 days after the previous unilateral occlusion. Then, we performed DWI (multi-shot spin echo EPI sequence; in-plane resolution:  $0.2 \times 0.2$  [mm<sup>2</sup>]; slice thickness: 0.8 [mm]; 9 b values: 0–3000 [s/mm<sup>2</sup>]) on a preclinical vertical 11.7 Tesla MRI (AVANCE II 500WB, Bruker) at acute (within 1 day), subacute (from 7 to 14 days) and chronic phase (after 21 days) after the second surgical treatment. In each rat, the  $f_{ivim}$  map was obtained and the  $f_{ivim}$  value also were estimated from the signal change composed of 9 points, of which each signal was averaged in a region of interest (ROI) manually located on the cortex. When the rat showed infarction, we located ROIs on both ipsilateral and contralateral side of infarction.

**Results:** We completely achieved the scan protocol in three of all ten rats. In two rats with showing no deficits and no findings on T2-weighted image (T2WI),  $f_{ivim}$  showed the abnormal elevation on the cortex at the subacute phase more than at the acute phase (mean  $f_{ivim}$  of 2 rats: acute, 0.0418; subacute, 0.0501), however, the elevation normalized at the chronic phase subacute, (chronic, 0.0443). On the other hand,  $f_{ivim}$  in the third rat has already elevated at the acute phase and the elevation was remarkable on the unilateral cortex (right, 0.0584; left, 0.0318). At the subacute phase, the rat showed a T2WI hyper-intensity indicating infarction on the right side, on which  $f_{ivim}$  elevated at the acute phase.

**Conclusion:** We could observe a hemodynamic change in rats with BCAO as  $f_{ivim}$  elevation. This suggested that CBV might be elevated in the rats and the  $f_{ivim}$  elevation could be detected before the onset of stroke. Consequently, the level of ischemia at the acute phase in the stroke rat might include the situation like ‘misery perfusion’ because the rat showed infarction at the subacute phase. In conclusion,  $f_{ivim}$  from IVIM-DWI analysis has the ability to detect subtle hemodynamic change in the rat brain.

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## P129

### Differences in the Clinical Manifestations and Short-Term Prognosis of Acute Cerebral Infarction after Exposure to Agent Orange

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**Background and Rationale:** Agent Orange (AO) is the code name for one of the herbicides and defoliants used in the Vietnam War. Studies conducted thus far show a significant correlation between AO and the occurrence of cardiovascular diseases. But there is little data on the association between AO and stroke, and limited studies have targeted patient groups exposed to AO.

**Methods:** We studied patients with acute ischemic stroke within 7 days of onset in VHS medical center and 4 other general hospitals. Among them, 91 consecutive patients with previous exposure to AO were evaluated. For controlled group, 288 patients with no history of AO exposure.

**Results:** There were 49 (44.0%) DM patient with a higher frequency in the exposure group (93 (32.3%) in control  $P = 0.045$ ). There were 6 (6.6%) hyperlipidemia in exposure group and 69 (24.0%) in control. ( $P < 0.002$ ). Small vessel occlusion was the most common subtype (36, 39.6%) in exposure group but in control group, the large artery atherosclerosis was (120, 41.7%) ( $P = 0.014$ ). The NIHSS of the exposure group on admission showed lower scores (median values, 2 and 4, respectively;  $P = 0.003$ ). The median mRS was 1 for the exposure group and 2 for the control group, at discharge and after 3 months. After 3 months of discharge, 55 (60.4%) in the exposure group and 171 (59.4%) in the control group showed below mRS 1 ( $P = 0.001$ ).

**Conclusion:** This study targeted patients who are Vietnam veteran. There is some difference in vascular risk factors and clinical manifestations suggest AO exposure has contributed to a certain extent to the stroke.

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## P130

### Insulin-Like Growth Factor as Predictor of Functional Outcome in Acute Ischemic Stroke Patients

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**Background and Rationale:** Insulin-like growth factor is involved in the maintenance of endothelial function and may contribute to the neuroprotective effect. In previous studies, insulin-like growth factor is increased after hypoxic brain injury, and animal model with administration of insulin-like growth factor have shown reduced infarct volume. We aim to evaluate the prognostic value of insulin-like growth factor in acute ischemic stroke patients.

**Methods:** In this retrospective observational study, a consecutive series of patients hospitalized for ischemic stroke within 7 days of onset were enrolled. The National Institutes of Health Stroke Scale (NIHSS) score was assessed on admission before reporting of serum insulin-like growth factor levels. For the assessment of functional outcome at 90 days Modified Rankin Scale (mRS) was used. Serum IGF-1 levels were determined by chemiluminescence immunoassay on admission. The influence of IGF-1 levels on functional outcome and death was assessed by multivariate logistic regression analysis.

**Results:** 213 Patients compatible with eligibility criteria were enrolled. The mean age was  $67.7 \pm 12.3$  years. (64.6% males, median baseline NIHSS 3) Patients with an unfavorable outcomes and death had significantly decreased serum IGF-1 levels on admission ( $P < 0.0001$  for both). Serum insulin-like growth factor levels  $< 105$  ng/ml was as a value for unfavorable functional outcome (OR 2.07, 95% CI: 1.35–4.48;  $P, 0.0001$ ), after adjusting for other significant confounders. However, there was no relation of hormone levels to either the clinical subtype of stroke or the early neurologic deterioration.

**Conclusion:** This study shows that a considerable correlation between decreased insulin-like growth factor level and unfavorable functional outcome at 3 months. Low level of insulin like growth factor may play a role in the progression of acute ischemic stroke. Limitations of this study are lack of long term follow up functional outcome after 3 months, measurement of insulin-like growth factor were performed once at admission, and retrospective study design.

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## P131

### Increased Brain Poly (ADP-Ribose) after Ischemic Stroke Are Attenuated by Poly (ADP-Ribose) Polymerase Inhibitor

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**Background and Rationale:** Poly (ADP-ribose) polymerase-1 (PARP-1) is a nuclear enzyme that is activated by DNA strand breaks or kinks. PARP-1 normally functions to facilitate DNA repair and prevent chromosomal rearrangements. However, extensive PARP-1 activation in ischemic stroke may deplete the cytosolic NAD<sup>+</sup> and increase PAR formation which may lead to cell death. Although PAR has been known to serve as toxic molecule, change of PAR level after ischemic stroke in brain and peripheral blood are remains unclear.

**Methods:** In animal study, a total 75 rats were subjected to transient (2 hours) middle cerebral artery occlusion (MCAO). After reperfusion, rats were randomly assigned to saline or PARP-1 inhibitor groups. Rats were sacrificed after 6 hours and 24 hours to assess brain and peripheral blood PAR by ELISA (n = 15/group). In addition, peripheral blood of 10 control subjects and 30 patients with acute ischemic stroke within 24 hours were sampled. Blood samples from patients were extracted at the time of within 1 day, 3 days and 7 days. Peripheral blood PAR level were assessed by ELISA. In addition, association between peripheral blood PAR levels and infarct volume, age and use of t-PA were measured.

**Results:** In animal study, peripheral blood PAR level after ischemic stroke were not different from sham group. PAR level were also similar after ischemic stroke regardless of the usage of PARP-1 inhibitors and time sequence. However, brain PAR level was increased after 6 hours of ischemic stroke and it was significantly reduced by PARP-1 inhibitors. In human study, PAR levels were not significantly changed after ischemic stroke during 7 days and it was also similar to control subjects. PAR levels were not affected by t-PA use, age and infarct volume during 7 days of ischemic stroke.

**Conclusion:** Ischemic stroke may increase brain PAR and it may decreased by inhibition of PARP-1. However, peripheral blood PAR are not affected by ischemic stroke and it may have limitation for use as a biomarker. Reduction of PAR immediately after ischemic stroke with PARP-1 inhibitor may ameliorate neuronal death by PAR related neuroprotective mechanisms.

## P132

### Nonfasting Triglyceride Profiles in Acute Ischemic Stroke Patients

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**Background and Rationale:** Several studies reported the association between nonfasting TG (NFTG) and risk of ischemic stroke. However, it is unknown how prevalent high NFTG is in patients with acute ischemic stroke (AIS) and what their clinical characteristics are. In this study, we investigated profiles of NFTG and characterized the patients with AIS and high NFTG.

**Methods:** Based on multicenter prospective stroke registry, we identified eligible 2,176 patients with AIS hospitalized within 24 hours of onset. Nonfasting lipid profiles were measured on arrival, then fasting lipid profiles were measured after overnight fasting. Initial TG levels collected within 8 hours from the last meal were categorized into NFTG. High TG levels ( $\geq 200$  mg/dl) and metabolic syndrome were defined as Adult Treatment Panel III guidelines.

**Results:** The mean age was 67 years and proportions of high NFTG and fasting TG were 24.6% and 11.5%. High NFTG was significantly prevalent in small vessel occlusion (SVO, 33.2%) and large artery atherosclerosis (LAA, 26.4%) than cardioembolism (CE, 16.2%) and other determined (OD, 14.0%) groups. Compared to nonfasting profiles, fasting total cholesterol, TG, HDL, and LDL cholesterol levels were decreased significantly ( $186 \pm 46$  vs.  $171 \pm 41$  mg/dl,  $160 \pm 115$  vs.  $121 \pm 80$  mg/dl,  $49 \pm 18$  vs.  $44 \pm 12$  mg/dl,  $108 \pm 39$  vs.  $104 \pm 35$  mg/dl, all  $p < 0.001$ ). High NFTG group was positively associated with male sex, young age, smoking, BMI, history of diabetes mellitus, and metabolic syndrome (all  $p < 0.001$ ). Differences between nonfasting and fasting TG were higher in LAA ( $41 \pm 99$  mg/dl) and SVO ( $41 \pm 68$  mg/dl) than CE ( $35 \pm 63$  mg/dl) and OD ( $37 \pm 84$  mg/dl). Patients with metabolic syndrome showed higher differences between nonfasting and fasting TG compared with those without metabolic syndrome ( $71 \pm 76$  mg/dl vs.  $60 \pm 85$  mg/dl,  $p = 0.009$ ).

**Conclusion:** Nonfasting lipid profiles of acute ischemic stroke patients showed higher total cholesterol, TG, HDL, and LDL cholesterol levels than fasting ones. High NFTG were prevalent in SVO and LAA subtypes and differences between nonfasting and fasting TG levels were associated with metabolic syndrome.

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### P133

#### The Coagulation Tests from Patients with Type 2 Diabetes Mellitus and Ischemic Stroke

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**Background and Rationale:** The coagulation tests including thrombin time, prothrombin time, activated partial thromboplastin time, show the speed at which blood clots, and changes of this parameters may indicate an increased risk of stroke. Abnormal bleeding is a potential cause of intracerebral hemorrhage; abnormal clotting is a potential cause of ischemic stroke (IS). Besides it is known the irregular influence of hyperglycaemia conditions under diabetes mellitus on haemostatic state (Fayeza Karim, et al, 2015).

**Methods:** So the aim of the study was to measure the body mass index (BMI), blood glucose, thrombin time (TT), prothrombin time (PT), activated partial thromboplastin time (APTT) under IS and stroke complicated by type II diabetes mellitus (DM). For the investigation were selected 120 persons with tomography and magnetic resonance imaging confirmed of IS, the 34 from them had diabetes, which was established by laboratory tests as a fasting plasma glucose levels greater than 7.0 mmol/L. PT, APTT, TT, BMI and plasma glucose level were estimated using standard methods.

**Results:** The accepted role played by hemostasis in the pathogenesis of strokes is important but still controversial (Chun-Hsien Lin, et al, 2015). The conducted research had established the statistically significant changes of all coagulation tests in both investigated patient groups. The TT for the plasma to clot was prolonged and amount 18,4 s in case of IS and 19,5s in patients with DM and stroke. The control value of this parameter was 10,5 s. The PT and APTT which were the marker for activation of extrinsic and intrinsic pathway of coagulation respectively were increased too. So the PT value reach 122% and 128% comparing with the control for IS and stroke with DM respectively. The APTT exceeded the reference value by more than 50% in both studied groups but was greater in case of diabetes. The BMI was abnormality high only under hyperglycaemia complicated IS.

**Conclusion:** The obtained results showed that the ischemic stroke was characterized by prolonged PT, APTT, TT and the presence of DM reinforce negative manifestations of coagulation tests changes.

## References:

- Chun-Hsien Lin, et al: 2015.  
Fayeza Karim, et al: 2015.

### P134

#### Reducing Hemorrhagic Complication by Rivaroxaban and Apixaban via Neurovascular Protection after Thrombolysis in Ischemic Stroke of Rat

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**Background and Rationale:** This study aimed to assess the risk and benefit of tissue-type plasminogen activator treatment after oral anticoagulation with rivaroxaban or apixaban compared with warfarin or placebo.

**Methods:** Pretreatment with warfarin (0.2 mg/kg per day), rivaroxaban (2 mg/kg per day), apixaban (10 mg/kg per day), or vehicle (0.5% carboxymethyl cellulose sodium salt) was performed for 7 days. Transient middle cerebral artery occlusion was then induced for 120 minutes, followed by reperfusion with tissue-type plasminogen activator (10 mg/kg per 10 ml). Clinical parameters, including cerebral infarction volume, hemorrhagic volume, and blood coagulation, were examined. Twenty-four hours after reperfusion, markers for the neurovascular unit at the peri-ischemic lesion were immunohistochemically examined in brain sections, and matrix metalloproteinase-9 activity was measured by zymography.

**Results:** The paraparesis score was significantly improved in the rivaroxaban-pretreated group compared with the warfarin-pretreated group. Intracerebral hemorrhage was observed in the warfarin-pretreated group, and this was reduced in the rivaroxaban and apixaban-pretreated groups compared with the vehicle group. Marked dissociation of astrocyte foot processes and the basal lamina or pericytes was observed in the warfarin-pretreated group, and this was improved in the rivaroxaban and apixaban-pretreated groups. Furthermore, activation of matrix metalloproteinase-9 in the ipsilateral warfarin-pretreated brain was greatly reduced in rivaroxaban- and apixaban-pretreated rats.

**Conclusion:** This study shows a lower risk of intracerebral hemorrhage after tissue-type plasminogen activator treatment in rats with ischemic stroke that are pretreated with rivaroxaban and apixaban compared with pretreatment with warfarin. Reducing neurovascular dissociation by rivaroxaban and apixaban compared with warfarin could partly explain a reduction in hemorrhagic complications reported in clinical studies.

# Differentiation of Serum sLOX-1 and NO Levels in Acute Ischemic Stroke Patients with Internal Carotid Artery Stenosis and Those Without Internal Carotid Artery Stenosis

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**Background and Rationale:** Soluble LOX-1 (sLOX-1) and nitric oxide (NO) are potential biomarkers for vascular oxidative stress that affect to atherosclerotic plaque. Atherosclerotic narrowing of the internal carotid artery is a well-known cause of acute ischemic stroke (AIS). We aim to measure serum sLOX-1 and NO levels in acute ischemic stroke patients with or without ICA stenosis after 24 hour-stroke symptom onset.

**Methods:** 118 patients with AIS within 24 hours-stroke symptom onset. Peripheral venous blood of all patients were collected for measuring blood sugar, cholesterol, triglyceride, HDL-c and LDL-c concentrations by standard laboratory techniques. Serum sLOX-1 and NO concentrations were measured by ELIZA kits. The patients were divided into two groups i.e. non-internal carotid artery stenosis (NICAS, n = 65) and internal carotid artery stenosis (ICAS, n = 53) by measuring internal carotid artery stenosis by ultrasound carotid duplex.

**Results:** Baseline characteristics were not significantly different between NICAS and ICAS except LDL-c levels. Serum NO level had significantly lower in ICAS ( $50.09 \pm 7.36 \mu\text{mol/l}$ ) when compared with NICAS ( $54.85 \pm 11.81 \mu\text{mol/l}$ ). Soluble LOX-1 had significantly higher in ICAS ( $1.82 \pm 0.34 \text{ ng/ml}$ ) compared with NICAS ( $1.13 \pm 0.40 \text{ ng/ml}$ ).

**Conclusion:** There are higher sLOX-1 and lower NO levels in AIS patients with ICAS when compared those with NICAS. These parameters may become the novel potential biomarkers for predicting risk to acute ischemic stroke.

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P136

### Edaravone Reduced the Damage on Pericyte after tPA Treatment in Rat Cerebral Ischemia

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**Background and Rationale:** Background & Objectives: Pericytes play a pivotal role in contraction, mediating inflammation, and regulation of blood flow in the brain. In the present study, changes of pericytes in the neurovascular unit (NVU) were examined in relation to the effects of exogenous tissue plasminogen activator (tPA) and a free radical scavenger, edaravone.

**Methods:** Immunohistochemistry and Western blot analyses showed that the overlap between PDGFR $\beta$ -positive pericytes and N-acetylglucosamine oligomers (NAGO)-positive endothelial cells increased significantly at 4 days after 90 min of transient middle cerebral artery occlusion (tMCAO).

**Results:** The number of pericytes and the overlap with NAGO decreased with tPA, but recovered with edaravone 4 days after tMCAO with proliferation. Thus, tPA treatment damaged pericytes resulting in the detachment from astrocytes and a decrease in GDNF secretion. However, treatment with edaravone greatly improved tPA-induced damage to pericytes.

**Conclusion:** The present study demonstrates that exogenous tPA strongly damages pericytes and destroys the integrity of the NVU, but edaravone treatment can extremely ameliorate such damage after acute cerebral ischemia in rats.

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Yamashita T, Deguchi K, Abe K, et al: JCBFM 2009.  
Deguchi K, Yamashita T, Abe K, et al: JNR 2014.

P137

### A Pathway Proteomic Profile of Ischemic Stroke Survivors Reveals Innate Immune Dysfunction in Association with Mild Symptoms of Depression

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**Background and Rationale:** Depression after stroke is a common occurrence, raising questions as to whether depression could be a long term biological and immunological sequela of the event itself. Early explanations for post stroke depression (PSD) focused on the neuropsychological/psychosocial effects of stroke on mobility and quality of life.

**Methods:** We examined the serum proteome of stroke patients ( $n = 44$ , mean age = 63.62) and correlated these with the Montgomery-Asberg Depression Rating Scale (MADRS) scores at 3 months post-stroke. A label-free approach for relative quantification was employed utilizing an LC-ESI-MS/MS coupled to a LTQ-Orbitrap Elite (Thermo-Scientific). Identified peptides were analyzed using the Gene Set Enrichment (GSEA) approach on several different genomic databases.

**Results:** We found significant downregulation of the complement and coagulation systems with increasing MADRS scores as predicted. Complement and coagulation systems are traditionally thought to play a key role in the innate immune system and are established precursors to the adaptive immune system through pro-inflammatory cytokine signaling. Both systems are known to be globally affected after ischemic or hemorrhagic stroke.

**Conclusion:** Our results suggest that lowered complement expression in the periphery in conjunction with depressive symptoms post stroke may be biomarkers for incomplete recovery of brain metabolic needs, homeostasis and inflammation following ischemic stroke damage.

P138

**Poor Delayed Response Task Performance in Aged Cynomolgus Monkeys Is Associated with Cerebral and Hippocampal Atrophy, Depletion of Beta Amyloid 42 and Accumulation of Tau Proteins**

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**Background and Rationale:** Alzheimers disease (AD) is one of the earliest characterized neurodegenerative diseases. Extensively studies using many different animal models. An ideal animal model of human AD should fulfil the current diagnostic criteria described by the National Institute of Neurological and Communicative Disorders and Stroke and Alzheimers Disease and Related Disorders Association (NINCDS-ADRDA).

**Methods:** Study with twelve adult cynomolgus monkeys, aged animals (>20 years), divided as two groups, low performers group and high performers group. The monkeys are doing some tests like memory test, biomarker analysis, and brain MRI.

**Results:** LowCSF levels of A42 may indicate a higher occurrence of plaques that sequester the A42 peptide in the brain parenchyma, resulting in reduced availability of A42 that can diffuse into CSF T-tau levels were significantly higher in low-performers compared with high-performers, suggesting the possibility of a neuronal injury.

Among biomarkers, A42 levels only correlated significantly (negatively) with t-tau levels ( $r = -0.684$ ,  $p < 0.05$ ) which may reflect that both Alheimers pathological hallmarks were established in the low memory performers All low-performers ( $n = 6$ ), but no high performers ( $n = 0$ ) showed indications of atrophy in the hippocampus (Fischer exact test:  $p < 0.01$ ). Five Low-performers also showed additional indications of cerebral atrophy by cortical sulci widening, while no high-performers did (Fischer exact test:  $p < 0.05$ ).

**Conclusion:** Aged cynomolgus monkeys with ppor delayed response task performance were found to have low levels of A42 and high levels of t-tau in their CSF.

Their brains exhibited structural changes comparable to those seen in human patients suffering from age-related dementia.

The findings support the utility of the aged cynomolgus monkey as a useful spontaneous animal model of age-related neurodegenerative diseases, specifically to alzheimer and vascular dementia.

**References:**

Blennow et al: 2009.  
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Duyckaerts et al: 2008.  
Obylesu and Rao: 2010.

P139

**Antagomir-145 Suppresses Atherogenic Low-Density Lipoprotein (L5)-Enhanced Platelet Activation and Ischemic Stroke Mediated by Amyloid  $\beta$**

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**Background and Rationale:**  $A\beta$ , abundantly stored in platelets, can trigger IKK2-mediated NF- $\kappa$ B activation to induce platelet aggregation. L5, as the most negatively charged subfraction of LDL, are elevated in stroke patients and increase  $A\beta$  production and release. miRNA-145 (miR-145) is a positive regulator of IKK2 through its actions on ubiquitin-specific peptidase 31 and ultimately I $\kappa$ B $\alpha$ . We examined whether L5 potentiates  $A\beta$ -mediated platelet activation and ischemic stroke can be prevented by silencing miR-145.

**Methods:** Plasma LDL from patients with stroke was chromatographically resolved into 5 subfractions (L1-L5) with increasing electronegativity. The expression of miR-145 in platelets was analyzed using stem-loop quantitative real time (qRT)-PCR. Using a mouse model of MCAO to examine the effects of L5 and antagomiR-145 on the extent of ischemia-induced stroke and the tail-vein bleeding time assay to determine the effects of antagomiR-145 on L5-induced blood clotting.

**Results:** Human platelets exposed to L5, but not L1, enhanced  $A\beta$ -induced degradation of I $\kappa$ B $\alpha$ , thereby activating NF- $\kappa$ B and platelet aggregation. Activated platelets rapidly formed aggregates bridged by the stimulated GPIIb/IIIa receptors.  $A\beta$ -induced NF- $\kappa$ B activation is inhibited by USP31, which is negatively modulated by miR-145. L5 increases levels of miR-145, thereby enhancing platelet aggregation by removing USP31-mediated inhibition of NF- $\kappa$ B activation and by augmenting  $A\beta$ -triggered NF- $\kappa$ B activation. The administration of L5 or L5+ $A\beta$  significantly shortened tail-bleeding time ( $n = 14$ ,  $p < 0.01$ ) and augment MCAO-induced brain injury ( $n = 5$ ,  $p < 0.05$ ). In further experiments, in which the antagomiR-145 was delivered with a transfection reagent, the L5-induced shortening of tail-bleeding time ( $n = 14$ ,  $p < 0.05$ ) and augment MCAO-induced brain injury were prevented by antagomiR-145 ( $n = 5$ ,  $p < 0.05$ ) but not control antagomir.

**Conclusion:** Atherogenic L5 LDL can enhance platelet aggregation, thrombosis and augment MCAO-induced brain injury in part by enhancing  $A\beta$  availability and can be counteracted by silencing miR-145.

P140

### Changing Patterns of Stroke Awareness among Primary Care Physicians: Results of an Ongoing Study from Kerala, India

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**Background and Rationale:** There have been dynamic and remarkable improvements in stroke care in the last decade. However, in spite of intensive campaigns, lack of awareness among primary care physicians (PCPs) remains as one of the major obstacle for early referral for thrombolysis as well as for continued care. We evaluated the stroke awareness on different aspects of stroke care among PCPs in Kerala by serial cross sectional studies conducted in 2009 and 2015.

**Methods:** A cross sectional survey, using standard Proforma by direct personal visit was conducted among 416 doctors, working as PCPs in 2009. The study was repeated in 2015 (with a correction for time window for thrombolysis) with 216 respondents so far and is still ongoing. An interim analysis was contemplated. Age, rural/urban location of work place, duration of clinical experience and presence of post graduate qualification were examined to see whether they affect awareness regarding stroke risk factors, acute treatment and stroke prevention.

**Results:** Compared to 2009, the respondents in 2015 were younger (mean age 39.5 and 36.8 respectively) with 56.7% and 76.4%, respectively being 40 years or younger. Majority of the respondents were females, increasing from 51% in 2009 to 56.5% in 2015. Similar trend was noted in those with post graduate qualifications (increasing from 23.1% to 39.4%), however participation from those working in rural areas had actually declined (76.2% to 62.5%).

There was marginal, but statistically significant ( $p < 0.05$ ) improvement in awareness levels in accurate identification of risk factors (22.15% to 37%), use of tPA for thrombolysis (44.7% to 54.6%) and prevention strategies (44.5% to 50.9%). However, there was a decline in awareness regarding exact time window for thrombolysis (52.4% to 30.5%). Presence of additional qualification was the only factor influencing awareness (regarding acute treatment and stroke prevention).

**Conclusion:** Overall awareness regarding various aspects of stroke care among PCPs has improved only marginally over the last five years. Declining awareness regarding window period for thrombolysis could be possibly related to failure to keep updated on medical guidelines and recommendations.

P141

### Study of Gastrodia on Improving Neurological Function in Rats of Acute Middle Cerebral Artery Occlusion

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**Background and Rationale:** Gastrodia, as a herb of traditional Chinese medicine, is used in treating headaches, dizziness, tetanus, and epilepsy and stroke for thousands years. In this study we investigate the Gastrodia on improving neurological function in rats of acute middle cerebral artery occlusion.

**Methods:** 54 adult male SD rats were randomly divided into sham group ( $n = 18$ ) and model group ( $n = 36$ ). Model group rats established by MCAO were randomly divided into control group ( $n = 18$ ) and dose group ( $n = 18$ ), respectively. After 24 h, control group were injected the same amount of isotonic saline by intraperitoneal, and dose group were injected Gastrodia by intraperitoneal (4 ml/time, 2 times/d, a total of 14 days). Neurological deficits were evaluated at 2 h, day 1, day 7, day 14, and infarct volume were assessed by hematoxylin and eosin-stained brain sections at day 14 in rats. Cells staining by Brdu were counted as immunopositive stained cells (Brdu) from ischemic subependymal zone (SVZ) and striatum in day 14.

**Results:** Compared with control group, dose group had a significant recovery of neurologic function from 7 days in rats ( $P = 0.043$ ,  $P = 0.031$ ). Gastrodin had significantly improved the neurologic functions in rats. The infarct volume of dose group rats was significantly different compared with that of control group ( $P = 0.044$ ). BrdU positive cells in the SVZ and striatum area of treatment group was significantly higher compared with the control group at day 14 ( $P = 0.009$ ,  $P = 0.040$ ).

**Conclusion:** Gastrodia can improve neurological function and has an effect on the proliferation of brain cells after acute infarction in MCAO rats.

P142

### Novel Cell Transplantation Therapy with Induced Neural Stem Cells for Stroke

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**Background and Rationale:** Somatic cells can recently be directly converted into induced neural stem cells (iNSCs) by defined transcription factors. However, the therapeutic effect of undifferentiated iNSCs for ischemic stroke has not been demonstrated.

**Methods:** In the current study, we used a mouse model of transient middle cerebral artery occlusion (tMCAO). iNSCs ( $5 \times 10^5$ ) were injected directly into the ipsilateral striatum and cortex after 24 hours of tMCAO. Histological analysis was performed at 7, 28 days and 8 months after tMCAO.

**Results:** We found that iNSC transplantation successfully improved the survival rate of stroke model mice with significant functional recovery from the stroke. The fate of engrafted iNSCs was that the majority of iNSCs had differentiated into astroglial cells but not into neural cells in both the sham-operated brain and the post-stroke brain without forming a tumor up to 8 months after tMCAO.

**Conclusion:** Our data suggested that directly converted iNSCs may represent a promising and safe cell resource for transplantation therapy in patients suffering from ischemic stroke.

## Reference:

Yamashita T, Abe K: Direct reprogrammed neuronal cells as a novel resource for cell transplantation therapy. *Cell Transplant* 2014;23:435–439.

## Clinical Rehabilitation

### P143

#### Developing a Screening Tool for Acquired Communication Disorders in Aboriginal Australians after Brain Injury

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**Background and Rationale:** Acquired communication disorders (ACD) following stroke may not be correctly identified in Aboriginal Australians due to a lack of linguistically and culturally appropriate assessment tools. As part of the Missing Voices project (NH&MRC funded 2013–2015) the Aboriginal Communication Assessment after Brain Injury (ACAABI) has been developed to detect the presence of ACD. This presentation will detail the processes involved in developing and trialling the ACAABI and the progress made to date.

**Methods:** Review of existing mainstream screening tools and consultation with key Aboriginal stakeholders and speech pathologists informed the development of the ACAABI. Fifty Aboriginal Australians who have experienced stroke or TBI and had either previously been diagnosed with an ACD or no communication disorder will be involved in the trial. The ACAABI is completed by an Aboriginal Research Assistant and an independent communication assessment is conducted by a speech pathologist to deter-

mine the validity of the screening tool. The results of the speech pathology assessment are reviewed by an Expert Advisory Panel (EAP) to determine a diagnosis. Percentage agreement between the results of the ACAABI and this diagnosis will be determined. Cut-off values, derived from the results of the individuals with and without an ACD, will be used to examine the sensitivity and specificity of the test.

**Results:** To date, 28 stroke survivors have been recruited with one metropolitan (n = 19) and one rural (n = 9) site involved in the trial.

**Conclusion:** The ACAABI is designed to be used by Aboriginal Health Practitioners to identify the presence of acquired communication disorders in Aboriginal Australians. It has the potential to play an important role in the clinical management of Aboriginal Australians after stroke.

### P144

#### Facilitators and Barriers to Adherence to Sub-Acute Specific Elements of Stroke Clinical Guidelines: A Narrative Literature Review

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**Background and Rationale:** In 2015, the Victorian Stroke Clinical Network (VSCN) announced a Sub-acute Stroke Initiative (Initiative). Over 2 years, it will provide a total of \$1.2 M funding to Victorian health services to improve stroke service delivery through innovative projects. A narrative literature review was conducted to examine clinician adherence to sub-acute components of Stroke Clinical Guidelines to identify common barriers and facilitators to guideline adherence and inform the development of this Initiative.

**Methods:** Literature related to adherence to clinical guidelines in the area of rehabilitation and sub-acute stroke was searched across PubMed, Ovid, CINAHL, Medline, Cochrane Systematic Reviews and Google Scholar databases. Search limits included English language articles and publication from 2008 to August 2015. Key search terms included: stroke, rehabilitation, sub-acute, clinical guidelines, adherence, barriers and enablers. Articles were included if research focused on elements of rehabilitation and adherence to clinical guidelines for stroke care. A single researcher identified, screened, reviewed and synthesised articles. The full text of articles included in the review were read in their entirety and thematically analysed.

**Results:** Forty articles were screened for eligibility from 280 identified. Of those, 13 articles were included. Four studies involved specific health disciplines, almost half adopted qualitative methodology to investigate barriers and enablers to guideline adherence. Two groups were identified: those measuring general adherence across sub-acute stroke care and those exploring barriers and facilitators to adherence to clinical guidelines. Adherence to guidelines in sub-acute stroke care demonstrated improved quality

of care leading to better patient outcomes. Common areas of measured poor adherence included: intensity of therapy, goal setting, education and community participation. Common facilitators to adherence to guidelines included: staff motivation, existence of stroke champions, dedicated stroke resources, organisational commitment and streamlined services. Common barriers included time limitations, guideline usability, staff attitudes and capabilities, education, training and resources.

**Conclusion:** There is emerging evidence supporting adherence to clinical guidelines for sub-acute stroke care improves patient outcomes. Despite the limited literature, evidence for sub-acute stroke identifies perceived barriers that align with existing evidence for guideline adherence. Variation in standards of care can be reduced by supporting health services to implement evidence-based models of care. Themes identified in this review have been used to inform the development of VSCN sub-acute initiatives.

#### P145

##### **A Pilot Study of Self-Help Relaxation for Post-Stroke Anxiety: One Year Follow-Up**

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**Background and Rationale:** Anxiety is prevalent after stroke and likely affects outcomes (Campbell-Burton et al. 2013). Research supporting treatment is highly limited (Campbell-Burton et al. 2011). A pilot randomised controlled trial (RCT) found autogenic relaxation delivered via CD effective relative to controls at one, two and three months post intervention (Golding, Kneebone & Fife-Schaw 2016). This study sought to assess the long-term impact of this treatment.

**Methods:** 12 month follow-up of the participants in the initial RCT ( $n = 15$ ).

**Results:** Median anxiety ratings significantly reduced from pre to post-intervention ( $Z = -3.19$ ,  $p = 0.001$ ,  $r = 0.82$ ), from pre-intervention to one year follow-up ( $Z = -3.42$ ,  $p = 0.001$ ,  $r = 0.87$ ) and from post-intervention to one year follow-up ( $Z = -2.29$ ,  $p = 0.022$ ,  $r = 0.75$ ). At one year follow-up five participants were no longer considered to have clinical levels of anxiety.

**Conclusion:** The benefits of autogenic relaxation training for anxiety after stroke appear to persist 12 months post-treatment. This supports a long term impact of this relatively inexpensive intervention.

#### **References:**

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Golding K, Kneebone I, Fife-Schaw C: 'Self-help relaxation for post-stroke anxiety: a randomised, controlled pilot study'. *Clin Rehabil* 2016;30:174–180.

#### P146

##### **Predictors of Community Ambulation Across the First Six Months of Returning Home from Hospital after Stroke**

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**Background and Rationale:** Community ambulation is restricted even late after stroke [1, 2]. Understanding which factors at hospital discharge predict community ambulation outcomes after stroke may assist in informing clinical decisions made during rehabilitation. Thus, this study aimed to determine what factors at hospital discharge post-stroke predict community ambulation outcomes at one, three and six months later.

**Methods:** 30 subacute stroke survivors (age: 73.0 SD 12.9 years, 66.7% male) were assessed one-week prior to hospital discharge and followed up at one, three and six months later. At discharge, predictors including fatigue, mood, executive function, walking speed, walking endurance, perceived stroke recovery, ambulation self-efficacy, pre-stroke activity and perceived health outcomes were collected. At follow-up, community ambulation (volume, frequency and intensity) was measured using the ActivPAL™ accelerometer, Garmin GPS and an activity diary. Significantly related predictors were entered into a stepwise linear regression model.

**Results:** All measures of community ambulation at one month were predicted by walking endurance alone (Adj  $r^2 = 0.29$ – $0.38$ ,  $p < 0.007$ ), except for frequency of community trips, which was also predicted by age (Adj  $r^2 = 0.40$ ,  $p = 0.04$ ). Beyond one month, daily volume of community ambulation was not predicted by any discharge factor. From three months, the frequency of community trips and long duration ambulation bouts were predicted by either age (Adj  $r^2 = 0.22$ – $0.34$ ,  $p < 0.03$ ) or pre-stroke activity (Adj  $r^2 = 0.19$ ,  $p = 0.04$ ). Time spent in high intensity ambulation bouts was predicted by a combination of walking endurance, executive function and pre-stroke activity at three months (Adj  $r^2 = 0.82$ ,  $p < 0.001$ ) and walking endurance and executive function at six months (Adj  $r^2 = 0.39$ ,  $p < 0.026$ ).

**Conclusion:** Discharge walking endurance predicted community ambulation at one month. After this time, age, pre-stroke activity and executive function were predictive of community ambulation outcomes. At six months, no post-stroke impairment or activity limitation predicted community ambulation.



## References:

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- 2 Robinson CA, Shumway-Cook A, Matsuda PN, Ciol MA: Understanding physical factors associated with participation in community ambulation following stroke. *Disabil Rehabil* 2011;33:1033–1042.

P147

### Brain Derived Neurotrophic Factor Increases Following Aerobic Exercise in Stroke and Other Neurological Populations – A Systematic Review and Meta-Analysis

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**Background and Rationale:** Brain Derived Neurotrophic Factor (BDNF) is a protein that has been implicated in the development and function of neurons (Szuhaney et al. 2015). In healthy populations, BDNF has been shown to increase in response to aerobic exercise (Seifert et al. 2010) with evidence also emerging that this is the case post stroke (El-Tamawy et al. 2014). The current systematic review aims to synthesize current data regarding the impact of aerobic exercise on levels of BDNF in neurological populations.

**Methods:** A search was conducted of Pubmed, Cochrane, Cinahl, PsycINFO, SportDiscus and Web of Science in October 2015. Two independent reviewers assessed full texts for inclusion based on (1) human studies, (2) investigating a neurological population, (3) measurement of BDNF in serum or plasma, (4) experimental or observational study design, and (5) implementation of an exercise intervention. Risk of bias was assessed using a quality appraisal tool (Pedro Scale).

**Results:** The search yielded a total of 602 articles, of which 19 met eligibility. On review of full text a further 10 articles were excluded due to an inability to satisfy all eligibility criteria. Nine studies were included involving 277 participants. Three RCTs (n = 82) were included in a meta-analysis, which found the experimental group (aerobic exercise intervention) demonstrated a large effect size for increases in BDNF following exercise (SMD = 2.38, 95% CI 0.52 to 4.23, Z = 2.51, p = 0.01) compared to usual care/no therapy.

**Conclusion:** This systematic review and meta-analysis provides evidence that BDNF may be increased with aerobic exercise in populations with neurological deficits. Further research is required to determine if this increase in BDNF corresponds with improved motor or cognitive recovery.

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P148

### Functional and Quality of Life Outcomes in Chronic Stroke Survivors Following Community-Based Rehabilitation: A Malaysian Experience

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**Background and Rationale:** Despite strong recommendation that stroke survivors should be engaged in community-based rehabilitation (CBR) following hospital discharge, research data about CBR for Malaysian stroke survivors remains limited (Aziz & Raymond, 2008). The aim of this study was to assess the benefit of CBR on functional performance and quality of life among community dwelling stroke survivors.

**Methods:** A one-group experimental study design was adopted to measure CBR outcomes at two community rehabilitation centers. A total of 45 ambulatory stroke survivors (mean age of 66 ± 10 years, 58 ± 44.6 months post-stroke) were recruited. Assessment was performed at baseline and after completion of a 2-hour per day, five-day per week for 12 weeks program. Primary outcome measures were functional performance tests consisting of Timed 10 meter walk test, Timed up and go (TUG) test and Five repetitions sit-to-stand test. A generic health state questionnaire, EuroQol-5D (EQ5D) was used as a secondary outcome measure.

**Results:** At week 12 of rehabilitation, time to complete TUG and Five repetitions sit-to-stand test decreased from 19.00 (SD = 18.9) secs to 17.87 (SD = 15.9) secs, (p < 0.05) and from 16.14 (SD = 8.23) secs to 14.70 (SD = 9.60) secs (p < 0.05) respectively, demonstrating greater balance ability and functional lower limb strength. EQ5D scores increased up to 18% following the 12-week program. However, no significant improvement in Timed 10 meter walk test score was demonstrated.

**Conclusion:** CBR is beneficial in enhancing post-stroke balance, functional lower limb strength and quality of life. Participation in CBR should be targeted for stroke survivors following hospital-based rehabilitation.

## Reference:

Aziz NA, Raymond AA: Managing further rehabilitation on long term stroke patients in the community: A new approach. *Med & Health* 2008;3:1–6.

## P149

### The Stroke Exercise Preference Inventory (SEPI): Development of a New Tool

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**Background and Rationale:** Physical inactivity is highly prevalent after stroke, increasing the risk of poor health outcomes. Individual tailoring, which can improve adherence to exercise interventions, is often overlooked after stroke. In other medical populations (e.g., cancer, cardiac), there are tools available to identify individual exercise preferences, but none exist for stroke.

**Methods:** The pool of items to be considered for inclusion in the SEPI was derived from an extensive literature review and an expert panel discussion. Once items were finalised, we recruited community-dwelling stroke survivors and asked them to respond to each SEPI item (e.g., 'I like to exercise at home') on a scale from 0% (don't agree at all) to 100% (totally agree). These data were used in an exploratory factor analysis to identify factor structure and to refine the SEPI to a core item set. In addition, regressions determined associations between exercise preferences and disability, fatigue, depression and anxiety.

**Results:** A group of 134 stroke survivors (mean age = 64.0, SD = 13.3) completed the 35-item SEPI. Seven distinct factors were identified: 'supervision-support', 'confidence-challenge', 'health-wellbeing', 'similar others', 'exercise context', 'home-alone' and 'music-TV'. Item reduction resulted in a core set of 13 items, and a factor analysis of the SEPI-13 yielded the same 7-factor structure as the 35-item version. Associations were found between personal characteristics and several SEPI factors; for example, participants with anxiety were more likely to express a preference for exercising with similar others ( $p = 0.01$ ) than those without anxiety.

**Conclusion:** The SEPI-13 is a brief instrument that can be used to assess individual exercise preferences in stroke survivors. We hope it will be employed by health professionals to inform the development of tailored exercise programmes, not just to boost adherence but also to increase enjoyment of physical activity.

## P150

### The Relationship between Energy Expenditure and Walking Capacity in Subacute Stroke: A Cross-Sectional Study

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**Background and Rationale:** Energy expenditure is low after stroke. There is limited evidence exploring relationships between modifiable factors that may influence energy expenditure in stroke survivors such as walking capacity, and fatigue. Activity behaviours also appear to be influenced by self-efficacy. This study investigated the relationship between energy expenditure during walking and walking, exercise self-efficacy and fatigue.

**Methods:** Stroke survivors admitted for rehabilitation who could walk were recruited to a pre-post study of high intensity treadmill training (IMPACT-TRANSLATE). On recruitment, participants were on average 24 days (SD18) post stroke, walking at a self-selected gait speed of 0.76 m/s (SD0.29). A subset with energy expenditure measured during the six minute walk test (6MWT) using the Metamax at six months after trial entry are included in this dataset. Walking capacity (speed over 10 m, 6MWT distance), perceived exercise self-efficacy and fatigue (Fatigue Severity Scale) were measured at six months.

**Results:** Data from 24 participants (33% male, aged 65 years (SD14), 50% left side lesion) are presented. Mean peak energy expenditure during the 6MWT was 4.45 (SD1.2) metabolic equivalents. Participants demonstrated good walking capacity (self-selected gait speed 1.02 m/s (SD.33), fast gait speed 1.5 m/s (SD0.37), 6MWT 422 m (SD140)), moderate levels of self-efficacy and low levels of fatigue. Strong correlations were found between energy expenditure and walking capacity ( $r > 0.813$ ). A moderate relationship was found with self-efficacy ( $r = 0.436$ ) and no relationship with fatigue ( $r = 0.059$ ). Multiple regression analyses indicated that distance walked during 6MWT explained 75% of the variance in energy expenditure ( $R^2 = 0.753$ ,  $p = 0.008$ ). Every 110 m increase in distance walked was associated with an increase of 0.8 MET.

**Conclusion:** This group of chronic stroke survivors walked at moderate intensity during 6MWT. Energy expenditure during walking appears strongly related to walking capacity. It is feasible that stroke survivors able to walk can meet intensity targets recommended in physical activity guidelines.

P151

# **A Role for Task-Related Functional Connectivity of Ipsilesional Secondary Somatosensory Cortex in Touch Impairment and Training-Facilitated Recovery after Cortical or Thalamic/Capsular Sensory Stroke**

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**Background and Rationale:** Neural networks underpinning somatosensory impairment and recovery following stroke remain relatively unexplored (Carey et al., 2011), despite high prevalence and functional impact of sensory loss. We aimed to investigate changes in task-related functional connectivity and touch discrimination in stroke survivors with somatosensory impairment following cortical or thalamic/capsular lesions before and after somatosensory retraining.

**Methods:** A functional MRI study of somatosensory task-related functional connectivity (involving primary somatosensory cortex [SI], secondary somatosensory cortex [SII], and somatosensory thalamus) six-months post-stroke and following somatosensory retraining. Clinical and fMRI assessments were conducted pre-post intervention for stroke participants and once for healthy controls.

**Participants:** Twelve stroke survivors, six with cortical SI and/or SII lesions and 6 with subcortical thalamic and/or capsular lesions. Twelve healthy age and sex matched controls.

**Intervention:** Six-week somatosensory retraining comprising 15x60-minute sessions. Training involved discrimination of texture surfaces using neuroscience training principles.

**Main Outcome:** Differences between connectivity maps of stroke subgroups and matched controls pre-intervention, and differences post-intervention within stroke subgroups. Somatosensory impairment and recovery was quantified using the Tactile Discrimination Test.

**Results:** Patients with lesions to cortical somatosensory areas demonstrated decreased connectivity between the ipsilesional SII connectivity seed and ipsilesional sensorimotor regions compared to controls initially. Re-emergence of these connections was observed post-intervention, together with increased functional connectivity between ipsilesional thalamus and hippocampal and visual areas. In contrast, patients with thalamic or capsular somatosensory lesions demonstrated decreased connectivity between ipsilesional SII, bilateral thalamus and contralesional cerebellum pre-intervention relative to controls. Increased connectivity was observed between ipsilesional SII and inferior frontal gyrus post-intervention. Notably, both groups demonstrated significantly improved touch discrimination following somatosensory rehabilitation.

**Conclusion:** Our findings suggest a common role for ipsilesional SII connectivity as well as lesion-specific patterns of neural recovery following cortical and thalamic/capsular somatosensory stroke and recovery.

## **Reference:**

Carey LM, Abbott DF, Harvey MR, Puce A, Seitz RJ, Donnan GA: Relationship between touch impairment and brain activation after lesions of subcortical and cortical somatosensory regions. *Neurorehabil Neural Repair* 2011;25:443–57.

P152

# **Validity of the Test of Visual Perceptual Skills-Third Edition in Patients with Stroke**

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**Background and Rationale:** The Test of Visual Perceptual Skills-Third edition (TVPS-3) has been widely used to assess visual perception in patients with stroke. It has seven subscales. However, convergent validity, ecological validity, and discriminative validity of the TVPS-3 have not been examined in patients with stroke. Therefore, the purpose of this study was to examine convergent validity, ecological validity, and discriminative validity of the TVPS-3 in patients with stroke.

**Methods:** A total of 100 patients with stroke participated in this study. We calculated correlations (Pearson's *r*) among the TVPS-3 scores (i.e., overall scale and subscales) and two cognitive measures (the Mini Mental State Examination [MMSE] and the Wisconsin Card Sorting Test [WCST]) to examine convergent validity. To examine ecological validity, the correlations among the TVPS-3 scores and two abilities of daily living (ADL) scores (Barthel Index [BI] and the Frenchay Activities Index [FAI]) were analyzed. To examine discriminative validity, the patients were divided into two groups based on their BI score. We used independent *t*-test to determine whether the TVPS-3 could distinguish the two groups.

**Results:** The results of convergent validity showed that the TVPS-3 scores had moderate correlations with the MMSE and low to moderate correlations with WCST indices ( $r = 0.26-0.69$ ). Regarding ecological validity, the TVPS scores had low to moderate correlations with the BI and the FAI ( $r = 0.21-0.48$ ). The *t*-test results showed significant differences in the overall scale and the five subscales ( $p < 0.05$ ) (i.e., visual discrimination, spatial relationships, sequential memory, figure-ground, and visual closure).

**Conclusion:** Our results provide evidence that the TVPS-3 has acceptable convergent validity, ecological validity and discriminative validity in patients with stroke. Therefore, the TVPS-3 can be appropriately used to assess visual perception in clinical and research settings. The test results of the TVPS-3 can also reveal the degrees of living independence in patients with stroke.

# A Conversation About Stroke Medications: Using Patient Perceptions to Personalise Educational Messages

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**Background and Rationale:** National guidelines make recommendations for secondary prevention of cerebrovascular accident including the use of medications. A strategy which uses evidence based educational material and a-priori key messages but which also engages in a conversation to personalise these messages may empower patients to better manage their medications.

**Methods:** Participants (≥18 years) with a principal diagnosis of stroke or transient ischemic attack (TIA), were recruited from a stroke unit. A brief educational exchange was conducted prior to discharge, and by telephone post-discharge using a two-sided single page educational resource, containing an infographic on one side, and four a-priori generic key messages on the other. Three validated tools (Medicines Adherence questionnaire (MAQ)<sup>1</sup>, beliefs about medicines questionnaire (BMQ) [2] and brief-illness perceptions questionnaire (BIPQ [3])) were used to identify participants' perceptions of barriers and enablers to taking stroke medications. The participant's perceptions identified by these tools was used during the conversations to personalise the educational messages/approach.

**Results:** Sixteen of 20 participants who consented to take part in the study completed both interviews. The mean age was 64 years (SD = 13 years), four were female and five had atrial fibrillation. Personalised responses to illness perceptions (BIPQ) included emphasizing long term treatment in response to the perception that stroke will last for a very short time, using the level of participant understanding about stroke to introduce the infographic and build on prior knowledge. Responses to the BMQ enabled reinforcement of necessity for medications beliefs and enabled exploration of individual concerns to promote further conversation. Self-report of adherence from the MAQ generated discussion about reasons for forgetting medications or plans for future medication use.

**Conclusion:** The three validated tools engaged the participants allowing them to share perceptions and beliefs, facilitating individualised educational exchange. This model will be compared with usual care in a proposed randomised controlled trial (ACTRN1261500088561).

## References:

- 1 Morisky DE, Green LW, Levine DM: Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care* 1986; 24:67-74.
- 2 Horne R, Weinman J, Hankins M: The beliefs about medicines questionnaire: the development and evaluation of a new method for assessing the cognitive representation of medication. *Psychology and Health* 1999;14: 1-24.
- 3 Broadbent E, Petrie KJ, Main J, Weinman J: The brief illness perception questionnaire. *J Psychosom Res* 2006;60:631-637.

# Filling the Void – A Successful Collaborative to Improve Evidence Based Practice in Continence Management for Stroke Patients

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**Background and Rationale:** Urinary incontinence is a common consequence after stroke and occurs in up to 60% of stroke survivors, and can remain prevalent in 15% of stroke survivors at 1-year [1]. It can have severe physical and psychological consequences [2]. In 2015 the Victorian Stroke Clinical Network (VSCN) coordinated the Filling the Void (FTV) practice collaborative to develop protocols, share learning and improve consistency of practice for stroke survivors with urinary incontinence.

**Methods:** Health services were engaged to participate via an expression of interest process. Redesign methodology was used as redesign leads were present in participating sites and it has demonstrated effectiveness in achieving outcomes. The induction package included a literature synthesis, copies of existing resources, redesign tools and education. Three workshops were conducted over the six month duration of the project to support collaborative redesign processes tailored to each organisation's population and needs. The workshops also developed project and change management skills and facilitated information sharing across the sites. The program advisor was available via email and phone for support. Project leads were encouraged to engage with their hospital redesign team to ensure consistency with other program methods. Networking across the sites and sharing of resources was encouraged.

**Results:** Ten sites representing metropolitan, regional, acute, subacute and community sectors committed to the VSCN FTV Collaborative. Collectively the sites managed over 2000 stroke patients per annum. Six organisations (60%) had existing protocols for urinary incontinence. Post program evaluation demonstrated a 54.6 per cent average improvement in assessment of urinary continence achieved by five health services. The maximum improvement was 100 per cent documented urinary continence management plans achieved by a single site. All project leads (n = 10) gained capability in project management and redesign methodology.

**Conclusion:** Practice collaboratives are an effective way to improve adherence to clinical guidelines. Health services share knowledge, reduce duplication of effort and develop customised protocols to enable implementation. The FTV collaborative resulted in an improved application of clinical guidelines for continence management with ongoing implementation at several sites. Central coordination facilitated the process, supporting clinicians to develop project skills and use redesign methodology.

## References:

- 1 Thomas LH, Cross S, Barrett J, French B, Leathley M, Sutton CJ, Watkins C: Treatment of urinary incontinence after stroke in adults. *Cochrane Database Syst Rev* 2008;(1):CD004462.
- 2 Jordan LA, Mackey E, Coughlan K, Wyer M, Allnutt N, Middleton S: Continence management in acute stroke: a survey of current practices in Australia. *J Adv Nurs* 2011;67:94-104.

## Effects of Communication Partner Training on People with Aphasia

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**Background and Rationale:** The communication impairments associated with aphasia can have negative effects on people with aphasia (PWA), including on their involvement in rehabilitation. Communication partner training (CPT) may minimise the negative psychosocial effects of aphasia. Previous research has focused on the communication partner or dyad as a whole, rather than the PWA. Our aim was to evaluate the effects of CPT on the PWA's confidence using communication techniques, self-esteem and conversation behaviours.

**Methods:** Ten PWA were recruited from an aphasia outpatient social group. Participants completed Connect's 'Running A Conversation Partner Scheme' and then provided feedback to groups of health professionals and health professional students as part of a CPT program about their use of communication techniques during general conversation. The PWA rated their own confidence using communication techniques (100 mm visual analogue scale) and self-esteem using the Visual Analogue Scale of Self-Esteem (VASES) before and after participation in the program. Differences in the PWAs' conversation behaviours when interacting with trained and untrained students and health professionals were analysed using conversation analysis and the Kagan scales.

**Results:** After the training, the PWA were significantly more confident using communication techniques ( $p = 0.036$ ) and when training other people to use the techniques ( $p = 0.021$ ). Self-esteem did not change significantly ( $p > 0.05$ ). There was no significant difference when conversing with the trained or untrained groups according to use of conversation techniques or Kagan scales (all  $p > 0.05$ ).

**Conclusion:** CPT may improve the confidence of PWA when using and training other individuals in effective communication techniques, however, the changes may not flow on to self-esteem or behaviours during conversation. Increasing the confidence of PWA at the prospect of educating health professionals in techniques to communicate effectively with other PWA has the potential to improve the participation of PWA in rehabilitation programs.

## Safety and Feasibility of the Application of Cathodal Transcranial Direct Current Stimulation Plus Upper Limb Therapy in Acute Stroke

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**Background and Rationale:** Neuromodulation data exist for the safety of transcranial direct current stimulation (tDCS) mostly in chronic stroke cohorts (Poreisz et al, 2007; Brunoni et al, 2011; Page et al, 2015); however, the safety and feasibility of the application of this modality in acute stroke (<1 month), in particular of cathodal (inhibitory) tDCS, has not been previously reported.

**Methods:** This pilot study aimed to investigate the safety and feasibility of conducting a multisite trial of the application of ctDCS plus upper limb (UL) rehabilitation 7–15 days post-stroke; and to estimate a sample size for a phase II trial. Participants were randomised to receive 10 sessions of ctDCS (1 mA) or sham tDCS to the contralesional primary motor cortex (M1) plus concurrent UL therapy for 30 minutes over a two-week period. Fugl Meyer Upper Extremity (FMUE) scores were collated at baseline and up to three months post intervention.

**Results:** A total of 607 patients were screened over five sites for eligibility in this study over a 19-month period. A total of 126 sessions of tDCS were delivered (60 ctDCS and 66 sham tDCS). Twelve participants completed the study. No adverse events were associated with the application of ctDCS as early as seven days post-stroke. Considerable improvement was seen over time in both groups, with no statistically significant difference between groups at any time point, consequently a minimal clinically important difference (MCID) was unable to be established from the FMUE data.

**Conclusion:** The application of ctDCS in an acute ischaemic stroke cohort is safe, and feasible in a multisite trial. Data from this pilot study were unable to be used to estimate a sample size for a phase II trial. Feasibility of a phase II trial would depend on adequate funding, the allocation of trained staff at all sites, and the addition of more recruitment.

## References:

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## P157

### Trial Status and Recruitment: Very Early Rehabilitation in SpEEch (VERSE) after Stroke Trial

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**Background and Rationale:** There is limited evidence to support very early intensive aphasia rehabilitation as a best-practice standard in stroke care. VERSE is a randomised, open-label, blinded endpoint evaluation trial designed to determine whether two different types of intensive aphasia therapy, provided for 20 sessions, beginning within 14 days of acute stroke, provides greater efficacy and cost-effectiveness than usual care.

**Methods:** 246 participants with acute post-stroke aphasia who meet the selection criteria are required. Participants are stratified by aphasia severity and randomised to receive usual care (usual ward based aphasia therapy), usual care-plus (usual ward based therapy provided daily) or VERSE therapy (a prescribed aphasia therapy provided daily). The primary outcome is the Aphasia Quotient of the Western Aphasia Battery at three months. Secondary outcomes include resource use, quality-of-life and depression measures.

**Results:** 14 sites are actively recruiting to date. 4790 people with confirmed stroke have been identified since July 2014. 1149 patients had aphasia (24%) and 230 (20%) were trial eligible. Of those, 93 (42%) have been recruited (February 2015). The top two reasons for non-enrolment include: Out of area rehabilitation services (32%) and participant refusal (20%).

**Conclusion:** The post-stroke aphasia rate is lower than predicted. Our recruitment rate is higher than anticipated for this population. A new multi-site network has been built for this trial, which has slowed start up. When complete, this trial will provide Level 1 evidence to support clinical practice guidelines. Site recruitment is still open.

## P158

### Assessment of Fluoxetine in Stroke Recovery (AFFINITY) Trial: Rationale, Design and Progress

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**Background and Rationale:** Small trials, such as the FLAME trial (Fluoxetine for motor recovery after acute ischaemic stroke, *Lancet Neurol* 2011; 10: 123–30; n = 118), have suggested, but not proven, that fluoxetine may improve neurological recovery from stroke. Possible mechanisms include increased neuroprotection, neurogenesis, neuroplasticity, and mood. However, other studies report important adverse effects of fluoxetine, such as hyponatraemia, seizures and bleeding, in some patients.

**Methods:** AFFINITY is an Australasian, investigator-driven, NHMRC-funded, multicentre, randomised, placebo-controlled trial which aims to determine whether oral fluoxetine, 20 mg daily, started 2–15 days after stroke, and continued for 6 months, is safe and improves functional outcome, as measured by the modified Rankin scale (mRs), at 6 months and 12 months. The planned sample size of 1600 patients will have 90% power to detect an absolute increase in the proportion of functionally independent patients (mRs of 0–2) at 6 months from 50% to 57.5%. Substudies will measure functional MRI and blood biomarkers.

**Results:** To date, 207 patients have been randomised from 24 sites in Australia and New Zealand. Another 10 sites in ANZ are awaiting approval. Plans are underway to enable sites in Vietnam to participate. Other interested investigators and sites are invited to participate. Investigator responsibilities are randomisation and 28-day and 90-day follow up (face-to-face, phone or post). Follow-up at 6 and 12 months is central, by the AFFINITY trial office.

**Conclusion:** If fluoxetine proves safe and effective in promoting functional recovery after stroke in the AFFINITY trial, the results could be implemented rapidly, widely and affordably into routine clinical practice, and reduce the burden of disability due to stroke.

## Reference:

Mead G, Hackett ML, Lundström E, Murray V, Hankey GJ, Dennis M: The FOCUS, AFFINITY and EFFECTS trials studying the effect(s) of fluoxetine in patients with a recent stroke: a study protocol for three multicentre randomised controlled trials. *Trials* 2015;16:369.

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**P159****Changes in Upper-Limb Muscle Synergies in Chronic Stroke and with Rehabilitation**

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**Background and Rationale:** The central nervous system controls motor tasks by generating co-ordinated activation of groups of muscles, referred to as 'muscle synergies'. Muscle synergies change after stroke as a consequence of the motor deficit. To investigate the mechanisms underlying the abnormal synergies, a non-negative matrix factorisation (NMF) algorithm was used to extract muscle synergies from EMG recordings.

**Methods:** EMG was recorded from 6 more-affected upper-limb muscles in 15 stroke patients at early (day 2) and late (between days 12–14) therapy during formal Wii-based Movement Therapy (WMT) sessions. WMT is a 14-day program focused on movement quality and independence in activities of daily living. The aim of this study was to compare muscle synergies during baseball batting swings from early- to late-therapy according to the level of residual motor-function. NMF provides a quantification of muscle synergies based on the combination of the temporal activation of each synergy within the movement and the contribution of each muscle in a synergy. Motor-function was assessed at pre- and post-therapy using the Motor Activity Log Quality of Movement scale.

**Results:** NMF analysis at early-therapy revealed that three distinct synergies were needed to define the movement of 60% of patients with low motor-function; while 75% and 80% of patients with moderate and high motor-function (respectively) converged to four muscle synergies with the remainder requiring fewer synergies. By late-therapy patients with low motor-function required four synergies and although 80% and 75% of the moderate and high groups (respectively) required four, the remainder of the moderate and high groups used five muscle synergies. Motor-function was improved at post-therapy for all patients ( $p < 0.001$ ).

**Conclusion:** The number of muscle synergies reflects greater movement complexity and task-related phasic muscle activation. The increased number of synergies by late therapy suggests improved motor control and movement quality with more distinct phases of movement.

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**P160****Dual Muscle Electrical Stimulation Improved Upper Limb Paresis of Patients with Chronic Stroke**

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**Background and Rationale:** We recently developed a dual muscle electrical stimulation system that stimulates synergistic muscles during shoulder flexion, elbow extension, wrist exten-

sion, and finger extension, and reciprocal muscles during scapular abduction and adduction, elbow flexion and extension, and forearm abduction and adduction. This system improves motor functions of the hemiparetic upper limbs. Here we investigated the effectiveness of this system in chronic stroke patients.

**Methods:** Participants: The eleven patients (male: female, 6:5; mean age: 65.9 years) with chronic stroke received dual electrical muscle stimulation. Five control patients underwent training without this system.

**Interventions:** The patients undergoing dual electrical muscle stimulation of the upper limb and control patients trained for 60 min per day, 5 days per week for 3 weeks.

**Main Outcome Measure:** Outcomes were assessed using the upper extremity component of the Fugel-Meyer Assessment (FMA).

**Results:** All patients completed the training successfully using this system without any incidents or complications. The mean FMA score increased from 24.09 to 30.09. ( $p < 0.05$ ). The patients receiving this system had greater improvement in UE function than control patients (total, proximal, and distal FMA,  $p < 0.05$ , retrospectively).

**Conclusion:** This study demonstrates that our new dual muscle electrical stimulation system may be effective for rehabilitation of chronic stroke patients experiencing upper limb paresis.

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**P161****Validity of the Sensewear Armband to Measure Energy Expenditure During Walking Early after Stroke**

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**Background and Rationale:** The energy cost (EC) of walking in chronic stroke is higher compared to healthy controls; it is unclear if this is the case in acute stroke. A metabolic cart is a widely accepted reliable method to determine EC by measuring volume of oxygen uptake, but it is a highly specialised, expensive method. The SenseWear Armband (SWA) is a wireless tri-axial accelerometer that can be used to monitor EC. However, there is a lack of studies that validate the accuracy of the SWA to estimate EC post-stroke.

**Methods:** We recruited 16 participants from an acute stroke ward. Two SWAs were used to measure EC, one worn on each (affected and non-affected) arm. The SWA records movement heat flux, galvanic skin response, skin and near body temperature. The Oxycon Mobile (OM) metabolic measurement system was used to measure oxygen uptake continuously. The participants performed 2 six-minute walk tests with a 30 minute rest-period in between. For the purpose of this abstract we will report on the level of agreement between the tools in measuring energy costs during the last three minutes of a six minute walk test, i.e. steady-state walking.

**Results:** We were able to include data of 13 participants in the analyses (9 males, mean age  $75 \pm 13$ , mean days post-stroke  $4 \pm 3$ ). The level of agreement was poor ( $< 0.70$ ) (Kottner et al.

2011) between OM and SWA on the affected arm (ICC = 0.56) and non-affected arm (ICC = 0.05). However, when inspecting the correlations graphically, we found that SWA on the non-affected arm systematically overestimating EC, which was not the case for the affected arm.

**Conclusion:** The SWA armband seems to systematically overestimate the EC of walking early after stroke. The SWA should not be used on the affected arm of acute stroke participants to measure EC.

## Reference:

Kottner J, Audige L, Brorson S, Donner A, Gajewski BJ, Hrobjartsson A, Roberts C, Shoukri M, Streiner DL: Guidelines for Reporting Reliability and Agreement Studies (GRRAS) were proposed. *J Clin Epidemiol* 2011;64:96–106.

## P162

### Stroke Survivors Use More Energy While Walking Early after Stroke Compared to Age and Gender Matched Controls

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**Background and Rationale:** Several guidelines recommend that stroke rehabilitation should start early and should include cardiorespiratory fitness (CRF) training. The energy cost (EC) of physical activity has implications for prescribing individual exercise post-stroke. EC of walking is higher in chronic stroke patients compared to healthy controls. However little is known about EC early after stroke. Our aim was to determine the difference in EC of walking between acute stroke patients and matched healthy controls.

**Methods:** We recruited participants within 2 weeks post-stroke from an acute stroke ward and age and gender matched healthy controls. Participants performed 2 bouts of 6-minute over-ground walking at a comfortable walking speed, separated by a 30-minute rest-period. EC was assessed by measuring oxygen uptake in ml/kg/m over 6-minutes and steady-state (final 3 minutes of each bout) walking, by breath-by-breath analysis using a mobile metabolic cart. Differences between groups were analysed using the t-test.

**Results:** We included 13 stroke survivors (mean age of 75 SD13, mean number of days post-stroke 4 SD 3.10) and 10 age and gender matched controls (mean age 73 SD13 years) in our analysis. EC during the 6 minute walk was higher in stroke survivors ( $0.26 \pm 0.12$  ml/kg/m) compared to healthy controls ( $0.16 \pm 0.02$  ml/kg/m) with a significant mean difference of 0.10 ml/kg/m; 95% CI 0.02–0.18. EC during steady-state was also higher in stroke ( $0.28 \pm 0.12$  ml/kg/m) compared to healthy controls ( $0.18 \pm 0.03$  ml/kg/m), showing the same significant mean difference of 0.10 ml/kg/m; 95% CI 0.02–0.18 as EC during the 6 minute walk.

**Conclusion:** We showed that stroke survivors require more energy while walking compared to healthy controls. Our findings should be taken into account when setting individual exercise intensity goals early post-stroke and it may help to inform the development of more specific exercise prescription guidelines for stroke survivors.

## P163

### Predictable Neuropsychological Tests on Driving Ability for Patients with Brain Disorders

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**Background and Rationale:** Predicting driving ability for patients with brain disorder is difficult problem. Purpose of this study is to investigate the best combination of neuropsychological tests to predict driving ability for patients with brain disorders.

**Methods:** We conducted retrospective survey on 80 participants with brain disorder including stroke, traumatic brain injury and brain tumor who underwent on-road evaluation during 2006 and 2015. All eligible data were analyzed by logistic regression analysis with backward stepwise manner entering neuropsychological test results as independent values and pass or fail on-road evaluation results as dependent values. After developed the model, the validity was tested by predicting the results of driving evaluation for another 36 participants. The statistical analysis was conducted by SPSS ver. 17.

**Results:** 20 and 60 participants were classified into either of the 'Fail' and 'Pass' the based on the on-road test. There were significant difference on TMT-A, B, Kohs IQ, Rey copy, immediate recall and Star cancellation between groups ( $p < 0.05$ ). Logistic regression analysis suggested that TMT-A and Kohs IQ were best combination to predict driving ability (Area under the curve 0.83). This model correctly classified 77% of another 36 participant with 80% and 76% on sensitivity and specificity.

**Conclusion:** Driving requires integrated cognitive functions including visual attention, spatial cognition and executive function. The results indicated that visual attention and spatial cognition, assessed by TMT-A and Kohs, may be important cognitive functions related to driving ability. Further studies with increased number of participants are needed.

## P164

### Effect of Vibrator Stimuli for Patient with Dyskinesia

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**Background and Rationale:** Dyskinesia is known as an involuntary movement that occurs through a combination of neurological symptoms including dystonia, chorea, and tremors. Re-



cently, the possibility of vibrator stimuli reducing dyskinesia was reported. In this study, we reported the effect of vibrator stimuli on tremors.

**Methods:** 70-year-old woman who suffered limb dyskinesia due to chronic subdural hematoma. Her ICARS score was 32/100 and FIM eating score was 6 points. To reduce the dyskinesia, vibrator stimuli (THRIVE, Daito Co., Ltd) was applied to 16 points, including wrist extensor and flexor, triceps, biceps, and quadriceps for one minute, respectively, per day for three weeks along with conventional physical therapy. The surface EMG of upper limbs during nose-finger test, and ICARS score were compared before and after the sessions.

**Results:** In the EMG, the average amplitude of the wrist extensor muscle and biceps during nose-finger test increased from 18.9  $\mu$ V to 35.9  $\mu$ V and 12.6  $\mu$ V to 42.1  $\mu$ V, respectively.

Her ICARS score also improved from 32 to 21. Finally, her FIM eating was increased to 7 points.

**Conclusion:** We determined that short-term vibrator stimuli has the potential to improve dyskinesia through this case. Earlier studies reported that increasing proprioceptive information by vibrator stimuli might be effective against tremors. In this case, the enhanced proprioceptive information induced by vibrator stimuli may improve dyskinesia. Further studies with increased number of patients are needed to verify the efficacy of vibrator stimuli to dyskinesia.

#### P165

### Relationship between Lower Limb Coordination and Walking Speed after Stroke

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**Background and Rationale:** Even after recovery of strength, many people with stroke walk slowly, and this may be the result of poor lower limb coordination.

**Aim:** To examine the relationship between walking speed and coordination after stroke.

**Methods:** An observational study was conducted with 30 people with stroke and 30 healthy controls. Inclusion criteria for stroke was recovery of lower limb strength (i.e.  $\geq$  Grade 4) and walk at  $>0.6$  m/s without aids and in barefeet (with recruitment stratified so that walking speed was evenly represented across the range). Walking speed was measured during the 6-min Walk Test and reported in m/s. Coordination was measured using the Lower Extremity Motor Coordination Test (LEMOCOT) reported in taps/s.

**Results:** The stroke group were 2 years after their stroke, walked at 0.97 (SD 0.26) m/s during the 6-min Walk Test, and performed the LEMOCOT at 1.20 (SD 0.34) taps/s. The healthy controls walked at 1.43 (SD 0.30) m/s during the 6-min Walk Test,

and performed the LEMOCOT at 1.85 (SD 0.36) taps/s. The relationship between LEMOCOT scores and walking speed for the stroke group was  $r = 0.50$  ( $p < 0.01$ ).

**Conclusion:** People with stroke were operating at about two-thirds of their age-matched counterparts in both their coordination and walking speed. In stroke group with enough strength to walk, coordination was strongly related to walking speed, suggesting that loss of coordination may contribute to slow walking. These findings suggest that once people after stroke have regained sufficient strength to walk at reasonable speeds, intervention targeting coordination may produce faster walking.

#### P166

### Functional Connectivity Recovery in Patients with Transcortical Sensory Aphasia Subsequent to a Left Frontal Lobe Infarction

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**Background and Rationale:** Transcortical sensory type of aphasia (TSA) is usually caused by the left temporoparietal lobe lesions. Rarely, however, patients with left frontal lobe lesion presenting TSA have been reported. Several explanations for impaired auditory comprehension ability in those patients have been proposed: hypoperfusional deficits in their posterior language area, frontal involvement in syntactic comprehension, or anomalous language representation.

**Methods:** We studied two patients with TSA after an infarction in the left frontal lobe. The results of diffusion and perfusion-weighted MRI completed on the day of their stroke onset revealed there was no diffusion-perfusion mismatch. Speech-language assessments for aphasia and functional MRI (fMRI) studies to verify the assumption of inter/intrahemispheric transposition of the language area were performed 2–5 days after the onset of their stroke. As the task of fMRI study, verb generation and sentence completion task were used. Resting-state functional MR (rs-fMRI) images were also obtained for network level analysis using probabilistic independent component analysis (ICA). As control subjects, a patient with acute transcortical motor aphasia (TMA) and a healthy normal (HN) adult were recruited. For TSA patients, rs-fMRI test was repeated on the day of follow-up aphasia test about 3 months after the stroke onset.

**Results:** The results of initial K-WAB in patients with TSA demonstrated mild to moderate (TS1, aphasia quotient: AQ = 76.1/100) and moderate to severe (TS 2, AQ = 40.2/100) aphasia. Both patients showed difficulties even in word level as well as sentences. The results of initial fMRI in TSA patients revealed some individual differences but there were no reversed inter/intrahemispheric activation patterns comparing to control subjects in each task. The results of probabilistic ICA in initial rs-fMRI test performed in acute stage of stroke showed significantly decreased resting state-functional connectivity in language network compared to the control subjects. The results of the follow up rs-fMRI study in TSA patients clearly demonstrated the functional connectivity changes correlated with language recovery (TS1, AQ =

94.0/100; TS2, AQ = 67.3/100) comparing to those of initial study. The enhancement of functional connectivity in frontoparietal network was prominent in later stage of stroke.

**Conclusion:** The results of our study clearly demonstrated the functional disconnections between language centers in acute stage of stroke and functional connectivity changes with language recovery in later stage. Therefore, it can be suggested that auditory comprehension deficits in our patients represent problems accessing the posterior language area due to their frontal lobe lesion and they recruit altering functional connectivity as the recovery of language.

## P167

### Translating Clinical Practice Guidelines into Rehabilitation Using Audit and Feedback

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**Background and Rationale:** There is evidence of a gap between the rehabilitation that stroke patients receive and what that is recommended in clinical practice guidelines (CPGs). Audit/feedback on adherence to CPGs are usually provided in limited doses with great expectation for change in behaviour. This study evaluated the effects of a sustained, fortnightly intervention of audit/feedback on adherence to stroke rehabilitation CPGs.

**Methods:** Using a periodic service review methodology, rehabilitation care was audited fortnightly for a year against ten published CPGs, including the National Stroke Foundation Rehabilitation guidelines. Together these CPGs produced n = 132 observable criteria. Each fortnight, two patients were randomly selected and audited against the observable criteria. Adherence was graphed and summarised into rehabilitation intervention areas, and feedback sessions were then facilitated with clinicians. These feedback sessions summarised the observed clinical adherence and, using a positive behavioural support model, encouraged clinicians to adjust their performance.

**Results:** Twenty three audit/feedback cycles were completed during the study. Adherence to the CPGs was observed during the study period, resulting in an improvement from 34% to 96% adherence to the possible 132 guidelines (baseline to end of year). Thus, using an audit/feedback intervention achieved a 54% increase in adherence to CPGs (p = 0.0001).

**Conclusion:** Findings have demonstrated that it is possible to improve clinical adherence to rehabilitation CPGs using an intensive audit/feedback method. To achieve sustainable change in practice we recommend that audit/feedback is incorporated into usual rehabilitation, and thus, becomes the responsibility of clinicians rather than researchers.

## P168

### Attend (Family Led Rehabilitation after Stroke in India) Trial: Potential for Better Stroke Rehabilitation Access in India

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**Background and Rationale:** India's limited manpower of 800 neurologists and 35,000–70,000 physiotherapists for 1.2 billion people results in limited rehabilitation and thus significant excess disability post-stroke. The situation is far worse for rural patients who cannot easily access public or tertiary level hospital care. Hence novel models of stroke rehabilitation are required.

**Methods:** The ATTEND Trial is a prospective randomised outcome blinded (PROBE design) multicentre study in India with a sample size of 1,200 across 14 sites in India.

The multidisciplinary team skills in the hospital or hospital stroke unit is condensed into a trained stroke co-ordinator, who acts as a 'virtual multidisciplinary team' delivering structured intervention to the patient-caregiver dyad. This duo, as led by this now trained caregiver, practices home-based stroke rehabilitation including multidimensional therapy, nursing and other stroke care practices, in liaison with the stroke co-ordinator who makes further home visits, supported by a written manual and phone calls upto 2 months post-randomisation. The control group gets routine care alone.

The primary outcome is modified Rankin Score at 6 months. Activities (and Extended) Activities of Daily Living, caregiver burden and quality of life are also assessed. Funding is from the Australian National Health and Medical Research Council.

**Results:** As of now, the trial has successfully recruited 1200 patients.

**Conclusion:** The ATTEND study, if positive, could help create access to low-cost rehabilitation services from either the hospital or the community to maximise recovery after stroke.

## P169

### Differences in Spatiotemporal Parameters of Gait and Quality of Life of Stroke Survivors Based on Functional Gait Assessment Performance

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**Background and Rationale:** Stroke survivors aspire to be safely and independently mobile within home and community (Lord et al, 2004) with walking linked to independence and com-

munity participation (Ada et al, 2009). Walking in the community requires stroke survivors to adapt to a variety of challenges (Shumway-Cook et al, 2002). Assessment tools including graded challenges required by community ambulation, such as the Functional Gait Assessment (FGA), may be more useful for clinicians.

**Methods:** Twenty-nine community ambulating stroke survivors were recruited through advertisements, the Stroke Association of Queensland and private neurological physiotherapists. Spatiotemporal gait parameters were recorded while the FGA was undertaken on the GAITRite instrumented walkway. Quality of life (QOL) was measured using the Assessment of Quality of Life (AQoL-6D). FGA score was used to differentiate spatiotemporal gait parameters and QOL of stroke survivors.

**Results:** Participants had a mean age of  $62.31 \pm 10.89$  years, mean time since stroke of  $3.78 \pm 4.10$  years, and included both genders, left and right sided strokes. Stroke survivors scoring higher ( $>22/30$ ) on the FGA had significantly increased velocity and step length, decreased stride width and single support variability, and higher scores on the AQoL-6D for the dimension of Independent Living ( $p < 0.05$ ).

**Conclusion:** The FGA is a clinical measure of functional gait able to differentiate the spatiotemporal gait parameters and QOL of chronic stroke survivors. The FGA can be used to help inform targeted interventions related to step length, stride width, single support and velocity of gait to improve functional walking performances of chronic stroke survivors.

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### P170

#### Upper-Limb Proprioception But Not Cutaneous Sensation Is Improved during a 14-Day Program of Wii-Based Movement Therapy

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**Background and Rationale:** Impaired sensation introduces another mechanism that potentially contributes to motor dysfunction post-stroke, independent of reduced descending motor drive from the lesioned hemisphere. Yet neither sensation nor changes in sensation with rehabilitation are routinely quantified

post-stroke. We investigated the effects of upper-limb motor rehabilitation on proprioception and cutaneous sensation in chronic stroke.

**Methods:** Forty-two stroke patients (aged 18–10 years, 3–264 months post-stroke) completed the standardised 14-day protocol of Wii-based Movement Therapy. Six positions of wrist proprioception were tested using a position-matching task. Cutaneous sensation was tested with calibrated monofilaments at six sites, with a subset also tested using standard clinical methods for light touch and sharp/blunt sensation. Upper-limb motor-function was assessed using the Wolf Motor Function Test-timed tasks (WMFT-tt) and Motor Activity Log (MAL).

**Results:** All patients had significantly improved upper-limb function (WMFT-tt  $p < 0.001$ ) and independence in everyday task (MAL,  $p < 0.001$ ). The change in proprioception only became apparent when patients were classified according to baseline residual voluntary motor capacity for wrist extension on the more- ( $=0.01$ ) and less- ( $p < 0.001$ ) affected sides; but only for the more-affected side in wrist flexion ( $p = 0.01$ ). Within each motor-function group opposite patterns of change were noted between the more- and less-affected sides during wrist extension and flexion. Cutaneous sensation did not change with therapy and was categorised as ‘present’ for all patients on clinical testing, including for those with monofilament thresholds within the zone of impaired sensation (ie  $>0.06$  g at the fingertip, or  $>0.1$  g on the palm).

**Conclusion:** Our results demonstrate that although sensation was not addressed during therapy, Wii-based Movement Therapy has the capacity to induce bilateral changes in proprioception but not cutaneous sensation after stroke. These data provide the evidence on which to incorporate targeted sensory training as an adjunct to upper-limb motor rehabilitation.

### P171

#### Towards a Mechanism Based Treatment in Brain Protection and Recovery after Stroke. New Clinical Data

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**Background and Rationale:** We identified neuroprotective and neurorehab therapies and reports of clinical efficacy via a systematic search. Controlled clinical studies were selected for analysis.

**Methods:** Relationships between outcome, drug mechanism, scope of testing, and clinical trial status were assessed statistically. Brain damage after focal ischemia affects all three levels of structural and functional organization of the brain and launches an endogenous defense response which consists in neuroprotection (the immediate response) and neurorecovery (a later response).

**Results:** There has been a substantial effort in understanding brain function, by using a large spectrum of neurotechnologies such as imaging techniques, quantitative electroencephalogram, magnetoencephalography, eye tracking, cognitive testing and more. The combination between these technologies provide valuable information about the structure-function relationship under-

ling task and resting-state networks, about the abnormalities in the functional connectivity after stroke and how to enhance endogenous recovery. Neurorecovery can be enhanced by pharmacological and non-pharmacological interventions (physical and cognitive activity, psychological support, environmental stimulation, electrical and magnetic stimulation) or any demonstrated combinations of these factors capable of improving the patient's condition after stroke.

**Conclusion:** From the pharmacological perspective, agents with multimodal and pleiotropic neuroprotective effects, capable to mimic the function of endogenous molecules, are better approach in brain protection and recovery than monomodal agents, especially when they are associated with comprehensive physical program.

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## P172

### **Lateral Step Up Test (LSUT): Reliability and Associations with Motor Functions in People with Chronic Stroke**

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**Background and Rationale:** Muscles weakness is common after stroke, and it could impede the performance of daily motor functions including standing up from sitting, walking on level ground, and walking up and down stairs. Thus, clinicians need a reliable, valid and easy-to-administer outcome measures in order to document the changes of muscle strength during the rehabilitation process.

The Lateral Step Up Test (LSUT) is one of the clinical tests which can quantify the functional muscle strength of the lower extremity. A 10 cm step was used and placed at one side of the subject. Subjects were required to extend the tested leg on the step into full extension, and then return to flexion until the non-tested leg touches the floor. Number of counts completed in 15 seconds was recorded. The objectives of this study was to investigate the reliability of LSUT and its correlation with stroke-specific impairments.

**Methods:** This study was a cross-sectional clinical trial with 33 people with chronic stroke. LSUT counts was administered along with Fugl-Meyer motor assessment for the lower extremities (FMA-LE), muscle strength of affected leg, Five Times Sit to stand test (FTSTS), Berg Balance Scale (BBS), timed Up and Go test (TUG) and Activities-specific Balance Confidence (ABC) scores. The LSUT was conducted in 2 sessions with 5–7 days apart by 2 independent assessors. The order of testing on motor functions was randomized by drawing lots.

**Results:** Both paretic and non-paretic LSUT counts showed excellent intra-rater, inter-rater and test-retest reliabilities (intra-

class correlation coefficients = 0.936–0.991) Significant correlations were found between both paretic and non-paretic LSUT counts and FMA-LE scores, muscle strength of knee extensors and flexors, FTSTS times, BBS scores, TUG times and ABC scores.

**Conclusion:** LSUT is a reliable, valid and easy-to-administer clinical assessment for assessing the functional muscle strength in people with chronic stroke.

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## P173

### **Toe Tap Test (TTT) for Assessing People with Chronic Stroke**

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**Background and Rationale:** Impaired ankle control is common in stroke survivors (Ng & Hui-Chan 2012, 2013). Ankle control, including ankle dorsiflexion and plantarflexion, is important in regaining normal gait pattern after stroke. Indeed, ankle dorsiflexor strength was independently associated with the walking endurance (Ng & Hui-Chan 2013) and functional mobility (Ng & Hui-Chan 2013) of stroke survivors. In order to reflect changes in ankle control during the rehabilitation process, a reliable, valid and comprehensive measurement tools for assessing ankle control are definitely needed.

Toe tap test (TTT) was initially introduced as a simple toe-tapping test to determine speed of ankle control in healthy adults (Kent-Braun & Ng 1999). Each subject was required to sit with knee and hip at 90 degrees of flexion, and maintain their heel on floor. Then, subjects were instructed to tap the floor as rapid as possible for 10 seconds.

The objectives of this study were to investigate: (1) the inter-rater and test-retest reliability, (2) the correlation of TTT counts with other measures of stroke-specific impairments (3) minimal detectable change (MDC) of TTT counts.

**Methods:** It was a cross-sectional study with 37 subjects with chronic stroke. The main outcome measured included: TTT counts, Fugl-Meyer Lower Extremity assessment (FMA-LE); ankle muscle strength; Five Times Sit-to-Stand Test (FTSTS) times; Berg Balance Scale (BBS) and Timed 'Up and Go' test (TUG) scores.

**Results:** Excellent intra-rater and test-retest reliability (ICC = 0.725–0.995) of TTT counts were found. The TTT counts of paretic legs were significantly associated with FMA-LE, ankle dorsiflexor and plantarflexor strength, BBS score, FTSTS completion time and TUG score. The 95% MDC of TTT counts was 8.7 counts and 12.6 counts of the paretic and non-paretic legs, respectively.

**Conclusion:** The TTT counts is a reliable and valid measurement tool for assessing the ankle control of subjects with chronic stroke.

**Acknowledgement:** This study was supported by the General Research Fund (Ref.562413) from the Research Grant Council of Hong Kong to Dr. Shamay Ng and her team.

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## P174

### Characteristics of Paradoxical Cerebral Embolism Associated with Isolated Pulmonary Arteriovenous Fistula

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**Background and Rationale:** Paradoxical embolism due to pulmonary arteriovenous fistula (PAVF) is by far rare cause of cryptogenic stroke (Moussouttas et al. 2000). Isolated PAVF, PAVF without Rendu-Osler-Weber disease and no significant vascular risk factors, is known to cause right-to-left shunt (RLS) and are associated with stroke, transient ischemic attack or migraine (Kimura et al. 2004). We investigated the clinical and radiological characteristics of paradoxical cerebral embolism associated with isolated PAVF.

**Methods:** Among 2453 acute stroke patients from our stroke registry database from 2008 to 2015, we selected four patients with PAVF confirmed by RLS on transesophageal echocardiograph (TEE) and digital subtraction angiography. Clinical features, stroke risk factors and radiological findings are analyzed.

**Results:** All patients were female (age: 41 to 68). No specific vascular risk factors exist except migraine in one patient. Clinical manifestations were diverse with transient motor weakness, hemisensory deficit, aphasia, Gerstmann syndrome and visual field defect. Stroke pattern on brain MRI showed also various; bilateral or unilateral, cortical or subcortical or mixed, middle or posterior cerebral artery territory. All patients showed RLS in agitated saline test on TEE but no abnormalities on transthoracic echocardiography. Plain chest films were all normal but chest CT showed abnormal dilatation of pulmonary vessels. Embolization with coil or plug were performed in all patients.

**Conclusion:** Patients in our study have all isolated PAVF and were female. Clinical and radiological features are various and not

specific for diagnosis of PAVF. Patients with cryptogenic stroke should be evaluated with TEE, chest CT or pulmonary angiography for the detection of isolated PAVF.

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## P175

### Application of Machine Learning to Understand Clinician's Rationale for Requesting Driving Tests Post Stroke

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**Background and Rationale:** Returning to drive is an important aspect of resuming normal function after stroke. There is lack of information guiding decisions on returning to drive. Only some ambulatory patients are referred for driving assessments after stroke. Understanding the reasoning behind this process can help clinician to better manage these patients. The aim of this study is to discover patterns which lead clinicians to request driving tests after stroke.

**Methods:** Medical records were searched for ambulatory patients presenting with a stroke at Monash Health (2010–2014). Those undergoing driving tests with an Occupational Therapist were included. We used non-negative matrix factorisation (NMF), an unsupervised machine learning method which extracts latent (hidden) patterns from observed clinical features with the constraints that the hidden variables are non-negative. The matrix for NMF decomposition consists of rows of patient data and columns containing NIHSS sub-component and disability Rankin scores and demographic data. The results are correlations between the observed and hidden variables. This method was chosen as it is not biased by the investigators' ideas on this subject.

**Results:** There were 82 subjects, mean age of  $62.7 \pm 12.1$  years, 74% male. The frequency of clinical deficits were: visual field deficit in 12%, visual extinction (neglect) in 15%, aphasia in 33%, and motor deficit in 74%. The heat-map of the coefficients shows the top ranked patterns were: 1) demographic features (age and male sex); 2) cognitive features consistent with right middle cerebral artery territory infarct (extinction, visual field deficit and sensory disturbance); 3) disability score, while the Rankin score, motor deficit and aphasia ranked the lowest.

**Conclusion:** Unsupervised machine learning methods may assist in provide an understanding of hidden patterns underlying a clinicians' decision to refer patients with stroke for driving tests.

## Reference:

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## P176

### Impact of Corticofugal Tracts to Disability and Motor Deficit in Subcortical Stroke: Hierarchical Partition Analysis

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**Background and Rationale:** Motor outcome following subcortical stroke may depend on integrity of the descending motor corticofugal tracts (primary motor cortex (M1), premotor area (PMdv) and supplementary motor area (SMA)). The aim of this study is to assess the independent contribution of corticofugal tracts to disability and motor deficit in patients with subcortical stroke.

**Methods:** Patients with subcortical infarcts on MR imaging admitted to our institution (2009–2011) were included. Stroke deficit were classified according to the National Institute of Health Stroke Scale (NIHSS) at 90 days. The infarcts were manually segmented, registered into standard space. In normal subjects ( $n = 16$ ), the corticofugal tracts were delineated using diffusion tractography and registered to standard space. Due to potential collinearity (relatedness) among the corticofugal tracts, the independent contributions of each corticofugal tract to disability were assessed by hierarchical partition of the goodness of fit of the regression models.

**Results:** There were 57 patients (57% male) with mean age  $64.3 \pm 14.4$  year-old. The variance inflation factors/VIF were 1.1 for age, 8.5 for M1, 27.1 for SMA and 45.9 for PMdv (VIF >10 suggest the presence of collinearity). The generalised  $R^2$  for the disability model was 0.52, motor arm and leg deficit were 0.33. The analysis showed that M1 tract had greater independent effect on motor arm deficit and disability. Age had greater independent effect on motor leg deficit.

**Conclusion:** The hierarchical partition analysis revealed differential effect of corticofugal tracts on disability and motor deficit. M1 tract involvement has greater role in motor arm deficit than motor leg deficit.

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## P177

### Impact of Time Post Stroke on Successful Return to Driving

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**Background and Rationale:** Returning to driving is an important aspect of resuming normal function after stroke. We aimed to correlate stroke severity with ability to pass a driving test, an area on which there is little or no previous information.

**Methods:** Medical records at Monash Health were searched for patients presenting with a stroke from 2010–2014. Ambulatory patients who underwent on-road occupational-therapy assessment for suitability to drive were included. The initial National Institute of Health Stroke Scale (NIHSS) score was extracted from the medical records as a measure of stroke severity. The data were partitioned into 3 groups: group 1-fail and never drive again (G1); group 2-fail initial test but pass subsequently (G2); and group 3-pass first time (G3). Analysis-of-variance and chi-square tests were used for continuous and categorical data analyses respectively.

**Results:** There were 71 of 81 patients who successfully passed the on-road driving test, mean age  $62.8 \pm 12.1$ , 74% male. The total number of patients who passed the driving test continued to increase with time. However, there were no statistical differences between the 3 groups (G1, G2, G3 respectively) in: age ( $64.8 \pm 9.28$  versus  $61.3 \pm 12.4$  versus  $63.1 \pm 12.7$ ), NIHSS ( $6.90 \pm 5.04$  versus  $6.89 \pm 5.55$  versus  $6.05 \pm 4.31$ ), time to initial driving test ( $317 \pm 211$  versus  $396 \pm 379$  versus  $283 \pm 362$ ), and disability Rankin score at 90 days ( $1.6 \pm 0.84$  versus  $1.17 \pm 1.15$  versus  $1.40 \pm 0.99$ ).

**Conclusion:** In this hospitalised sample of post-stroke ambulatory patients who underwent driving assessment, there were no differences in clinical features among the groups. Time may be a key factor behind successful return to driving, as a proxy for different individual rates of recovery.

## P178

### A Multimodal Investigation of Motor Heterogeneity and Motor Recovery in the Chronic Period Post-Stroke

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**Background and Rationale:** Stroke is characterised by substantial heterogeneity that complicates outcome prediction and the optimisation of stroke management and recovery. Much of this variability cannot be accurately modelled using conventional clinical and neuroimaging measures. Here a rich multimodal dataset was utilised to undertake exploratory analyses investigating novel

correlates of motor heterogeneity, and potential predictors of motor improvement following targeted post-acute therapy.

**Methods:** 10 chronic stroke patients (35–75 years, 3–45 months post-stroke) with a wide range of residual voluntary motor-function completed a 14-day upper-limb rehabilitation protocol of Wii-based Movement Therapy. Patients completed a suite of multimodal assessments at baseline, including: clinical motor assessments; neurophysiological assessment via transcranial magnetic stimulation; structural and diffusion MRI; and magnetoencephalography (MEG). Multivariate stepwise regression modelling was used to identify predictors of i) chronic baseline motor-function, and ii) post-therapy motor improvements.

**Results:** At baseline, the absence of a motor evoked potential (MEP) and reduced fractional anisotropy of the ipsilesional relative to contralesional corticospinal tract together predicted poorer motor-function ( $r^2 = 0.874$ ,  $p = 0.002$ ). Motor improvements were evident for all patients post-therapy, where MEP absence was identified as the only significant predictor of greater post-therapy improvement ( $r^2 = 0.916$ ,  $p < 0.001$ ). MEG measures correlated with both baseline motor-function and therapy improvements but did not appear to improve predictive power.

**Conclusion:** Measures of corticospinal tract integrity are important predictors of chronic baseline motor-function, but play a different role in predicting therapy gains in the post-acute period. While MEP absence is associated with poorer function at baseline, here it strongly correlated with greater therapy gains and thus should not be assumed to indicate poor recovery potential. Even patients with low motor-function and compromised corticospinal tract integrity can make meaningful gains with therapy.

#### P179

### Variance in Stroke Regional Liaison Pathway Among Patients with Brain Infarction during Convalescence Phase

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**Background and Rationale:** In our stroke regional liaison pathway, we defined as ‘variance’ when a patient dies in convalescent hospital or is re-admitted to an acute hospital for treatment of acute complication. We compared the patients with variance to those without variance to know the factors for prediction.

**Methods:** Subjects are 416 patients with variance (variance group) and 3569 patients without variance (non-variance group) among 4146 patients who were registered in stroke regional liaison pathway in convalescent hospitals. We compared sex, age and length in acute hospital stay before transfer to convalescent hospital between the groups. Among determinable main causes of variance, we worked out the frequencies of stroke recurrence, infection and heart disease.

**Results:** In variance group, patients were significantly older (78.9 y.o. vs. 75.2 y.o.) and had longer acute hospital stay (21.1 days vs. 17.1 days) than non-variance group ( $p < 0.01$ ). No sex difference was observed between them. We observed stroke recur-

rence in 76 cases (18.3%), infection in 63 cases (15.1%) and heart disease in 55 cases (13.2%) These three accounted for about half of the causes of variance (46.6%).

**Conclusion:** Higher age and longer stay in acute hospital stay have relationships with variance. We should pay attention to stroke recurrence, infection and heart disease to avoid variance.

#### P180

### Stratifying Upper-Limb Motor-Function Post-Stroke – Refining an Existing Scheme for Clinical Practice

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**Background and Rationale:** A new stratification scheme for upper-limb motor-function was developed in 2014 (Thompson-Butel, 2014) whereby patients are stratified as low, moderate or high motor-function depending on their ability to complete two tests of dexterity, the Box and Block Test (BBT) and the grooved pegboard test. However, further investigation is required to determine the strength of this scheme in a larger cohort and to confirm if the pegboard time limit must be refined for use in clinical practice.

**Methods:** 90 patients' pre-intervention scores were collated from upper-limb rehabilitation studies targeting community-dwelling stroke survivors with upper-limb impairment. Function was assessed with the Wolf Motor Function Test (WMFT), Fugl-Meyer Assessment (FMA), BBT and grooved pegboard. Hypothesis-free hierarchical cluster analyses of all assessments were used to generate 2-, 3-, 4- and 5-cluster models. Raw values were standardized on a 0–1 scale in all analyses. The derived clusters were compared to the proposed stratification scheme.

**Results:** The 3-cluster models from both the hypothesis-free and hypothesis-driven analyses matched the stratification scheme with one misclassification. On further examination this misclassification was due to the patient's fear avoidant behaviour during assessments and thus was not a true representation of his motor-function. Interestingly, the 4-cluster analysis identified a new group of patients with very-high motor-function. The 2- and 5-cluster models showed no clear groupings. More-affected pegboard times ranged from 66.45–1503.41s ( $n = 38$ ) with 87% of participants placing all 25-pegs within 5-minutes.

**Conclusion:** Stratifying motor-function is essential to developing sensitive and tailored rehabilitation programs post-stroke. The scheme described by Thompson-Butel remains an objective way to stratify stroke survivors upper-limb motor-function. However, it is clear that a 10-minute pegboard time limit with clear peg placement instructions is required to maintain a time-efficient set of tools for clinical practice. All four upper-limb measures are required to identify patients with very-high motor-function.

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### P181

#### The Activity Card Sort – Australia: Validation and Reliability in an Australian Stroke Cohort

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**Background and Rationale:** Participation is a broad concept and difficulties operationalizing it have been reported (Dijkers, 2010). In a review of participation measures used in clinical stroke studies, the Activity Card Sort (ACS) was identified as the tool that covered the most domains of the ICF Activities and Participation and met the most psychometric properties (Tse, Douglas, Lentin, & Carey, 2013). The aim of this study was to evaluate the validity and reliability of the ACS-Aus in an Australian stroke cohort.

**Methods:** Stroke survivors recruited through the STroke imaging pRevention and Treatment (START) – Extending the time for Thrombolysis in Emergency Neurological Deficits and START\_Prediction and Prevention to Achieve Optimal Recovery Endpoints (n = 100) were assessed using the Activity Card Sort – Australia (ACS-Aus), the Stroke Impact Scale and the Modified Rankin Scale at 3 and 12 months post-stroke.

**Results:** The internal consistency for the ACS-Aus total retained activity participation score was excellent ( $\alpha = 0.91$  at 3 months,  $\alpha = 0.89$  at 12 months) and moderate to excellent for the sub-categories of the ACS-Aus ( $\alpha$  ranged from 0.67 to 0.85 at 3 months and 0.72 to 0.84 at 12 months). The ACS-Aus demonstrated moderate to good concurrent validity with correlations with the SIS-Participation score ( $\rho = 0.61$   $p < 0.001$  at 3 months,  $\rho = 0.47$   $p < 0.001$  at 12 months), moderate to good convergent validity with correlations with the Modified Rankin Score ( $\rho = 0.52$   $p < 0.001$  at 3 months,  $\rho = 0.46$   $p < 0.001$  at 12 months).

**Conclusion:** The ACS-Aus is a valid and reliable measure of activity participation after stroke. Future studies are needed to examine further the psychometric properties for people with different diagnoses.

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### P182

#### Longitudinal Changes in Activity Participation after Mild Stroke

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**Background and Rationale:** Since the endorsement of the World Health Organization International Classification of Functioning, Disability and Health in 2001, participation has become a term used by health professionals and is considered a critical outcome of successful rehabilitation. Yet few longitudinal studies of participation exist. Therefore, the research question for this study was ‘does activity participation improve over time in the first year of recovery after stroke?’

**Methods:** Stroke survivors recruited through the STroke imaging pRevention and Treatment (START) – Extending the time for Thrombolysis in Emergency Neurological Deficits and START\_Prediction and Prevention to Achieve Optimal Recovery Endpoints were assessed using the Activity Card Sort – Australia (ACS-Aus) at 3 and 12 months post-stroke. The scores used in this study were pre-stroke and current activity participation at 3 month and 12 month, with sub-categories of high- and low-demand leisure, social/educational and household activities.

**Results:** The mean age of the study participants 69 years (range 27 to 90 years) and the majority had National Institutes of Health Stroke Scale scores below five consistent with mild neurological stroke severity. Significant improvements in current activity participation from 3 months to 12 months was observed ( $t = -4.5$  95% CI  $-4.2$  to  $-1.7$ ,  $p < 0.01$ ). All sub-categories of the ACS improved over time with greatest improvement in low-demand leisure activities. The average number of activities the participants engaged in pre-stroke, at 3 months and 12 months post stroke showed a decrease at 3 months that improved by 12 months but did not return to pre-stroke numbers.

National Institutes of Health Stroke Scale.

**Conclusion:** This study is the first longitudinal study using the ACS, a comprehensive and psychometrically sound measure of participation, in stroke survivors with mild stroke severity in the first year of recovery after stroke.



## Depression and Anxiety Following a Transient Ischemic Attack

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**Background and Rationale:** Anxiety and depression are common among patients after stroke and cardiac events and are known to impede physical recovery and secondary prevention strategies. However less is known about the emotional experience of patients following transient ischemic attack (TIA).

**Methods:** Participants had been diagnosed with TIA and were attending the outpatient stroke nurse practitioner clinic at the Royal Melbourne Hospital. Following their clinic appointment participants completed qualitative and quantitative assessments of mood and health with a trained researcher, including a structured clinical interview for DSM IV Major Depressive Episode (MDE). Participants were reassessed three months later by telephone.

**Results:** Fifty-one participants completed the baseline assessment (aged 24–94, mean = 69.4, SD = 14.9 years, 67% male), with 46 (90%) completing the 3-month follow-up. At baseline, 10% met criteria for MDE in the past 6 months, with 22% meeting criteria during their lifetime. Self-report questionnaires indicated that 14% and 9% of participants scored above threshold (Patient Health Questionnaire-9 >9) for current depression symptoms at baseline and follow-up respectively; while 10% and 11% reported above threshold (GAD7 >9) anxiety symptoms at the same time-points. Of those receiving mental health care in the previous three months (n = 7 baseline; n = 4 follow-up), care was primarily provided by the general practitioner. Satisfaction with mental health care was rated as 'very good' or 'excellent' by 72% at baseline, 75% at follow-up.

**Conclusion:** We found depression and anxiety rates lower than those generally seen in stroke populations, but higher than general population studies. General practitioners provide the majority of care. Future studies could investigate the role of mental health clinicians (psychologists, nurses) in supporting TIA patients with anxiety and/or depression.

## Aerobic Exercise to Increase Efficacy of Task-Specific Training for the Upper Limb after Stroke: A Pilot Study Protocol

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**Background and Rationale:** Recent research suggests that improvements in motor function as a result of motor learning may be enhanced if aerobic exercise is paired with the motor training. One potential mechanism is that aerobic exercise can increase concentrations of brain-derived neurotrophic factor (BDNF) which is important in processes of synaptic plasticity (e.g. long-term potentiation) involved in motor skill learning and motor memory consolidation.

**Methods:** A two-arm single-blinded randomised pilot study will be performed in which stroke survivors will be randomly allocated to either a task-specific training group or a combined aerobic exercise and task-specific training group. Both groups will perform 60 hours of task-specific training with the affected upper limb over 10 weeks, comprised of 3x1 hour sessions per week with a physiotherapist and 3x1 hours of home-based self-practice per week. The combined intervention group will also perform 30 minutes of aerobic exercise immediately prior to the 1 hour task-specific training session with the physiotherapist. Outcome measures will be performed pre-randomisation at baseline, after completion of the training program and at 1 and 6 months follow-up. Primary outcome measures will be the Action Research Arm Test and Wolf Motor Function Test, and secondary outcome measures will include the Stroke Impact Scale, Motor Activity Log and peripheral blood serum BDNF concentration.

**Conclusion:** If aerobic exercise prior to task-specific training improves upper limb function more than task-specific training alone, this combination of interventions could further improve outcomes for patients, and would merit further investigation by a randomised controlled trial.

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P185

### The Potential Effect of a Novel Vibrotactile Glove Rehabilitation System on Motor Recovery in Chronic Post-Stroke Hemiparesis: A Case Study

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**Background and Rationale:** Regaining fine motor control is important for patients with chronic hemiparesis. Few studies had demonstrated the effectiveness of isolated and repetitive finger movement training in patients with acute stroke; however, evidences also showed the difficulties to improve fine motor function. We aimed to examine whether our novel rehabilitation tool – a vibrotactile glove system integrating virtual reality interface, had the potential effects to benefit patients with chronic hemiparesis.

**Methods:** 2 chronic right hemiparesis patients (Brunnstrom stage U/E (P/D): V/V) with regular rehabilitation training for months in our rehabilitation center were enrolled. Patients received additional novel vibrotactile training for 30 mins/day, twice a week, total 5 weeks. Clinical assessments were performed at 5 weeks before training (-5 wk), the day before training (0 wk) and the day after training (5 wk). Outcome measurement included modified Ashworth scale (MAS), finger range of motion, grip strength, pinch strength, nine hole peg test (NHPT), Michigan hand outcomes questionnaire (MHQ) and satisfaction questionnaire.

**Results:** No significant improvement were found in all physical measurements among three time points. However, consistent reports of high satisfaction score were found in both patients.

**Conclusion:** A short-period of game-based vibrotactile finger training was not sufficient to improve motor function in chronic stroke. However, higher satisfaction was reported, suggesting an increase in patient's training motivation when using this novel device. Studies with larger sample size and longer duration should be considered for future investigations.

## Reference:

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## Future of Stroke

P186

### High Levels of Soluble Lectin-Like Oxidized Low-Density Lipoprotein Receptor-1 in Acute Stroke: An Age- and Sex-Matched Cross-Sectional Study

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**Background and Rationale:** Lectin-like oxidized low-density lipoprotein receptor-1 (LOX-1) is known to be a key molecule in the pathogenesis of atherosclerosis. Although high levels of serum soluble LOX-1 (sLOX-1) were demonstrated in patients with acute coronary syndrome, there are no reports about acute stroke patients. We hypothesized that serum sLOX-1 levels would be also used as a biomarker of acute stroke as in the case of acute coronary syndrome.

**Methods:** We enrolled a total of 377 patients with a stroke (men/women: 251/126; age: 40–79 years), 250 ischemic stroke and 127 intracerebral hemorrhage (ICH). Patients were admitted to our hospital within 3 days after the onset of stroke. As controls, we randomly selected age- and sex-matched subjects without a past history of cardiovascular disease according to stroke subtype from the community-based cohort of the Suita study. Conditional logistic regression analysis was used to calculate odds ratios and 95% confidence intervals for high sLOX-1 level, defined as 1177 ng/L (corresponding of the 80th percentile of all stroke patients) or more, by each stroke subtype.

**Results:** Median values of serum sLOX-1 in stroke patients were significantly higher than those in controls (526 vs. 486 ng/L in ischemic stroke and 720 vs. 513 ng/L in ICH, respectively). Among subtypes of ischemic stroke, median sLOX-1 levels in atherothrombotic brain infarction (ABI) (641 ng/L) were only significantly higher than those in controls (496 ng/L). Ischemic stroke (odds ratio, 3.28; 95% confidence interval, 1.68–6.39) and ICH (5.20; 1.87–14.45) were independently associated with high levels of sLOX-1.

**Conclusion:** Higher levels of sLOX-1 were observed in patients with acute stroke compared with those of controls. High levels of sLOX-1 could be useful biomarker for acute stroke.

## Sex Differences in Health-Related Quality of Life (HRQoL) in the Long-Term after Stroke: the International Stroke Outcomes Study (INSTRUCT)

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**Background and Rationale:** The reasons why women have poorer HRQoL post-stroke than men are uncertain. We examined this in a large, international collaborative study of stroke outcomes.

**Methods:** Individual participant data on strokes (ischemic and hemorrhagic) from 1993–2013 were obtained from high-quality

incidence studies from Australasia, Europe, South America and the Caribbean. Data obtained included socio-demographics, stroke-related factors and pre-stroke health. HRQoL utility scores were calculated from the EQ5D, SF6D and AQoL at 1 year (3 studies) and 5 years (3 studies) post-stroke. Random-effects linear regression estimated pooled unadjusted and adjusted mean differences (MD) in HRQoL utility scores for women compared to men for confounding factors including age, pre-stroke dependency, stroke severity, comorbidities and post-stroke functional status.

**Results:** Women had lower pooled mean utility scores (unadjusted) than men (1 year:  $n = 1,219$ , MD  $-0.11$  [95% CI  $-0.12$ ;  $-0.03$ ]; 5 years:  $n = 1,057$ : MD  $-0.07$  [95% CI  $-0.12$ ;  $-0.03$ ]). These differences were attenuated after adjustment for confounding factors (1 year: MD  $-0.03$  [95% CI  $-0.06$ ;  $0.00$ ]; 5 years: MD  $-0.04$  [95% CI  $-0.06$ ;  $-0.01$ ]). Results were similar when using EQ5D utility scores mapped from the modified Rankin Scale (1 year: 8 studies,  $n = 4,082$ , unadjusted MD  $-0.07$  [95% CI  $-0.10$ ;  $-0.04$ ] and adjusted MD  $-0.04$  [95% CI  $-0.05$ ;  $-0.02$ ]; 5 years: 5 studies,  $n = 2,335$ , unadjusted MD  $-0.08$  [95% CI  $-0.11$ ;  $-0.04$ ] and adjusted MD  $-0.06$  [95% CI  $-0.10$ ;  $-0.02$ ]).

**Conclusion:** Poorer HRQoL was consistently observed in women after stroke. It was mostly attributable to their advanced age and greater severity of stroke, although these did not fully account for the sex differences in HRQoL.

## P188

## Is High Serum Uric Acid Level in Patients with Acute Stroke a Predictor of Recurrent Stroke or All-Cause Mortality?

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**Background and Rationale:** Recent studies indicated that hyperuricemia is a risk factor for mortality and stroke in general population. However, in patients who had acute stroke, whether hyperuricemia is a risk is still undetermined. This study aimed to determine whether high serum uric acid (sUA) level in stroke patients increased risk of all-cause mortality or recurrent stroke.

**Methods:** We used dataset from the Taiwanese Stroke Registry, a collection of 42,610 registered stroke patients. After excluding those who had missing data of sUA ( $n = 17,480$ ), fasting glucose ( $n = 6,648$ ), total cholesterol ( $n = 278$ ), body mass index (BMI) ( $n = 2,998$ ), hypertension ( $n = 73$ ), diabetes ( $n = 80$ ) or follow-up time ( $n = 24$ ), we enrolled 15,029 stroke patients in this study. Cox proportional hazards model was used to determine the risk of mortality and stroke.

**Results:** In this retrospectively cohort study, we found a significantly increased risk of all-cause mortality in stroke patients by 11% with every 0.1-mmol increase of sUA (adjusted hazard ratio [aHR] 1.11, 95% confidence interval [CI] 1.05–1.18), especially in those aged  $\geq 65$  years (aHR 1.09, 95% CI 1.02–1.17) after adjusting for age, ischemic heart disease, heart failure, chronic kidney disease, fasting glucose, cholesterol, BMI and NIH Stroke Scale at admission. The all-cause mortality rates increased from 2.53 per  $10^4$  person-years (PY) in patients with sUA 0.30–0.41-mmol/l to 3.81 per  $10^4$  PY in patients with sUA

0.42–0.53-mmol/l, 6.07 per 10<sup>4</sup> PY in patients with sUA 0.54–0.65-mmol/l, and 14.57 per 10<sup>4</sup> PY in patients with sUA ≥0.66-mmol/l. The corresponding aHR were 1.11 (0.90–1.37), 1.40 (1.02–1.91) and 2.31 (1.53–3.50) relative to the reference group of patients with sUA 0.30–0.41-mmol/l. However, we failed to confirm sUA as a significant predictor for recurrent stroke.

**Conclusion:** Our analysis confirmed that sUA >0.53-mmol/l in patients with acute stroke is a significant predictor of all-cause mortality.

## P189

### Preoperative Prediction of Cerebral Hyperperfusion after Carotid Endarterectomy Using 1.5-Tesla Magnetic Resonance Angiography Followed by Single-Photon Emission Computed Tomography with Acetazolamide

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**Background and Rationale:** The purpose of the present study was to determine whether signal intensity of the middle cerebral artery (MCA) on preoperative 1.5-T magnetic resonance angiography (MRA) could identify patients at risk for hyperperfusion following carotid endarterectomy (CEA) as a screening test and whether an additional measurement of preoperative cerebrovascular reactivity (CVR) to acetazolamide on brain perfusion single-photon emission computed tomography (SPECT) could increase the predictive accuracy.

**Methods:** In 301 patients, the signal intensity of the MCA ipsilateral to CEA on MRA was preoperatively graded according to the ability to visualize the MCA. For patients with reduced MCA signal intensity on the MRA study, CVR to acetazolamide was subsequently assessed using brain perfusion SPECT. Cerebral hyperperfusion was also determined using brain perfusion SPECT.

**Results:** Preoperative reduced MCA signal intensity was significantly associated with the development of cerebral hyperperfusion (95% CI, 1.188–3.965;  $P = 0.0352$ ). While the sensitivity and negative predictive value were 100% both for the preoperative MCA signal intensity alone and in combination with subsequent preoperative CVR to acetazolamide, the specificity and positive predictive value were significantly greater for the latter than for the former ( $P < 0.05$ ).

**Conclusion:** Signal intensity of the MCA on preoperative 1.5-T MRA identifies patients at risk for hyperperfusion following CEA as a clinical screening test. An additional measurement of preoperative CVR to acetazolamide increases the predictive accuracy for the development of hyperperfusion.

## P190

### Developing a Novel Mobile Solution to Advance Data Collection in a National Stroke Registry

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**Background and Rationale:** The Australian Stroke Clinical Registry (AuSCR) is a national collaboration designed to monitor, audit and improve the quality of stroke care in Australia. The aim of this study was to determine if the development of a mobile application would support timely, accurate, and sustainable data collection of the AuSCR dataset without the need to increase staff resources.

**Methods:** In 2015, Barwon Health was awarded funding from the Victorian Stroke Clinical Network to develop and implement systems and processes that would enable them to contribute data to AuSCR. A mobile, device agnostic, point of care solution for stroke data capture was developed that enabled data input by multiple users. In addition to the core AuSCR data elements, additional acute stroke quality of care measures, as decided by key clinician stakeholders, were included in the application. An external provider was engaged to develop the application.

**Results:** A user friendly mobile application, able to run on a smartphone, tablet or desktop computer, was produced. The collected data includes all AuSCR fields and clinically relevant fields from the Australian Stroke Data Tool (AuSDaT). Duplication of data collection is avoided through integration with the organisation's existing clinical information systems. Automatic notification of new stroke admissions and multiuser data input are key features.

Data is extracted from the application, combined with data from other clinical applications and uploaded to AuSCR. In addition, data is imported into the organisation's data warehouse and surfaced for clinicians to enable near real-time monitoring of key clinical indicators.

**Conclusion:** A novel mobile application has been developed and implemented which facilitates multiuser, point of care data entry, and avoids duplication of data. Our early results indicate that the application has facilitated sustainable, accurate data collection and contribution of data to AuSCR without the need for additional staff resources.

## P191

### RE-SPECT ESUS\* Trial: Rationale and Design

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**Background and Rationale:** Approximately 20–25% of ischemic strokes are cryptogenic and most are Embolic Strokes of Undetermined Source (ESUS) (Hart RG et al, 2014). ESUS are defined as non-lacunar infarcts, without relevant arterial stenoses, or cardiac sources with a clear indication for anticoagulation. The optimal antithrombotic treatment for prevention of recurrent ESUS is unknown.

**Methods:** RE-SPECT ESUS is a phase III, double-blind, randomized trial comparing dabigatran etexilate (150 or 110 mg twice daily) with acetylsalicylic acid (100 mg once daily) for secondary stroke prevention in patients with ESUS (Diener HC et al, 2015). The trial began in December 2014 and is recruiting in >40 countries. Eligibility criteria include ESUS diagnosed within 3 months of randomization (6 months in selected patients), modified Rankin Score  $\leq 3$  and age  $\geq 60$  years or 18–59 years with a stroke risk factor (mild–moderate symptomatic heart failure, diabetes mellitus, hypertension, patent foramen ovale, prior stroke or transient ischaemic attack, or  $\text{CHA}_2\text{DS}_2\text{VASc} \geq 3$ ). The trial is event-driven and powered to detect superiority (~6000 patients; observation period: 0.5–3 years). The primary efficacy outcome is time to first recurrent stroke and the primary safety outcome is time to first major hemorrhage.

**Results:** As of February 2016, 1161 patients have been enrolled: mean age 67 years, 37% females. Median time from stroke to study entry was 41 days. Duration of cardiac monitoring before inclusion into the trial was 20 to <49 hours in 83% of patients. Approximately 5%, 23%, 26%, 25%, and 21% had  $\text{CHA}_2\text{DS}_2\text{-VASc}$  scores of 2, 3, 4, 5, and  $\geq 6$ , respectively. A trial update will be presented.

**Conclusion:** The results of RE-SPECT ESUS will help physicians optimally treat patients with ESUS to prevent recurrent strokes.

## References:

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## P192

### Addressing Disparities for Aboriginal People: The South Australian Aboriginal Heart and Stroke Plan

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**Background and Rationale:** The incidence and mortality pattern of cardiovascular disease including stroke experienced by Aboriginal people in South Australia (SA) is characterised by early onset and significant differentials, most notably at young ages AIHW 2015. As such, a focused effort on reducing disparities in burden and care can have a significant impact on life expectancy differentials.

**Methods:** Funded by SA Health, the SA Aboriginal Heart and Stroke Plan outlines what services are required, where, provided by whom, and how often. The method of development was a three-phase project. Phase 1 involved a current profile of burden, service availability, activity and coordination. Phase 2 was a gap analysis which considered, in a systematic manner, the availability and activity of services against quality of care against national indicators, the profile of burden, and evidence of what should be provided. Phase 3 was the development of recommendations and action plan to address disparities.

**Results:** Aboriginal people in SA are 70% more likely to be hospitalised for stroke than non-Aboriginal counterparts, after age-standardisation (FY2010–2015), with substantial burden in young people. There are significant gaps in community awareness, risk assessment and management, accessibility and quality of timely specialised care, culturally and age appropriate rehabilitation and ongoing care. Key regional centres with significant burden lack appropriate access to specialist care. The plan identifies actions across the prevention, acute care and rehabilitation, and enablers for system reform.

**Conclusion:** The development of the plan has strongly engaged key stakeholders including the Aboriginal community and service providers across the continuum, and intersects with mainstream reforms. The translation of action into outcomes is an integral element of the plan to be closely monitored over time.

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### P193

#### Signal Changes on Magnetic Resonance Perfusion Images with Dual Arterial Spin Labeling after Carotid Endarterectomy

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**Background and Rationale:** Cerebral hyperperfusion (CH) after carotid endarterectomy (CEA) is defined as an increase in ipsilateral cerebral blood flow (CBF). Arterial spin labeling (ASL) is a completely noninvasive magnetic resonance perfusion imaging technique. Following CEA, improvement of the delayed antegrade flow in the internal carotid artery (ICA) may shorten the arterial transit time (ATT), and ASL may lead to overestimation of the CBF.

**Methods:** Five consecutive patients who underwent CEA were enrolled in this retrospective study. Conventional ASL measurements using a single post labeling delay (PLD) may lead to underestimation of tissue perfusion. We demonstrate the chronological changes in ASL signals with dual PLD of 1.0 s and 1.5 s after CEA and compare these findings with preoperative clinical conditions and hemodynamic states.

**Results:** On postoperative day 1, 3 and 1 patients exhibited increased ASL signals bilaterally (Group A) and on the operated side (Group B), respectively. Follow-up ASL showed improvement in these findings within 7 days. One patients developed CH syndrome in Groups B. Coincidence in the localization of increased ASL signals and neurological disorders was noted in this patients.

**Conclusion:** The purpose of this study was to determine whether ASL can assess post-CEA hemodynamic changes and identify patients at risk for CHS. ASL examination is suitable for evaluation of post-CEA hemodynamic changes, including both increased CBF and shortened arterial transient time, which suggest a risk of CH syndrome.

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### P194

#### Stroke Clinical Registry Initiative – Ballarat Health Services Solution

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**Background and Rationale:** Ballarat Health Services has been successful in submitting an expression of interest to receive funding to develop a dynamic e-form to provide a sustainable pro-

cess for ongoing contribution to AuSCR and an individualised discharge care plan to stroke patients on discharge.

**Methods:** Ballarat Health Services convened a key stakeholder group to allow for collaboration of both the clinical and technical requirements of the dynamic e-form. Through the key stakeholder group and an external vendor, the dynamic e-form will be created to allow for data to be collected once but used multiple times.

The dynamic e-form has been designed to be multi directional so the document can utilise pre existing hospital systems to pre populate relevant data fields as well as share the collected data with other relevant clinical documents. This multi directional process provides a formalised approach to data collection to protect the integrity of the data as well as providing an individualised discharge care plan for stroke patients upon discharge.

**Results:** The implementation of the dynamic e-form will provide patients with an individualised discharge care plan while also enhancing data capture, and providing a sustainable solution for ongoing contribution to AuSCR is in progress at BHS.

**Conclusion:** It is anticipated that the introduction of the dynamic e-form will provide a time effective, sustainable solution for ongoing contribution to AuSCR. The document will also provide an individualised discharge care plan for all patients with stroke admitted to BHS, in accordance with the National Stroke Standards and AuSCR requirements.

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### P195

#### Association of Vascular Endothelial Growth Factor (VEGF) Serum Level with Clinical Outcome of Acute Ischemic Stroke Patient

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**Background and Rationale:** To analyze the relationship between levels of vascular endothelial growth factor (VEGF) serum and the clinical outcomes of patients with acute ischemic stroke based on the National Institute of Health Stroke Scale (NIHSS).

**Methods:** The method of study was observational prospective with cohort study approach. Data were obtained from ischemic stroke patients who were hospitalized in Wahidin Sudirohusodo and other teaching hospital in Makassar from September 2013 to February 2014 who met the inclusion criteria. VEGF serum levels obtained by ELISA (enzyme-linked immunosorbent assay) and clinical outcomes were evaluated with NIHSS scores.

**Results:** The results of this study indicated that the 35 samples obtained with a mean serum VEGF onset for <72 hours was  $268.80 \pm 257.01$  pg/ml, while the onset of the 10th day was  $302.31 \pm 325.60$  pg/ml significance value 0.374 with positive correlation value of 0.155 and the value of  $r = 15.5\%$ .

**Conclusion:** There was increasing of VEGF serum level in acute ischemic stroke patients after couple of days compared with the first admission. No significant difference of VEGF serum level after treatment in intermediate and mild stroke. There is positive correlation but not statistical significant between VEGF serum level changing and clinical outcome acute ischemic stroke patients.

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## P196

### Stroke Education for Elementary School Children by School Teacher-Led Lessons: The Suita Project

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**Background and Rationale:** We have shown that our stroke education materials could conduct message of FAST for the youth, however, that teacher-led lessons would be expected for better understanding of risk factors as well as stroke symptoms. We developed teaching materials those of which are easily used to perform stroke lessons by teachers. The aim of this study is to examine the effect of stroke education for the elementary school children by school teachers using these materials.

**Methods:** We enrolled 662 children (10 to 12 y.o.) and their 504 parents of six elementary schools in Suita city, Japan. Stroke lessons included the lecture by the teacher, viewing animated cartoon, and reading a Manga. After the lessons, teachers distributed a magnet poster with the FAST message, and a Manga, and asked children to communicate with their parents. Questionnaires of stroke knowledge were examined for both children and parents at baseline and immediately after the lesson (IL).

**Results:** In children, correct answer rates at IL in stroke symptoms, such as facial weakness (65 vs. 99%), dysarthria (84 vs. 99%), and hemiplegia (77 vs. 96%), were significantly higher than those at baseline. In parents, correct answer rates at IL was also improved in facial asymmetry (77 vs. 95%), and hemiplegia

(93 vs. 97%). The risk factors in children, such as alcohol (71 vs. 99%), and smoking (77 vs. 96%) improved ( $p < 0.05$ ). In parents, dyslipidemia (85 vs. 90%), alcohol (66 vs. 89%), and smoking (77 vs. 92%) were improved ( $p < 0.05$ ). Most of parents as well as children could understand the meaning of FAST mnemonic after the lessons (92% in children, 97% in parents).

**Conclusion:** Stroke education by school teacher-led lesson with our teaching materials could conduct stroke knowledge to children, and to their parents through their children.

## P197

### Comparison between Aspirin and Clopidogrel for Secondary Stroke Prevention

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**Background and Rationale:** Early reports have indicated that clopidogrel, a much more expensive antiplatelet agent, is superior to aspirin for secondary prevention of ischemic stroke. However, in practice, aspirin is the most commonly used drug. Because healthcare costs are escalating, the merit of prescribing clopidogrel to replace the lower-priced aspirin for stroke prevention deserves closer scrutiny.

**Methods:** In this retrospective study, patients with ischemic stroke were enrolled in the Taiwan stroke registry from May 1, 2006 to September 30, 2012. Stroke recurrence and mortality rates in patients receiving aspirin ( $N = 10109$ ) or clopidogrel ( $N = 2033$ ) during a 12-month follow-up period were compared. The Cox proportional hazards regression model was used to control for confounding factors and to obtain the adjusted hazard ratios (HRs) of recurrent stroke and mortality. Using propensity score matching, safety and efficacy were compared between the aspirin and clopidogrel groups, each with 1496 patients.

**Results:** During the 12-month follow-up period, stroke recurrence rates were comparable between groups, with 84 patients in the aspirin group (5.61%) and 81 in the clopidogrel group (5.41%) experiencing recurrence ( $HR = 0.98$ , 95% confidence interval  $[CI] = 0.72-1.3$ ,  $P = 0.87$ ). However, during the same period, the mortality rate was significantly higher in the clopidogrel group (83 patients, 5.5%) than in the aspirin group (38 patients, 2.54%) ( $HR = 2.31$ , 95%  $CI = 1.56-3.44$ ,  $P < 0.001$ ).

**Conclusion:** In practice, aspirin was as effective as clopidogrel for stroke prevention. Significantly higher mortality rates among stroke patients taking clopidogrel raises the need to reassess the merit of prescribing this second-line antiplatelet agent for secondary stroke prevention.

P198

### Complete Workup Leads to Less Incidence of Cryptogenic Stroke

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**Background and Rationale:** Stroke is the leading cause of long-term severe disability and the important cause of death. Approximately one third of first time strokes are cryptogenic, or due to unknown cause [1]. It is necessary to establish the cause of stroke to decrease the risk of future strokes, determine functional prognosis and select appropriate preventative care. Inadequate work up of stroke mechanism leads to cryptogenicity of mechanism of stroke.

**Methods:** In our Neurology Department, I've collected data of all patients admitted with me. I work in a prominent Private Superspeciality Hospital in South India, having total 4 general neurologists, working as a team. Of which 3 neurologists have recently started General Neurology practice, including me. The fourth neurologist has 30 years of experience. Our department distributes new patients equally amongst all consultants for Inpatient care.

All ischemic stroke and TIA patients underwent necessary investigations, including neuroimaging, preferably MRI Brain (1.5 T), Stroke Protocol (DWI, FLAIR, MR Angio (Intracranial, sometimes Extracranial), 2 D Echo (All patients), Carotid Doppler (if indicated), TEE (if indicated), TCD (some patients), TSH & Homocysteine (All patients), Thrombocheck Panel (if indicated), including AntiThrombin-III (AT-III), Protein C & S, Factor V Leiden.

**Results:** In a duration of 21 months, starting from 1st May, 2014 to 31st Jan, 2016, a total of 254 patients were admitted with me. Amongst these, there were 100 stroke patients and 8 TIA (Transient Ischemic Attack). Amongst these 100 stroke patients, 88 were ischemic, 11 were hemorrhagic and 1 patient went DAMA (Discharge Against Medical Advice) without any stroke work up.

According to TOAST classification, the mechanism of stroke amongst all 88 patients of ischemic stroke.

falls under the following 5 categories:

- 1) 40 large-artery atherosclerosis, (45.45%)
- 2) 24 cardio-embolism, (27.27%)
- 3) 19 small-artery occlusion (lacune), (21.60)
- 4) 03 stroke of other determined etiology (3.41%), and
- 5) 02 stroke of undetermined etiology (2.27%)

**Conclusion:** In this observational study, I was able to determine mechanism of 86 (97.73%) ischemic stroke patients. Thereby I conclude that a proper and extensive stroke work up can determine the mechanism in most of the patients, excluding few, who may require regular follow-up.

The limitations are, a short duration study and single person observational study, but I'm likely to continue this pilot project for a longer duration, thereby leading towards more conclusive data.

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P199

### Uncomplicated Left Ventricular Wall Motion Abnormalities Are Associated with Cryptogenic Stroke

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**Background and Rationale:** Regional or global left ventricular (LV) wall motion abnormalities (LVWMAs) seem unrecognized as a current stroke risk factor. But several line of evidences suggesting the association between LVWMAs and stroke have been emerged. To consolidate recent suggestions, we inspected the causal relationship between LVWMAs and stroke by evaluating the association of LVWMAs and cryptogenic stroke.

**Methods:** We recruited 4316 acute ischemic stroke patients and examined the association between cryptogenic stroke and LVWMAs unrelated to acute or recent MI, dilated cardiomyopathy, and terminal heart failure (uncomplicated LVWMAs, ucLVWMAs) using logistic regression analyses.

**Results:** In univariable binary logistic regression, ucLVWMAs had a positive relationship with cryptogenic stroke than stroke from SVO and other-causes, and had a trend of positive association ( $p = 0.052$ ) with cryptogenic stroke than stroke from LAA. Meanwhile, ucLVWMAs were negatively associated with cryptogenic stroke compared than CE ( $p = 0.013$ ). Measuring with 2 or more causes stroke, the association of ucLVWMAs and cryptogenic stroke was similar ( $p = 0.141$ ). In multivariable binary logistic regression, ucLVWMAs had an independent association with cryptogenic stroke than stroke from LAA, SVO, and other-causes, had a trend of association with CE stroke than cryptogenic stroke, and had no significant association with cryptogenic stroke compared with stroke from 2 or more causes.

**Conclusion:** ucLVWMAs may be considered as a risk factor for cryptogenic stroke. And given that ucLVWMAs are resulted from cardiac pathology and had a strong association with stroke from CE, ucLVWMAs can be a cardioembolic sources for stroke in addition to LVWMAs associated with MI, dilated cardiomyopathy, and terminal heart failure.

P200

### Cervical Artery Dissection and Vascular Tortuosity

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**Background and Rationale:** Dissection is an increasingly recognized cause of ischemic stroke, which even occurs with minor trauma. We hypothesized that a predisposing factor weakening the vascular wall exists and the arterial tortuosity may be higher in those with dissection.

**Methods:** Cervical artery dissection (CerAD) patients with magnetic resonance angiography (MRA) were consecutively en-



rolled. Age and sex matched healthy subjects who received MRA from a routine health examination was used as a control. The tortuosity (arc/chord ratio) of the contralesional carotid (CA) and vertebral artery (VA) was semi-automatically measured and was compared between patients with CerAD and controls. Independent risk factors for CerAD were investigated from the multivariable analysis. Subgroup analysis with patients with CA and VA dissection was performed.

**Results:** Of the 150 patients (75 with CerAD and 75 controls), there was no difference in terms of vascular risk factors. The tortuosity of VA ( $116.3 \pm 6.8$  vs.  $112.1 \pm 4.5$ ;  $p < 0.001$ ) and CA ( $108.8 \pm 4.0$  vs.  $107.3 \pm 2.9$ ;  $p = 0.01$ ) was higher in patients with CerAD comparing to that of control. Hypertension (OR = 2.652;  $p = 0.029$ ) and VA tortuosity (OR = 1.170;  $p = 0.001$ ) was independently associated with the presence of CerAD. Arterial tortuosity increased with aging, and more sharply in those with CerAD. In the subgroup analysis, VA tortuosity was significantly higher in patients with VA dissection ( $p < 0.001$ ), and CA tortuosity was marginally higher in patients with CA dissection than it of the controls ( $p = 0.05$ ).

**Conclusion:** CerAD may be associated with weaker vascular structure against tensile strength, which may be presented by higher tortuosity of VA and CA.

## P201

### Higher CHA<sub>2</sub>DS<sub>2</sub>VASc Score Is Associated with Diastolic Dysfunction in Stroke Patients with Atrial Fibrillation

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**Background and Rationale:** The CHA<sub>2</sub>DS<sub>2</sub>VASc score is widely used for estimating the risk of stroke in patients with non-valvular AF (NVAf). The presence and severity of diastolic dysfunction is associated with increased risk of NVAf. The aim of this study is to demonstrate a relationship between CHA<sub>2</sub>DS<sub>2</sub>VASc score and the severity of DD in stroke patients with NVAf.

**Methods:** We conducted a retrospective analysis of prospectively collected data on consecutive NVAf-induced ischemic stroke patients from September 2009 to December 2015. All of the baseline characteristics including CHA<sub>2</sub>DS<sub>2</sub>VASc components were assessed. Early transmitral diastolic peak velocity (E) and the mitral annular diastolic peak velocity (E') were obtained for the grading of DD (E/E') by transthoracic echocardiography. Logistic regression analysis was used to determine the association between DD and CHA<sub>2</sub>DS<sub>2</sub>VASc score.

**Results:** A total of 177 patients (mean age,  $74.1 \pm 9.8$ , male, 46.3%) were included in this study. Among the baseline characteristics and the parameters of echocardiography, Sex, previous anti-thrombotics, smoking, LA volume index, LV ejection fraction, and CHA<sub>2</sub>DS<sub>2</sub>VASc score was statistically significant factors for severe DD (E/E' > 13.15) on a univariate analysis. CHA<sub>2</sub>DS<sub>2</sub>VASc score was independently related with DD after adjusting for covariates with an adjusted OR of 2.07 (95% CI 1.46–2.93). Patients who have higher CHA<sub>2</sub>DS<sub>2</sub>VASc scores were more likely to DD

with an adjusted OR of 15.78 (score 0–1 vs. 4–6, 95% CI 3.92–63.63).

**Conclusion:** Higher CHA<sub>2</sub>DS<sub>2</sub>VASc score is associated with DD in NVAf-induced stroke patients. Patients with severe DD (high level of E/E') are more likely to have higher CHA<sub>2</sub>DS<sub>2</sub>VASc score and are more prone to develop stroke. DD should be strictly managed and monitored for the prevention of ischemic stroke.

## P202

### Cystatin C Is a Strong Predictor of Early Neurological Deterioration Following Ischemic Stroke in Elderly Patients Without Chronic Kidney Disease

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**Background and Rationale:** The mechanisms of early neurological deterioration (END) in patients with acute stroke remain unclear. Cystatin C is promoted a better marker of renal function compared to estimated glomerular filtration rate (eGFR). Despite cystatin C has emerged as a risk factor of stroke, the relationship between cystatin C and END remains to be elucidated. We assessed the prognostic value of cystatin C for END in elderly patients without chronic kidney disease (CKD).

**Methods:** A total of 841 patients with acute ischemic stroke who were admitted to within 7 days of onset between March 2010 and March 2015 were enrolled. We included patients without CKD and aged  $\geq 60$  years. Patients were divided into four groups based on the quartiles values of cystatin C. END was defined as an increase of  $\geq 2$  points from the baseline NIHSS score during the 7 days after onset. We compared clinical characteristics and cystatin C between patients with and without END.

**Results:** Among the total patients, 59.2% were male, with a mean age of 72.2 years. Eighty-seven (10.3%) patients experienced END after onset. The patients with END tended to be older ( $P = 0.001$ ), more likely to have coronary heart disease ( $P = 0.036$ ), and higher level of cystatin C ( $P = 0.008$ ). After adjustment, patients in the second, third, and fourth quartiles cystatin C had a risk of subsequent END of 1.25 (95% CI, 0.57–2.75), 2.39 (1.11–5.14), and 2.47 (1.13–5.41) as compared with the lowest quartile ( $P$  for trend = 0.047). In contrast, eGFR did not show any significant association with the END (1.01; 0.99–1.02,  $P = 0.053$ ).

**Conclusion:** Higher cystatin C concentrations were related to END in elderly patients without CKD, despite the normal concentration. In this context, our data suggest that cystatin C may be a potent predictor of END in elderly patients without CKD.

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## P203

### Long-Term Mortality and Trends of Risk for Death after Ischemic Stroke Over 10 Years

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**Background and Rationale:** There have been few population-based cohort studies of long-term prognosis and risk factors for death after ischemic stroke. We evaluated the 10-year mortality and trends of risk factors at 1, 3, 5 and 10 year after ischemic stroke.

**Methods:** Patients were identified from the prospective registry database of Seoul National University Bundang Hospital. We included all the patients with ischemic stroke patients and lesion positive transient ischemic attack between January 2004 and December 2013. We excluded from the study if they had an admission over 7 days from onset and died during hospitalization. We obtained information on patient's death from Ministry of Government Administration and Home Affairs. Unadjusted and adjusted 10-year mortality rates were computed using Kaplan-Meier analyses and Cox proportional hazards regression models. The survival-dependent Cox proportional hazards regression models were run for 1, 3, 5 and 10-years from the index admission date.

**Results:** Among the eligible 5634 patients, cumulative risk of death over 10-year was 40.7%. At 1-year after stroke, age >65 years, diabetes mellitus (DM), hyperlipidemia, severe initial stroke severity (National Institutes of Health Stroke Scale >20) and poor functional status during hospitalization (modified Rankin Scale ≥3) were significantly associated with mortality. Beyond the 1-year, the risk factors remains significantly associated with long term mortality, but hazard ratios for several risk factors showed decreasing trends over 10 years except for advanced age (>65 years) and DM. With respect of stroke mechanism, the risk of incompletely evaluated stroke for 1-year mortality was approximately two times greater than the other stroke mechanism (except for other determined stroke) and remains higher over 10 years.

**Conclusion:** Our results showed that importance of secondary prevention at first year of stroke. Furthermore, full evaluation for stroke mechanism may be important to improve the long-term prognosis after stroke.

## P204

### Types of Stroke Recurrence in Cryptogenic Stroke with Patent Foramen Ovale

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**Background and Rationale:** A causal relationship between patent foramen ovale (PFO) and cryptogenic stroke has been reported. However, it is still unclear whether PFO is causative in recurrent stroke. We studied the etiology of recurrent stroke in patients with cryptogenic stroke and PFO.

**Methods:** Among 2125 patients with stroke or TIA, who were admitted from November 2007 to December 2013, we identified consecutive patients with cryptogenic stroke and PFO. Therapeutic regimens for secondary stroke prevention at discharge were up to the attending neurologist. Follow-up information, especially stroke recurrence, was retrospectively collected by reviewing medical records.

**Results:** Sixty-seven patients with cryptogenic stroke and PFO were identified. Three patients, who were transferred to other hospitals at discharge, were excluded, and the remaining 64 patients (mean 63 years, 39 males) were included in this study. Of these, 12 had deep venous thrombosis (DVT). At discharge, anticoagulation was administered to 36 patients, antiplatelet therapy to 26, both of them to 1, and no antithrombotic drugs to 1. A mean follow-up period was 29 months (range, 1–82 months). Six patients had stroke recurrence (3.9%/person-years): 3 had paradoxical embolism (2.0%; 14, 17, 23 months after initial stroke), 2 had a lacunar infarct (1.3%; 26, 27 months), and 1 had a thalamic hemorrhage (0.7%, 41 months). Among patients with DVT, 2 suffered from stroke recurrence (8.1%/person-years), and both had paradoxical embolism. Regarding therapeutic regimens at discharge, stroke recurrence rate was 3.2%/person-years in antiplatelet therapy, and 5.2% in anticoagulation.

**Conclusion:** Although patients with cryptogenic stroke and PFO had a low recurrent risk of paradoxical embolism, a particular case with DVT should be carefully observed because of relatively high stroke recurrence.

## P205

### Association of CA125 with Hypercoagulable State in Acute Stroke Patients with Active Cancer

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**Background and Rationale:** Carcinoma mucins have been reported to play an important role for hypercoagulable state in cancer patients. Carbohydrate antigen-125 (CA125) is a typical mucin molecule and a mucinous tumor marker. Some studies suggested the possible association between CA125 and cancer related coagulopathy. The purpose of our study was to clarify the associa-

tion of CA125 with hypercoagulable state in acute stroke patients with active cancer.

**Methods:** We retrospectively studied 43 acute ischemic stroke patients admitted to our institute (16 with active cancer and 23 without cancer) in whom tumor markers as carcinoembryonic antigen (CEA), carbohydrate antigen 19-9 (CA19-9), and CA125 was measured. Active cancer was defined as a diagnosis of cancer within 6 months before stroke, any treatment for cancer within the previous 6 months, or metastatic cancer. Elevation of tumor markers was defined as exceeding twice the upper limit of normal range.

**Results:** CA125 elevation was observed in 8 patients (62%) in active cancer patients (ovary in 2, lung in 1, uterine in 1, breast in 1, renal in 1 and unknown origin in 2), whereas CEA and CA 19-9 elevation were in 8% and 21%. In non-cancer patients, the elevation rate of CEA, CA19-9, and CA125 were 11%, 0%, and 4%, respectively. Median (IQR) of D-dimer values in active cancer patients were 5.6 (0.9, 19.3)  $\mu\text{g/ml}$ . D-dimer values were significantly higher in cancer patients with CA125 elevation than in those without ( $43.0 \pm 64.6$  vs.  $0.4 \pm 0.8$   $\mu\text{g/ml}$ ,  $p = 0.003$ ). All the cancer patients with a D-dimer value of more than 3.5  $\mu\text{g/ml}$  showed CA125 elevation. Among 8 active cancer patients with CA 125 elevation, 7 were classified into embolic strokes of undetermined source.

**Conclusion:** CA125 was elevated frequently in stroke patients with active cancer and may be associated with cancer-related hypercoagulable state and stroke.

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## P206

### Optimal Magnetic Resonance Plaque Imaging for Cervical Carotid Artery Stenosis in Predicting Development of Microembolic Signals during Carotid Dissection in Endarterectomy

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**Background and Rationale:** Intraplaque characteristics assessed by preoperative magnetic resonance (MR) carotid plaque imaging may be associated with development of microembolic signals (MES) during exposure of carotid arteries in carotid endarterectomy (CEA). The purpose of the present study was to determine which plaque imaging technique most accurately predicts development of MES during exposure of carotid arteries in CEA.

**Methods:** The present study included 80 patients with ipsilateral ICA stenosis 70% and useful residual function who underwent CEA. The following four MR plaque imaging techniques were compared: cardiac-gated black-blood fast spin echo (BB-FSE), magnetization-prepared rapid acquisition with gradient echo (MPRAGE), source image of three-dimensional time-of-flight MR angiography (SI-MRA) and non cardiac-gated SE. The contrast ratio (CR) of the carotid plaque was calculated by dividing the plaque signal intensity by sternocleidomastoid muscle signal intensity. Intraoperative transcranial doppler (TCD) was performed

to detect MES of the middle cerebral artery ipsilateral to the carotid artery undergoing CEA. The accuracy of the CR or the percentage area to predict development of the MES was determined using a receiver operating characteristic (ROC) curve, and the ability to discriminate between presence and absence of the MES was estimated using the area under the ROC curve (AUC).

**Results:** MES during exposure of carotid arteries were detected in 23 patients (29%), 3 of whom developed new neurologic deficits postoperatively. Those deficits remained at 24 hour after surgery in only 1 patient. While the CR in patients with MES was higher than that in patients without MES in MPRAGE, SI-MRA and non-gated SE, the CR in BB-FSE did not differ between patients with and without MES. The AUC of non-gated SE was greater than that of MPRAGE (difference between areas, 0.106;  $p = 0.0023$ ) or SI-MRA (difference between areas, 0.128;  $p = 0.0010$ ).

**Conclusion:** Non cardiac-gated SE may predict the development of MES during exposure of the carotid arteries in carotid arteries in CEA more accurately than other MR plaque imaging techniques.

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## P207

### Hypoxic Viable Tissue in Human Chronic Cerebral Ischemia Because of Unilateral Major Cerebral Artery Steno-Occlusive Disease

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**Background and Rationale:** Positron emission tomography (PET) with radiolabeled 2-nitroimidazoles directly detects hypoxic but viable tissue present in an acute ischemic area in the human brain. This study using PET with 1-(2-[18F-fluoro-1-[hydroxymethyl]ethoxy) methyl-2-nitroimidazole (18F-FRP170) aimed to determine whether tissue with an abnormally elevated uptake of 18F-FRP170 exists in human chronic cerebral ischemia because of unilateral atherosclerotic major cerebral artery steno-occlusive disease.

**Methods:** 18F-FRP170 PET was performed, and cerebral blood flow and metabolism were assessed using 15O-gas PET in 20 healthy subjects and 52 patients. A region of interest (ROI) was automatically placed in 3 segments of the middle cerebral artery

territory in both cerebral hemispheres with a 3-dimensional stereotaxic ROI template using SPM2, and each PET value was determined in each ROI. The ratio of values in the affected versus contralateral hemispheres was calculated for the 18F-FRP170 PET image.

**Results:** A significant correlation was observed between oxygen extraction fraction and 18F-FRP170 ratios ( $\rho = 0.509$ ;  $P < 0.0001$ ) in a total of 156 ROIs in 52 patients. The specificity and positive-predictive value for a combination of an elevated oxygen extraction fraction and a moderately reduced cerebral oxygen metabolism for detection of an abnormally elevated 18F-FRP170 ratio (19 ROIs; 12%) were significantly greater than those for the individual categories (elevated oxygen extraction fraction, moderately reduced cerebral oxygen metabolism, or reduced cerebral blood flow).

**Conclusion:** Tissues with abnormally elevated uptake of 18F-FRP170 exist in human chronic cerebral ischemia characterized by a combination of misery perfusion and moderately reduced oxygen metabolism because of unilateral atherosclerotic major cerebral artery steno-occlusive disease.

## P208

### The Implication of CHA<sub>2</sub>DS<sub>2</sub>VASc Score on Short-Term Outcomes of the Patients with Hyperacute Ischemic Stroke Receiving Thrombolysis

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**Background and Rationale:** The CHA<sub>2</sub>DS<sub>2</sub>VASc score has been validated in risk prediction for stroke and thromboembolism in patients with atrial fibrillation. It was shown that CHA<sub>2</sub>DS<sub>2</sub>VASc score was useful in predicting mortality for the patients who had congestive heart failure without atrial fibrillation. We aimed to investigate whether CHA<sub>2</sub>DS<sub>2</sub>VASc scores could be used to predict mortality in patients with hyperacute ischemic stroke.

**Methods:** We retrospectively selected patients with hyperacute ischemic stroke from stroke registry between June 2008 and September 2013. Included patients were those who had received intravenous or intra-arterial thrombolysis. All patients were received the diagnostic work-up to reveal etiology for stroke including cardioembolic source. The CHA<sub>2</sub>DS<sub>2</sub>VASc score was calculated by the result of diagnostic work-up and past medical history. We analyzed the factor associated with mortality after three months.

**Results:** Six hundred and twenty-seven patients (382 male; mean age: 67 years, range; 26–91 years) were treated by multimodal thrombolytic therapy and 571 patients were followed up to 3 months after stroke. Among 571 patients, 84 patients (14.71%) were dead. The CHA<sub>2</sub>DS<sub>2</sub>VASc score of the patients who died were higher than the other patients ( $3.39 \pm 1.67$  vs.  $2.68 \pm 1.58$ ,  $p < 0.001$ ). The CHA<sub>2</sub>DS<sub>2</sub>VASc score was correlated with the

mortality risk (adjusted OR = 1.326; 95% CI = 1.142–1.539,  $p < 0.001$ ).

**Conclusion:** The CHA<sub>2</sub>DS<sub>2</sub>VASc score was useful to predict the short-term mortality after hyperacute ischemic stroke receiving thrombolysis. Long-term follow up data are required to confirm the usefulness of CHA<sub>2</sub>DS<sub>2</sub>VASc score in predicting the clinical outcomes of thrombolysis.

## P209

### Stroke Education for Elementary School Children by Emergency Medical Technicians: The Second Report of the Akashi Project

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**Background and Rationale:** The aim of this study is to evaluate the effectiveness of stroke education by emergency medical technicians (EMT) for elementary school children and to clarify whether numbers of patients calling an ambulance after the stroke awareness would be increased by the school-based interventions by EMT.

**Methods:** We enrolled 874 children in 11 public elementary schools (aged 9–10 y.o.) and their parents ( $n = 489$ ) between September 2014 and October 2015. EMT of the firefighting headquarters in the Akashi City, Hyogo Prefecture, Japan made stroke lessons to children using our education materials. At the end of the lesson, EMT distributed a magnet poster with the FAST message, and a Manga (comic book), and asked children to communicate with their parents. Questionnaires on stroke symptoms and risk factors, each of which has a total of 7 points, examined for both children and their parents at baseline and 3 months after the lessons. We compared numbers of patients calling an ambulance within 3 hours after the stroke awareness during 1 year before (between Jan and Dec 2014) and after (between Jan and Dec 2015) receiving the stroke education.

**Results:** Both points of children and parents in stroke symptoms (children/parents;  $5.84 \rightarrow 6.79/6.42 \rightarrow 6.85$  points) as well as risk factors ( $5.54 \rightarrow 6.33/5.74 \rightarrow 6.35$ ) at 3 months were significantly higher than those at baseline. Average percentage of patients calling an ambulance within 3 hours after the stroke awareness in all suspected strokes by EMT was 67% in the first and 76% in the second period, respectively.

**Conclusion:** Stroke education for elementary school children by EMT could conduct stroke knowledge to parents as well as their children. We are examining whether the number of patients calling an ambulance after the stroke awareness promptly could be increased by the stroke-based interventions by EMT.

## P210

### Physical Activity for Stroke Prevention: Direct and Indirect Impact

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**Background and Rationale:** The benefits of physical activity in stroke prevention are known, but received limited clinical attention. Revealing that exercise has a direct and indirect impact on various stages of stroke prevention may promote its everyday application.

**Methods:** Two cohorts from Taiwan were used in the present study: The MJ Group medical screening program (MJ-cohort, N = 469,088, Lancet, 2011), recruited in 1994–2008, with individual activity data, and Taiwan Stroke Registry (TSR-cohort, N = 39,835, Circulation, 2010), recorded in 2006–2009. Cox model was used to calculate hazard ratios (HR).

**Results:** Out of 11,804 deaths in the MJ-cohort, stroke constituted 7.7%, with 519 ischemic and 386 hemorrhagic stroke. Significant HR risks for stroke were smoking (1.56), hypertension (3.71), diabetes (1.36) and chronic kidney disease (1.69). Physical activity directly reduced stroke mortality by 34%, with 25% from hemorrhagic and 39% from ischemic stroke. Post-stroke exercise reduced all-cause mortality by 31% among those with previous stroke. In the TSR-cohort, physically active subjects had less severe stroke based on National Institutes of Health Stroke Scale on admission, fewer complications and better functional status at 3 months after stroke. Exercise also reduced stroke mortality in patients with risk factors to variable extent: hypertension (18%), CKD (6%), and smoking (5%).

**Conclusion:** Physical activity, both pre-stroke and post-stroke, should receive renewed clinical attention in all aspects of stroke prevention. Exercise reduced stroke complications and severity, improved post-stroke mortality and mitigating the effects of stroke risk factors before stroke.

## P211

### Ambient Temperature and Stroke Occurrence: Systematic Review and Meta-Analysis

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**Background and Rationale:** Biologically plausible associations exist between climatic conditions and stroke risk, but the results of studies are inconsistent. We aimed to summarize current evidence on ambient temperature and stroke occurrence.

**Methods:** We performed a comprehensive literature search across Medline, Embase, PsycINFO, Cinahl, Web of Science, and Geobase from inception to the 16th October 2015 to identify all population-based observational studies examining the relationship between ambient temperature and admission to hospital for stroke. Two authors independently screened articles and conducted data extraction based on pre-defined inclusion criteria. Odds ratios (OR) with corresponding 95% confidence intervals (CI) were pooled by means of the random effects method.

**Results:** We included 21 studies with a total of 476,511 patients. Pooled ORs (95% CI) associated with every 1 degree Celsius increase in ambient temperature were 1.00 (0.99–1.00) for ischemic stroke (IS), 0.96 (0.93–1.00) intracerebral haemorrhage (ICH), and 1.00 (0.98–1.01) for subarachnoid haemorrhage (SAH). For IS, 5 of 6 studies found statistically significant associations in women; 3 of 3 studies identified significant associations in the elderly; and 3 of 7 reported significant associations with larger variations in ambient temperature. For ICH, significant associations were found for the elderly; and 5 of 8 studies found significant associations with larger variation in ambient temperature.

**Conclusion:** Larger variations in temperature appear to be associated with higher rates of stroke occurrence, especially in the elderly population.

## P212

### Increased Risk of Atrial Fibrillation among Patients with Gallstone Disease

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**Background and Rationale:** Atrial Fibrillation (AF) is associated with a 5-fold increased risk of stroke. To prevent the embolic stroke, it is important to recognize more potentially reversible causes of AF. This nationwide population-based and retrospective study was designed to estimate the risk of AF following a diagnosis of gallstone disease (GD).

**Methods:** Data were obtained from the Taiwan National Health Insurance Research Database during the study period (2001–2009). A total of 233,377 patients with a diagnosis of GD and 466,754 age- and gender-matched non-GD control patients were included to assess the risk of AF using Cox proportional hazard regression.

**Results:** Total 3,094 (68.8/10,000 person-years) AF occurred in the GD patients, and 8,843 (32.2/10,000 person-years) among the controls. The diagnosis of GD carried a higher risk of developing AF with a hazard ratio (HR) of 1.54 (95% confidence interval [CI] 1.47–1.60). After cholecystectomy, only 1,978 (25.1/10,000 person-years) AF occurred with significantly decreased HR to 0.63 (95% CI = 0.59–0.66). After stratification by age, the HRs of AF were 1.44 (95% CI = 1.32–1.57), 1.23 (95% CI = 1.15–1.31) and 1.20 (95% CI = 1.15–1.26) in age <45 years, 45–64 years and age ≥65 years, respectively. The female GD patient had a 1.20-fold increased risk of AF (95% CI = 1.14–1.27) and male GD patient had a 1.33-fold increased risk of AF (95% CI = 1.27–1.39). Compared with AF patient with CHA2DS2-VASc score equal to 0, the HRs of ischemic stroke risk were 2.12 (95% CI = 1.40–3.19), 2.60 (95% CI = 1.73–3.91) and 3.01 (95% CI = 2.01–4.49) for the AF patient with score equal to 1, 2, 3 and 4+, respectively.

**Conclusion:** In this population-based longitudinal follow-up study, we noted an increase in the risk of developing AF among GD patients. This trend, however, was reversed following cholecystectomy, raising a possible causal relationship for GD to increase the risk of developing AF. For stroke prevention, screening for AF may be needed for patients with GD, especially those at younger age and with other traditional risk factor(s).

## P213

### Age Effect on the Obesity Paradox in Functional Outcome after Acute Ischemic Stroke – Only the Overweight Aged Show the Paradox

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**Background and Rationale:** Obesity paradox shows that obesity and overweight are associated with increased stroke risk but reduced mortality and favorable functional outcomes in acute ischemic stroke patients. We aimed to test the age effect on the obesity paradox in functional outcome after acute ischemic stroke.

**Methods:** With the data from the Taiwan Stroke Registry (TSR), patients of acute ischemic stroke were categorized with body mass index (BMI) as underweight (BMI <18.5), normal weight (BMI 18.5–22.9), overweight (BMI 23–27.4), and obese (BMI ≥27.5 kg/m<sup>2</sup>) and divided into four age groups (20–44, 45–64, 65–74, and ≥75 years). Functional outcome was defined with modified Rankin Scale (mRS) with 0–2 as favorable and 3–5 as unfavorable, and measured 3 and 6 months after acute ischemic stroke.

**Results:** Totally there were 26955 patients recruited for analysis. As compared within four BMI categories, overweight patients had the most favorable outcome at 3 and 6 months (OR, 0.90; 95% CI, 0.82–0.99, and 0.90; 95% CI, 0.82–0.99), while underweight patients had the worst outcome at 3 and 6 months (OR, 1.65; 95% CI, 1.34–2.04, and 1.72; 95% CI, 1.38–2.14). After stratification by age, only overweight patients with the age over 75 years had the most favorable outcome 3 and 6 months (OR, 0.86; 95% CI, 0.74–0.99, and 0.82; 95% CI, 0.70–0.95), while underweight patients had the worst functional outcome with the age over 45 years. Overweight patients with the age under 75 years or obese patients with any age group did not show better functional outcome than those with normal weight.

**Conclusion:** In consideration of age effect on obesity paradox, only the overweight aged patients have better short-term and mid-term functional outcomes than those with normal weight after acute ischemic stroke. Underweight patients sustain the most worst functional outcome among four BMI categories.

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### Predictors of Cardioembolic Stroke in Japanese Patients with Atrial Fibrillation: The Fushimi AF Registry

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**Background and Rationale:** The Fushimi AF Registry is aimed to enroll all patients with atrial fibrillation (AF) in Fushimi ward, Kyoto, with 280,000 population, to reveal the incidence of stroke, and to detect its risk factors. Although several cohort studies of patients with AF have indicated risk factors for ischemic stroke events, these studies included not only cardioembolic stroke (CS) but also lacunar and atherothrombotic infarction. We report here the specific predictors for CS in Fushimi AF registry.

**Methods:** Patients with AF observed on electrocardiogram in 79 participating institutions were consecutively enrolled. We evaluated clinical features of participants in the AF Registry who developed CS during 3-year observation period and had a brain MRI at the time of the onset, on which the diagnosis of CS was made based.

**Results:** From March 2011 to December 2016, 3,749 cases were enrolled. The average age was  $73.5 \pm 10.9$  y, male 59.3%, female 40.7%, and the average CHADS<sub>2</sub> score was  $2.02 \pm 1.33$ . Anticoagulants were prescribed for 53.5% cases (warfarin 1728, NOAC 270). CS occurred in 91 cases during 3 years. They were older, had low diastolic blood pressure, and were more likely to have a past history of stroke/TIA, congestive heart failure, chronic kidney disease (CKD) and hypertrophic cardiomyopathy. The prevalence of sustained (persistent or permanent) AF was higher in CS. The CHADS<sub>2</sub> and CHA<sub>2</sub>DS<sub>2</sub>-VASc score were higher in CS. The median infarct volume (IV) was 26.4 ml (interquartile range, 4.1–87.4 ml). On multivariate analysis, older age per 10 years (odds ratio (OR)=1.50;  $p = 0.0006$ ), past history of stroke/TIA (OR = 1.956;  $p = 0.0044$ ) and sustained AF (OR = 1.61;  $p = 0.04$ ) were predictors of CS. CS with large IV (>30 ml) was significantly related to age, CKD and history of stroke/TIA.

**Conclusion:** We are first to indicate that older age, past history of stroke/TIA, and sustained AF are specific risk factors for CS.

## Intracerebral Haemorrhage

### Semi-Automated Planimetry Has Excellent Interrater, Intrarater and Intersoftware Reliability in Acute Intracerebral Haemorrhage But Can Underestimate Volumes by Up to 45%

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**Background and Rationale:** Haematoma and oedema size determine outcome after intracerebral haemorrhage (ICH), with each added 10% volume increasing mortality by 5%. We assessed the reliability of semi-automated CT planimetry in the softwares Analyze and Osirix.

**Methods:** We randomly selected one hundred scans from 1329 ICH patients from two centers. We used Hounsfield Unit thresholds of 5–33 for oedema and 44–100 for ICH. Three raters segmented all scans using Analyze, 20 scans with Osirix, and repeated these with both software for intrarater reliability and segmentation timing. Volume estimates from the segmentations were produced automatically by Analyze and Osirix, and then calculated taking individual slice effective thickness, i.e. voxel depth, into account.

**Results:** Mean Analyze haematoma volume was  $23.5 \pm 29.7$  ml and oedema volume  $20.8 \pm 25.6$  ml. There was excellent interrater, intrarater and intersoftware reliability, all intraclass correlation coefficients >0.918. Analyze and Osirix produced similar haematoma volumes (mean difference 0.1 (1%)  $\pm 2.3$  ml,  $p = 0.64$ ), while oedema volumes were systematically smaller with Osirix ( $-5.3$  ( $-31\%$ )  $\pm 8.8$  ml,  $p < 0.001$ ). The automated haematoma volume output was 2.4 ml ( $-10\%$ ) too small with Analyze and 3.2 ml ( $-18\%$ ) too small with Osirix, while the oedema volumes were 2.2 ml ( $-10\%$ ) and 6.1 ml ( $-27\%$ ) too small correspondingly, compared to the method using true voxel depth. In scans with variable slice thickness the volume underestimations were larger,  $-28\%$ – $42\%$  for ICH and  $-26\%$ – $45\%$  for oedema. Mean segmentation time was  $6:53 \pm 4:02$  minutes with Analyze and  $9:06 \pm 5:24$  minutes with Osirix,  $p < 0.001$ .

**Conclusion:** Our results demonstrate the method used to determine voxel depth can influence the final volume output

markedly. Results of clinical and collaborative studies need to be considered in the context of these methodological differences.

## P216

### Estimated GFR and the Effect of Intensive Blood Pressure Lowering after Acute Intracerebral Haemorrhage

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**Background and Rationale:** Past studies on the effect of renal function on intracerebral haemorrhage (ICH) outcomes have yielded inconsistent findings. Although the Intensive Blood Pressure Reduction in Acute Cerebral Hemorrhage Trial (INTERACT2) suggests effectiveness of early intensive blood pressure (BP) lowering in improving functional recovery after ICH, the balance of potential benefits and harms of this treatment in those with decreased renal function remains uncertain.

**Methods:** INTERACT2 trial was an international, open, blinded endpoint, randomised controlled trial of spontaneous ICH patients with elevated systolic BP (SBP, 150–220 mm Hg), assigned to intensive (target systolic BP <140 mm Hg) or contemporaneous guideline-based (<180 mm Hg) BP management. Admission estimated glomerular filtration rate (eGFR) of patients were categorised into 3 groups based on the Chronic Kidney Disease Epidemiology Collaboration equation: normal or high ( $>90$  ml/min/1.73 m<sup>2</sup>), mild (60–90 ml/min/1.73 m<sup>2</sup>), and moderate-severe ( $<60$  ml/min/1.73 m<sup>2</sup>) decrease. The effect of admission eGFR on the primary outcome of death or major disability at 90 days (defined by scores of 3 to 6 on the modified Rankin Scale) was analysed using multivariable logistic regression model. Potential effect modification of intensive blood pressure lowering treatment by admission eGFR was assessed by interaction terms.

**Results:** Of 2623 included participants, 912 (35%) and 280 (11%) had mild and moderate-severe decrease in eGFR, respectively. Patients with moderate-severe decrease in eGFR had the greatest risk of death or major disability at 90 days (adjusted odds ratio 1.82, 95% CI 1.28–2.61). The effects of early intensive BP lowering were consistent across different levels of eGFR ( $P = 0.5$  for homogeneity).

**Conclusion:** Decreased eGFR predicts poor outcome in acute ICH. Early intensive BP lowering provides similar treatment effects in ICH patients with decreased eGFR.

## P217

### Predictors of Patients with Acute Intracerebral Haemorrhage Who Require Long-Term Nursing Home Facilities

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**Background and Rationale:** Acute intracerebral haemorrhage (ICH) is associated with poor outcome. Whilst most patients may recover over several months or even years, many require long-term institutional care for their severe disability. We aimed to determine the predictors of institutional care during 90 days of follow-up among participants for the Intensive Blood Pressure Reduction in Acute Cerebral Haemorrhage Trial (INTERACT2).

**Methods:** INTERACT2 was an international, open, blinded endpoint, randomized controlled trial of 2839 ICH patients (<6 hrs) and elevated systolic blood pressure (SBP) allocated to receive intensive (target SBP <140 mm Hg) or guideline-recommended (target SBP <180 mm Hg) treatment. Any nursing home residential living was collected at 90 days post-randomisation. Multivariable logistic regression were used to determine independent associations.

**Results:** Predictors of nursing home residence included baseline variables – older age, China recruitment, severe neurological impairment (NIHSS score  $\geq 15$ ), large ICH volume ( $\geq 15$  ml), and intraventricular hemorrhage (IVH) extension – and management variables of requirement for intubation and venous thromboembolism prophylaxis.

**Conclusion:** Early recognition of poor prognosis ICH patients related to nursing care requirements, may facilitate appropriately timed discharge discussions with families and inform other aspects of management.

## P218

### Impacts of Supratentorial Intracerebral Hemorrhage Locations on the Complexity of Heart Rate Variability

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**Background and Rationale:** Acute stroke commonly affects cardiac autonomic responses (De Raedt, 2015). Our previous study showed that lower complexity of heart rate variability

(HRV), assessed by multiscale entropy (MSE), is associated with worse outcome in acute stroke patients (Tang, 2015). This study aimed to further investigate the impact of stroke locations on various HRV parameters in patients with non-surgical supratentorial intracerebral hemorrhage (ICH), and their correlations with stroke severity, and outcome.

**Methods:** Continuous one-hour ECG signals were obtained in ICH patients within 48 hours after admission and controls. The complexity index was defined as the area under the MSE curve from scale 1 to 20. Stroke severity was assessed by NIHSS. The ICH size and ICH score (Hemphill, 2001) were calculated. A favorable outcome was defined as modified Rankin scale  $\leq 2$  at 3 months after stroke.

**Results:** From February, 2012 to June, 2014, a total of 93 supratentorial ICH patients were classified into 3 groups: basal ganglia ( $n = 40$ ), thalamic ( $n = 35$ ), and lobar ICH ( $n = 18$ ). The values of complexity index were apparently lower in patients with ICH than controls ( $26.9 \pm 7.4$  vs.  $33.6 \pm 3.7$ ,  $P < 0.001$ ). Lobar ICH had significantly lower value of complexity index ( $21.6 \pm 7.9$ ) than basal ganglia ( $27.9 \pm 6.4$ ) and thalamic ( $28.5 \pm 7.2$ ) groups. Complexity index was negatively associated with NIHSS score ( $= -0.25$ ,  $P = 0.02$ ), especially in the thalamic ICH ( $= -0.39$ ,  $P = 0.02$ ). Forty patients (43%) had a favorable outcome. Complexity index was an independent outcome predictor (OR 1.09, 95% C.I. 1.00–1.19,  $P = 0.039$ ) after adjustment of clinical parameters, though the effects did not exist in the subgroup analyses.

**Conclusion:** In patients with supratentorial ICH, those with lobar ICH had the lowest complexity of HRV. The values of complexity index correlated negatively with the stroke severity, especially among patients with thalamic ICH.

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## P219

### Low Cholesterol Level Associated with Severity and Outcome of Spontaneous Intracerebral Haemorrhage: Results from Taiwan Stroke Registry

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**Background and Rationale:** The relationship between cholesterol level and haemorrhagic stroke is inconclusive. We hypothesized that low cholesterol levels may have impact on severity and outcome of intracerebral haemorrhage (ICH).

**Methods:** This study used data obtained from a multi-centre Taiwan Stroke Registry (Hsieh et al, *Circulation*, 2010). We categorized acute spontaneous ICH patients, based on their baseline levels of total cholesterol (TC), into 3 groups with  $<160$ ,  $160$ – $200$  and  $>200$  mg/dl of TC. The initial stroke severity measured by National Institutes of Health Stroke Scale (NIHSS), risk of unfavorable outcome (modified Rankin Scale [mRS] score  $>2$ ) and 3-month mortality post stroke in relation to TC were explored.

**Results:** A total of 2444 ICH patients (mean age  $62.5 \pm 14.2$  years; 64.2% men) were included in this study with 854 (34.9%) carrying baseline TC  $<160$  mg/dl. Patients with TC  $<160$  mg/dl presented more often with severe neurological deficit (NIHSS  $>15$ , adjusted odds ratios [OR], 1.80; 95% confidence interval [CI], 1.41 to 2.30), 3-month mRS  $>2$  (adjusted OR, 1.41; 95% CI, 1.11 to 1.78) using TC  $>200$  mg/dl as reference. Those with TC  $<160$  mg/dl and lowest body mass index (BMI)  $<22$  kg/m<sup>2</sup> had higher risk of 3-month mortality (adjusted OR 4.11, 95% CI 1.71 to 9.86) using TC  $\geq 160$  mg/dl and BMI  $\geq 27$  kg/m<sup>2</sup> as reference. Prior use of lipid-lowering drugs was not associated with initial stroke severity and 3-month functional outcome and mortality.

**Conclusion:** A total cholesterol level lower than 160 mg/dl was common in patients with acute ICH and was associated with greater stroke severity on presentation and poor 3-month outcomes, especially with lower BMI.

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## P220

### Health-Related Quality of Life after Intracerebral Haemorrhage: Pooled Analysis of the Interact Studies

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**Background and Rationale:** Limited data exist on health-related quality of life (HRQoL) in patients with acute intracerebral haemorrhage (ICH). We aimed to identify the determinants of HRQoL among 90-day ICH surviving participants of the Intensive Blood Pressure Reduction in Acute Cerebral Haemorrhage Trials (INTERACT).

**Methods:** INTERACT1 and INTERACT2 were pilot and the main phases of a randomised controlled trials of early intensive blood pressure (BP) lowering in patients with ICH (<6 hrs) and elevated systolic BP (150–220 mm Hg). HRQoL was determined at 90-days by telephone or in-person follow-up of the patient or proxy using the European Quality of Life Scale (EQ-5D). Multi-variable models were used to identify associations of poor HRQoL adjusted for age, sex, country, medical history, antithrombotic use, onset to randomisation time, systolic BP, baseline severity (NIHSS score), CT haematoma parameters, treatment arm, and proxy-responders.

**Results:** Of 2756 patients, predictors of lower EQ-5D utility score and measures of all 5 dimensions of EQ-5D were higher NIHSS score, larger ICH, and proxy-responders. Being 10-year older was associated with a lower utility score and lower scores in most dimensions except pain/discomfort.

**Conclusion:** Clinical severity, haematoma characteristics and proxy-responders were associated with poor HRQoL after ICH.

## P221

### Modified SPAN-100 Index in Patients with Intracerebral Hemorrhage: Correlation and Outcomes

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**Background and Rationale:** Stroke severity and age are major determinants of stroke outcomes but incorporating them to a single test to be used for prognostication is challenging. This study determined the SPAN score or index that would correlate to outcomes following primary intracerebral hemorrhages.

**Methods:** The Stroke Prognostication using Age and NIH Stroke Scale (SPAN) that combined age and stroke severity, was originally evaluated and used as prognosticators of outcome in

ischemic stroke. In this study, the utility of SPAN index in primary intracerebral hemorrhages was evaluated, and a score that will correlate to outcomes were determined. The main comparator is the ICHS, which was dichotomized into 2: 0–2 predicts good outcome, and 3–5 relates to poor prognosis.

**Results:** Among the 316 patients included, 58.55% had a SPAN score of 74 and below, but this did not show significant relationship with worse outcomes (ie. death, mRS >3), ( $p > 0.05$ ). Further analysis showed that a score of 75 and above, which comprised 41.45% of the patients, showed significant results. These data correlates well with the findings that patients who had a SPAN score of <75 had mean parenchymal hemorrhage volume of 25.1 ml and ICHS of 0–2, which we earlier defined as good prognosis. On the other hand, patients who had a SPAN score >75 had a mean parenchymal hemorrhage volume of 45.8 ml and which corresponds to ICHS 3–5 denoting poor prognosis.

**Conclusion:** The SPAN-75 index could be a simple method for estimating the clinical prognosis in patients with intracerebral hemorrhages.

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**P222****Predictors of Large Haematomas and Neurosurgical Intervention in Acute Intracerebral Haemorrhage: The INTERACT Trials**

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**Background and Rationale:** Prognosis in acute intracerebral haemorrhage (ICH) is related to ICH volume, where a >30 ml threshold is commonly used to define the need for neurosurgical decompression without clear supporting evidence. We aimed to determine the predictors of large ICH and neurosurgery in participants of the Intensive Blood Pressure Reduction in Acute Cerebral Hemorrhage Trials.

**Methods:** Pooled analysis INTERACT1 (n = 404) and INTERACT2 (n = 2839) of ICH patients (<6 hrs) with elevated systolic BP (SBP, 150–220 mm Hg) randomized to intensive (target SBP <140 mm Hg) or guideline-recommended (target SBP <180 mm Hg) management. Neurosurgical intervention data were collected at 7 days post-randomization. Multivariable logistic regression was used to determine associations.

**Results:** There were 372 (12.6%) patients with large ICH volume, predicted by non-Chinese ethnicity, non-diabetic status, severe stroke (NIHSS ≥15), lobar location, IVH extension, raised leucocyte count, and hyponatraemia. Of 166 (5.7% overall; 45% of large ICH) patients who underwent surgery; predictors were younger age, severe stroke (NIHSS ≥15 and baseline IVH volume >30 ml), and IVH.

**Conclusion:** Early identification of severe ICH based on age, severity and neuroimaging, may facilitate use of neurosurgery and more intensive monitoring in the immediate post-ICH period.

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**P223****Improving the Use and Timeliness of Anticoagulation Reversal for Warfarin Related Intracranial Haemorrhage**

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**Background and Rationale:** Warfarin related intracranial haemorrhage (WRICH) is an uncommon but life-threatening complication of warfarin use. Rapid and complete reversal of the coagulopathy is required. Reversal protocols which include prothrombin complex concentrates (PCC) are now recommended. We report on a quality improvement project aimed at implementing and refining such a protocol.

**Methods:** One retrospective, and then 2 prospective audits of all patients presenting to a single centre with WRICH. Results were analysed according to which protocol was in use at the time

(No protocol 2004–2009, First protocol 2009–2012, Emergency department protocol 2012–2013).

Outcome measures included times to scanning, to treatment and overall door-needle times, use of PCC as well as proportion of patients who had adequacy of reversal checked.

**Results:** Use of PCC increased significantly ( $p < 0.001$ ), whereas units of Fresh frozen plasma (FFP) reduced ( $p < 0.001$ ). Over the 3 audits, there were improvements in time to scanning (median (hours) 1.9 vs. 1.5 vs. 1.3,  $p = 0.03$ ) and door-needle times (first reversal agent-median (hours) 4.5 vs. 2.9 vs. 1.9,  $p = 0.018$ ; PCC – median (hours) 5.6 vs. 4.4 vs. 2.8,  $p = 0.04$ ).

The proportion of patients who had adequacy of reversal checked remained unchanged, but time to first checking improved ( $p = 0.001$ ).

**Conclusion:** The introduction (and revisions) of an anticoagulation reversal strategy for WRICH has led to increased PCC use and reduced times to diagnosis and treatment. Ongoing work is required to further improve door-needle times and post reversal monitoring.

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**P224****Impact of Antiplatelets and Anticoagulants on Prognosis of Patients with Intracerebral Hemorrhage**

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**Background and Rationale:** Intracerebral hemorrhage (ICH) associated with antithrombotic therapy is becoming more common as the use of those medications increases in the aging population. We reviewed the medical records of the patients admitted to our hospital due to ICH, and evaluated the impact of antiplatelets and anticoagulants on prognosis of patients with ICH.

**Methods:** This study includes consecutive 490 patients hospitalized with non-traumatic ICH in a single center during 8-year period between January 2008 and December 2015, which are subdivided into Former (from 2008 to 2011) and Latter (from 2012 to 2015). The patients were classified into those with no antithrombotic drugs (NAT) and those with antithrombotic therapy (AT), which was sub-classified into 4 groups: patients with an antiplatelet drug (AP1), multiple antiplatelet drugs (AP2), anticoagulant drug (AC), and antiplatelet and anticoagulant drugs (APC). Their clinical variables-including age and gender, hematoma's location and volume, current antithrombotic treatment status, hemorrhage expansion, hematoma removal by craniotomies, and clinical outcomes were reviewed. We evaluated their clinical characteristics and prognosis, and analyzed whether or not there is difference in the ratio of the patients with AT between the Former and Latter groups.

**Results:** There were 125 patients treated with AT (25.5%), including 50 patients of AP1 (10.2%), 14 patients of AP2 (2.9%), 32 patients of AC (6.5%), and 29 patients of APC (5.9%). The ratio of the patients with AT, AP1, AP2, AC, and APC were more frequently observed in the Latter than in the Former (31.7%, 10.6%, 4.1%, 8.1%, and 8.9% in the Latter versus 19.3%, 9.8%, 1.6%, 4.9% and 2.90% in the Former, respectively). The proportion

of the patients who underwent hematoma removal by craniotomies was slightly higher in the AT than in the NAT (21.6% versus 16.4%). Moreover, in the AT, hematoma volume was larger than in the NAT (41.6 cm<sup>3</sup> versus 23.6 cm<sup>3</sup>), and hematoma expansions were more frequently occurred (15.2% versus 4.1%). Furthermore, a higher rate of poor outcome was observed in the AT than in the NAT (56.0% versus 31.2%), especially high in the APC (65.5%). There were 10 patients taking NOAC in the Latter (4 patients in the AC and 6 in the APC), and two of those underwent hematoma removal.

**Conclusion:** The number of the patients with ICH who are treated with antithrombotic therapy is increasing, and this study demonstrated poor prognosis in those patients with antithrombotic treatment. We should be careful with a combination antithrombotic therapy using antiplatelets and anticoagulants.

## P225

### Surgical Intervention in Patients with Intracerebral Hemorrhage: Mortality and Functional Outcome from Taiwan Stroke Registry

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**Background and Rationale:** Clinical trials over the past 5 decades have not firmly established the benefit of neurosurgical intervention in treating intracerebral hemorrhage (ICH). Neurosurgical intervention, however, continues to be applied in selected ICH patients. We explored the impact of neurosurgical intervention in real world practice in a retrospective analysis of the prospectively collected data in Taiwan Stroke Registry (TSR).

**Methods:** ICH patients in TSR were categorized into 3 levels of consciousness impairment based on Glasgow Coma Scale (GCS) (Severe: 3–7; Intermediate: 8–11; Mild: 12–15). The mortality rate and functional outcome assessed by modified Rankin Scale (mRS) were compared between those with and without neurosurgical intervention at 1 and 3 months after ICH onset. Neurosurgical intervention is usually indicative for patients with large lobar or putaminal hemorrhage (ICH volume >50 cm<sup>3</sup> with GCS ≤14; or 30–50 cm<sup>3</sup> with GCS <12) in young adults (<60 years), cerebellar hemorrhage (>3 cm in diameter) with neurological deterioration, and hydrocephalus. For elderly and other conditions, the decision for neurosurgical intervention is depend on individual circumstances.

**Results:** Among 11,934 patients with ICH, 3,177 (26.6%) received neurosurgical intervention. Surgery was associated with lower mortality in the Severe group (surgery, n = 1,109 vs. conservative, n = 1,644, HR 0.37, 95% CI 0.33–0.42, *P* < 0.001), but not in the Intermediate group (surgery, n = 921 vs. conservative, n = 1,383, HR 1.00, 0.81–1.23, *P* = 0.99). In the Mild group, the mortality rate was higher with surgery (surgery, n = 1,147 vs. conservative, n = 5,730, HR 2.56, 2.07–3.17, *P* < 0.001). Functional outcomes were comparable between those with and without surgery in the Severe group, but poorer among those receiving neurosurgical intervention in the Intermediate (RR 1.15, 1.03–1.30) or Mild

(RR 1.83, 1.66–2.02) group. Propensity score matching, applied to address the potential biases inherent to retrospective analysis of clinical practice data, shows similar results as described above.

**Conclusion:** Neurosurgical intervention may have to be undertaken based on the level of consciousness impairment. Future clinical trials applying more advanced neurosurgical techniques to establish the merit of neurosurgical intervention in ICH may have to categorize patients by the level of consciousness impairment. The uncertainty of neurosurgical interventions also strengthens the rationale for exploring medical therapy in well-designed clinical trials.

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## P226

### Subarachnoid Haemorrhage (SAH) of Unknown Origin

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**Background and Rationale:** The aim of this study is to find out the recurrent bleeding, risk factors associated with SAH, necessity of follow-up angiography, special finding of SAH on CT. Furthermore, we evaluate the outcome of these patients with or without management at final follow-up.

**Methods:** During 2006–2015, we reviewed 52 patients with SAH of unknown origin among 1023 patients with spontaneous SAH. The cases which vessels are not visible on CTA because of severe cerebral edema are excluded.

**Results:** Among total 1023 SAH patients, SAH of Unknown Origin was 52 (5%); male 23 (44.2%), female 29 (55.8%). SAH location of Initial CT was shown variously in perimesencephalic cistern, prepontine cistern, and sylvian cistern.

The number of patients according to Fisher grade of initial CT, grade 4 was 8, 27 of grade 3, 9 of grade 2, and 8 of grade 1. In Hunt-Hess grade of onset time, grade 5 was 2, grade 4 was 1, grade 3 was 9, grade 2 was 28, and grade 1 was 12. The 76.9% of patients had no neurologic Sx.

The number of patients who were diagnosed without DSA (digital subtraction angiography) was 11, 20 patients with DSA once a time, twice of DSA was 21. Average follow up interval of DSA was 10.5 days. Any aneurysms were not found through this follow up DSA. Except the 3 patients who got 3 points of Initial GCS, all patients' outcome was good with mRS 0.

**Conclusion:** Prognosis of patients with SAH of Unknown Origin was good. The SAH location turned up to be various. There was no SAH origin found even though retesting with DSA or CTA when the origin was not found in the first study. Also, there was no re-bleeding in all patients. No long-term tracking was needed. If there was no neurological manifestation initially, it was also not found later.

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P227

### Developing a New Model of Spontaneous Intracerebral Haemorrhage in Rats

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**Background and Rationale:** Intracerebral haemorrhage (ICH) accounts for ~15% of all strokes. It has a high mortality rate and an effective treatment is yet to be found. This may be explained by failure of current animal models of spontaneous ICH to closely mimic the human condition.

The aim of this study was to induce spontaneous ICH in rats using a model of acute-on-chronic hypertension.

**Methods:** Male rats (16–32 weeks) received L-NAME (100 mg/kg/day) via drinking water and systolic blood pressure (SBP) was measured daily by tailcuff. Osmotic-minipumps containing Angiotensin II (AngII, 1 µg/kg/min) were implanted to induce chronic hypertension over 7 days. Bolus injections of AngII (500 µg/kg, s.c., twice daily) were administered from day 8–28, inducing peaks in SBP. Animals were sacrificed upon signs of stroke or at day 28, and presence of ICH assessed macroscopically and quantified using image analysis software (Image J).

**Results:** Chronic AngII infusion significantly increased mean SBP in young (control:  $141.96 \pm 30.99$  mm Hg; AngII:  $160.50 \pm 27.94$  mm Hg,  $t(56) = 6.293$ ,  $p < 0.0001$ ) and aged (control:  $141.96 \pm 30.99$  mm Hg; AngII:  $181.26 \pm 25.25$  mm Hg,  $t(56) = 2.011$ ,  $p = 0.049$ ) animals. No difference was found in the degree of SBP increase in young and aged AngII treated animals ( $t(56) = 1.615$ ,  $p = 0.112$ ). Bolus AngII injections lead to further increases in SBP between 212–248 mm Hg, peaking 3 hours post-injection, with no apparent effect of age. Bolus injections of saline in control animals did not affect SBP. No control rats ( $n = 16$ ) showed signs of ICH. Bleeds were detected in 75% of young ( $1.04 \pm 0.37$  µl,  $n = 8$ ) and 69% of aged treated rats ( $1.6 \pm 0.93$  µl,  $n = 13$ ).

**Conclusion:** Acute-on-chronic hypertension successfully induces spontaneous ICH in both young and aged rats. This approach has several advantages over existing models of ICH.

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P228

### Minimally Invasive Surgery Plus rt-PA in the Treatment of Intracerebral Haemorrhage: MISTIE III Trial Update

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**Background and Rationale:** Intracerebral haemorrhage (ICH) is the second most common cause of stroke, and causes more loss of productive life than ischaemic stroke on a global scale (Hachinski et al, 2010). The NINDS-funded MISTIE III trial aims to evaluate the efficacy and safety of minimally invasive surgery (MIS) plus rt-PA on moderate-large ‘stable clot’ ICH patients.

**Methods:** An international phase III, randomized, open-label, multicenter clinical trial of 500 subjects from ~100 centres. Subjects with acute non-traumatic supratentorial ICH ( $\geq 30$  ml), stable clot size over  $\geq 6$  hrs, within 72 hrs of diagnostic CT, will be randomised 1:1 to surgery+rt-PA catheter flushes (1 mg tds; up to 9 doses) or standard medical management. Vital and disability status are measured intermittently over 12 months, with disability status (mRS) adjudicated centrally by blinded assessors.

**Results:** From November 2013, 80 centers have been activated with 287 patients enrolled. In Australia and China, 6 patients have been randomized from 9 centers – 3 patients to each group – from August 2015. Further centers from Singapore and China will be activated through 2016. Data are presented on our experience of the procedure among Australian and Asian patients.

**Conclusion:** Combination MIS+rt-PA could improve outcome in ICH without the harms associated with open procedures. Recruitment and quality efforts continue in Australia/Asia.

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P229

### Early Outcomes of the Spontaneous Intracranial Hemorrhage Patients in Vietnam

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**Background and Rationale:** To provide information and the outcomes of spontaneous intracranial hemorrhage (ICH) in Vietnam, mortality and functional status was assessed 3 months



after stroke onset among a cohort of patients discharged from a stroke unit in Ho Chi Minh City, Vietnam.

**Methods:** Consecutive stroke patients were diagnosed with spontaneous ICH by brain computer tomography scan when admitted to a stroke unit within 3 months between March and June 2014 and were assessed for socio-demographic information, location and volume of the hematoma, co-morbidity, lifestyle risk factors and functional status. Face-to-face interviews were conducted in patient's homes 3 months after stroke, and functional status was again assessed by modified Rankin Scale.

**Results:** Among the patients with acute stroke ( $n = 2418$ ) admitted to the People's 115 hospital within 3 months, there were 376 (15.5%) with documented spontaneous ICH. The mean age was 59.09 years (SD 12.9), and 60.6% of them were male. The hematoma location was varied from putamen 52.7%, thalamus 21.5%, lobe 14.4%, brainstem 6.4%, cerebellum 3.7% and intraventricular 1.3% respectively. The mean volume of the hematoma was 17.2 ml (SD 19.4). Three months case-fatality was 21.3%. There was 32.4% of patients had least severe disability (mRS 0–2) at 3-month follow-up.

**Conclusion:** These data indicate spontaneous ICH due to hypertension are causing a big burden in Vietnam. Tight blood pressure control in the hypertensive patients should be a target for the healthcare system in future.

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## P230

### Simultaneous Bilateral Thalamic Hemorrhage: A Case Report

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**Background and Rationale:** Intracerebral hemorrhage (ICH) is the second most common subtype of stroke after ischemic stroke which accounts for 20% of all strokes. ICH is generally solitary and the occurrence of Multiple Simultaneous Intracerebral Hemorrhage (MSICH) is a rare clinical entity with a prevalence rate of 1 to 4.7% of all spontaneous ICH (Yi et al, 2013).

**Methods:** We present a case of a 50 year old hypertensive male on irregular treatment who presented with left sided weakness. On computed tomography scan, it showed simultaneous multiple intracerebral hemorrhages on bilateral thalami.

**Results:** MSICHs were found in certain brain regions, the most common location being at the bilateral basal ganglia, followed by the thalamus, cerebellum and lastly the cerebral cortex (Laiwattana et al, 2014). The majority of spontaneous ICHs are associated with hypertension, however various factors may be considered including a deep cerebral vein thrombosis, neoplasm, intravenous administration of tissue plasminogen activator and coagulopathies. Although the mechanism of bilateral simultaneous hypertensive ICH remains unclear, there are two currently proposed mechanisms, the coincidental rupture and the subsequent rupture of bilateral micro-aneurysms or perforating arteries (Kono and Terada, 2014). Chronic hypertension can cause hyaline degeneration of the perforating vessels which would be likely to be symmetrical. The findings suggest that the patient may have

symmetrically vulnerable vessels which can simultaneously rupture.

**Conclusion:** In a single center in Manila, Philippines, a total of 2451 patients with ICH were seen and admitted from the year 2010 to 2015 and this is the only reported case of MSICH making it a rare clinical entity. Currently, a total of 41 cases of simultaneous thalamic hemorrhages have been reported worldwide.

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## P231

### Distribution of Subclinical DWI Lesions in Patients with Intracranial Hemorrhage

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**Background and Rationale:** Subclinical ischemic lesions on diffusion weighted MR imaging (DWI) were recently described in patients with spontaneous intracerebral hemorrhage (ICH) and convexity subarachnoid hemorrhage (cSAH), possibly related to amyloid angiopathy. The topography of these lesions may provide clue regarding their pathogenesis with investigators suggesting preference of these lesions in watershed infarct location. The aim is to study the topography of these lesions.

**Methods:** Patients presenting to Monash Medical Centre between 2011–2014 with ICH and cSAH were included in the absence of aneurysm, arteriovenous malformation, hemorrhagic infarction, or contra-indication for Magnetic Resonance Imaging (MRI). Diffusion weighted imaging (DWI) lesions were segmented and registered to stereotactic coordinates. Their locations were compared to digital maps of arterial territory and watershed areas.

**Results:** There were 114 eligible patients; mean age was  $69.6 \pm 12.3$  years (male 53.9%). The distribution of patients were cSAH 16 (14.0%), lobar ICH 48 (42.1%) and deep ICH 50 (43.9%). Among 30 patients (26%) who had DWI positive lesions, 16 (53.3%) occurred within 7 days and 29 (96.7%) by 6 months. The predominant locations were frontal 15/30 (50.0%), parietal 10/30 (33.3%) and subcortical 7/30 (23.3%). These locations and the haemorrhage types are displayed [convexity subarachnoid hemorrhage (red), lobar hemorrhage (blue) and deep hemorrhage (yellow)]. There were no statistical association between the DWI lesion locations and the type of intracranial haemorrhage.

**Conclusion:** Subclinical ischemic lesions have random distribution and are not easily explained by current hypotheses.

## P232

### Risk Factor Analyses for Intracerebral Haemorrhage versus Ischaemic Stroke among Chinese in Taiwan

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**Background and Rationale:** Chinese populations have a relatively higher stroke incidence, younger onset, a higher proportion of intracerebral haemorrhage (ICH), and a lower proportion of ischaemic stroke (IS) as compared with white populations. We aimed to evaluate the differences of major risk factors between ICH and IS among Chinese in Taiwan.

**Methods:** We analysed acute ICH and IS patients consecutively recruited in National Taiwan University Hospital Stroke Registry from 2006 to 2011. We used multiple logistic regression models to examine the associations of risk factors with ICH versus IS, adjusting for confounding factors. Additionally, when we detected strongly significant interactions, we conducted analyses of risk factor associations in different subgroups.

**Results:** We included a total of 1373 ICH patients and 4953 IS patients. Patients with ICH were younger than those with IS (mean age 61 versus 68 years,  $p < 0.001$ ), but there was no significant difference in gender (males 62% versus 59%,  $p = 0.064$ ). A logistic regression model adjusted for all relevant confounders showed that both hypertension (OR 2.23, 95% CI 1.74 to 2.87) and alcohol intake (OR 1.44, 95% CI 1.16 to 1.77) had significantly stronger associations with ICH than IS, whereas diabetes, atrial fibrillation, ischaemic heart disease, hyperlipidaemia, smoking and transient ischaemic attack were negatively associated with ICH versus IS. In subgroup analyses, the association of hypertension with ICH versus IS was more marked in younger patients.

**Conclusion:** Hypertension and alcohol intake are more strongly associated with ICH than IS in among Chinese in Taiwan. Furthermore, the association with hypertension is stronger in younger stroke patients.

## P233

### Predictors of Pneumonia and Its Outcome in Intracerebral Haemorrhage

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**Background and Rationale:** Patients with acute intracerebral haemorrhage (ICH) are at high risk of developing stroke-associated pneumonia (SAP), an established risk factor for poor outcome. We aimed to determine predictors of SAP and outcome in INTERACT studies.

**Methods:** Pooled analysis – INTERACT1 ( $n = 404$ ) and INTERACT2 ( $n = 2839$ ) – of spontaneous ICH patients ( $< 6$  hrs) with elevated systolic BP (SBP, 150–220 mm Hg) randomized to intensive (target SBP  $< 140$  mm Hg) or guideline-recommended (target SBP  $< 180$  mm Hg) management. SAP was recorded as a serious adverse event (SAE). Poor clinical outcome was death or major disability (mRS score  $> 3$ ) at 90 days. Hematoma expansion at 24 hours was defined as growth of absolute  $> 6$  ml or relative  $> 33\%$ . Logistic regression models were used to determine associations.

**Results:** The predictors of SAP, which occurred in 154 (5.0%) patients, included older age, female sex, severe impairment (NIHSS score  $\geq 15$ ), large baseline ICH volume, IVH extension, any intravenous BP lowering treatment within 7 days, and requirement for intubation. Hematoma expansion was associated with SAP in univariate analysis, but not after adjustment for confounders. SAP patients were more likely to have poor clinical outcome (odds ratio 6.82, 95% CI 2.68–17.37;  $P < 0.0001$ ).

**Conclusion:** SAP is associated with poor outcome in ICH. Older, female patients with severe stroke are at particularly high risk. More active targeting of high risk patients could improve outcome in ICH.

## P234

### During Waffle Cone Technique in Management of Wide Neck Aneurysm, Stent Migration into Cerebral Aneurysm

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**Background and Rationale:** Stent-assisted coil embolization (SACE) is a common method to manage intracranial wide-neck aneurysm. Using waffle cone technique, a stent must be successfully deployed into the parent artery to cross the aneurysm neck. Sometimes, we meet unexpected complications. We describe the complication case that during waffle cone technique in management of wide neck basilar tip aneurysm, stent migration into aneurysmal sac.

**Methods:** A 40-year-old woman presented with severe headache, drowsy mentality. Brain computed tomography revealed all cisternal subarachnoid hemorrhage (SAH). DSA revealed giant

basilar tip aneurysm. We determined to treat by waffle cone technique in endovascular treatment.

**Results:** During the waffle cone technique using Enterprise stent, there was stent migration into aneurysmal sac. But, fortunately we noticed early. Then, we deployed coils aneurysmal sac and in stent portion into sac. The procedure. That procedure has ended satisfactorily.

**Conclusion:** It is sometimes meet the complication of intra-procedural distal stent migration. In waffle cone technique, there is required special attention this is because the risk of rupture. If the rest of the treatment as soon recognized because it is not particularly difficult, always requires careful attention.

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## Nursing

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### P235

#### **Nurse-Led Community-Based Intervention to Improve Knowledge of Risk Factors in Patients with Stroke or Transient Ischaemic Attack: A Randomised Controlled Trial**

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**Background and Rationale:** Knowledge regarding risk factors for secondary events is essential to improving risk awareness and perception in patients with stroke. However, there is evidence that survivors of stroke are often unaware of these risk factors. We aimed to determine whether a nurse-led, community-based, multidisciplinary intervention improved the knowledge of risk factors in patients with stroke/TIA.

**Methods:** Shared Team Approach between Nurses and Doctors For Improved Risk Factor Management (STANDFIRM) study is a randomised controlled trial of risk factor management in people with stroke/TIA. We included patients aged  $\geq 18$  years, hospitalised for stroke or TIA, and living within 50 km of the recruitment hospital. We excluded patients participating in another trial, and admitted from or discharged to a nursing home. The intervention comprised a multidisciplinary, individualised secondary prevention management program, including two nurse home education visits. The study outcome was knowledge of at least one risk factor for stroke at 12-month follow-up. Assessments were conducted in a consecutive sample of the trial cohort, using a structured questionnaire. We used multivariable

logistic regression to identify factors associated with knowledge.

**Results:** From May 2014 to January 2015, 135 patients (70.4% male, median age 69.1 years) undertook the outcome assessment: 60 in the usual care group, and 75 in the intervention group. Overall, 36.3% of patients had no knowledge of risk factors for stroke. In adjusted analyses, we found no significant difference between the study groups in the proportion of patients with knowledge of risk factors for stroke at 12 months (OR 1.6, 95% CI 0.7–3.6).

**Conclusion:** A community-based nursing intervention had no impact on knowledge of risk factors for recurrence in patients with stroke/TIA, with more than a third of patients having no knowledge of any risk factor. Better education strategies are needed to improve risk awareness in this population.

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### P236

#### **An Evaluation of the Impact of the StrokeLink Program in Queensland: Perceptions of Participants**

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**Background and Rationale:** StrokeLink, is a team-based, externally facilitated quality improvement program, designed to support health professionals maintain and improve evidence-based stroke care that uses a workshop format for identifying service gaps, reviewing barriers and enablers, and implementing agreed improvement initiatives following development of action plans. We conducted participant evaluation of the StrokeLink program at 36 hospitals within Queensland.

**Methods:** Participants of the StrokeLink program were surveyed in June 2015 on their satisfaction with the program and we sought feedback on their perceptions of subsequent changes to clinical care. Descriptive analysis of the data is presented.

**Results:** Overall, 671 clinicians participated in 14 site specific StrokeLink workshops, 34 StrokeLink team meetings, 42 nurse education in-services and 144 stroke education modules were completed between January 2014 and April 2015. Additional support throughout the program was provided by the coordinator (n = 129 face to face and n = 521 via email and telephone).

Virtually all, 99% (n = 179) of respondents, found the workshop content useful, the presenter knowledgeable and agreed the presentation of audit data were highly valuable. Thirteen of the 14 workshop sites (93%) agreed or strongly agreed that the StrokeLink program led to the establishment of improved locally targeted stroke care processes within their stroke unit.

Eight workshop sites (60%) developed an action plan to improve clinical practice. Sites involved in action planning as part of the StrokeLink program significantly improved adherence to 5 out of 7 clinical indicators in contrast to hospitals that did not develop an action plan.

**Conclusion:** The perception of participants is that StrokeLink has made a valuable contribution to clinical stroke care throughout Queensland. The use of externally facilitated work-

shops to develop action plans with ongoing support was successful reducing identified service gaps. Similar programs are recommended for other jurisdictions.

## P237

### Early Scandinavian Stroke Scale Scores as a Predictive Tool for Rehabilitation and Discharge Planning

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**Background and Rationale:** Early prognostication regarding the need for inpatient rehabilitation or early discharge planning would be useful early in the course of a patient's admission. Clinical tools are available to determine a patient's current level of stroke severity, but it is unknown whether a stroke severity scale can accurately predict a patient's discharge destination. Our centre uses the Scandinavian Stroke Scale (SSS) and we hypothesised that SSS would predict early discharge and the need for rehabilitation.

**Methods:** Details of age, gender, history of previous stroke, SSS in first 24 hours of admission, and discharge destination from acute care were collected on consecutive patients over an 8 months period. SSS scores were divided into three groups: good (> 50), intermediate (30–49) and poor (< 30). Data were analysed to see how well the admission SSS scores predicted discharge destination.

**Results:** In total, 162 strokes were analysed. Mean age was 72 years, 52.5% were male, and 33.3% had prior stroke. 88.9% of strokes were ischaemic.

69 (90.8%) of the 76 patients with an SSS of >50 were discharged directly home from acute care. 5 (6.6%) and 2 (2.6%) patients went to rehabilitation and residential care, respectively.

Of the 30 patients with a SSS of <30, 60% had died or required residential care. No patient was discharged directly home from this group.

Of the 56 patients with a SSS score between 30–49, 52% needed rehabilitation.

**Conclusion:** An admission SSS of >50 was highly predictive of discharge home while a score of <30 was highly predictive of death or lack of early independence. Over 90% of all patients who died scored less than 30. A score of 30–49 correlated was not predictive of discharge destination. Further longitudinal studies are needed to validate the predictive potential of the SSS and other clinical stroke severity scales.

## P238

### Estimating Body Weight for tPA Administration: A Review of the Literature

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**Background and Rationale:** The purpose of this literature review is to examine the evidence related to accuracy of adult stroke patient weight estimates by attending acute care personnel and the patient. Few medications carry as significant a risk for negative outcomes due to over or under dosage, as tissue plasminogen activator for acute ischemic stroke. While weight-based dosing is the gold standard for patients admitted with acute ischemic stroke, patient weight is often 'guesstimated' by staff (Barrow et al., 2016).

**Methods:** We performed computerized English language articles searches to identify clinical and controlled trials and reviews of body weight estimation for tPA administration making use of the following 8 databases: CINAHL, Nursing Reference Center, Medline, Pubmed, Cochrane Library, Science Direct, Joanna Briggs Institute Evidence Based Practice database and Scopus. Inclusion criteria were peer reviewed full text stroke-related articles written in English between the years 2000–2016. Titles and abstracts were reviewed by 2 primary authors for relevance.

**Results:** A total of 356 articles were retrieved from CINAHL (5 articles), Nursing Reference Center (27 articles), Medline (17 articles), Pubmed (75 articles), Cochrane Library (33 articles), Science Direct (82 articles) and Scopus (117 articles) respectively. There were no articles found in Joanna Briggs Institute Evidence Based Practice database and 3 more articles were found from other sources. Of these, 164 replicates were found and the remaining 195 articles were scanned by title, abstract and article type with 190 articles excluded. Thus, a total of 6 articles (3 RCTs, 3 observational studies) that discussed a relationship between body weight estimation and tissue plasminogen activator (tPA) administration met with both inclusion and exclusion criteria were retrieved for detailed analysis and formed the core of the literature review provided in this study.

**Conclusion:** Overall visual estimation of body weight is inaccurate in a majority of stroke patients and health care providers (Breuer et al., 2010); tPA dose administration based on weight estimations, commonly applied in routine clinical practice, results in mis-dosaging in nearly 30% of all stroke patients (Garcia-Pastor et al., 2015).

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## P239

### Integrated Oral Care for Stroke Patients

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**Background and Rationale:** Stroke has disabling oral health (OH) effects, such as dysphagia and hindered brushing due to upper limb hemiparesis. Together, these can increase bacterial load, leading to pneumonia (Kwok et al, 2015). Since the National Clinical Guidelines (National Stroke Foundation, 2010) mention the need for post-stroke oral care, this review aims to identify OH attitudes and practices of nursing and allied health professionals and the benefits of integrating them into a post-stroke oral care program.

**Methods:** A literature search was conducted using multiple databases (MEDLINE, EMBASE etc.) and combinations of medical, nursing and AH staff and OH terms were searched.

**Results:** Currently, no studies have been conducted in Australia. However, studies in Malaysia suggest that nurses have inadequate oral health knowledge, reflected in their infrequent assistance with stroke patient brushing and mouthwash (Malik et al, 2015). There is limited information regarding the benefits of an integrated oral care program, with only a couple of trials indicating that involving nurses in assisted oral care can reduce plaque score (Lam et al, 2013), and reduce NPO status and stroke patient length of stay (Talley et al, 2015). Another questionnaire study suggests that involving nurses and speech pathologists in oral rehabilitation can improve dysphagia outcomes (Zheng et al, 2014).

**Conclusion:** This scoping review highlights the need for further studies to be conducted, especially in Australia, to assess the role of non-dental professionals in an integrated oral care program for stroke patients. The debilitating oral health effects of stroke make future studies vital, potentially leading to a pathway between non-dental staff and oral health professionals, improving overall stroke outcomes.

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## P240

### The Nursing Care Experience of a Patient Who Suffered from a First Stroke

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**Background and Rationale:** Cerebrovascular accident 61 years since the Republic of Taiwan, has been among the top three among the top ten causes of death (Ministry of Health and Welfare, 2013), the initial risk of stroke, lead to limb, language and social function with varying degrees of impairment, resulting in physical activity by restrictions, due to the loss of daily living, the patient loses body control sense, often anxiety (Liu FY, Wang HW, Chen PC and Yang PC, 2014).

**Methods:** The nursing care for the period July 6, 2014 to July 19, 2014. Gordon 11 health patterns were used as an architecture, through direct care, physical assessment, direct care, observation and talks, to collect information on cases, of subjective and objective, to establish the case of health problems like Mobility impaired physical, self care deficit bathing/hygiene, dressing/grooming, and feeding, anxiety, injury risk for.

**Results:** By the author establish a good nurse-patient relationship and case through companionship, to divert attention, listening, active care, positive encouragement and emotional responses to accept the case, help reduce anxiety, and through cooperation with the medical team, for example: discuss the rehabilitation division and to develop rehabilitation plans and to cases and caregivers of the importance of rehabilitation, enhance self-confidence of cases and then actively rehabilitation, improve limb weakness, to achieve a good quality of life. After the case was discharged, hospital stroke tubes division to follow up and health education, so that the case can reduce the risk of stroke again.

**Conclusion:** With the experience of the author's care given set of individual resistance and appropriate care plans and mea-

tures, together with the case regularly organize seminars, community health education, to improve health care knowledge with each other by sharing the care of their experiences, exchange of views, in order to achieve a complete and proper body, mind, and spirit of the care.

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### P241

#### Nursing Experience of Caring for a Patient with Aphasia Caused by Ischemic Stroke in Taiwan

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**Background and Rationale:** Stroke disability affect self-care ability and quality of life of patients. Language is one of the most important on the ability to communicate, in acute stroke patients, about 21%–38% will occur aphasia, the loss of this capacity, patients are unable to express feelings, prone to negative emotions. This article described the nursing experience of caring a 75-year-old male patient with aphasia, impaired physical mobility and anxiety due to ischemic stroke.

**Methods:** The nursing period was from August 27 to September 19, 2015. Data was collected by clinical care, reviewing medical records and interviews and then analyzed by Gordon's eleven functional health patterns assessment tool. Health problems were found: impaired verbal communication, impaired physical mobility and anxiety. The author use empathy, caring, listening and accompany the way to build patient confidence. Together with the patient and family set nursing plans, and language therapists and physical therapist common set rehabilitation plans, and common treatment with acupuncture.

**Results:** Through plans, the patient anxiety improve, smile on his face changed much. The patient can learn to use sketches and notes and non-verbal behavior as a communication tool to improve communication skills. The patient actively participates in rehabilitation initiative campaign, has been using a walker can walk independently about 2 meters, and can perform to eat and other simple activities.

**Conclusion:** The author deeply feel the importance of care during cross-team model, nurses assume the role of coordinator and spokesman, combined with the team to develop a common plan of care, so that patients get better quality care. Help patients through sickness adjustment period.

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### P242

#### Stroke Swallow Screen Implementation Project (SSSIP)

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**Background and Rationale:** To meet current National Stroke Foundation (NSF) guidelines for dysphagia, a validated tool, the Barnes Jewish Hospital Acute Stroke Dysphagia Screen (BJH), was selected for Calvary Hospital Stroke Service. It enables nurses to differentiate patients safe for oral intake from those at risk of dysphagia who require Speech Language Pathology (SLP) assessment. Evaluation of the BJH and nursing perspectives will determine its feasibility and rigor for ongoing use in an Australian Stroke Service.

**Methods:** Evaluation was a three-step approach. A retrospective file audit was completed to benchmark the BJH against NSF guidelines, followed by a survey to determine nurses' perspectives. Finally, a prospective study is being conducted to confirm validity in which screened patients are also formally assessed by SLP using the Mann Assessment of Swallowing Ability (MASA).

**Results:** Data from the retrospective file audit shows 548 patients were admitted with suspected stroke. 496/548 (90.6%) were screened with the BJH within 24 hours. Pass/fail results were recorded for 165 patients. 100% of failed patients were referred to SLP. Nursing surveys showed the BJH is quick to administer and staff are confident in its use.

To date, 35 subjects have been recruited prospectively to establish validity. Compared with patients who passed the screen, patients who failed scored significantly lower on the MASA: with a mean score of 174 ( $\pm 19.5$ ; range 124–200) versus 195 ( $\pm 3.8$ ; 189–200) (Mann-Whitney;  $p = 0.001$ ). Consistent with previous BJH studies, sensitivity to detect dysphagia is high (preliminary analysis 100%).

**Conclusion:** High compliance with NSF guidelines has been attained following implementation of the BJH. Alongside positive nursing perspectives and indirect cost and time savings, the BJH appears feasible for an Australian Stroke Service. Preliminary findings show the BJH has high sensitivity and significant validity, although our sample size is low. Further results are pending.

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P243

**A Study About the Construction of a Nursing Intervention Model Which Promotes Self-Care Reconstruction of Higher Brain Dysfunction Patients**

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**Background and Rationale:** Researchers are continuing the study of the development of a nursing intervention model, which promotes self-care reconstruction of higher brain dysfunction patients. This model presents the sequential order (priority) of interventions and methods of intervention (environmental coordination and the use of 'voluntaristic role'). We also tried to show the expected degree of effectiveness. The purpose of this study is to introduce to processes related to the development of this intervention model.

**Methods:** 1. The first study on the construction of this nursing intervention model was performed in the 2010 to 2012 period. Eight patients who suffered plural higher brain dysfunction participated in this study. Researchers analyzed the effective nursing intervention methods and outcomes of these patients through the use of a case study. After examining similarities of effective interventions, they created the diagrams of their nursing intervention model.

2. The second study has been performed from 2014 up to the present, focusing on exploring the effectiveness of using 'voluntaristic role' intervention methods for unilateral spatial patients.

**Results:** Results were obtained for the first study suggested: 1) Regarding the sequential order (priority) of interventions, to first maintain patients' concentration. This method affected the patients' stable behavior. Then researchers recognized improvements in disinhibition and unilateral spatial neglect. 2) Regarding effective methods of intervention, to use environmental coordination, such as provide a private room with the aim of decreasing visual and auditory stimulation. The use of 'voluntaristic role' methods might be effective for patients who have attention disorder, unilateral spatial neglect, and memory deficit as well. The second study is conducting focused on using this method for unilateral spatial neglect patients, now in the process of analysis.

**Conclusion:** These results show that to presenting nursing intervention model might be helpful for nurses who care for patients with plural higher brain dysfunction when they feel difficulty in selecting effective nursing interventions. Further studies are needed to conduct quantitative analyses to verify the effectiveness of this intervention model.

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P244

**The Effects of Social Skills Training on Communication Skills of Nursing Students: A Study of Communication with Stroke Patients**

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**Background and Rationale:** Different communication skills are needed for stroke patients because of damage to the brain and symptom severity. Therefore, nurses often experience difficulty communicating with stroke patients. Nursing students experience similar problems. Social Skills Training (SST) is now being used in the development of communication skills in the education field. The purpose of this study was to investigate the effects of SST on the communication skills of nursing students during clinical training.

**Methods:** An interventional study was conducted in December 2015 with four students who participated in SST and were undergoing adult nursing practice. SST was conducted once a week, with three sessions in total. The theme of the SST was, 'Difficulties experienced in communication with patients.' SST role-play was video-recorded and played as feedback for the students. The effect of SST was evaluated with questionnaires based on the Kikuchi Social Skill Scale (KISS-18; Kikuchi, 1988), Patient-Nurse Communication Skill Scale (Ueno, 2005) and General Self-Efficacy Scale (GSES; Bando, 1986) before and after clinical training. Data were analyzed using descriptive statistics and compared before and after clinical training.

**Results:** SST topics were about patients' body image, reactions to crying, and reactions to memory disorder experiences. Following clinical training, the average KISS-18 score increased by 6 points, the average Patient-Nurse Communication Scale Score increased by 5 points, and the average GSES score increased by 8.5 points.

**Conclusion:** By participating in SST during adult nursing practice, students developed skills to resolve difficulties experienced in communicating with patients. As KISS-18 and Patient-Nurse Communication Skill Scale scores increased after clinical training, SST may also increase students self-efficacy and improve communication skills. Future studies that include increased the sample size and including qualified nurses in the sample are necessary.

P245

# **The Relationship between FIM-Score-Recovery and Cognition of Self-Ideals Assessed by Roy Adaptation Model Focusing on Stroke Patients in a Convalescent Rehabilitation Ward in Japan**

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**Background and Rationale:** Seiai Rehabilitation Hospital is handling electronic healthcare records based on Roy Adaptation Model (RAM; Roy, C., 2009). We hypothesized that patients' cognition of self-ideals affect functional recovery. Self-ideal is defined as personal self-concept that relates to what the person would like to become or to be able to do according to RAM. The purpose of this study is to disclose the relationship between functional recovery and cognition of self-ideals assessed by RAM in stroke patients.

**Methods:** 1. 323 consecutive stroke patients who admitted to our hospital in 2014 were evaluated. Patients with disturbance of consciousness and aphasia were excluded; finally, 229 patients were analyzed.

2. Cognition of self-ideal in each patient was interviewed by a nurse in charge based on RAM. Patients were divided into two groups; the patients who could express their self-ideals (Group A) and those who could not (Group B).

3. Quantitative analyses were conducted using Mann-Whitney-U test to assess the relationship between the two groups.

**Results:** Of the 229 patients, 188 patients (82.1%) were in Group A and 41 (17.9%) were in Group B. Total Functional Independence Measure (FIM) scores on admission ( $75.3 \pm 24.8$  [S.D.] in Group A vs.  $62.6 \pm 25.8$  in Group B) as well as those on discharge ( $100 \pm 24.9$  vs.  $86.9 \pm 30.5$ ) were significantly higher in Group A than in Group B ( $p < 0.01$ ). There were also significant differences in every items of the FIM scores between the groups ( $p < 0.05$ ).

**Conclusion:** The stroke patients capable of expressing self-ideals tended to make an effort to achieve their goals during hospitalization. Therefore, nursing assessment of self-ideals based on RAM might be helpful to predict patients' goals and motivations, in other words, recovery processes. However, some patients in Group B, possessed compromised processes of self-concept, such as anxiety, weakening, and so on. Further studies are needed to investigate these results in detail.

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P246

# **Head Position in Stroke Trial (HeadPoST): An International Cluster Randomised Nursing Trial**

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**Background and Rationale:** Limited evidence exists over the optimal head position in patients with either acute ischaemic stroke (AIS) or intracerebral haemorrhage (ICH). Potential benefits of lying flat in AIS (increased collateral blood flow) and sitting up in ICH (reduced cerebral oedema) may be offset by increased risks of aspiration pneumonia and cardiac-respiratory failure.

**Methods:** HeadPoST aims to compare the effects of lying flat ( $0^\circ$ ) with sitting up ( $\geq 30^\circ$ ) head position in the first 24 hours of admission for patients with acute stroke on poor outcome (death or disability) at 90 days. A multicentre, prospective, cluster randomised, crossover, blinded outcome assessed clinical trial in 100+ hospitals globally. Key aspects of the study to avoid bias include consecutive recruitment thorough preparation and training of site staff and centralised blinded outcome assessment. Sample size is calculated on each hospital recruiting 140 consecutive patients (2 x 70 per randomized arm). Patient recruitment commenced in 2015. The study is funded by the National Health and Medical Research Council (NHMRC) of Australia and the Brazilian stroke Network.

**Results:** Site set-up in the study is ongoing with 80 of 100+ hospitals actively recruiting 3000+ patients to date. Adherence to randomised head position and follow-up is excellent. The study is ongoing through to end of 2016. Early challenges, initial characteristics and adherence to positioning will be presented.

**Conclusion:** Cooperation, training and communications are essential for set up and conduct of this complex intervention (service remodelling) study. Given uncertainty over benefits/risks, and variability regarding the ideal head position for stroke patients around the world, reliable randomized evidence is required to standardize clinical and nursing practice.



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## P247

### FeSS+ Bundled Nursing Actions to Improve Stroke Care in a Specialised Stroke Unit

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**Background and Rationale:** Three specific simple nursing care activities known as FeSS (Fever, Sugar, Swallow) when used together have been found to be effective in improving patient outcomes following a stroke (Middleton et al., 2011). Additionally, enabling and encouraging hospital patients, particularly older people, to sit out of bed to eat their meals assists with effective swallowing, improves oral intake and reduces falls (Corcoran, 2005; West and Redstone, 2004).

**Methods:** These nursing interventions have been studied separately but not as an integrated nursing care strategy. We propose to implement this 'bundle' of nursing care into the Mater Centre for Neurosciences Stroke Unit in a structured way to test if adding the fourth strategy of sitting patients out of bed for meals to the FeSS bundle will further improve patient outcomes and care delivery.

A cross-sectional, repeated measures design with a historical reference group will be used. Baseline data will be compared to within-study and end of study measures of the outcomes of interest to establish changes. Prospective data will be collected from the beginning of the study and analysed at one, three, six, nine and twelve months commencing in May 2016.

**Results:** The primary outcome of interest to this study is functional status at discharge (measured with the modified Rankin Scale). Secondary outcomes are in-patient death, post-stroke diagnosis of chest infections, length of stay, and discharge destination.

**Conclusion:** The results of this study will be submitted to relevant national and international conferences for presentation. An article based on the study will be written by the study team and submitted to a peer-reviewed journal.

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## P248

### Reducing Clinical Variation in Acute Stroke Care Using a 'Code Stroke' Strategy

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**Background and Rationale:** Reperfusion therapy and admission to a Stroke Unit improve outcomes for patients with ischaemic stroke. In our metropolitan hospital, Stroke Unit care is provided but reperfusion therapy is centred at a local tertiary hospital. Despite ambulance bypass for FAST positive patients, many patients with acute stroke present directly to our Emergency Department requiring specialist assessment and care. Two clinical audits showed clinical variation in their management from National Guidelines.

**Methods:** We instigated a clinical redesign project and implemented a Code Stroke strategy. Under Code Stroke, all patients presenting with suspected stroke symptoms (regardless of onset time) are identified at Triage or initial medical assessment. A pager system alerts the stroke doctor, specialist nurse, speech pathologist (who all attend the patient) and the duty radiographer. Processes of care were compared with local stroke audit data using the Mann-Whitney U-test.

**Results:** 20 patients were seen in the six-week pilot phase conducted during office hours. Significant reductions were seen in median times from arrival to (a) stroke team notification (95 to 8 minutes), (b) documentation of dysphagia screening (173 to 45 minutes) and (c) admission to Stroke Unit (393 to 180 minutes). Reductions in times from arrival to CT request (38 to 19 mins) and CT completion (50 to 45 mins) were non-significant. Discharge diagnoses were ischaemic stroke (n = 7), transient ischaemic attack (n = 4) and non-stroke (n = 9). No patients required reperfusion therapy.

**Conclusion:** The Code Stroke model has been well-described for reperfusion assessment; our findings suggest the principles could improve the process of care for a broad range of acute stroke patients.

### Informed Consent in a Multicenter Stroke Registry: Fukuoka Stroke Registry (FSR)

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**Background and Rationale:** Low consent rate causes serious selection bias in the consent-based registry of clinical data. In the Fukuoka Stroke Registry (FSR), a multicenter registry system of acute stroke patients, research nurses help to obtain written informed consent from patients as clinical research coordinators (CRCs) in participating hospitals. This study aimed to investigate the status of informed consent in this registry.

**Methods:** We investigated the rate of obtained consent and reasons for lack of consent in the FSR. In the FSR, one or more full-time CRC work at each hospital and help in obtaining patients' consent. This study included 11,427 acute stroke patients who were admitted to the seven participating hospitals in Fukuoka Prefecture from July 2007 to December 2014.

**Results:** Among overall stroke patients, CRC could explain the details of the study to 10,566 (92.4%) patients and obtained consent from 10,092 patients. Therefore, informed consent was obtained from 95.5% among informed patients and from 88.3% among overall patients. The consent rate ranged from 80% to 94% depending on the participating hospitals. The reasons for failure to obtain informed consent were as follows: patients' social backgrounds (2.5%), earlier discharge or death before informing (1.9%), and refusal to participate in the study (4.0%).

**Conclusion:** A high consent rate could be attained in the FSR enrolling acute stroke patients. Support by full-time research nurses may contribute to the high consent rate.

### Differences of Nursing Practice between an Expert Nurse and a Competent Nurse for a Patient with Unilateral Spatial Neglect Following a Stroke

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**Background and Rationale:** For cognitive rehabilitation of Unilateral Spatial Neglect (USN) patients, there are compensatory approaches, including teaching strategies to make behavioral adjustments. However, it is hard to promote awareness in patients of their neglected side. Researchers experienced nurses' interventions differ from each assessment ability. The purpose of this study was to research the differences of nursing practice between an expert nurse and a competent nurse for a patient with USN following a stroke.

**Methods:** 1. Participants: The expert nurse (*Nurse A*) and the competent nurse (*Nurse B*) participated in this study.

2. These two nurses joined feeding self-care deficit interventions for a patient with USN. First, *Nurse B* performed intervention for the patient, after which *Nurse A* did an intervention for the same patient. *Nurse B* participated in the intervention settings, and then observed and recorded *Nurse A*'s expert practice and patient outcomes (by shadowing). After these intervention periods, *Nurse B* reflected on both practices and both researchers compared each other's practices and outcomes by using context analysis.

3. Ethical considerations: Informed consent was obtained.

**Results:** There were some differences between the two nurses about intervention methods and patient outcomes. 1. The characteristics of the expert nurse's practices: *Nurse A* noticed and weighed the patients' major complaint, which was swallowing problems. The patient complained about drinks that were too thick, and that prevented him from aspirating. *Nurse A* rapidly noticed and tried to adjust the drinks to allow him to swallow as soon as possible. As a result, the patient trusted *Nurse A*, and a good relationship was constructed between them. This relationship supported the patient's understanding of the teaching strategies employed to explore his neglected side. 2. The characteristics of the competent nurse's practices: *Nurse B* urged the patient to notice his neglected left side, and supported his feeding self-care deficit. However *Nurse B* did not give priority to the patient's complaint as *Nurse A* did.

**Conclusion:** There were cognitive gaps between both nurses in the weighing of the importance of patient's complaint. This suggests nurses' differences of in attitude toward for patient's difficulties, and it shows different attributes of empathy for the patient's situation. Throughout the comparison of these practices, results suggested that the key aspects of good practice were the nurse's abilities to precisely assess patient's complaint and how to judge the patient's complaint.

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**P251****Is Age a Predictor for Length of Stay in an Acute Stroke Unit?**

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**Background and Rationale:** The average length of stay (LOS) in major Australian hospitals for an acute stroke patient over 65 years is 9.4 days (ACSQHC 2013), but little data exists for LOS on acute stroke units. Increased LOS is associated with increased mortality and morbidity (Ingeman et al. 2011). Calvary Health Care stroke unit has a target LOS of 72 hours but we are unaware how patients perform across different age groups. We hypothesise that age is an independent predictor of increased LOS in the acute stroke unit.

**Methods:** We retrospectively reviewed stroke unit data collected between 01/04/2014 to 31/12/2015. We classified each age group into those below 65 years, 65–74 years, 75–84 years, and 85 years and over. Data for LOS were divided into LOS less than 72 hours and LOS more than 72 hours. Admission NIHSS scores were divided into those with scores less than 4, 5–15 and scores  $\geq 16$ . Odds ratio was calculated across each age group and LOS after correcting for NIHSS scores.

**Results:** 236 of 351 (67.2%) patients were in the stroke unit for less than 72 hours. Of 115 (32.8%) patients staying more than 72 hours; 24 (21%) were under 65, 28 (24%) were between 66–74 years, 38 (33%) were between 75–84 years and 25 (22%) were above 85 years.

For NIHSS less than 4; patients in each age group were more likely to have a shorter LOS when compared to older patients more than 85 years (odds ratio 1.88, 1.25, 1.25 respectively) but none were statistically significant. Similar statistically non-significant results were seen with NIHSS 5–15 group (odds ratio 3.125, 1.13, 0.938 respectively) and NIHSS more than 15 group (odds ratio 0.5, 2.0, 0.85 respectively).

**Conclusion:** Our study shows that increasing age is not a predictor for prolonged LOS in an acute stroke unit and only LOS should be used as an independent key performance indicator. We acknowledge low sample size is our study and ongoing study is required to validate these findings.

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**P252****The System of Care for Stroke Patients in Khiri Mat Hospital, According to the Concept of 4 P. Model**

Sonlop P.

Thailand

**Background and Rationale:** Acute Stroke is a silent killer which waiting to take away the life of Thai people. For Khiri Mat hospital, Sukhothai province had a number of acute stroke patients into service during the year 2012–2014 were 53, 60, 73 persons. Service for patients at risk of stroke and acute stroke patients had a variety of role-based multidisciplinary. So, the multidisciplinary team of stroke were jointly voted to adjust the paradigm for acute stroke patients by the concept of the 4 P Mode.

**Methods:** 4 P Mode, including to P1 was Prevention ; S.I.C. (S: Screen stroke risk score/I: Intervention care/C: Continuous care) P2 was Protection ; Complication A. C. T. (A: Ask On set/C: Check Exclusion criteria/T: Transfer for ER) P3 was Planning discharge; C3.T. (C: Care map/C: Caregiver/C: Continuous care/T: Team work) P4 was Palliative care; 2P.S.H. (P: Patient center & Family inclusive/P: Pain control/S: Spiritual care/H: Home care).

**Results:** In 2015, 1. Diabetes/Hypertension patients are screened the risk stroke were 100%.

2. New acute stroke patients were 101 person. 3. Acute stroke patients are received r-TPA were 8 person. 4. Stroke patients are continuously care were 95%.

**Conclusion:** In 2015, 1. Diabetes/Hypertension patients are screened the risk stroke were 100%.

2. New acute stroke patients were 101 person. 3. Acute stroke patients are received r-TPA were 8 person. 4. Stroke patients are continuously care were 95%.

**Reference:**

Thai neurological nurses society (2011): Clinical Nursing Practice Guideline for Stroke.

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**P253****Nursing Experience of a Young Stroke Patient with Hopelessness**

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**Background and Rationale:** The goal of the report was to explore the process of assisting a 39-year-old man with stroke to face the impact of bedridden state and rebuild confidence through the cooperation of the patient, caregivers, and health professionals.

**Methods:** During the period of care, the author utilized Gordon's 11 Functional Health Patterns Assessment to collect data. The main difficulties were on the psychological aspect: the inferi-

ority for impairment in expression ability, the depression in self-care deficit, the high stress from 'long-term' rehabilitation, and caregivers' anxiety especially in lack of nursing knowledge. According to the data and assessment results, the author planned an individual caring program. The author strengthened sense of trust with the patient and caregivers by offering correct nursing skills and giving stroke-related knowledge through caring activities. Besides, health professionals provided appropriate medical resources through observation, listening, interview, and periodic physical examination.

**Results:** While obtaining effective rehabilitation treatment and comprehensive nursing service, the patient promoted self-expectation and improved hopelessness.

**Conclusion:** I want to offer my contribution to communication in stroke nursing via this experience.

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## Small Vessel Disease and Stroke Dementia

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P254

### Post Stroke Checklist as an Informative Data in Association with Vascular Neurocognitive Disorders in a Thai Military Stroke Centre

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**Background and Rationale:** The Post Stroke Checklist (Philp et al., 2013) was developed to standardise and surveillance a long-term stroke care (Ward et al., 2014; Dong et al., 2014). Application of Post Stroke Checklist leads to medical interventions and holistic care. This study aimed to identify sequential disability and impairment by applying the Post Stroke Checklist in association with cognitive outcome in stroke survivors by using the Montreal Cognitive Assessment (MoCA) test (Hemrungsrojn et al., 2009).

**Methods:** A cross-sectional study was conducted and stroke survivors were recruited at Stroke clinic Phramongkutklao Hospital. Demographic data and stroke information were collected. All cases were assessed by interviewing multiple items in the Post Stroke Checklist and MoCA battery test.

**Results:** Among 240 patients, mean age was 65.55 years, 65% were male and hypertension was the most prevalent comorbidity (91.25%). The right hemisphere was the most common affected side (51.25%). The average time after stroke onset was 40.63 months, and 177 patients (73.7%) had good outcome (mRS 0–2).

The Post Stroke Checklist revealed that patients received the secondary prevention (62.5%), had impaired activities of daily living (32.5%), mobility deficit (35%), spasticity (22.5%), pain

(20.8%), incontinence (24.6%), communication problem (26.7%), abnormal mood (31.3%), reduced cognition (47.1%), overall disabling quality of life after stroke (28.3%), and poor relationship with families (21.3%). Apart from secondary prevention, all impairment items in the individual Post Stroke Checklist were significantly associated with poor MoCA performance ( $p < 0.05$ ). The presence of cognitive problem in the checklist was associated with left hemispheric stroke ( $p = 0.037$ ).

**Conclusion:** The Post Stroke Checklist is feasible and applicable and can be used to predict cognitive impairment measured by MoCA test. Left hemispheric stroke is significantly correlated with cognitive deficit.

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P255

### Cerebral Motor Executive Network Function Is Associated with Neurological Outcome in Acute Ischemic Stroke with Subcortical Infarction

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**Background and Rationale:** In the resting state functional MRI (rs fMRI), the cerebral motor executive network has been found to be linked to neurological recovery in ischemic subcortical infarction. However, link of functional connectivity (FC) in motor executive network at acute stage of ischemic stroke to neurological recovery remains to be established. The present study explored the link of FC in motor executive network to neurological recovery in patients with acute subcortical infarction.

**Methods:** 17 patients with first acute subcortical infarction and 28 age- and sex-matched controls received rs fMRI at 3 days and 3 months after stroke with controls receiving only one session. FC between 14 brain regions (7 at each hemisphere) belonging to motor executive network were analyzed. The FC at 3 days and 3 months after stroke were compared between patients and controls, as well as between patients with good outcome (modified Rankin Scale, mRS = 0–1) and poor outcome (mRS  $\geq 2$ ).

**Results:** Of the 17 patients with ischemic stroke, 13 had good outcome (age =  $54 \pm 11$ , 8 males, NIHSS =  $3.6 \pm 2.0$  at 3 days,

1.0 ± 1.7 at 3 months and mRS = 0.7 ± 0.2 at 3 months), 4 had poor outcome (age = 64 ± 11, 3 males, NIHSS = 6 ± 2.9 at 3 days, 3.8 ± 1.5 at 3 months and mRS = 2.3 ± 0.5). Patients with good outcome had better FC of motor executive network than those with poor outcome at both 3 days and 3 months, especially FC between ipsilesional primary motor cortex and other regions of motor executive networks including bilateral supplemental motor area, post-central gyrus, dorsolateral premotor cortex, and inferior cerebellum ( $p < 0.05$ ). FC between bilateral primary motor cortex at 3 days is negatively associated with mRS at 3 months (correlation coefficient = -0.493,  $p < 0.05$ ).

**Conclusion:** FC between bilateral primary motor cortex during acute stage of ischemic stroke is linked to neurological recovery at 3 months in patients with subcortical infarction.

## P256

### Informing Prognostication of Post-Stroke Cognitive Impairment: The Accuracy of a Pre-Discharge EEG Marker

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**Background and Rationale:** Cognitive impairments are common following stroke although screening for or prognosticating these is challenging. Electroencephalogram (EEG) markers of post-stroke brain dysfunction may inform such screening. This study investigates the accuracy of pre-discharge EEG measures for informing prognostication of which patients will have post-stroke cognitive impairments.

**Methods:** Routine resting EEG was recorded at bedside at median 90 h (range: 48–239 h) after onset of middle cerebral artery territory, ischaemic stroke. A marker of abnormal EEG 'alpha slowing' (power/amplitude of posterior, 4–8Hz activity) was calculated from 3 min of EEG. Montreal Cognitive Assessments (MoCA) were administered following EEG and at median 99 d (range: 69–138 d) post-stroke. Cognitive outcomes were classified as unimpaired (MoCA scores ≥26) or impaired (MoCA scores ≤25). Spearman correlation coefficients were computed between pre-discharge measures and MoCA scores. The accuracies of pre-discharge measures to predict cognitive outcomes were analysed using binary logistic regression modelling.

**Results:** Thirty-five patients were enrolled. Two were lost to follow-up and two couldn't complete outcome MoCA due to functional impairments. Across 31 patients (10 female, 11 left hemisphere, ages: 18–84 [median 69]), there was a significant negative correlation between posterior slow alpha power and outcome MoCA scores. This EEG measure correctly classified 25 patients (81%) as cognitively impaired or unimpaired at outcome. Of 25 patients who could complete the pre-discharge MoCA, this correctly classified 23 (92%) as impaired or unimpaired at outcome.

**Conclusion:** Outcome cognitive impairments were generally associated with greater degrees of slowed alpha activity. This readily-obtainable EEG marker could potentially inform early screening or prognostication of post-stroke cognitive impairments; providing particularly valuable information in frequent cases unable to be thoroughly assessed pre-discharge (including with MoCA) due to stroke symptoms (aphasia, hemianopia, hemiplegia, apraxia, drowsiness) or other factors (e.g. non-fluent in English).

## P257

### Isolated Central Vestibular Syndrome Due to Superior Vestibular Nucleus Infarction

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**Background and Rationale:** Isolated central vestibular syndrome can result from lesions restricted to the vestibular nuclei, the nucleus prepositus hypoglossi, the flocculus, the nodulus, and the inferior cerebellar peduncle. Each structure disclose distinctive ocular motor findings, and these can aid in understanding the function of each central vestibular structure in humans. We report a patient with dorsolateral pontine infarction who showed distinctive vestibular signs from previous central vestibular syndrome.

**Methods:** A 55-years-old man presented with acute vertigo, unsteadiness, and vertical diplopia. He had no other neurological or auditory symptoms. We performed neurological examination and vestibular work-up including video-oculography, subjective visual vertical, fundus photography, bithermal caloric test, and vestibular-evoked myogenic potential test.

**Results:** Neurological examination showed spontaneous right-beating horizontal-torsional nystagmus that increased during rightward gaze and changed into left-beating during leftward gaze. Bedside head impulse tests were normal. He veered to the left side, but did not have dysarthria, limb weakness, dysmetria, or sensory loss. Tests of subjective visual vertical showed conjugated rightward deviation. Fundus photography revealed a 25° extorsion of the right eye and 14° intorsion of the left eye. He had a skew deviation with a left hypertropia of 4 prism diopters in the primary gaze. Bithermal caloric tests and a vestibular-evoked myogenic potential test were normal. Diffusion-weighted images revealed an acute, tiny infarction on the right dorsolateral pons, and magnetic resonance angiography disclosed no abnormalities. He was treated with antiplatelet agent, and his symptoms resolved within 2 weeks of symptom onset.

**Conclusion:** Our patient with dorsolateral pontine infarction presented with isolated central vestibular syndrome characterized by ipsilesional spontaneous nystagmus, gaze-evoked nystagmus, normal head impulse, and ipsilesional ocular-tilt reaction. These findings are inconsistent with that observed in lesions of medial vestibular nucleus and inferior cerebellar peduncle located on the dorsolateral pons. Instead, selective involvement of the superior vestibular nucleus might explain our patient's signs.

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### P258

#### **Cognitive Survey in Post-Stroke Patients at Phramongkutklao Hospital Stroke Centre**

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**Background and Rationale:** Post-stroke neurocognitive disorder is common and results in morbidity and mortality (Fitzpatrick et al., 2004 & 2005; Béjot et al., 2011). This study aimed to determine prevalence of post-stroke cognitive impairment (Gorelick et al., 2011) and associated factors.

**Methods:** Post-stroke patients treated at Phramongkutklao Hospital Stroke centre were recruited. Patients' characteristics and stroke data were recorded. Montreal Cognitive Assessment (MoCA) Thai-version (Tangwongchai et al., 2009) was applied to identify neurocognitive disorder in all participants.

**Results:** Among 178 cases, most of them had infarct 97%, first ever stroke 90%, hypertension 90%, dyslipidemia 80%, and 73% were in minimal or nondisabled. The affected hemispheres were right 51.3% and 37.1% and other locations were 11.7%.

The average MoCA score was 16.2 (SD 6.7). Importantly, major neurocognitive disorder or dementia (score <23) was detected in 149 cases (83.7%), mild vascular neurocognitive disorder or MCI (score 23–26) in 26 (14.6%), and unimpaired cognition (MoCA score >26) in 3 (1.7%). For patients living >1 year after stroke, dementia was found 80% and MCI 18%. Additionally, patients living <6 months after stroke had dementia 84% and MCI 12%. Age was a significant factor that negatively correlated with MoCA performance (Pearson correlation coefficient of  $-0.380$  ( $p = 0.001$ )). Interestingly, locations of stroke had no impact on cognitive test.

**Conclusion:** Post stroke neurocognitive impairment is prevalent especially dementia, even though patients survive in non or minimal disabling lives. Medical intervention and modification of care would be beneficial for stroke survivors.

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### P259

#### **Association between Cerebral Microbleeds and Transcranial Doppler Derived Pulsatility Index in Cognitively Normal Elderly Individuals**

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**Background and Rationale:** Microbleeds are one of feature of cerebral small vessel disease. Although pulsatility index (PI), measured by transcranial Doppler (TCD) ultrasound has been considered as a predictor of cerebral small vessel disease such as white matter lesions, it is still unclear whether PI is associated with cerebral microbleeds. Therefore, we explored the association between PI measured by TCD ultrasound and cerebral microbleeds in cognitively normal individuals.

**Methods:** We performed TCD and magnetic resonance imaging in 148 cognitively normal elderly individuals who were visited neurologic clinic due to headache. The patients with history of clinical stroke (including lacunar and hemorrhagic stroke) or transient ischemic attack were excluded. We investigated the association between middle cerebral artery (MCA) PI with microbleeds.

**Results:** Cerebral microbleeds were present in 28 of 148 participants (18.9%) with a total of 45 microbleeds. The presence of cerebral microbleeds was associated with age ( $p < 0.001$ ), white matter lesions ( $p < 0.001$ ) and MCA PI ( $P = 0.03$ ). After adjusting demographic and clinical variables by multiple logistic regression analysis, MCA PI was significantly associated with cerebral microbleeds (odds ratio, 1.11 per 0.1 increase in PI; 95% CI, 1.01–1.29;  $p = 0.03$ ).

**Conclusion:** Our present study findings show that mean MCA PI was associated with cerebral microbleeds. This suggests that mean MCA PI in cognitively normal elderly patients may serve as a marker of cerebral microbleeds related small-vessel disease.

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**P260****Small Vessel TIA and Lacunar Infarction Detected with Perfusion-Weighted MRI**

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**Background and Rationale:** The clinical diagnosis of transient ischemic attack (TIA) or minor stroke is highly subjective, especially if the brain imaging does not reveal any evidence of ischemic lesion. Herein, I report the cases of small vessel TIA and lacunar infarction in which the ischemic lesions were detected with the perfusion-weighted MRI.

**Methods:** Case 1. A 60-year-old hypertensive woman presented with transient left side weakness. She experienced slurred speech and weakness of her left arm and leg for 5 minutes. On neurological examination, she did not show any deficit. The initial multimodal MRI, taken 2 hours after the symptom, revealed no abnormality on diffusion-weighted imaging (DWI) but showed perfusion defect in her right basal ganglia. The intracranial and extracranial MR angiography did not show any abnormality. The patient did not experience further symptom. However, the follow-up DWI 2 days later revealed diffusion restriction corresponding to the initial perfusion defect.

**Results:** Case 2. A 66-year-old hypertensive woman presented with the clinical findings of cheiro-oral syndrome. Neurological examination revealed sensory deficit in her left fingers and left hemi-mouth. MRI taken 12 hours after the symptom onset revealed no abnormality on DWI but showed perfusion defect in her right lateral thalamus. MR angiography did not show any vascular lesion related to the perfusion defect. Her symptom persisted and the follow-up DWI 2 days later showed acute lacunar infarction in the right thalamus, which corresponded to the initial perfusion defect.

**Conclusion:** This report shows the usefulness of perfusion-weighted imaging (PWI) in detecting the ischemic lesions caused probably by small vessel diseases, which presented clinically as TIA and lacunar syndrome. Whereas PWI has been known to be helpful for detecting ischemic lesions caused by large vessel disease and cardioembolism in DWI negative patients, our cases show its usefulness for small vessel TIA and lacunar infarction as well.

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**P261****Application of Unsupervised Machine Learning to Discover Themes in Literature on Lacunar Stroke**

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**Background and Rationale:** Fisher's clinicopathological works on lacunar stroke has been popularised as intrinsic small vessel disease. It is not certain if there are other undiscovered themes in those works. Unsupervised machine learning has the advantage of generating themes without the intervention of the investigator. In this study, an unsupervised machine learning method, probabilistic topic modeling (PTM), is used to discover if

the 'hidden' themes from the scientific work by Fisher on lacunar stroke.

**Methods:** Articles were searched from Pubmed, Medline, Scopus. The inclusion criteria were: 1) papers authored by CM Fisher; 2) the term 'lacunar' is mentioned at least once in the document. The portable document format (pdf) of these articles were downloaded and transformed into text files. A standardise approach of processing these articles were performed to create a document term matrix: removing of number, punctuation, font in lower case, stop words. These topics were fitted to Dirichlet (multivariate probability) distribution for theme discovery.

**Results:** There were 16 pdf articles. The top 5 frequent words in these articles were: artery [word frequency 569], lesion [frequency 397], right [frequency 374], left [frequency 326], lacune [frequency 285]. Figure is a word cloud depicting frequent occurring words by the size of the words. The top 5 themes were: 1) sensory and motor stroke; 2) pontine stroke; 3) histopathology of vessel lumen (tem such as plaque [frequency 47] and atherosclerosis [frequency 83]); 4) cerebellar stroke; 5) histopathology of vessel wall.

**Conclusion:** This analysis show that the Fisher's works on lacunar stroke were not as homogenous as depicted. Theme discovery from PTM provides an unbiased method to re-evaluate works by key contributor to the literature on lacunar stroke or other scientific works.

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**P262****Asymmetrical Cerebral White Matter Hyperintensities and Predilection of Lacunar Infarct**

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**Background and Rationale:** Pathogenesis of white matter hyperintensities (WMHs) is largely unknown. Recent studies have indicated that the distinction between WMHs and lacunar infarcts seems to be less clear than previously thought. If WMHs increase the susceptibility of lacunar infarct and lacunar infarct turns into WMHs, symptomatic lacunar infarct may preferentially develop in the hemisphere with more severe WMHs.

**Methods:** 315 patients with supratentorial acute lacunar infarct were included. WMHs on MRI were graded by a neurologist blinded to the study hypothesis using modified Scheltens Scale (0–30 for each hemisphere). Because there is no consensus on the definition of WMHs asymmetry, we used diverse cut points of the difference of modified Scheltens Scale between hemispheres ( $\geq 2$ ,  $\geq 3$ ,  $\geq 4$ , or  $\geq 5$ ). Chi-square test was used to examine the relation-

ship between asymmetrical WMHs and the location of lacunar infarct in each definition of asymmetrical WMHs.

**Results:** Mean age was 63.7 (SD 13.0) and 190 (60.3%) were men. When the difference of modified Scheltens Scale  $\geq 2$  was used as the definition of asymmetrical WMHs, 71 patients had right-dominance WMHs, 70 left-dominance and 174 symmetric. In patient with right-dominance WMHs, 42 (59%) had lacunar infarct in right hemisphere whereas, in those with left-dominance WMHs, 49 (70%) had lacunar infarct in left hemisphere ( $p = 0.002$ ). When the difference of modified Scheltens Scale  $\geq 3$  was used as the definition, the preference of lacunar infarct was stronger. When the difference of modified Scheltens Scale  $\geq 5$  was used as the definition, 8 patients had right-dominance of WMH, 6 left-dominance and 301 symmetric. In patients with right-dominance WMHs, 7 (88%) had lacunar infarct in right hemisphere, whereas, in those with left-dominance WMH, 5 (83%) had lacunar infarct in left hemisphere ( $p = 0.019$ ).

**Conclusion:** We found that lacunar infarct preferentially develops in the side with more severe WMH. Our findings corroborated the notion that small lacunar infarcts turn into WMHs. Further studies are warranted to decipher a temporal relationship between lacunar infarct and WMH.

## P263

### Orthosiphon Stamineus Improve Memory and Hippocampal Long Term Potentiation Impairment in a Chronic Cerebral Hypoperfusion Model in Rat

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**Background and Rationale:** Chronic cerebral hypoperfusion is a major contributor to cognitive decline and a critical determining factor for dementia. Permanent, bilateral occlusion of the common carotid arteries (PBOCCA) is a well-characterized animal model used to investigate the cognitive consequences of chronic cerebral hypoperfusion. In the present study, the effects of *Orthosiphon stamineus* (OS) on memory and long term potentiation (LTP) were evaluated in PBOCCA model.

**Methods:** Male Sprague-Dawley (SD) rats (250–300 g) were used in the study. PBOCCA surgery was carried out in anesthetized rats and sham operated group underwent a similar procedure without ligation. Animals were allowed a period of 1 week for recovery. Acute treatment with OS at 100, 200 and 400 mg/kg was given to different groups prior to behavioral testing in passive avoidance (PA) and morris water maze (MWM). Four weeks post-surgery, LTP was recorded.

**Results:** In the Morris water maze test, no insignificant increase in time spent in the target quadrant was observed, whereas a significant decrease in escape latencies during training observed in the group treated with 100 & 200 mg/kg OS extract. OS treated rats showed significantly increased step-through latency at 100 &

200 mg/kg dose when test using the passive avoidance paradigm. The amplitude of fEPSP was improved in OS (200 and 400 mg/kg) treated groups compared to PBOCCA rats.

**Conclusion:** The behavioral results showed that OS treated group significantly improved learning and memory functions when tested on PA and MWM. The results suggest that OS improve memory functions induced by cerebral hypoperfusion.

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## P264

### Usefulness of Finger Tapping in Evaluating Vascular Mild Cognitive Impairment (MCI)

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**Background and Rationale:** The aim of this study is to estimate the efficacy of finger tapping examination for evaluating the patients with MCI caused by atherosclerosis.

**Methods:** Fifteen subjects (more than 60-year-old) diagnosed as MCI with atherosclerosis (Framingham risk score >16 points for men and >14 points for women) and no neurological dysfunction were assessed. In this study, the patients MCI was defined as 22–28 scores of Mini-mental State Examination without obvious dementia. The patients with MCI were instructed to perform the finger tapping examination consisting of finger tapping with a dominant hand, that with both hands at the same time, that with both hands alternately, and that with fitting the 2Hz metronome by using the finger tapping measurement system with magnetic sensors, 'UB-1', produced by HITACHI, Ltd. They were also estimated by the Instruction manual of Japanese version of Montreal Cognitive Assessment (MoCA-J) and the Frontal Assessment Battery (FAB). The relationship between the finger tapping parameters and scores of MoCA-J and FAB was statistically analyzed.

**Results:** In 44 parameters extracted from finger tapping examination, 6 parameters (standard deviation/coefficient of variation of contact duration ( $r = -0.51$ ,  $p = 0.05$ / $r = -0.51$ ,  $p = 0.05$ ), average of distance rate of velocity peak in opening motion ( $r = -0.50$ ,  $p = 0.06$ ), skewness of tapping interval distribution ( $r = 0.57$ ,  $p = 0.02$ ), similarity of both hands/time lag of similarity of



hands ( $r = 0.53$ ,  $p = 0.04$ / $r = 0.63$ ,  $p = 0.01$ )) were correlated to FAB and 1 parameter (average of distance ratio in both hands ( $r = -0.54$ ,  $p = 0.04$ )) to MoCA-J.

**Conclusion:** The finger tapping examination using the 'UB-1', finger tapping measurement system with magnetic sensors, may be effective for evaluating frontal lobe function in atherosclerotic patients with MCI.

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## Tele-Rehab/Tele-Health

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P265

### Effect of Supplementary Video Based Teaching Program in Reporting of Post Stroke Complications – A Randomized Controlled Trial (Movies4Stroke)

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**Background and Rationale:** Pakistan is the world's sixth most populous country with a stroke vulnerable population without a single dedicated chronic care center. In order to provide evidence for a viable solution responsive to this health-care gap, and leveraging the existing greater than 70% mobile phone density, we rationalized to test the effectiveness of a mobile phone-based video intervention of short 5 minute movies to educate and support stroke survivors and their primary caregivers.

**Methods:** *Movies4Stroke* was a randomized controlled, outcome assessor blinded, parallel group, single center superiority trial. Participants having an acute stroke, medically stable, with mild to moderate disability and having a stable primary caregiver were included. Intervention group participants had the movie program software installed in their android device which allowed them to view 5 minute videos on stroke related topics. Control group participants received standard of care at an internationally accredited center with defined protocols. The primary outcome measure, post-stroke complications requiring medical attention was ascertained between the two groups at first month follow-up post-discharge. This trial was designed to enroll 210 participant dyads after increasing to 10% to incorporate attrition. Survival Analysis was used to model post-stroke complications against video-based intervention and other covariates. Final analysis was carried out by intention-to-treat (ITT) principle.

**Results:** We recruited 210 participant dyads (stroke survivors and their caregivers) over a period of 4 months. Seven participant dyads were lost to follow-up and twelve stroke survivors died during the follow-up period. After one month post-discharge, stroke survivors reporting at least one post-stroke complication were 15 in the intervention group as compared to 6 in the control group ( $p$ -

value = 0.05). On applying Cox Proportional Hazard Model at multivariable analysis level, video-based intervention had an adjusted hazard ratio of 2.63 (C.I.: 1.17–5.93) for reporting post-stroke complications, when adjusted for quality of life of stroke survivors (HR = 0.99, C.I.: 0.98–0.99), stroke subtype (HR = 3.78, C.I.: 1.61–8.87), caregivers' education (HR = 2.61, C.I.: 1.05–6.47), stroke survivors' education (HR = 3.05, C.I.: 1.18–7.87), and number of brain scans (3 or more) (HR = 7.51, C.I.: 1.26–44.62).

**Conclusion:** Post stroke complications were more likely to be reported by those with ischemic stroke sub-type, higher education and schooling in the dyads, and greater number of scans (due to stroke severity) in the presence of video intervention.

This randomized trial tested an application aimed at supporting caregivers and stroke survivors in a low-middle income country setting. Moreover, in future effectiveness trials are needed to best define pragmatically the roll out of these interventions.

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P266

### Increasing Practice Intensity after Stroke: Description of a Caregiver-Led Exercise Program Using a Telehealth Approach

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**Background and Rationale:** Caregiver-mediated exercises (Vloothuis et al. 2014) and tele-rehabilitation (Kairy et al. 2013) solutions are novel ways to assist with exercise delivery and increase practice intensity. We describe the content of an 8-week caregiver-mediated exercise program combined with tele-rehabilitation after stroke.

**Methods:** Key elements were: coaching role of carer, 'practice and homework', easy-to-use technologies, and videoconferencing. An iPad with customised exercise application was provided, including 31 standardized exercises to improve sitting, standing and transfer skills, as well as strength and balance. Patients and caregivers were asked to practice for 8 weeks, 5 times/week, for 30 minutes. The program commenced in hospital and, after discharge, continued in the community for up to 8 weeks. Telehealth support using a secure videoconferencing app allowed contact with physiotherapists outside weekly face-to-face sessions. Participants wore a *Fitbit Zip*<sup>TM</sup> to encourage increasing physical activity. Amount of practice was self-reported, and the intervention was evaluated with the System Usability Scale (SUS) (Bangor, Kortum and Miller, 2008) and a satisfaction questionnaire.

**Results:** Over the 8-week period, patients (N = 31) reported practicing on average 3749.5 min (SD 2168), and had approximately 1000 min of total extra therapy time (~2 hrs/week) when compared to a control group (N = 32) receiving usual care only. The average total number of video calls was 2.9 (SD 1.4), receiving on average a total of 45 min (SD 27.2) video call therapy. The average number of face-to-face therapy sessions was 7.3 (SD 1.0). Technical support was provided for on average 19.3 min (SD 9.6). High scores on the SUS, mean 73.8 (SD 24.7), indicated that participants were generally confident with the technology. Over 90% of the patients and caregivers stated they would continue with the programme and would recommend it to others.

**Conclusion:** This caregiver-led exercise program combined with telehealth support shows promise to increase practice intensity. With little direct therapist contact required to deliver the intervention, this could be a cost-effective way to improve outcomes after stroke in the community.

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P267

### A Randomized Controlled Behavioural Intervention Trial to Improve Medication Adherence in Adult Stroke Patients with Prescription Tailored Short Messaging Service (SMS)-SMS4Stroke Study

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**Background and Rationale:** Medication adherence is the key to improvement in chronic disease outcomes. (Ho et al., 2009). The effectiveness of mobile technology in improving medication adherence via customized Short Messaging Service (SMS) reminders for stroke has not been tested in resource poor areas. We designed a randomized controlled trial to test the effectiveness of SMS on improving medication adherence in stroke survivors in Pakistan.

**Methods:** This was a parallel group, assessor-blinded, randomized, controlled, superiority trial. Participants were centrally randomized in fixed block sizes. Adult participants on multiple medications with access to a cell phone and stroke at least 4 weeks from onset (defined by last seen normal) were eligible. The intervention group received reminder SMS for 2 months that contained a) Personalized, prescription tailored daily medication reminder(s)

b) Twice weekly health information SMS. The Health Belief Model (Janz and Becker, 1984) was used to design the content of messages. Frontline SMS software was used for SMS delivery. Medication adherence was measured on the validated Urdu version of Morisky Medication Adherence Questionnaire (Saleem et al., 2012) Multiple linear regression was used to model the outcome against intervention. Analysis was conducted by intention-to-treat principle.

**Results:** Two hundred participants were enrolled. 38 participants were lost to follow-up. After 2 months, the mean medication score was 7.4 (95% CI: 7.2–7.6) in the intervention group while 6.7 (95% CI: 6.4–7.02) in the control group. The adjusted mean difference ( $\Delta$ ) was 0.54 (95% CI: 0.22–0.85). The mean diastolic blood pressure in the intervention group was 2.6 mm Hg (95% CI: –5.5 to 0.15) lower compared to the usual care group.

**Conclusion:** A short intervention of customized SMS reminders can improve medication adherence and effect stroke risk factors like diastolic blood pressure in stroke survivors with complex medication regimens living in resource poor areas. The intervention seems promising not only in for secondary stroke prevention but also for targeting primary prevention against stroke.

**Trial Registration:** Clinicaltrials.gov NCT01986023.

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P268

### Sustaining the Use of a New Stroke Telemedicine Service: Barriers and Facilitators Identified after Implementation

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**Background and Rationale:** The success of stroke telemedicine programs, including increased access to thrombolysis, is typically determined using quantitative methods, providing little detail on how success was achieved. Developing strategies to address barriers and emphasise facilitators is essential for successful implementation. However, what remains unknown is whether barriers and facilitators change after implementation. The aim of the

study was to identify factors for sustaining a new stroke telemedicine service.

**Methods:** A qualitative study using a pre-post design was conducted. Purposive sampling identified regional and metropolitan clinicians involved in the telemedicine service: pre-implementation (n = 24) and 6–12 months post-implementation (n = 25). Individual, semi-structured interviews were conducted (October 2010–December 2012). Recordings were transcribed and inductive thematic analysis was performed (10% double-coded independently) within NVivo.

**Results:** Similar themes were identified at post-implementation as were revealed at pre-implementation: perceptions of telemedicine systems and technology, organisational and cultural environment, processes of clinical care and benefits of utilisation. The close connection between thrombolysis and telemedicine was consistently reported pre- and post-implementation; that is, negative perceptions held about tPA were extended to telemedicine. There was variation in the sub-themes with additional barriers and facilitators identified. Clinicians' concerns around trust and confidence in each other as well as the technology were only reported prior to experiencing telemedicine. However, sustaining a telemedicine service requires ongoing education to address rotating staff and infrequent use. Fewer direct patient-related benefits and more clinician-related benefits emerged after experiencing the telemedicine service.

**Conclusion:** Sustainable telemedicine practices require ongoing evaluation of telemedicine services beyond the preliminary pilot stage to ensure identification of both persistent and emerging barriers. By addressing these, the sustainability of the service can be improved.

## P269

### 'Well If the Kids Can Do It, I Can Do It': A Qualitative Study of the Experiences of Users of Telerehabilitation Delivered by a Hospital Home Rehabilitation Team

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**Background and Rationale:** Health services across the globe are being driven to consider alternative options for rehabilitation due to an ageing population with increased incidence and prevalence of debilitating disease [1, 2]. In Australia, rural and remote dwelling patients can benefit greatly from a reduction in travel and the improved access [3] provided by telerehabilitation. Technology can be used for videoconferencing, exercise prescription, chronic disease management, information dissemination, peer group support and activity monitoring. Rehabilitation services are beginning to integrate the use of technology into usual practice but whilst there is a growing body of evidence about the efficacy of telerehabilitation, implementation has been slow [2, 4, 5]. It is unclear whether the use of technologies and reduced face-to-face contact are acceptable to elderly patients undergoing rehabilitation as there have been few in-depth explorations of patient

experiences of telerehabilitation, with most studies focusing on satisfaction surveys [6].

**Methods:** Sixty-one elderly community dwelling adults, 32 (53%) of whom had had a recent stroke, participated in a pilot of an individualised home telerehabilitation programme which used a combination of face-to-face and video consults with clinicians. The program used 'off-the-shelf' technologies including iPads for videoconferencing and the use of therapeutic apps for exercise and homework, and electronic FitBit<sup>R</sup> devices to encourage activity [7]. A qualitative study was then conducted with thirteen participants, three spouses and one carer via interview [8].

**Results:** Thematic analysis revealed five emergent themes: 1) Telerehabilitation is convenient; 2) Telerehabilitation promotes motivation and self-awareness; 3) Telerehabilitation allows positive therapeutic relationships; 4) Mastering technologies used by younger relatives is a valued aspect of telerehabilitation; and 5) Telerehabilitation does not replace traditional face-to-face rehabilitation therapies.

**Conclusion:** Telerehabilitation allows engagement of both patient and carer with the treating team. The telerehabilitation programme promoted self-management approaches particularly practice. However the expectation that responsive technology support is available may mean that health services will need to consider ways of providing 7 day a week IT support or partner with private telecommunication companies to implement. Current funding models and reluctance of health services to fund telerehabilitation using mobile devices, in particular, remain hurdles to full implementation.

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P270

### Cost-Effectiveness of Caregiver-Mediated Exercises Combined with E-Health Services after Stroke

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**Background and Rationale:** Demand for rehabilitation after stroke exceeds supply and novel approaches are needed (Langhorne, Bernhardt and Kwakkel, 2011).

This study assesses the cost-effectiveness of an 8-week program caregiver-mediated exercises program combined with e-health services after stroke.

**Methods:** An economic evaluation, including 63 hospitalised stroke patients (mean age 68.7, 64% female), estimated the relative cost-effectiveness (CE) of the program when compared to usual care. The outcome was expressed in terms of incremental costs per readmission avoided. Both trial arms included costs of usual rehabilitation care (\$871/patient/day). The intervention arm additionally included costs of the telehealth intervention itself (staff, administration and equipment). Intention-to-treat (ITT) as well as per-protocol CE analyses were conducted.

**Results:** In the ITT analysis, compared to usual care, the intervention was associated with higher mean costs per patient of \$1,466 (\$22996 versus \$21530) mainly due to the longer length of stay as well as the additional costs of the telehealth intervention. In the longer-term, however, the intervention was associated with fewer hospital readmissions per patient (0.32 versus 0.47) resulting in an incremental cost-effectiveness ratio of \$9773 per admission avoided. In the per protocol analysis, the intervention was associated with lower mean costs per patient of \$9,545 (\$11,985 versus \$21,530) when compared to usual care. In the longer-term, the intervention was associated with even fewer hospital readmissions per patient (0.25 versus 0.47) implying that the program outperforms usual care i.e. it was both cheaper and more effective.

**Conclusion:** In the ITT, CE caregiver-mediated exercises and tele-health support after stroke will be considered cost-effective if policy makers are willing to pay an extra \$9,773 per patient to get one readmission avoided. The per-protocol analysis however suggests that the program is cost-effective when compared to usual care as it results in fewer readmissions per patient at a lower cost.

### Reference:

Langhorne P, Bernhardt J, Kwakkel G: Stroke rehabilitation. *Lancet* 2011; 377:1693–1702.

P271

### Access to and Use of a Tablet Computer Contributes to Better Quality of Life After Stroke

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**Background and Rationale:** Tablet computers have the potential to enable stroke patients to: engage in higher levels of self-directed therapy and leisure based cognitive activities, communicate easier and have a greater sense of independence (White et al, 2015). This pilot randomised-controlled trial investigated the effect access to tablet computers had on post-stroke quality of life one month after discharge from rehabilitation.

**Methods:** Stroke patients from three rehabilitation units received training and access to a tablet computer during inpatient rehabilitation. The intervention group were given a tablet computer to take home and use for one month whilst patients in the control group were not (ie. standard care). Weekly phone surveys were conducted with all participants to record frequency and purpose of use. Quality of life (Stroke and Aphasia Quality of Life [SaQOL]) (primary outcome) and mood, cognition, communication, self-efficacy and activity participation (secondary outcomes) were measured by a blinded assessor one month post-discharge.

**Results:** The intervention group (n = 8) used tablet computers 2–3 times per week with 59% of use allocated to self-directed therapy. There was no reported use of tablet computers in the control group (n = 7). The intervention group had significantly better quality of life than the control group one month after discharge from inpatient rehabilitation (mean SaQOL 3.84 [95% CI 3.33 to 4.34] vs. 2.98 [95% CI 2.13 to 3.82], p = 0.05). There was no significant difference between groups in other outcomes.

**Conclusion:** Providing patients with a tablet computer after stroke may be an effective way of promoting self-directed therapy and improving quality of life. Larger multi-unit clinical trials are warranted to determine the clinical feasibility, cost-effectiveness and functional efficacy of using tablet computers during stroke recovery.

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White J, Janssen H, Jordan L, Pollack M: Tablet technology during stroke recovery: a survivor's perspective. *Disabil Rehabil* 2015;37:1186–1192.

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P272

### Network Robustness and Resilience among Different Acute Stroke Team Models in the Delivery of Acute Reperfusion Therapy: Less Is More from Spoke to Hub and Telestroke

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**Background and Rationale:** In the era of endovascular clot retrieval (ECR), there is immense interest in developing model which provides high standard of stroke care to metropolitan and rural networks (via telemedicine). Interactions (edges) among members (vertices) of acute stroke network can be described by graph. This framework has rich tools for describing properties such as connectedness and path length. The aim is to evaluate network properties among acute stroke team in different settings of therapy delivery.

**Methods:** Graphs were constructed from different models of interaction among members of acute stroke team: the hub hospital (Model 1a/emergency department [ED], radiology and stroke teams), hub hospital with layer (Model 1b/ED-medical, radiology and on site stroke teams), spoke and hub hospitals (Model 2/ED-medical, radiology and off site stroke team), spoke and hub hospital and telestroke call centre (Model 3/ED-medical, radiology, telestroke and stroke team). From these graphs, we calculate the Fiedler value and the number of steps required to treatment with tissue plasminogen activator (TPA) or ECR. The Fiedler value (algebraic connectivity), is a property of the graph and is hidden in the Laplacian matrix. High Fiedler value indicates greater number of connected components and consequently, resilience to breakdown in flow of information between members.

**Results:** The Fiedler value was highest in Model 1a = 0.439 (11 members) and decrease with increasing size of network; Model 1b = 0.291 (13 members), Model 2 = 0.271 (12 members); Model 3 = 0.199 (16 members). The shortest path from ED presentation to treatment with TPA or ECR was 3 in Model 1a, 4 in Model 1b and 2 and 5 in Model 3.

**Conclusion:** Smaller size acute stroke network is resilient to communication breakdown compared to larger network such as Model 3 with TeleStroke. Optimisation of acute stroke care pathway is crucial to patient care and outcome.

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Jamakovic A, Van Mieghem P: On the Robustness of Complex Networks by Using the Algebraic Connectivity. *Networking – Networking 2008*, pp. 183–194.

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P273

### Measuring Pain, Fatigue and Perceived Exertion in Rehabilitation

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**Background and Rationale:** Pain and fatigue post stroke are major issues that impact the volume and level of exertion in rehabilitation, which is problematic when rehabilitation requires high levels of activity to drive neuroplasticity. We validated an electronic tool to measure pain, fatigue and exertion in people undergoing rehabilitation and described relationships between these factors. This research assists clinicians in optimising measurement and recording of pain, fatigue and exertion in rehabilitation.

**Methods:** Thirty-three adults (78.1 ± 10.8 years) undergoing rehabilitation participated in a randomised crossover trial measuring pain, fatigue and exertion on paper and electronically using an iPad after a one-hour physiotherapist supervised exercise session. Visual analogue scales measured pain and fatigue and BORG scale measured exertion. Validity for all outcomes were measured using Bland Altman (limits of agreement and bias). Regression analysis described relationships for exertion with pain and fatigue.

**Results:** For pain there was a small negative bias (± SD of bias) towards the iPad (−0.05 ± 6.75) with limits of agreement between −16.29 and 10.19. For fatigue there was a small negative bias (± SD of bias) towards the iPad (−0.02 ± 6.57) with limits of agreement between −15.90 and 9.86. For exertion there was a small bias (± SD of bias) towards the iPad (0.03 ± 1.29) with limits of agreement between −2.49 and 2.55. Although people with higher levels of fatigue reported higher levels of perceived exertion (OR 2.1; 95% CI 0.78 to 5.96), this result was not statistically significant (p = 0.14). Similarly, people with higher levels of pain reported higher levels of perceived exertion (OR 2.2; 95% CI 0.79 to 6.18), this result was not statistically significant (p = 0.13).

**Conclusion:** Using electronic data collection tools to measure pain, fatigue and exertion in rehabilitation population is valid. Although not significant, the level of pain and/or fatigue is positively associated with perceived exertion.