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PROCEEDINGS

Proceedings of the 2012 Spring meeting of the Society of British Neurological Surgeons

This meeting is being hosted by the Aberdeen Royal Infirmary, Ardoe House, Aberdeen, UK, commencing on 18th April, 2012.

The full abstracts of platform presentations are followed by the titles of those submissions accepted as posters.

These abstracts are published in advance of the meeting – if any papers are subsequently withdrawn or not read to the society – an addendum to this effect will be published in the next issue of the journal.

The order of abstracts is that of presentation, with the abstracts presented in the parallel session following those in the first.

PRESENTED ABSTRACTS

WPM1–Top Papers

WPM1-1: Simvastatin in aneurysmal subarachnoid haemorrhage (STASH): a phase III randomised placebo controlled trial – a progress report

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Objectives. The use of statins in the treatment of acute subarachnoid haemorrhage patients continues to be controversial. The aim of the STASH trial is to establish whether a 3-week course of Simvastatin 40 mg can improve the long term outcome following an aneurysmal subarachnoid haemorrhage.
Design. This is a phase III randomised placebo controlled trial with a cohort of 800; all remaining patients to be recruited from UK sites. The trial is funded by the British Heart Foundation and supported by the UKCRN.
Subjects. All grades of subarachnoid haemorrhage patients with a radiological proven aneurysm are eligible. Patients are excluded if taking statin therapy on admission or are >96 hours from ictus.
Methods. Patients are randomized to receive daily oral Simvastatin 40 mg or placebo for up to 21 days. Primary outcome measure is the modified Rankin Disability Score at 6 months. Secondary outcome measures are the Short Form 36 (SF-36 questionnaire) at 6 months, the incidence, duration and need for delayed ischemic deficit (DID) rescue therapy, incidence and severity of sepsis, length of intensive care and total acute hospital stay and percentage of patients discharged directly home.
Results. A total of 532 patients (169 male, 363 female), have been recruited, 85 from UK sites since relaunch in February 2011, mean age 50 years (range 21–65 years). Out of the total, 394 patients (75%) were WFNS grades 1–2 on arrival, 137 (25%) were grades 3–5. Eighty-three per cent were admitted with Fisher Grades 3 or 4. A total of 238 patients (46%) were admitted to either high dependency or intensive care unit, with mean length of stay 12 days (range 1–68 days). In total, 44 patients have died (9%). There have been no unexpected adverse events. We have 6-month outcome data on 444 patients (97%).
Conclusions. Recruitment is increasing steadily. If we can achieve a recruitment rate of 14 per month, we will reach our target of 800 patients by February 2013. We welcome the new UK centres and will provide appropriate funding and regulatory support.

WPM1-2: DTI findings in normal appearing grey and white matter correlate with deficits in cognitive function after mild and moderate traumatic brain injury

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Objectives. Mild traumatic brain injury (TBI) may be complicated by long term cognitive symptoms. Conventional imaging findings often do not correlate with the clinical picture in these patients, underestimating the extent of

damage. Diffusion tensor imaging (DTI) techniques are sensitive to microstructural damage in grey matter (GM) and white matter (WM) appearing uninjured on conventional MRI. We explored the application of DTI in acute mild and moderate TBI and examined correlations between regions of detectable microstructural damage and the neurocognitive functions related to them.
Design. A prospective cross-sectional study.
Subjects. Fifty-three patients (44 mild, GCS 13–15; 9 moderate, GCS 9–12) and 30 matched control subjects were recruited in a 2 year period.
Methods. Patients and controls underwent MRI scanning and neuropsychological testing. The DTI parameters: mean diffusivity (MD) and fractional anisotropy (FA) were analysed using pre-determined regions of interest, after removing any visible lesions. Correlations between DTI data and neuropsychology scores were assessed using the Pearson correlation coefficient after correcting for IQ and multiple comparisons.
Results. Patients were scanned and assessed a mean of 6 days from injury (range 1–14 days). Significant findings were a positive correlation between frontal GM MD and phonemic fluency, a negative correlation between frontal GM FA and both memory and executive function, and a correlation between a decrease in verbal fluency and both an increase in FA and decrease in MD in the corpus callosum.
Conclusions. In acute mild and moderate TBI, we have demonstrated correlations between post-concussive cognitive deficits and detectable microstructural damage in tissue appearing normal on conventional imaging.

WPM1-3: Spinal Halo Immobilisation for the management of cervical spine injuries: prospective cohort analysis

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Objectives. To study prospectively the outcome and complications rate patients with upper C-spine injuries treated conservatively with spinal halo immobilisation.
Design. Prospective observational cohort study.
Subjects. The study cohort comprised of 38 patients (19 M and 19 F) of an average age of 52 years (range, 19–87). The underlying injuries included C2 odontoid peg fracture in 18 patients (Type II in 12 and Type III in 6 patients), occipital condoyle fractures in 6 patients, C2 hangman fracture in 3 patients; the rest had a combination of upper cervical injuries.
Methods. The mechanism of injury was also recorded as 'low energy' if resulting from fall or minor trauma or 'high energy' if resulting from road traffic collisions (RTC) or major trauma.

All patients were treated non-operatively on the first instance with spinal halo immobilisation. On recruitment, patients' demographics, mechanism of injury and details of the specific C-spine injury were recorded. The study group were followed up weekly in a specialised clinic. Upon the conclusion of patients' management, a telephonic questionnaire was conducted to determine patients' satisfaction and the functional outcome using the neck disability index (NDI).
Results. The duration of Halo application was 4.3 ± 1.8 months (average $\pm$ SD) ranging between 1 and 8 months. Twenty-three patients had their C-spine injury caused by low energy trauma, while the remaining 15 were due to high energy trauma. The primary outcome was 'complete bony healing', which was defined radiologically by CT scan. Sixty-six per cent (25 patients) had documented complete healing. Out of the 13 patients with non-union, 11 (85%) were fixed surgically.

The collected variables were examined in multivariant analysis with the primary outcome being 'complete bony healing'. Variables included: age, mechanism of injury, presence of ligamental injury, duration of halo, presence of pin site infection (PSI), displacement, and Pin cranial migration (PCM). In the primary analysis, the mechanism of injury and duration of halo application were the most significant although they have fallen short of statistical significance ($p = 0.07$ for variables, odds ratio (OR) was 11.8 and 1.5, respectively). Halo immobilisation for >3 months and low energy trauma were associated with higher chances of bony healing (68% vs 32% and 68% vs 50%, respectively). A subgroup analysis for patients requiring surgery subsequently revealed that the most important variable was ligamental injury ($p = 0.06$).

The recorded complications included: PSI in 6 patients, displacement in 6 patients and PCM in 5 patients. On an average, patients had three CT scans (range, 1–8) during their halo immobilisation. Of the surveyed patients, 63% expressed satisfaction with the halo immobilisation, and 42% had no disability on the NDI functional outcome scale.
Conclusions. Spinal halo immobilisation is an effective method of treating some C-spine injuries. The exact predictive factors of the outcome are not fully known although high injury trauma, length of halo application and underlying ligamental injury are likely to influence the outcome. Larger prospective studies would be helpful in informing the current practice.

WPM1-4: Endoscopic vs microscopic transsphenoidal surgery: our experience with 184 cases

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Objectives. Endoscopic transsphenoidal surgery, when compared with microscopic approaches, improves illuminated access to sellar and parasellar tumours. Whether this translates into improved outcomes is not yet clear. We compared outcomes of endoscopic and microscopic transsphenoidal surgeries performed in a single unit during the same time period.

Design. A single-centre retrospective observational study.
Subjects. A total of 184 patients underwent transsphenoidal surgery including 98 microscopic and 86 endoscopic surgeries. Groups were well matched in terms of age, recurrent tumours and number of pituitary adenomas.
Methods. Although patients were not randomised, the choice of approach largely depended on the availability on a given day of the ENT surgeon who co-performed the procedures. Outcome measures examined retrospectively included rates of DI, CSF leak and control of hormonally active tumours.
Results. Patients undergoing endoscopic surgery were more likely to suffer DI (Fisher exact $p = 0.017$) with seven patients requiring continued DDAVP on discharge. The rate of CSF leak did not differ significantly (Fisher exact $p = 0.1423$). Seven endoscopic and six microscopic patients required surgical repair of a CSF leak. In the endoscopic group, rates of DI and CSF leak decreased with experience of this procedure. Endoscopic procedures tended to achieve greater control of hormonally active tumours although this did not reach significance.
Conclusions. Endoscopic transsphenoidal surgery offers improved visual access over the traditional microscopic approach reflected by greater control of hormonally active tumours but at the expense of greater rates of DI, particularly during the learning curve for this procedure.

WPM1 - 5: Are we being Stupp'ed? The survival analysis of GBM patients pre- and post-Stupp regime in the West of Scotland

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Objectives. It is now accepted that the addition of temozolomide to radiotherapy (Stupp regime)[1] in the treatment of patients with newly diagnosed glioblastoma multiforme (GBM) significantly improved survival. With the ongoing reorganisation and rationalisation in the National Health Service, we aimed to perform the survival analysis of our patients with GBM pre and post-Stupp regime to justify our current practice.
Design. Prospective data collection for post-Stupp period. Retrospective data collection for pre-Stupp period.
Subjects. In the post-Stupp cohort, 105 patients. In the pre-Stupp cohort, 108 patients.
Methods. Prospectively collected clinical data were analysed on 105 consecutive patients receiving concurrent chemoradiotherapy (Stupp regime) following surgical treatment of GBM between December 2004 and February 2009. This was compared to 108 consecutive GBM patients who had radical radiotherapy (pre-Stupp regime) post-surgery between January 2001 and February 2006.
Results. The median overall survival for the post-Stupp cohort was 15.31 months (range, 2.83–50.5 months), with 1-year and 2-year overall survival of 65.7% and 19%, respectively. This is in comparison to the median overall pre-Stupp survival of 10.75 months, with 1-year and 2-year survival of 42.6% and 12%, respectively (log rank test, $p < 0.001$).
Subgroup analyses showed that significant survival benefit post-Stupp regime were in the older patients (age > 60 years), patients with no neurological deficit (WHO performance status 0) and patients who had gross total resection of tumours.
Conclusions. Significant survival benefit has been achieved post-Stupp regime in our GBM patients in the West of Scotland, especially in the older patients, patients with excellent performance status and those who had gross total resection of tumours.

Reference

1. Stupp R, Mason WP, van den Bent MJ, et al. European Organisation for Research and Treatment of Cancer Brain Tumor and Radiotherapy Groups; National Cancer Institute of Canada Clinical Trials Group. Radiotherapy plus concomitant and adjuvant temozolomide for glioblastoma. *N Engl J Med* 2005;352: 987–96.

WPM1 - 6: Red blood cell transfusion may protect against the development of delayed cerebral ischaemia in anaemic patients after aneurysmal subarachnoid haemorrhage

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Objectives. To audit our transfusion practice in aneurysmal subarachnoid haemorrhage (aSAH) patients and examine the effect of red blood cell transfusion (RBCT) on development of delayed cerebral ischaemia (DCI).
Design. Retrospective multivariate analysis of incidence of DCI in transfused patients.
Subjects. Between 2009 and 2011, 117 patients with aSAH admitted to neurocritical care.
Methods. Data collected included demographics, severity of aSAH and evidence of DCI. Nadir haemoglobin (Hb) was noted for the 'non-transfused' group, and pre- and post-transfusion Hb in transfused patients.
Results. Thirty-four (29%) developed DCI and 26 (22%) were transfused. The incidence of DCI was higher in transfused patients, but most RBCTs occurred after DCI had been diagnosed. These non-contributory 'late transfusions' were considered to be 'non-transfused' in further analyses.
After accounting for timing, there was a trend towards reduction in DCI in transfused patients (OR 0.34, 95% CI 0.17–1.17). For the subgroup with nadir Hb < 9.0 g/dL, RBCT was associated with significantly reduced risk (OR 0.10, 95% CI 0.02–0.45). In a multivariate model accounting for potential confounders, RBCT remained a significant negative predictor of subsequent DCI (OR 0.13, $p < 0.001$).

Conclusions. Judicious RBCT may protect against DCI. The observed effect was greatest for anaemic patients, indicating that oxygen-carrying capacity may be the underlying mechanism. This retrospective study has inherent limitations but merits prospective evaluation.

WPM2 – Neurovascular

WPM2 - 1: A fully automated system for intracranial aneurysm segmentation and detection from CT angiography

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Objectives. To report a novel system for fully automated segmentation and detection of intracranial aneurysms from CT angiography studies.
Design. A computer program is written and then prospectively tested on 62 CTA studies containing 70 aneurysms.
Subjects. Sixty-two patients undergoing CTA for suspected or proven intracranial aneurysms with total 70 aneurysms.
Methods. CTA source images are used without post-processing of any kind. The intracranial arteries are extracted from the CTA source images by masking out air, bone and vein. The arterial tree is defined mathematically from the anatomically invariate location of the internal carotid arteries in the skull base and then segmented out using a novel region growing approach. The extracted arteries are then mathematically searched for potential aneurysms according to mathematical definitions, and these regions ranked in order of likelihood. Potential aneurysms may then be segmented out to be both mathematically defined and presented to the clinician for review.
Results. Detected aneurysms varied from 3 to 16 mm in diameter. Out of 70, 68 aneurysms were detected as aneurysms giving sensitivity of 97%. False positives were an average of 2 per study although in 38 of 70 studies the correct aneurysm was ranked top of all potential aneurysmal regions. Sample images are presented.
Conclusions. This system has great potential for secondary reporting of CTA studies, and to define aneurysms mathematically for future work involving risk stratification and monitoring of unruptured aneurysms.

WPM2 - 2: Coiling versus clipping in patients with aneurysmal subarachnoid haemorrhage – nine year experience at a single unit

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Objectives. Retrospective study of outcomes of intervention in a single unit since ISAT in 2002 to see whether advances in technology and experience have been translated into improved clinical outcome for patients with subarachnoid haemorrhages.
Subjects. Patients admitted with aneurysmal subarachnoid haemorrhage from January 2002 to the end of December 2010.
Methods. Total number of patients was 968 (639 treated with coil embolisation and 329 with surgical clipping). Review of patient notes, hospital coiling database and follow up clinic letters to work out pre-treatment WFNS and Glasgow Outcome Scores. Audit standard was the ISAT study.[1]

Results

1. In patients who underwent embolisation, 74.3% were WFNS grades I or II prior to treatment, whereas 78% of patients that underwent clipping were WFNS I or II.
2. Of the patients who underwent coil embolisation, 84%had good clinical outcomes, being independent at 3 months. Among patients who underwent clipping, 83.5% had good clinical outcomes.
3. WFNS and outcome scores were not significantly different between the two cohorts ($p > 0.05$).

Conclusions. Following ISAT, our unit established a policy of offering patients coiling wherever possible and comparatively few aneurysms are now clipped every year. This has resulted in an inevitable selection of more difficult cases for surgery, but also in the subspecialisation of neurovascular surgery. For this reason, advances in technology and experience in interventional radiology appear to have been matched by favourable outcomes in the surgical group, and both cohorts fare well in comparison with the historical ISAT outcome data.

Reference

1. Molyneux AJ, Kerr RSC, Stratton I, et al. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with rupturedintracranial aneurysms: a randomised trial. *Lancet* 2002;360:1267–74.

WPM2 - 3: The sensitivity of modern CT scanner in detecting subarachnoid haemorrhage

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Objectives. A recent paper by Cortnum et al.[1] suggested that modern CT scanners have 100% sensitivity in detecting

subarachnoid haemorrhage (SAH) if performed within 5 days of ictus and, therefore, recommended abandoning lumbar puncture (LP) to exclude SAH if patients present early after ictus. We aimed to audit our results prior to implementing such a change in practice.
Design. Prospectively collected clinical data
Subjects. A total of 206 consecutive patients with subarachnoid haemorrhage referred to our neurosurgical service were analysed between August 2010 and August 2011.
Methods. Using statistical software, the sensitivity of CT diagnosed SAH were determined for patients who presented within 24 hours, 3 days and 5 days of ictus.
Results. During the study period, SAH was diagnosed in 184 patients by CT scan alone, 22 patients had negative CT scan, but positive bilirubin detected in CSF by lumbar puncture, with time from ictus to presentation ranging from 0 to 14 days (median 0 days). The overall sensitivity of CT scanning was 89%.

A total of 142 patients presented within 24 hours of ictus, with 139 being diagnosed on CT scan alone, thus giving a CT sensitivity of 98%. The sensitivity of CT scanning in diagnosing SAH in our cohort of patients who presented within 3 days and 5 days of ictus was 92% (173/189) and 91% (178/196), respectively.
Conclusions. In comparison to previous studies in the 1980s and 1990s that quote the sensitivity of CT scanning at 90–95% within 24 hours and 85% within 3 days of ictus, our results have shown an improvement in detecting SAH with the use of modern high resolution, multidetector CT scanners. However, our data do not support abandoning LP for patients who present early after ictus, as recommended by Cortnum et al.[1]

Reference

1. Cortnum S, Sorensen P, Jorgensen J. Determining the sensitivity of computed tomography scanning in early detection of subarachnoid haemorrhage. *Neurosurgery* 2010;66:900–3.

WPM2 - 4: STICH II: analysis plans

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Objectives. STICH II is an NIHR EME funded trial to evaluate whether a policy of early surgery improves outcome compared to a policy of initial conservative treatment in patients with spontaneous superficial lobar intracerebral haemorrhage (LICH).
Design. This is an international multicentre pragmatic randomised controlled trial.
Subjects. Patients with LICH are eligible if they have a GCS motor score of 5 or 6, a GCS eye score of 2 or more and are within 48 hours of ictus. The haematoma should be between 10 and 100 ml and there should be no blood in the ventricles.
Methods. Patients are randomised using an independent telephone or web-based service. Those randomised to surgery have craniotomy within 12 hours. Outcome is measured via postal questionnaire to patients at 6 months.
Results. On 16th November, 2011, the 500th patient from a target of 600 was recruited. Patients have been recruited from 68 centres including 72 patients from 11 centres in the United Kingdom. Patients had a median age of 64, a median GCS of 13 at recruitment, and the median haematoma volume was 36 ml. The crossover rate (within 12 hours) for the first 400 patients was 6.5%. A further 7% of patients did undergo delayed surgery.
Conclusions. Crossover rates are much lower than in STICH while follow-up rates are high. The trial will complete recruitment in 2012 with results being reported in early 2013. The primary analysis will be by intention to treat. Predefined subgroup analyses will be defined: age, GCS, volume and the time from ictus.

WPM2 - 5: The influence of aneurysm location, patient characteristics and treatment on length of stay and mortality in subarachnoid haemorrhage patients

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Objectives. A recent review reported a higher incidence of in-hospital complications, length of stay (LOS) and mortality in patients with clipped aneurysmal subarachnoid haemorrhage (aSAH).[1] We performed a study to evaluate aSAH outcome from our unit.
Design. Retrospective review of aSAH patients admitted to St Georges Hospital from 2004 to 2011.
Methods. For each subject, we determined LOS (days), outcome (survived/died), aneurysm location and time to treatment. Cox's regression analysis with hazard ratios (HR) was performed to determine the influence of patient factors (age and sex), aneurysm factors (aneurysm location) and treatment factors (clipping/coiling/no treatment and time to treatment)on LOS. Using a multivariate logistic regression, we evaluated the influence of the same factors on death.
Results. A total of 708 cases were identified, 66.3% female, mean age 56.7 years. Of the total, 259 were clipped, 308 treated with endovascular coiling, 8 clipped and coiled, and 133 treated conservatively. Median time to treatment from admission was 1 day (range = 0–31), median LOS 14 days. Aneurysm location: carotid artery n = 50, middle cerebral artery n = 176, anterior communicating artery n = 259, posterior communicating artery n = 167, basilar artery n = 46, vertebral artery n = 10. Patients around 107 died during admission.

Analysis of cases that survived and underwent treatment (n = 527), identified patient age [HR 1.0 (1.00–1.01) $p = 0.043$] and time to procedure [HR 1.06, (1.04–1.09) $p < 0.01$] as inde-

pendent predictors of LOS. Treatment (clipping or coiling) or aneurysm location was not significant $p = 0.491$. Death during admission was influenced by whether the patient was treated or not, $p < 0.0001$ OR 6.98 and LOS $p < 0.0001$ OR 0.935, however, was not influenced by time to procedure, age, sex, location of aneurysm or whether the patient was clipped or coiled.
Conclusions. Length of stay and in-hospital mortality from aSAH is not influenced by patient age, aneurysm location or treatment (clipping/coiling). However, in cases of aSAH, which are likely to survive, increasing age and time to procedure will have a small influence on LOS.

Reference

1. Vergouwen MD, Fang J, Casaubon LK, et al. Higher incidence of in-hospital complications in patients with clipped versus coiled ruptured intracranial aneurysms. *Stroke* 2011;42:3093–8.

WPM2 - 6: Retrospective validation of three clinical decision rules to aid the diagnosis of subarachnoid haemorrhage in patients presenting with acute headache

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Objectives. Differentiation of subarachnoid haemorrhage (SAH) from benign pathology in neurologically intact patients presenting to A + E with sudden onset headache is challenging. Decision rules such as the Canadian C-spine Rule aid clinicians to avoid unnecessary investigation of significant but rare pathologies on the basis of clinical examination and history alone. Perry et al. have developed three decision rules to aid investigation of suspected SAH.[1] We aimed to retrospectively validate these rules in the setting of a UK District General Hospital.
Methods. The A + E record system was used to identify patients who presented with headache and underwent CT scanning of the head. Reports were searched to identify patients with SAH. Lumbar puncture results were searched for patients with suspected SAH but no evidence on CT. We applied the decision rules retrospectively to identify if any SAHs would have been missed.
Results. A total of 280 patients presenting to A + E with acute headache in a 2-year period underwent CT scanning of the head. Eight patients had a SAH. None of the SAHs would have been missed using the clinical decision rules suggested by Perry et al. However, in our cohort of patients there were nine cases of other significant pathologies such as intra-parenchymal bleeds, tumours and infarction that would have been missed by employing the rules.
Conclusions. The application of a clinical decision rule may help reduce the unnecessary investigation of patients presenting with sudden onset headache. However, blind application of these rules may lead to a missing other important causes of acute headache.

Reference

1. Perry JJ, Stiell IG, Sivilotti ML, et al. High risk clinical characteristics for subarachnoid haemorrhage in patients with acute headache BMJ. 2010;341:c5204.

WPM2 - 7: Microsurgical management of ophthalmic segment aneurysms

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Objectives. Surgical treatment of ophthalmic segment aneurysms is challenging and technically difficult. Personal experience and results presented.
Design. Retrospective and prospective operative series.
Subjects. Author presents experience of treating 26 (25 patients) ophthalmic segment aneurysms by surgical clipping (total 252 aneurysms). There were seven males and 18 females, age ranging from 25–60 years (mean age 43.5 years). Twenty patients presented with SAH, while in five patients it was incidental detection. Nineteen patients were in WFNS grade 1–2 and one in grade 4. Thirteen aneurysms, each arising from dorsal and ventral wall, three of the ventral wall aneurysms were proximal posterior wall aneurysms. There were 6 giant, 9 large and 11 small aneurysms.
Methods. Frontotemporal craniotomy and clipping was done with carotid exposure in neck for proximal control. Anterior clinoid drilled to unroof optic canal and define dural rings. Falciform ligament cut to mobilize the optic nerve for better visualization of the proximal neck while clipping.
Results. Twenty-one aneurysms clipped, four wrapped and one trapped. Postoperative complications were mild visual deterioration (1), EDH (1), symptomatic vasospasm (2), hyponatremia (2), third nerve paresis (3) and hemiparesis (1). There were two mortalities in this series. One patient needed shunt for hydrocephalus. Follow up ranged from 1 month to 8 years. One of the patient developed left MCA territory stroke after 1 year. All other patients are independent and back to their premorbid state.
Conclusions. Ophthalmic segment aneurysms are challenging lesion but microsurgery is a safe treatment option.

WPM2 - 8: Is a computerised tomography (CT) scan enough to confirm or refute a diagnosis of subarachnoid haemorrhage (SAH)?

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Objectives. Current guidelines state that patients suspected of having SAH with a negative CT scan, should have a lumbar puncture (LP) to exclude or confirm the diagnosis. We have recently shown that an LP is uninterpretable in up to 40% of cases, and given this, we asked the question – Is a CT brain scan enough to confirm or refute the diagnosis of SAH?

Methods. All patients referred to the Greater Manchester neurosurgical service between May 2008 and May 2009, with a diagnosis (confirmed or suspected) of SAH were identified. Presenting features, radiological findings, lumbar puncture results and interventions performed were collated. The sensitivity of a CT scan for SAH and/or need for emergent intervention for an aneurysm was determined.
Results. A total of 288 patients were identified. Of these, 65 (23%) were negative. The median time frame to scan was one day and 84% of patients underwent a CT scan within 2 days of ictus. The sensitivity of a plain CT brain scan done was 100% within 24 hours, 100% within 48 hours and 80% within > 48 hours *post ictus*.
Conclusions. There is increasing data for improved sensitivity of CT scans in detecting SAH. Recent data has reported that sensitivity is highest within 6 hours.[1]

Our data suggests that this time frame may be increased to 48 hours. This proposes the need for a wider prospective trial.

Reference

1. Perry J, Stiell IG, Sivilotti ML, et al. Sensitivity of computed tomography performed within six hours of onset of headache for diagnosis of subarachnoid haemorrhage: prospective cohort study. *BMJ* 2011;343:d4277.

WPM2 - 9: Randomised controlled dose-finding study of the effect of calcitonin gene-related peptide

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Objectives. To investigate whether Calcitonin Gene-Related Peptide is safe to administer into the cerebral ventricular system in patients who have had aneurysmal subarachnoid haemorrhage and to determine its effect it has on cerebral perfusion.
Design. Randomised controlled dose-finding study
Subjects. Patients who have been admitted to Department of Clinical Neurosciences Edinburgh with aneurysmal subarachnoid haemorrhage
Methods. This is a randomised, controlled, blinded study to determine pharmacokinetics and dynamics of CGRPh administered into CSF in patients following aneurysmal subarachnoid haemorrhage. We will evaluate possible side effects and safety. From the pharmacokinetic and pharmacodynamic data, dosing schedules for intrathecal CGRPh will be derived. This will inform a subsequent larger study.
Results. Investigations in experimental models in which CGRP was administered intrathecally, as well as *in vitro* and *in vivo* studies, have all proven the potent dilatory effects of CGRP in cerebral vessel narrowing after aSAH.[1] Given intrathecally in rabbits, 10–10 mol/kg resulted in 6 hours of > 110% vessel dilation in a model of aSAH cerebral arterial vessel narrowing. Clinical trials of intravenous administration of CGRP (n = 62 patients) with cerebral arterial vessel narrowing after aSAH showed a potential role of CGRP in dilating spastic cerebral vessels compared with best standard care.[2]
Conclusions. There is growing evidence that the pathogenesis of DCI is multifactorial. Micro-thromboembolism, cortical spreading ischemia, delayed effects of acute SAH-induced brain injury and impaired cerebral autoregulation have been suggested to have a role in clinical outcome. aCGRP is pleiotropic and offers the potential to beneficially modify multiple mechanisms. This intervention offers the potential that a more effective therapy may have a greater effect, measurable if the analysis of outcome assessment is refined.

References

1. Imaizumi S, Shimizu H, Ahmad I, et al. Effect of calcitonin gene-related peptide on delayed cerebral vasospasm after experimental subarachnoid hemorrhage in rabbits. *Surg Neurol* 1996;46: 263–70.
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WPMP1 – Paediatric

WPMP1 - 1: Selective dorsal rhizotomy for spastic diplegia – development of a new neurosurgical service

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Design. Prospective case series.
Subjects. Children with cerebral palsy and spastic diplegia, aged 4–14, referred to a tertiary paediatric spasticity unit between January and November 2010 for consideration of SDR.
Methods. A total of 75 children were seen in clinic. Out of total, 26 underwent formal evaluation and multidisciplinary discussion; NHS funding is still being sought for most of the others. Seventeen were considered suitable for SDR. Ten procedures have been undertaken to date, through a single-level laminotomy at the conus, with division of 50–70% of L1 to S1 sensory rootlets under neurophysiological guidance.
Results. Pre-operative GMFCS was 2–3. Mean distal Ashworth score was 3. Spasticity was reduced immediately post-operatively. There were no surgical or neurological complications. The 3-week in-patient physiotherapy commenced on post-operative day 3 and was tolerated by all patients. Improvement in posture, mobility and lower-limb range of movement was evident at 3 months.
Conclusions. SDR offers safe, effective and permanent tone reduction in spastic diplegia. Patient selection and rehabilitation require multidisciplinary input. Funding issues need to be addressed on a national level. Long-term follow up of our patients is underway.

WPMP1 - 2: Paediatric craniopharyngiomas – the experiences of one unit

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Objectives. A review of 60 paediatric patients with craniopharyngiomas operated upon in our neurosurgical unit over a 20-year period was conducted. Most of the operations were performed by the senior author (MT). A cure infers radical resection, but it increases the risk of postoperative panhypopitutarism. Post-operative radiotherapy on the other hand carries a higher risk of delayed complications in paediatric patients. We set out to compare the results from our cases with the data from the literature.
Methods. A retrospective analysis of 60 paediatric patients with craniopharingiomas between 1990 and 2009 was performed. We collated the parameters of our group and the outcomes and compared this data with results presented in the literature. The parameters included neurological status, visual impairment, incidence of hydrocephalus, location of tumour, the surgical approach, tumour consistency and extent of resection. We noted the morbidity and mortality. Post-operative radiotherapy was instituted in subtotal resections.
Results. There were 35 males and 25 females. Radical resection was achieved in 19 patients, surgically deemed subtotal resection with no residual seen on postoperative MRI in 5 patients, subtotal resection with visible postoperative remnant on MRI in 26 patients and partial tumour resection only was noted in 10 patients. Overall, 41 of our patients developed radiologically demonstrated hydrocephalus, but only 10 patients required CSF diversion. Three patients died.
Conclusions. Our results are comparable with published data. We recommend that small tumours without retrosellar extension and no breach of the 3rd ventricle floor should be excised completely. Large tumours retrosellar extension that breach the 3rd ventricle floor and associated hydrocephalus should have limited surgery and post-operative radiotherapy.

WPMP1 - 3: Surgical outcome of paediatric posterior fossa pilocytic astrocytoma – a 10-year review

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Objectives. A retrospective study of posterior fossa pilocytic astrocytomas over a period of 10 years to look at the resection rates. Cases with incomplete resection were analysed in particular. A retrospective study of posterior fossa pilocytic astrocytomas over a period of 10 years to look at the resection rates. Cases with incomplete resection were analysed in particular.
Design. Retrospective review of posterior fossa pilocytic astrocytomas from January 2001 to December 2010 – a 10-year review.
Subjects. All patients aged 0–8 years admitted to Leeds General infirmary with posterior fossa pilocytic astrocytoma.
Methods. Patients were identified from the neuro-oncology database over a period of 10 years from January 2001 to December 2010. The main aim was to look at the resection rates, which were classified as complete and incomplete resections on the basis of post-operative imaging.
Results. Forty-one patients were identified, with detailed data available for 39 patients. Twenty-one patients were male and twenty were female. Thirty-five patients had complete resection (85.3%), four patients had incomplete resection (9.8%) and for two patients, the extent of resection could not be confirmed (4.9%) For the group of 35 patients with radiologically complete resection, 3 patients had recurrence, which was successfully treated by a second resective operation. A total of 91% (32/35) of the tumours were cerebellar lesions, while the remainder were cervicomedullary and pontine tumours. The patients with incomplete resection were studied to clarify the reasons for this. Factors included patient age, anatomical location and intra-operative events. In this group, two patients were identified to have residual tumour on post-op imaging, while the other two patients had residuum left in intentionally due to adverse intra operative events: bradycardia and hypotension. They involved the medulla and fourth ventricle. Two patients had died, one at 15 days post-op with infection, and the other at 6 months due to increasing breath holding spells and respiratory failure.
Conclusions. This data shows that extensive resection at first operation can be achieved for majority of patients. Some tumours presenting in the eloquent areas may need a staged approach to surgery. There is a group whose tumours were incompletely excised due to uncertainty at the time of surgery. Advanced intra operative imaging with intra operative MRI could have helped facilitate complete resection in that group. There were two patients with incomplete resection, who required second stage surgery due to involvement of brainstem and IV ventricle. In the two patients with residual tumour in the cerebellum, intra operative imaging would have been helpful.

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WPMP1 - 4: Suspected shunt infection in children: are inflammatory markers a good positive indicator?

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Objectives. Shunt infection represents a significant morbidity for paediatric neurosurgical patients. Inflammatory markers including CRP, white cell count (WCC), platelet count and erythrocyte sedimentation rate (ESR) are used in decision-making in suspected shunt infections.[1] We hope to determine the usefulness of these markers in differentiating true shunt infections from other diagnoses at presentation.
Design. This is a retrospective pilot review of admission data and laboratory results (microbiology, haematology and biochemistry). From this we report the utility of specific inflammatory markers in predicting shunt infections in children.
Subjects. A total of 31 children, 20 boys and 11 girls, admitted to Birmingham Children's Hospital (BCH) with suspected shunt infections were identified. Their ages ranged from 1 week to 16 years.
Methods. A database of children (aged 0–16) referred to neurosurgery between July 2006 and August 2011 at BCH was reviewed. Patients presenting with a diagnosis of suspected shunt infection were included. Data from blood samples taken within 24 hours of admission, including haemoglobin, white cell count, CRP and platelet count was analysed. Microbiological samples from shunts were reviewed to confirm infection.
Results. Out of the total,15 had proven shunt infections and 16 did not. The admission WCC ($p = 0.019$), PLT ($p = 0.011$) and CRP ($p = 0.005$) were significantly higher in the proven infection group than the unproven group. A WCC of greater than or equal to 10.45×109/l resulted in an 80% sensitivity and 50% specificity, as did a CRP of 14 mg/l. A platelet count of 420 resulted in an 80% sensitivity and 75% specificity.
Conclusions. CRP, WCC and PLT on admission were accurate predictors for microbiologically proven shunt infections, with threshold values of CRP = 14, WCC = 10.45 and Plt = 420. Inflammatory markers are invaluable in assessing suspected shunt infection at presentation. A larger, more sensitive review of our data is planned to improve the sensitivity and usefulness of these figures.

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WPMP1 - 5: 30-day unplanned re-operation rates in pediatric neurosurgery: a single centre experience and proposed use as a quality indicator

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Objectives. The paediatric neurosurgery practice over 3 years was reviewed at a tertiary neurosciences centre. The intention was to establish the frequency of unplanned reoperations within 30 days of the index operation at our centre, to investigate the factors responsible and to consider using this as a quality indicator.[1–3]
Design. Observational study.
Subjects. Children ≤ 16 years who underwent an operative procedure at the Regional Neurosciences Unit.
Methods. All paediatric neurosurgical operations done between January 2008 and April 2011 were reviewed using data from operation theatre logs and hospital records. Data were recorded as per the standard requirements of the national neurosurgical society for incorporation into the national database. 'Unplanned reoperation' was defined as any unscheduled secondary procedure required for a complication resulting directly or indirectly from the index operation or an unscheduled return to theatre for the same condition. Operations were defined as 'Urgent' if they had to be performed out-of-hours, 'Emergency elective' if they were performed on the emergency list but within working hours and 'Routine elective' if they were on a scheduled operating list. Factors influencing the 30-day return to theatre rate were explored using logistic regression.
Results. A total of 587 operations were analysed. The 30-day unplanned reoperation rate was 20.7%. The median time to an unplanned reoperation was 15 days. Risk factors for unplanned reoperations included CSF diversion procedure (OR 7.95, $p < 0.003$), grade of surgeon (OR 1.6, $p = 0.57$, higher unplanned reoperations with trainees) and an urgent procedure (OR 6.99, $p = 0.07$, higher unplanned reoperations for urgent procedures relative to routine electives). Urgent cases comprised 30% of all operations. Trainees performed 52.5% of the urgent operations. Fourty-one per cent of all operations were related to CSF diversion.
Conclusions. A 30-day unplanned return to theatre is common in our pediatric neurosurgical practice and is procedure specific. Unplanned reoperation rates may be useful for monitoring quality across hospitals and for identifying opportunities for quality improvement. We propose the use of this index as a quality indicator and advocate its validation in a prospective multicentre study.

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WPMP1 - 6: Immediate post-operative imaging following resection of paediatric posterior fossa tumours – an effective alternative to intra-operative MRI

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Objectives. To evaluate effectiveness of immediate post-operative MRI scanning in achieving complete resection of paediatric posterior fossa tumours when intra-operative MRI is not available.

Design. Retrospective review of paediatric posterior fossa tumour resections in single institution over 2-year period. Outcomes – completeness of resection, complications, recurrence, survival. Mean length of follow up 23 (15–44) months.
Subjects. A total of 11 children, median age 3 (0 - 14) years; 10 new diagnoses, 1 recurrence. One had spinal metastases at presentation.
Methods. All patients underwent post-operative MRI on day of surgery, while under same anaesthetic. If MRI showed residual tumour when gross total resection was thought to have been achieved, the child was returned immediately to theatre for further resection.
Results. Intra-operative gross total resection was achieved in all 11 cases (1 case was a 2-stage procedure). On post-operative MRI, nine had no residual tumour. However, two patients thought to have complete excision intra-operatively actually had residual tumour on MRI. They both returned to theatre from scan and complete excision was achieved (confirmed on MRI) in both. Post-operatively, two developed mutism (completely resolved). One experienced new mild cognitive problems (improving). No other new deficits occurred. Eight have no recurrence to date. One had radiosurgery for recurrence, now also disease-free. The child with spinal metastases at presentation and the child operated on for recurrent tumour have died.
Conclusions. Immediate post-operative imaging allowed us to achieve complete resection in all 11 patients in a single sitting, with a very low complication rate.

WPMP1 - 7: Morbidity following surgery of posterior fossa medulloblastomas in children: a 10-year review

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Objectives. To review and analyse the surgical outcome and morbidity in patients with age 0–18 years with medulloblastoma.
Design. A retrospective review of patients from January 2001 to December 2010 at Leeds General Infirmary.
Subjects. All patients were under 18 years of age with medulloblastoma.
Methods. Patients were identified from neuro oncology database. Case notes were examined to identify the extent of surgical resection and any post-operative morbidity.
Results. Thirty-four patients were treated for medulloblastoma during the study period. Age range was 8 months to 17.75 years. Male: Female ratio was 2.4:1. Five patients were aged less than 3 years (14.7%). Four patients (11.8%) had metastatic disease at presentation. Eight patients had positive CSF on post-operative analysis. All patients underwent surgical resection. The extent of resection was judged on the post-operative imaging. Gross total resection was possible in 29 (85.3%) patients, while three patients have partial resection. For two patients, we could not identify the extent of resection. Two patients had endoscopic third ventriculostomy (ETV) as a consequence of obstructive hydrocephalus. Four patients had external ventricular drain before surgery. Posterior fossa syndrome (PFS) occurred in eight (23.5%) patients. Four patients had mild-moderate PFS and recovered within 1–3 months. All patients received post-operative care from the paediatric neuro oncology team. There were no 30-day mortality. Nine (26.5%) patients had died from their disease. Two patients died 3 months after their initial surgery, the remainder died between 8 and 64 months from surgery. Four patients required insertion of VP shunt post-op.
Conclusions. Gross total resection is possible at first operation for majority of patients with medulloblastoma. Rates of tumour residue could be potentially reduced by the use of intra-operative imaging. Hydrocephalus remains a common problem for these patients and can be successfully treated either with a VP shunt or ETV. Posterior fossa syndrome was a significant morbidity (23.5%).

WPMP1 - 8: Paediatric brain and spinal tumour resection and morbidity rates 2008–2011

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Objectives. The safe and sustainable review of paediatric neurosurgery looked at rates of posterior fossa tumour resections. In light of this we undertook an internal review of resection rates and the outcomes of paediatric brain and spinal tumours 2008–2011.
Design. Review.
Subjects. A total of 99 children had surgery (M:F 62:36, median age 9 years): 20 underwent biopsies, 29 had tumour debulking and 50 had complete resections.
Methods. Pre-operative imaging was reviewed to determine the proposed viability of complete resection, and post-operative imaging was reviewed to measure the extent of resection achieved. Medical notes were reviewed for complications and morbidity.
Results. In 52 patients, the aim was complete resection; this was possible for 43 (83%) of these patients. In 27 patients, the aim was debulking, but complete resection was achieved in 7 (26%) of these patients. A total of 31 patients required a form of CSF diversion of which 20 patients had VP shunts (20% of all patients). Eight patients (8%) had new post-operative neurological deficit, occurring at similar frequencies in patients receiving tumour debulking and complete resection.
Conclusions. Complete tumour resection rates were high. Many of the residual tumours were adherent to the brainstem and an intraoperative decision was made to leave residual tumour. Even when debulking was only thought possible, some children had complete tumour clearance.

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WPMP1 - 9: Value of intra-operative CSF sampling in staging of paediatric medulloblastomas

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Objectives. The Chang staging and subsequent risk stratification in medulloblastoma is well established. The current literature indicates that sampling CSF post-operatively, via lumbar puncture (LP), is more sensitive than intraoperative sampling for the detection of M1 disease.[1] However, this appears counter intuitive as sampling ventricular CSF, prior to tumour handling, theoretically reduces the likelihood of a false positive result. We attempted to test this hypothesis. The objectives of this study were to determine the value of intraoperative CSF sampling by (1) comparing patients with MRI proven leptomeningeal disease (LMD) and intraoperative and LP CSF results, and (2) analysis of paired CSF results.
Methods. A retrospective study of the children presenting with medulloblastomas from January 2000 to November 2011 identified 26 children (M:F, 13:13, Mean age: 6.41, SD:4.26 years).
Results. There were proportionally more false negative results in the intra-operative (i.e. 46.2%) than in the post-operative LP sampling of CSF (i.e. 25.0%) and more true positive results in post-operative LP (i.e. 33.3%) than intra-operative CSF sampling (i.e. 7.7%). The paired samples demonstrated greater sensitivity for LMD in LP rather than intraoperative CSF sampling. A significant correlation was only demonstrated between post-operative LP CSF cytology and spinal metastases ($r = 0.707$, $p = 0.010$).
Conclusions. Intraoperative CSF cytology had a greater proportion of false negatives, while LP demonstrated more positive results. Only lumbar CSF cytology was associated with LMD on MRI. Continued use of lumbar CSF cytology for the determination of M1 disease is recommended.

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TAM1 – Short Orals (various topics)

TAM1 - 1: MRI using a higher field strength (3T) platform shows no significant distortion in pericommissural points of interest and DBS target when compared to datasets obtained from a 15T platform: a case report confirming safety of 3T MRI based direct targeting

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Objectives. Deep brain stimulation (DBS) is used for movement disorders and more indications are being considered. Direct targeting from MRI based volume scan followed by intraoperative verification of the target is commonly practised. Image distortion remains a point of concern with use of higher field MRI. We describe a case of Parkinson's disease where both 1.5T and 3T MRI scans were used to target the subthalamic nucleus (STN). Our objective was to study the degree of displacement of points of interest (POI) as visualised in this subject and discuss safety of use of 3T MRI in direct targeting.
Subjects. We have analysed data from a 50-year-old female patient with advanced idiopathic Parkinson's Disease. Bilateral DBS device was implanted into the subthalamic nuclei on two occasions. On the first occasion, surgery was planned using a 1.5T MRI scan. Infection of the surgical tract at 4 months required removal of the device. Repeat surgery was planned using a 3T MRI scan. A post-op 3D CT was also available following the first procedure showing electrodes *in situ*.
Methods. We visually compared and measured the positions of STNs, mammillary-bodies, mammilothalamic tract, commissures and electrode landmarks from the mid-commissural point by co-registering and blending the 1.5T and 3T dataset with the 3D CT scan. We also compared the microelectrode data and clinical outcome.
Results. There was no displacement between the POIs in the two MRI datasets. Clinical outcomes following both surgeries were comparable.
Conclusions. Direct targeting with 3T MRI is as safe as with 1.5T.

TAM1 - 2: Neurosurgery patient questionnaire satisfactory survey in elective ward patients

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Objectives. Patient questionnaires are useful methods to generate information that helps to guide neurosurgical management. We undertook a questionnaire to analyse our management of elective neurosurgical patients. The questionnaire was completed upon discharge from a neurosurgical ward. The results demonstrated overwhelming patient satisfaction that reinforces the demand for a neurosurgical unit in the North-East of Scotland.
Design. The construction of a questionnaire was undertaken to document the satisfaction of elective neurosurgical patients during their admission. They then completed a simple box regarding the type of operation they had.
Subjects. Subjects had to be oriented to time, place and person to complete the questionnaire.
Methods. Patients then answered a series of questions as charted marked out of ten unless a simple tick was required (1 Disagree & 10 Agree). These included whether the operation a success, if the pre-surgery outpatient clinic experience a good experience (then scoring from 1 through 10 the performance

of the doctors, the nurses, the receptionist and the waiting time) and if the time on the ward was a good experience (then scoring from 1 through 10 the performance of the doctors, the nurses, the theatre experience and the physiotherapists).
Results. The scores from the collated questionnaires are tabulated. The total number of 25 patients responded to the questionnaire. They marked the operation being a success 9.3/10 (range 1–10). The clinic experience 7.6/10 (range 1–10). The ward experience 9.5/10 (range 7–10).
Conclusions. The neurosurgical department provides an extremely high standard of care for elective management as judged by the patients. Patient impression is important to the continual development of health care practice in our department. This makes robust support for the Aberdeen Royal Infirmary to continue to provide elective neurosurgical services that is greatly valued by population.

TAM1 - 3: An audit of waiting times for neurosurgical procedures listed on a generic emergency operating list at a tertiary London hospital

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Objectives. In departments that do not have exclusive use of a neurosurgical emergency operating list, neurosurgeons must negotiate with other specialties about the clinical urgency and timing of their cases. Concerns were raised regarding the length of time neurosurgical patients had to wait for surgery on the generic emergency list at our institution. This study was therefore designed to audit current practice.
Design. Prospective audit.
Subjects. All neurosurgical patients listed on the generic emergency operating list at The Royal London Hospital within a 3-month period.
Methods. Demographic details, pathology, operations performed and time waiting for surgery were recorded. The hospital's existing Emergency Operating Policy was used as the current standard and procedures were stratified accordingly to immediate, urgent (<12 hours) or expedited (<48 hours) surgery.
Results. A total of 80 patients [M:F 56:24, age 7–89 years (median 45 years)] were operated on during the study period. Operations performed: 31 immediate, 16 urgent, 33 expedited. Of the immediate cases, 71% were operated on within 2 hours (range: 5 minutes–15 hours), 75% of urgent cases within 12 hours (range: 2 hours–1 day) and 69% of expedited cases within 48 hours (range: 4 hours–9 days).
Conclusions. A number of neurosurgical patients listed on the generic emergency operating list had to wait for surgery for longer than was initially considered appropriate. After recognizing this problem, we devised and instigated a new operating policy within the Trust. Two operating lists now exist: one for the most clinically urgent cases and another for patients approaching their time-limit according to their initial clinical stratification. Further stratification of the desired timeframe for surgery may also ensure more timely intervention.

TAM1 - 4: Subtemporal access to the internal auditory meatus: a radio-anatomical characterization of surgical landmarks in three-dimensional models

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Objectives. The exposure of the internal auditory meatus (IAM) from the subtemporal approach carries technical challenges. The anatomical landmarks guiding the approach are the greater superficial petrosal nerve (GSPN), the superior semicircular canal (SSC) and the arcuate eminence (AE). The anatomy of these structures has been studied extensively in cadaver specimens and recently using three-dimensional radio-anatomical models to some degree. We still, however, lack a radio-anatomical analysis dedicated to the structures guiding IAM exposure in the subtemporal approach. In the current study, we characterized the relation of these landmarks using three-dimensional reconstructions of high-resolution temporal bone CT scans.
Design. Retrospective audit.
Subjects. Three-dimensional reconstructions of high resolution computer tomography scans.
Methods. We retrospectively reviewed 24 three-dimensional reconstructions of 48 disease-free temporal bone CT scans and measured the distance and angulations of the IAM axis to relevant anatomical landmarks. The dimensions of the bone overlying SSC and IAM were also quantitated.[1–3]
Results. The distance of the SSC and AE from the IAM were 18.28 ± 2.16 mm (range: 24.2–14.4 mm) and 22.05 ± 3.3 mm (range: 30.4–17 mm), respectively. The AE was overlying the SSC in only 43.75% of the cases, in accordance with previous radio-anatomical studies. The IAM axis intersected the SSC and GSPN axis at $41.39 \pm 7.97°$ (range: 43.5–16°) and $55.61 \pm 8.9°$ (range: 76.7–39.3°), respectively, paralleling previous cadaver data. The roof of the IAM was pneumatized in the majority of the temporal bones (70.83%) with an average thickness of 5.69 ± 1.15 mm (range: 3.7–8.1 mm) and cross section measuring 71.18 ± 17.22 mm^2 (range: 106.9–40.1 mm^2). Bone overlying the SSC was 2.2 ± 1.1 mm thick (range: 0.4–5 mm).
Conclusions. The relations of the SSC, the GSPN and the IAM can be assessed using three-dimensional CT reconstructions allowing stepwise planning of IAM exposure from the subtemporal approach. Considering the possible variability of these landmarks and the amount of bone removal needed for the exposure, three-dimensional CT reconstructions are a helpful adjunct in preoperative planning.

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TAM1 - 5: Analysis of skull base approaches to the internal auditory meatus using three-dimensional radio-anatomical models

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Objectives. The retrosigmoid and posterior transpetrosal approaches are widely used for resecting lesions of the internal auditory meatus (IAM) and petroclival region.[1–3] Multiple variants of these approaches have been described, most recently the transcrural approach with the proposed benefit of preserving hearing with good exposure of the clivus. In the current study, we provide the first morphometric comparison for these surgical corridors to the IAM using three-dimensional (3D) radio-anatomical models.
Design. Retrospective audit.
Subjects. Three-dimensional reconstructions of high resolution computer tomography scans.
Methods. Our analysis covered the classical and extended retrosigmoid exposure as well as three increasingly invasive variants of posterior petrosal approaches – the retrolabyrinthine, transcrural and translabyrinthine exposures. Surgical freedom, 'angle of attack' and angle of trajectory to the internal auditory canal (IAC) were measured in 3D radiological models derived from 40 disease-free temporal bone CT scans.
Results. The surgical freedom and angle of attack showed steady increments with the extension of the retrosigmoid and posterior petrosal approaches. The angle of access to the IAM axis was dramatically reduced in the translabyrinthine approach compared to less invasive approaches ($3.17 \pm 2.85°$ vs. $24.56 \pm 4.6°$ and $37.51 \pm 5.7°$, respectively, $p < 0.001$). The retrosigmoid approach had a steeper angle to the IAC ($53.75 \pm 8.83°$), but in the extended variant, it was statistically identical to the retrolabyrinthine exposure ($39.33 \pm 6.37°$ and $37.51 \pm 5.7°$, respectively, $p = 0.087$).
Conclusions. Using this 3D technique, we are the first to compare the favourable exposure of the IAM in the translabyrinthine and extended retrosigmoid approaches. In vestibular schwannoma surgery, the narrower transcrural approach may only be justified over the wider translabyrinthine corridor in cases with significant salvageable preoperative hearing.

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TAM1 - 6: Aneurysmal subarachnoid haemorrhage in the elderly: does treatment make any difference?

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Objectives. The incidence of subarachnoid haemorrhage increases with age and together with the elderly constituting a significant and growing proportion of the population in developed countries, this poses unique challenges to the healthcare system. Treatment of subarachnoid haemorrhage in the elderly is traditionally under-represented due to pessimism towards its outcome. With recent advances in management techniques, it has been suggested that elderly patients with subarachnoid haemorrhage would benefit from treatment. Thus the aim of this study is to evaluate the treatment outcome in patients with aneurysmal subarachnoid haemorrhage aged 65 years or older.
Design. Retrospective cohort study.
Subjects. A total of 88 consecutive patients aged 65 years or older with aneurysmal subarachnoid haemorrhage admitted and managed in a single institution between 01/01/2008 and 31/12/2010.
Methods. A retrospective analysis was conducted on consecutive patients aged 65 years or older, from 01/01/2008 to 31/12/2010, with aneurysmal subarachnoid haemorrhage admitted and managed in a tertiary neurosurgical institution, which serves a population of about 3.2 million people in the United Kingdom.
Results. A total of 88 patients were identified in this study period. Out of that, 55 (62.5%) patients underwent endovascular coiling, while 16 (18.2%) had microsurgical clipping. Six (6.8%) patients had failed coiling without further surgical intervention, and there were 11 (12.5%) patients upon whom no treatment was started. Overall, at 3 months, a Glasgow Outcome Score (GOS) of 4 or 5 were achieved in 57 (65%) patients, 8 patients were dependant with a GOS of 2 or 3, and 23 patients died. Lower World Federation of Neurological Surgeons (WFNS) grades were associated with an improved outcome.
Conclusions. Advanced age should not be a deterrent for treating patients with aneurysmal subarachnoid haemorrhage. Appropriate selection of patients with prompt investigation and intervention can achieve favourable outcomes with an expectation of independent living. Low WFNS grades are associated with improved outcomes.

TAM1 - 7: An audit of outpatient follow-up of neurosurgical patients

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Objectives. To identify neurosurgical patients who, following discharge, should have been reviewed in the outpatient clinic (OPC), but were 'lost to follow-up'. To investigate reasons and cost to the Trust, to implement change and re-audit.
Design. A retrospective review of neurosurgical patients discharged between April and June, 2010, with completion of the audit cycle between January and March, 2011.
Subjects. All patients discharged from neurosurgical inpatient care during the months specified, excluding those undergoing elective daycase radiological procedures.
Methods. A list of discharged patients during the relevant months was correlated with that of patients attending OPC within 3 months of discharge. Valid reasons for not attending clinic were identified and excluded from final evaluation. A financial analysis was conducted based on the cost for new and follow-up OPC attendees.
Results. From April to June, 2010: 438 patients were discharged, of which 309 patients should have been reviewed in OPC. A percentage of 24 were not seen, resulting in a loss of £24 045 for the 3-month period. Following the first audit, changes were made to ensure patients requiring follow-up were informed of the appointment details. From January to March, 2011: 347 patients were discharged, of which 233 required neurosurgical follow-up. Of the total, 17% were not reviewed, with a loss of £11 949 for the trust.
Conclusions. A sizeable proportion of patients were 'lost to follow-up' during this audit. This may highlight a common problem and has both clinical and financial implications. Subsequent re-audit to complete the cycle showed a modest improvement in follow-up rate, but showed an ongoing need to deliver a better service.

TAM1 - 8: Trigeminofacial reflex: a means of detecting proximity to ophthalmic and maxillary divisions of the trigeminal nerve during surgery

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Objectives. To detect incipient damage to the ophthalmic and maxillary branches of the trigeminal nerve during tumour surgery.
Design. Observational study: Sindou (1994)[1] described how 5 Hz stimulation during RF-thermorhizotomy could aid localization of lesions by evoking facial twitching. We observed facial muscle activation during tumour dissection around cavernous sinus when the stimulator approaches trigmenial sensory branches, which has been used subsequently to detect these intraoperatively.
Subjects. Patients with skull base, retro-orbital or cavernous sinus tumours warranting dissection towards the cavernous sinus at a University Hospital.
Methods. Stimuli applied as normal during approach to the cavernous sinus to localise CN III, IV and VI. Recordings were also obtained from the facial muscles to localize VII. The reflex described by Sindou was sought simply by observing a longer time base routinely.
Results. Clear facial EMG responses seen reproducibly, when stimuli applied to the region of V1 and V2. Response latency increased compared to direct VII stimuli seen in some cases. Responses gave early warning of approach to these sensory trigeminal branches.
Conclusions. We submit this as a new technique, which may improve the chances of preserving trigeminal sensory branches during surgery in this region.

Reference

1. Sindou M, Fobe JL, Berthier E, Vial C. Facial motor responses evoked by direct electrical stimulation of the trigeminal root. Localizing value for radiofrequency thermorhizotomy. *Acta Neurochir (Wien)* 1994;128:57–67.

TAM1 - 9: The use of a multimodal external ventricular drain simulator in neurosurgical training

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Objectives. External ventricular drain (EVD) placement is recognised to sub-optimally performed lead to excessive morbidity and re-operation.[1,2] We describe the development of a high-fidelity EVD simulator.
Design. The simulator is based on a plastic model skull. A right-sided Kocher's point craniostomy was made and a haptic media placed within the skull. The skull was CT scanned with a neuronavigation sequence. This data was co-registered with a MRI brain scan.
Subjects. Twelve neurosurgical trainees.
Methods. A 'blind' EVD insertion was performed by the trainees, based on anatomical landmarks. The insertion was performed using a neuronavigation registered pointer. The final position was recorded by the neuronavigation system. This process was repeated under 'direct-vision' guided by neuronavigation computer. A final 'blind' insertion was then repeated and final EVD position recorded.
Results. Statistically significant improvement in accuracy of placement of EVD tip was measured using paired student's T test (pre, 14 mm; post, 10 mm ($p = 0.01$)). Statistically significant reduction in procedure related anxiety was observed (Paired student's t-test analysis demonstrated the reduction in state anxiety from pre 42 to post 40 ($p = 0.02$)).
Conclusions. Reported is an effect simulator, which significantly improves accuracy in an important area of neurosurgical practice. The simulator is highly accurate, cost neutral and potentially reproducible in every neurosurgical unit.

References

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2. Lee JH. Accuracy of the free hand placement of an external ventricular drain (EVD). *Kor J Cerebrovasc Surg* 2010;12:82–6.

TAM1 - 10: Should we implement the Canadian clinical decision rules for subarachnoid haemorrhage in patients with acute headache?

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Objectives. A recent large prospective cohort study in Canada determined a number of high-risk clinical characteristics for subarachnoid haemorrhage (SAH) in patients with acute headache.[1] We aimed to evaluate the potential impact of incorporating the Canadian clinical decision rules for SAH on British practice.
Design. Retrospective case note review.
Subjects. All adult patients presenting to the emergency department with acute headache between August and October, 2011.
Methods. The Canadian clinical decision rules for SAH were applied retrospectively to the cases identified, and the sensitivity, specificity and negative predictive values calculated. The two-tailed McNemar test was used to evaluate the differences between proportions of patients undergoing investigations using the clinical decision rules against current practice.
Results. In all, 112 patients met the inclusion criteria, of which 41 patients (36.6%) underwent unenhanced computed tomography and 4 (3.6%) were found to have SAH. Nine patients subsequently had a lumbar puncture and none demonstrated xanthochromia. None of the patients who were not fully investigated were readmitted to the regional neurosurgical centre with missed SAH. The Canadian clinical decision rules led to an investigation rate between 59–74%. All the rules led to significantly more patients being investigated than current practice ($p < 0.05$).
Conclusions. As the Canadian decision rules were developed to reduce the number of patients being investigated for acute headache, it appears they are less useful to British practice than in North America.

Reference

1. Perry JJ, Stiell IG, Sivilotti MLA, et al. High risk clinical characteristics for subarachnoid haemorrhage in patients with acute headache: prospective cohort study. *BMJ* 2010;341:c5204.

TAM1 - 11: The role of lumbar puncture in patients with suspected subarachnoid haemorrhage but negative CT scan

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Objectives. The current guidelines for diagnosing subarachnoid haemorrhage (SAH) are based mainly on studies done in the 1980s and 1990s. Modern high resolution, multidetector CT scanners have high sensitivity in diagnosing SAH, especially for patients who present early. The role of lumbar puncture is therefore questionable.
Design. Prospectively collected clinical data.
Subjects. A total of 51 consecutive patients transferred to our neurosurgical service with suspected subarachnoid haemorrhage but negative CT scans were analysed between August 2010 and August 2011.
Methods. Patients were analysed in four categories: bilirubin positive consistent with SAH, oxyhaemoglobin peak masking bilirubin leading to inconclusive CSF result, failed LP locally or insufficient CSF for analysis.
Results. Of the 51 patients transferred, 4 had failed LP locally, 22 were bilirubin positive, 23 had inconclusive CSF results due to oxyhaemoglobin peaks masking bilirubin and 2 had insufficient CSF for analysis. The time from ictus to presentation ranged from 0 to 18 days (median 2 days). Of the total, 48 patients underwent CT angiography, and 14 patients underwent digital subtraction angiography. Five out of 22 patients (22.7%) with CT negative, bilirubin positive results had cerebral aneurysms (4 patients) or an AVM (1 patient) and, subsequently, underwent treatment. For the 23 patients with inconclusive CSF results, 1 cerebral aneurysm was identified and another had a vertebral artery dissection.
Conclusions. A positive bilirubin result is still very important in diagnosing aneurysmal SAH for patients with a negative CT brain despite the advent of medical imaging technology. The importance of inconclusive CSF results, however, is questionable, as a blanket policy to perform cerebral vascular imaging in these patients would no doubt detect cases of incidental cerebral aneurysms.

TAM1 - 12: Pre-operative fasting times in a neurosurgical unit: are we starving patients longer than is necessary?

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Objectives. The indications for pre-operative fasting are well recognised. There are clear guidelines indicating appropriate durations for stopping the intake of solids and liquids prior to surgery. Due to the nature of our specialty, lists are commonly modified to meet clinical requirements and specifically to address emergencies. This poses an impact on pre-operative preparation including fasting times.

Design. For each patient, we reviewed the duration of halting solid and clear fluid intake prior to the induction of anaesthesia. Our results are compared with published national recommendations,[1] allowing improvements to be made to better our service.
Subjects. Over a 3-month period from September to November, 2011, data was collected for 35 patients (19 male, 16 female).
Methods. Fasting times for solids and clear fluids were collected for each patient and compared with national guidelines, that is, 6 hours for solids and 2 hours for clear fluids.
Results. The mean duration of stopping solids was 17 hours 44 minutes (mode of 15 hours), for liquids 9 hours 20 minutes (mode of 8 hours 45 minutes).
Conclusions. Where identified, we discuss the reasons for prolonged starvation, the potential for deepening co-morbidity in this group and identify management strategies to deal with unexpected changes in elective neurosurgical lists. We also propose the use of preoperative carbohydrate loading[2] as successfully trialled in studies involving general surgery and orthopaedic patients.

References

1. Brady MC, Kinn S, Stuart P, Ness V. Preoperative fasting for adults to prevent perioperative complications. *Cochrane Database Syst Rev* 2003;4:CD004423.
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TAM1 - 13: Preservation of tattoos in spinal surgery

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Objectives. To evaluate the outcome with regard to the post-operative scar overlying the tattoos in patients undergoing lumbar spine surgery.
Design. Retrospective review of the results of tattoos following lumbar spinal surgery.
Subjects. All those patients with tattoos undergoing lumbar spine surgery who consented having their tattoos photographed before and after the operation were included in the study.
Methods. All those patients who were included in the study had their pre-operative photographs of the operative area including tattoo taken. Most of those patients had their post-operative photographs also taken at variable time intervals depending upon their convenience.
Results. Majority of the patients had their tattoos preserved and their satisfaction ranged from good to excellent on four-point scale. Some of these were substantiated by the tattoo artists whom the patients visited post-operatively for evaluation and re-doing.
Conclusions. It is possible to preserve the tattoos in the operative field provided meticulous technique of skin incision as well as wound closure is employed.[1]

Reference

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TAM1 - 14: Post-operative air travel: a survey of advice given to patients by neurosurgeons in the United Kingdom

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Objectives. Air travel following intracranial surgery is considered to be associated with a risk of tension pneumocephalus. However, the likelihood of it is currently undetermined in the literature. We decided to establish if there was any consensus among UK neurosurgeons with regards to advice given to patients.
Design. E-mail based questionnaire.
Subjects. UK Consultant Neurosurgeons undertaking cranial neurosurgical procedures.
Methods. A questionnaire was approved by the Scientific Meeting Committee of the Society of British Neurological Surgeons and then distributed to all full members via e-mail.
Results. A total of 61/66 responders advised patients not to fly for a period of time postoperatively. Of these neurosurgeons, 35/61 advised a fixed post-operative timescale against flying irrespective of the nature of surgery. The remaining 26/61 advised patients with complex surgical procedures against flying for a longer period. However, the timescales advised by different surgeons in both categories varied between <2 weeks and >8 weeks. Pneumocephalus was the main concern for air travel (42/61). From the total of 61, 17precluded flying due to concerns regarding complications away from home. CT scans were obtained prior to discharge by 11/61 of these neurosurgeons. Five out of 66 neurosurgeons did not advise patients against flying, and their advice was independent of the type of surgery. Only one of these neurosurgeons obtained a pre-discharge CT scan.
Conclusions. Clinical practice varies widely due to a lack of clear evidence, standards or guidelines.
Should the SBNS be producing national guidelines to standardise the advice given to patients?

TAM1 - 15: Modified acrylic cranioplasty for large cranial defects

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Objectives. To describe a novel technique for constructing polymethylmethacrylate (acrylic) cranioplasty to repair large cranial defects.

Design. Retrospective case series.
Subjects. We describe our case series of five patients (aged 27–63 years) who underwent this modified technique, and compare them to the ten most recent titanium cranioplasties performed at our unit (aged 23–62 years).
Methods. A rim of bone is cut from the edge of the skull, the inner edge of which is circumferentially drilled to form a groove. This provides a scaffold to fashion the acrylic away from the patient allowing for continuous manipulation of the paste from both sides. An excellent cosmetic result is achieved while avoiding thermal injury to the brain. We compared patient demographics, length of surgery (skin to skin), estimated blood loss, implant production time, size and cost of cranial defect. We used the unpaired t-test with statistical significance at $p < 0.05$.
Results. There was no significant difference in size of defect, length of surgery or estimated blood loss. Titanium cranioplasty was seven times as expensive and took 1–2 months to compare with the modified acrylic cranioplasty, which was cheap and immediately available.
Conclusions. Our technique is quick, cheap and easy to perform, avoids thermal injury to the brain and produces a strong implant with excellent cosmesis even with large bony defects.

TAM1 - 16: The value of an ICH cavity in the management and timing of the microsurgical resection of AVM/DAVF

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Objectives. To review the management and timing of surgery of patients with acute intracranial haemorrhage from arterio-venous malformations (AVM) or dural arterio-venous fistula (DAVF).
Design. Review of prospectively collected database.
Subjects. A total of 92 patients with angiographically-proven AVM or DAVF and acute intracranial haemorrhage (ICH, IVH and SAH), all involving the senior author.
Methods. Timing of microsurgical resection of the AVM/DAVF in relationship to intracerebral haematoma (ICH) was defined as 'acute' when performed within 72 hours, as 'sub-acute' between days 6–28, and 'delayed' if beyond 28 days. Outcome was assessed using modified Rankin Score (mRS).
Results. Of total, 55 patients had mass producing ICHs; 16 required ICH evacuation and AVM resection in the acute phase. mRS 6: 6%. mRS 5: 6%. mRS 2: 38%. mRS 0 - 1: 50%. Obliteration rate (OR) is in 81% of the cases. Thirty-two had ICH evacuated and AVM/DAVF resected in the sub-acute phase. In 16, the ICH cavity provided a trajectory to a deep AVM/DAVF and in 16 a deep dissection plane. OR is in 93% of the patients. mRS 3: 4%. mRS 2: 34%. mRS 0 - 1: 62%. Seven patients had partial ICH evacuation in the acute phase, to relieve mass effect with definitive treatment of the AVM/DAVF in the delayed phase. Three underwent to surgical resection: mRS 3 (33%), mRS 2 (67%).
Conclusions. A liquefying ICH in the subacute phase can provide a trajectory for a deep AVM/DAVF, and facilitate dissection on the deep surface of the nidus, then by minimizing morbidity.

TAM1 - 17: Yawning as a presenting symptom of Chiari malformation

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Objectives. We report a case of excessive yawning as a presenting symptom in a patient with a Chiari malformation.
Design. Case report and PubMed review of the literature.
Subjects. A 12-year-old girl whose twin sister had previously undergone a foramen magnum decompression for a Chiari malformation. As well as yawning, her presenting symptoms included rapid progressive increasing lethargy. On examination, she had right 11th and 12th cranial nerve palsies, a mild weakness on her right side and dissociated sensory loss.
Methods. Review of the patient's notes and PubMed search using the terms 'yawning' and 'Chiari' as well as 'yawning' and 'brainstem' – the latter to ascertain, which brainstem disorders presented with yawning.
Results. An MRI scan showed a Chiari I malformation with extensive high signal in the medulla. There was also an associated syringomyelia of the cervicothoracic cord. In view of the rapid deterioration and acute presentation, she underwent urgent foramen magnum decompression. The excessive yawning completely resolved.
Conclusions. Yawning is thought to be a behaviour regulated by the brainstem. Although excessive yawning has been reported in two cases of brainstem stroke, this is the first report of excessive yawning in a patient with Chiari malformation. We believe that in this specific case the compression at the craniocervical junction and ensuing oedema in the brainstem are implicated in this curious symptom. The exact mechanism is not yet fully understood.

TAM1 - 18: Efficacy of thalamic stimulation for tremor under general anaesthesia

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Objectives. Patients are apprehensive about cerebral operations performed under local anaesthesia. We successfully perform bilateral subthalamic and globus pallidus deep brain stimulation for movement disorders under general anaesthesia.[1] We now perform thalamic deep brain stimulation under general anesthesia. Our aim was to determine

efficacy of performing thalamic deep brain stimulation under general anaesthesia.
Design. We performed case note review of patients undergoing thalamic deep brain stimulation for tremor between 2009 and 2011.
Subjects. A total of 7 patients, (2 female, 5 male), mean age of 64, range 45–71 years.
Methods. General anaesthesia of intravenous propofol and remifentanyl were used during surgery. MRI sequences obtained were T1 multiplanar reconstructed (MPR). The thalamic ventral intermediate nucleus (VIM) was chosen using direct vision close to 14 mm lateral, 3 mm posterior and 3 mm superior to the midpoint of the AC/PC line. Patients were stimulated within 24 hours of surgery or when their tremor returned. Patient satisfaction and efficacy was established by use of tremor rating scales and quality of life assessment (SF36).
Results. We present the patient's in-patient duration, operative duration and post-operative complications. Neurophysiological recordings were obtained on average over 3 mm for the left side (range 1–6 mm), and 2.5 mm on the right (range 1–4 mm). Parameters were—pulse width 60 ms, rate 130 Hz and voltage up to 3 volts. Post-operative imaging demonstrated position of electrodes. Efficacy of VIM deep brain stimulation under general anaesthetic was shown by reduction in the tremor rating scales.
Conclusions. Thalamic deep brain stimulation for tremor is effective and safe under general anaesthesia.

Reference

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TAM1 - 19: Trials for patients on neuro-intensive care: removing the headache

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Objectives. It is increasingly important for neurosurgeons and indeed all doctors to have an evidence base for their decision-making. It is therefore surprising that there is a relatively sparse amount of robust clinical research available to guide clinicians when making decisions about patients who are arguably the most critically ill (i.e. those managed in a neuro-intensive care setting). These patients tend to be jointly managed by multiple specialities, each with their own management paradigms for the patients – there is not always a consensus of opinion. There has, however, been a recent increase in the number of large, multi-centre trials investigating the outcomes of different management strategies. These trials are all seeking to recruit increasing numbers of patients in order to achieve adequate statistical power. There is the potential for confusion regarding which trials are suitable for which patients, and what exactly each trial entails.
Design. Up-to-date information obtained from the clinical leads of the main trials currently recruiting within neurosurgery. Liaison with the SBNS Research Development Manager.
Methods. We have collated a synopsis of the major trials currently recruiting within neurosurgery and neuro-intensivism in order to provide a quick reference poster that can be downloaded from the Internet and displayed in neurosurgical units across the United Kingdom as an aide memoir for the treating teams.

TAM1 - 20: Audit of venous thromboembolic prophylaxis on a neurosurgical ward using the January 2010 NICE guidelines

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Objectives. Hospital acquired VTE accounts for 25 000 preventable deaths annually in the United Kingdom. Our aim was to implement a simple, cost-effective intervention to improve our VTE prophylaxis prescribing on a neurosurgical ward.
Design. Using the January 2010 NICE guidelines, we audited the number of patients receiving adequate venous thromboembolic (VTE) prophylaxis on our neurosurgical wards pre- and post-intervention.
Subjects. In-patients on our acute neurosurgical wards.
Methods. On three separate occasions, we audited if patients had been prescribed sufficient VTE prophylaxis on the neurosurgical ward. We then inserted VTE prophylaxis assessment stickers into the drug charts of all patients over a 2-week period. We then repeated the same process and compared the two sets of data.
Results. On the first three assessments prior to the intervention, 18.6%, 12.5% and 15.6% of patients had not been given sufficient VTE prevention cover. After the sticker intervention in the drug charts, there was 100% adherence to VTE prophylaxis.
Conclusions. Placing a VTE prophylaxis sticker into a drug chart is a simple manoeuvre; however, the results show a dramatic improvement. Stickers in the drug chart draw attention to the medical team if VTE prophylaxis has been addressed adequately. This intervention helped us to improve patient management, and we hope this cost-effective initiative will reduce the number of VTE events on our wards.

TPM1 – Oncology/Radiosurgery

TPM1 - 1: Abrogation of rat and human glioma cell line proliferation after administration of Decorin

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Objectives. Glioblastoma multiforme (GBM) is the most aggressive primary brain tumour. Human recombinant Decorin – a glycoprotein that modulates Transforming Growth Factor (TGFß), Vascular Endothelial Growth Factor (VEGF) and Epidermal Growth Factor Receptor (EGFR) – may suppress GBM growth.
Design. Growth rates of *in vitro* GBM cell lines were determined with addition of Decorin or medium alone (control).
Subjects. Laboratory methodology.
Methods. C6, U87 and primary human (grown from patients) GBM cells were plated at a density of 200 000/ml in complete medium. Serum free medium containing Decorin was administered to cells by either single doses of 5 ug/ml (n = 4), 20 ug/ml (n = 4) and 100 ug/ml (n = 4) or repeated doses of 100 ug/ml/24 hours (n = 4). Control groups contained serum free medium only. Daily cell counts were analysed with T-Tests.
Results. From 200 000 baseline, C6 cell counts increased to 700 000 after 3 days incubation. Single dose Decorin reduced growth: 100 mg/ml grew only 420 000 cells ($p > 0.005$). After 5 days of daily Decorin dosing, cell counts in C6 cells were only 505 000 (controls = 1 280 000, $p > 0.001$) and in primary cells were 300 000 (controls = 667 500, $p > 0.001$). Moreover, Decorin reduced cell numbers in U87 cells to 180 000 (controls = 550 000, $p > 0.001$).
Conclusions. Decorin abrogates growth of glioma cell lines and primary GBM cells. Ongoing experiments, additionally inhibiting TGF, VEGF and EGFR, will help elicit Decorin's mode of action.

TPM1 - 2: Predictive value of MR diffusion metrics on prognostic outcomes in preoperative glioblastoma multiforme

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Objectives. Diffusion MR imaging provides non-invasive quantitative information about the cellularity of brain tumours. We aimed to retrospectively correlate a range of MR Diffusion Metrics to Overall Survival (OS) and Time To Progression (TTP) in preoperative Glioblastoma Multiforme (GBM).
Design. This project was a retrospective analysis of routine clinical data.
Subjects. Forty-six histologically confirmed GBM patients identified from a single hospital's neuro-oncology multidisciplinary team database.
Methods. Preoperative GBMs underwent Diffusion Tensor Imaging using a 3.0 Tesla MR scanner (Philips Achieva). Jim software (Xinapse Systems) was used to identify two parameters on Mean Diffusivity (MD) maps: minimum MD (minMD) and normalized minMD (NmMD). Analysis was undertaken with Cox Proportional Hazards Regression Model and the statistical package SPSS (version 17) was used.
Results. There were 30 deaths and 37 patients progressed during the study period. The mean OS was 221 days and TTP was 175 days. Univariate analysis showed NminMD values < 0.9 were associated with poorer prognosis for OS (HR = 1.499) and TTP (HR = 1.506), however, neither reached statistical significance. Multivariate analysis with significant patient parameters (treatment modality and gender) showed that minMD values $< 6.1 \times 10\text{-}4$ mm^2s^{-1} predicted shorter OS [HR = 2.317 (1.044–5.139), $p = 0.039$] and TTP [HR = 4.426 (1.809–10.831), $p = 0.001$]. Furthermore in multivariate analysis, NminMD values < 0.9 had shorter TTP [HR = 4.397 (1.822–10.61), $p = 0.001$].
Conclusions. In GBM patients, relative diffusion restriction as indexed by MR Diffusion Metrics predicted shorter OS and TTP in gender and treatment adjusted GBM patients. This study adds to the growing literature of the prognostic value of MR Diffusion Metrics as non-invasive imaging biomarkers.

TPM1 - 3: Petroclival meningiomas: institutional experience of 119 cases

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Objectives. A retrospective analysis of 119 cases of petroclival-premeatal meningiomas surgically managed in our institute from 1st Jan 1990 till 30th November 2011 was carried out to see the outcome with various approaches.
Design. Medical records of all the patients were reviewed to see the clinical presentation, operative approaches including extent of resection of the tumour, post-operative complications and condition at last follow-up.
Subjects. Out of the 119 admitted patients, 114 underwent surgical resection of the tumour.
Methods. While the tumour resection was carried through a anterolateral/lateral (subtemporal/anterior transpetrosal) route in 32, it was through a combined posterior subtemporal/pre or transsigmoid (posterior petrosal) in 24 and retrosigmoid supra-paracebellar route in 55 cases. In three cases with extra cranial extension to infratemporal area, a modified Fisch approach was used. Five patients had only a CSF diversionary procedure. The percentage of these tumours operated by conventional retrosigmoid route have increased in the later part of the series thus proving that in many of these tumours without significant middle fossa extension, it is not necessary to use complex and time consuming skull base approaches which in themselves can cause morbidity.
Results. The tumour could be radically removed in 79 patients (66%), subtotally in 26 and decompression only in nine. Six patients had tumour excision in two stages. There was an operative mortality of 8.4% (10 cases). There was no significant difference in the mortality associated with different approaches. Out of the 85 patients on long-term follow-up, 56 are independent. Six patients were reoperated for symptomatic recurrence.

Conclusions. The primary factors limiting complete removal of these tumours are the anatomo-pathologic characteristics of the tumour (size, consistency, arterial encasement, involvement of cavernous sinus) rather than the operative approach itself and majority of these tumours can be resected through the conventional retrosigmoid route.

TPM1 - 4: Stereotactic radiosurgery treatment of cerebral metastases: comparison of outcome between radiosensitive and radioresistant histological subtypes

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Objectives. To assess the overall outcome of cerebral metastases treated with stereotactic radiosurgery (SRS). To establish whether tumours considered 'radioresistant' had a different outcome compared with 'radiosensitive' primary tumours.
Design. Observational study, analysing prospectively recorded tumour volumetric data over 6 years in a single centre.
Subjects. In total, 109 SRS treatments were delivered to 90 patients. Out of these, 77 had one SRS treatment, 8 had two, 4 had three and 1 had four treatments respectively. Treatment selection was guided by recursive partitioning criteria.
Methods. A multileaf M3 collimator adapted LINAC (Brainlab) was used to perform frame based, day case SRS. The outcome of patients with radioresistant primary lesions (melanoma and renal) was compared with other primary sites (radiosensitive). Kaplan Meier survival analysis was recorded.
Results. In total, 141 lesions with median volume of 4.29 cm^3 were treated. Overall 6 and 12 months survival rates were 87% and 47% respectively. Complete radiological follow up was available in 81 patients (74%). Of these, 71 (88%) achieved local control. The median survival time was 10 months for radioresistant tumours (n = 31) and 10.3 months (CI 8.5, 15.6) for radiosensitive tumours (n = 75). The 12 month survival rates were 45.2% (CI 30.7, 66.5) and 45.3% (CI 35.4, 58.1) for these subgroups respectively.
Conclusions. The outcome of patients undergoing SRS is favourable compared with other treatment modalities. SRS appears efficacious for the treatment of radioresistant and radiosensitive metastatic tumours.

TPM1 - 5: Stereotactic radiosurgery and the natural history of acoustic neuroma

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Objectives. To ascertain whether a difference exists in the growth pattern of acoustic neuromas treated with stereotactic radiosurgery (SRS) and receiving no treatment.
Design. A prospective cohort study.
Methods. Between 1997 and 2010 data was recorded on consecutive patients presenting with an acoustic neuroma who were treated with SRS or no treatment. Follow up was with yearly MRI scans analysed by a Consultant Neuroradiologist. We recorded tumour size at presentation and any subsequent change in size or appearance.
Results. Seventy patients with an acoustic neuroma were treated with SRS or received no treatment in the study period. Data was available for 63 patients. Thirty-four patients received SRS (median age 59) and 29 patients received no treatment (median age 64). Mean tumour size at presentation was 13.2 mm in the SRS group and 8.1 mm in the no treatment group. In the SRS group, mean time to latest follow up was 53 months (12–167 months). In the no treatment group, mean time to latest follow up was 79 months (6–138 months). At latest follow up, tumours in patients treated with SRS showed a mean decrease in size of 0.1 mm, and tumours in patients who received no treatment showed a mean increase in size of 0.7 mm. However, a t test comparing the difference in tumour size between groups showed no significant difference ($p = 0.20$).
Conclusions. In patients with acoustic neuromas, no significant difference was found in the change in tumour size from presentation to latest follow up between the SRS and no treatment groups.

TPM1 - 6: Gamma knife stereotactic radiosurgery for cranial haemangioblastomas – A single centre experience

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Objectives. To assess the safety and efficacy of Gamma Knife Stereotactic Radiosurgery (GKS), with respect to local tumour control and survival in the management of haemangioblastoma.
Design. Retrospective study.
Subjects. Over a period of 10 years a total of 58 haemangioblastomas in 18 consecutively presenting patients were treated with GKS. Age Mean 39.7(15.2–60.6)years. Male: Female = 11:7
Methods. Tumour volume mean = 7.7 cc (0.156 – 41.9). Median dose to tumour margin = 16 Gy (11–20). Seventeen patients had undergone prior surgical debulking of one or more lesions – 8 on a single occasion, 5 on 2 occasions, 2 on 3 occasions, and one each on 5 and 7 occasions. One patient underwent further debulking of tumour after initial GKSRS, which was then followed by repeat GKSRS. Seven received DXT before GKSRS, one of them receiving 2 courses of such treatment.
Results. With mean clinical and radiological follow up = 33.3 months, median = 30 (6–90), four patients died from disease progression and three foreign patients were lost to follow up. Good tumour control and radiological stabilisation of treated

lesions was seen in the remaining 11 patients. No significant complications of GKSRS were observed.
Conclusions. GKSRS is a useful adjuvant modality of treatment for these pathologically benign but locally aggressive and often multiply recurrent vascular lesions.[1,2] Given that these are frequently located in inaccessible or eloquent areas of brain, and that multiple treatments are often required at intervals over a long period of time, the necessity for employing multimodality management in this long term strategy is even more apparent than for most other supposedly benign pathologies.

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TPM1 - 7: A 10-year audit of intracranial tumour surgery

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Objectives. There is a recent trend towards delivering neurosurgical care in large supraregional centres with intradepartmental subspecialisation. We report a 10-year prospective audit of a single surgeon's experience of intracranial tumour surgery with an emphasis on complications.[1,2]
Design. Prospective audit.
Subjects. In total, 527 procedures were performed on 520 patients of which 294 were male and 226 were female. The age range was from1 to 84 years.
Methods. Surgery was categorized as Glioma, Meningioma, Metastasis and Other. Complications were recorded as infection, haematoma requiring evacuation, neurological deterioration, and other.
Results. Of the 258 patients who underwent glioma surgery 2(0.76%) developed a haematoma, 5(1.9%) had new neurological deficit, and 2 died within 30 days of surgery. Of the 87 patients who underwent surgery for meningioma 6(6.8%) developed an infection, 1 developed a haematoma, and 6(6.8%) had neurological deterioration. Of the 52 patients who underwent surgery for brain metastasis 1 developed a haematoma. Of the remaining 123 patients, 3 (2.4%) developed a haematoma and 7 (5.6%) had neurological deterioration.
Conclusions. The overall complication rate was infection 1.14%, haematoma 1.3% and neurological deterioration 3.4%. These results compare favourably with published series.

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TPM1 - 8: The safety and feasibility of intraoperative ultrasound to aid intrinsic tumour resection: a retrospective case-control series

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Objectives. Standard neuronavigation using pre-operative imaging becomes increasingly inaccurate during tumour resection. Intraoperative imaging conveys a solution but to date MR systems can be time consuming and cumbersome. Intraoperative ultrasound (Sonowand™) provides real-time imaging and a 3D image volume to update the neuronavigation dataset but its disadvantages have yet to be analysed. We identified a cohort of patients with intrinsic tumours for which Sonowand™ had been utilised. Primary end-points were (1) Impact on operation duration and (2) Post-operative complications.
Design. Retrospective case-control series.
Subjects. Eighty-two patients with intrinsic brain tumours resected using Sonowand™. Eighty-nine control patients using standard neuronavigation were identified.
Methods. Consecutive patients between Feb 2008 and April 2011 were identified as cases and controls. Controls matched for age, sex, tumour histology and tumour volume. Volume calculated on pre-op T2 weighted MRI scans assuming ellipsoid shape. Complications identified on manual searching of case notes and clinical correspondence. New neurological deficits labelled as major complications.
Results. Groups were similar with regards median age (55 vs 57 years, $p = 0.89$), gender (61% male vs 67% male, $p = 0.38$), mean tumour volume (32 cm^3 vs 30 cm^3, $p = 0.68$) and histology. No significant difference in total procedure time was observed. Median operation duration was 186 minutes with Sonowand™ and 140 minutes for controls ($p = 0.07$). Number of major (6 vs 4) and minor (3 vs 5) complications were also similar.
Conclusions. Intra-operative ultrasound has the potential to aid resection of intrinsic brain tumours. Although a relatively small sample our data suggest that there is no disadvantage with respect to operation duration or complication rates. Our preliminary data also suggests better volumetric resection with Sonowand™. Further data collection on resection volume and potential survival effect will be discussed.

TPM1 - 9: Increased frequency of presenting with seizures in patients with isocitrate-dehydrogenase-1 (IDH1) mutant gliomas

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Background. Mutations in the enzyme cytosolic isocitrate dehydrogenase 1 (IDH1) are found in approximately 80% of grade II-III gliomas and secondary glioblastomas in humans. These mutations occur at a single amino acid residue of IDH1, arginine 132, which is most commonly mutated to histidine (R132H). It has been shown that glioma associated IDH-1 mutations result in a new ability of the enzyme to catalyse reduction of ketoglutarate to 2-hydroxyglutarate (2HG,) resulting in activation of NMDA receptors. A disease of 2-HG metabolism, D-2-hydroxyaciduria, commonly results in epilepsy. We performed a retrospective study of patients with glioma to investigate whether patients with the R132H IDH-1 mutation are more likely to present with seizures.
Methods. We retrospectively identified 390 adult patients with pathologically confirmed diffuse gliomas. Clinical data were compiled including seizure at presentation, tumor grade, and location (by MRI review). IDH1 status was determined by sequencing.
Results. The cohort of 390 glioma patients includes 48 grade II (79% with IDH1 mutation), 69 grade III (67% with mutation), and 273 grade IV (5% with mutation) tumours. Fifty-six per cent of patients had seizure at presentation. Overall, patients with IDH1 mutations were significantly more likely to present with seizures ($p < 0.0001$, $n = 390$). In patients with tumors isolated to a single lobe, there were increased seizures at presentation with IDH1 mutation in the frontal ($p = 0.01$, $n = 69$) and temporal ($p = 0.16$, $n = 34$) lobes. Patients with high-grade (grade III and IV) but not low-grade gliomas showed increased seizures at presentation with IDH1 mutation ($p = 0.0008$ by Fisher's exact test, $n = 342$).
Conclusions. Glioma patients with IDH1 mutant tumors are significantly more likely to present with seizures compared to patients with IDH1 wild-type tumors. The association between IDH1 genotype and seizures may be dependent on tumor grade but is seemingly independent of tumor location in our cohort. The relationship between tumor grade, IDH1 status, and seizures requires further investigation.

TAMP1 – Miscellaneous

TAMP1 - 1: The use of a stereoscopic camera for recording of microsurgical operations – a 4-year experience

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Objectives. The educational value of stereoscopic imaging in neurosurgical training has increasingly been appreciated and its use increased in popularity during the last decade. Our objective is to describe one of the techniques we developed at our department to acquire and reproduce intra-operative stereoscopic images.
Methods. A 3D stereoscopic camera (Leica-IC3D Digital Camera) is positioned between the binocular head and the zoom optics of an operative microscope pre-operatively, and connected to a computer with a monitor (Planar-PL2010M) setup for stereoscopic 3D playback viewing.
Results. We used this technique in a wide range of elective, scheduled and emergency micro-neurosurgical operations over a period of four years. The recordings were used for post-operative discussion of the technical details of the operation as well as for creating a case library. The library now contains over 50 cranial and spinal cases. The acquired 3D-images were presented in two ways: for a small audience, for example in the operative theatre or in the neuro-anatomical laboratory, the StereoMirror SD2020 with the Planar 3D glasses were used; for a large audience, we used a dual head projector with passive glasses.
Conclusions. This technique is a novel, simple and a relatively low-cost way to record 3D-images of microsurgical operations. Its setup requires little time and it causes minimal interference during the operation. The main limitation is the impossibility to watch and record motion pictures.

TAMP1 - 2: Patient controlled intracranial pressure for treating idiopathic intracranial hypertension

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Objectives. To describe a simple way of managing idiopathic intracranial hypertension (IIH) that allows patients to anticipate and control their own intracranial pressure (ICP).
Design. Case report.
Subjects. A 28-year-old woman presented with headaches and blurred vision. She was known to have IIH and had multiple shunt revisions elsewhere. She developed slit ventricle syndrome with intermittently high ICP, which we treated with subtemporal craniectomies. H
Methods. We employed a novel approach to manage these headaches. We instructed her to wear headbands of different tightness depending on type of headache: for severe low ICP headache, she wore a tight headband, milder ICP headache a looser headband. She made her own headbands using different designs to match her clothes. We assessed the effect of the headband by MRI and ICP monitoring.
Results. In the 4 years before our novel approach, she had 22 events (shunt revisions, inpatient admissions, emergency outpatient visits) vs no events in the 10 months after. MRI imaging revealed a tight headband caused the brain surface to become concave at the craniectomy sites. Applying the headband raised ICP by 5–8 mmHg when lying or sitting.
Conclusions. We conclude headbanding is beneficial by compressing the brain, as well as allowing patients to anticipate and control their ICP, analogous to patient controlled analgesia for pain management. The headband is a fash-

ion accessory creating a positive psychological effect that distracts from the headache. Based on this experience, we now recommend shunting, subtemporal craniectomies and headbanding for IIH patients who have intractable headaches despite multiple shunt revisions.

TAMP1 - 3: Surgical site infection surveillance for patients following craniotomy surgery for tumours

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Objectives. Surgical site infections (SSIs) are one of the most common health-care associated infection (HCAI) seen in our healthcare today. Beaumont Hospital was chosen to pilot a surveillance program for patients who were undergoing craniotomy surgery for supratentorial tumour resection.
Design. The aim of this study was to ascertain the infection rate of patients undergoing tumour resection, to identify risk factors and to assess the feasibility of performing long term surveillance on all Neurosurgical patients.
Methods. Surveillance was performed on all patients undergoing craniotomy surgery for supratentorial tumour resection from our unit. Using the definitions and standards set by CDC, patients who were identified pre-operatively were contacted 4 weeks post-surgery.
Results. A total of 197 patients were enrolled. Fifty-six per cent of patients were male, mean age 53.30 years ($\pm$ 16.87 years). Prophylaxis antibiotic was used in 95% of cases. The average length of surgery was 136.08 minutes ($\pm$ 79.67 minutes). In 43% of surgeries the principle surgeon was the consultant. Overall infection rate was 6%, 4.5% superficial, 0.5% deep incisional and 1% organ space. Fourty-five per cent of the infections were detected post-discharge, 3 patients required readmission and a further 3 infections were identified whilst still an inpatient. Using Pearson's testing there was no significance between infection and gender (<0.19), surgeon (<0.67) or re-do surgery (<0.39).
Conclusions. Overall there was a 6% post-operative infection rate. Nearly half of these infections were detected on surveillance following discharged but before clinic review, therefore highlighting the necessity of post-operative surveillance. We would recommend continuing this method of surveillance in all Neurosurgical conditions.

TAMP1 - 4: The continuing hidden burden of referrals

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Objectives. The hidden burden of on call referrals that are either inappropriate, incomplete or do not require any neurosurgical intervention has been discussed in the past.[1] Under the current system of pay by results, this is a proportion of out of hour's work that is not funded. Payment is generated by clinical activity that is a result of an admission. Changes in referral patterns between 1994, 2001 and 2010 will show how this funding is being eroded. A recent publication in the BJN by another unit discusses their experience with funding a tertiary referral service.[2] The authors hope to continue this discussion by sharing trends over 15 years.
Design. This is a retrospective study looking at all the referrals made in one particular unit in the calendar years of 1994, 2001, and 2010. There are a total of 4090 referrals.
Subjects. Consecutive referrals during the calendar years of 1994, 2001, and 2010 were recorded. The total number of referrals for these years was 4090.
Methods. The referral database was analysed by a single researcher for the calendar year of 2010. The referral database had been standardised outcomes: Advice only, admitted, refused no bed, outpatients and ward attender.
Results. The total referrals per annum were 659 in 1994, 1090 in 2001, and 2341 in 2010. An increase of 65% from 1994 to 2001 and 114% from 2001 to 2010. Total number of emergency admissions 250 in 1994, 273 in 2001 and 544 2010. Thirty-four per cent of referrals in 2001 were for advice only where the figure is 72% in 2010. The numbers of beds were 38 in 1994, 25 in 1999 and are now 29.
Conclusions. A larger proportion of our out of hours workload is now unfunded. The current economic climate is creating a restrictive atmosphere in regards to funding and expansion of any specialty in the NHS. Pressures from the European Working Time Directive are causing units to be staffed by more and more juniors to become compliant. It is quite likely that all the above will affect the ability of many units to modernise in the approaching decade. If the trend continues it is possible that a new paradigm for financing neurosurgery in the NHS may be required.

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TAMP1 - 5: Monitoring of multiple cranial nerves in skull base surgery

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Objectives. Removal of large tumours in the skull base can compromise several cranial nerves. Though limited monitoring has become routine for some procedures, monitoring III to XII is now possible. We have attempted to asses potential

benefits of monitoring multiple cranial nerves in major skull base procedures.
Design. Retrospective analysis of cranial nerve monitoring.
Subjects. Last 30 patients undergoing major skull base procedures.
Methods. A total of 144 nerves monitored in 30 patients: Nerves monitored according to perceived risk from III-XII, motor nerves with free-running plus stimulated EMG activity: VIII by auditory evoked response, often on opposite side to monitor brainstem when stem displaced.
Results. Four bad facial palsies resulted: 2 predicted during procedure: one during a difficult reoperation. Some temporary facial weaknesses occurred. One permanent and one temporary throat weakness. Intraoperative nerve irritation generally predicted temporary problems.
Conclusions. Though a perfect control group is not possible, the complication rate of $5/144 = 3.4\%$ nerves monitored ($5/30$ patients $= 16.6\%$) we submit is very low for these large tumours, compared to available literature. Sughrue et al. (2010)[1] suggest $> 30\%$ facial nerve damage common for the best available comparable group. We submit that the monitoring of multiple cranial nerves can minimize complications in this group of patients.

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TAMP1 - 6: 7 years of cranioplasty in a regional neurosurgical centre

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Objectives. To review the indications, techniques used and outcomes for patients undergoing cranioplasty over a 7-year period in a regional neurosurgical centre.
Design. Retrospective analysis.
Subjects. Total 87 cranioplasty patients.
Methods. A retrospective audit of case histories was performed. The study was approved by the trusts audit department.
Results. The majority of craniectomies were performed for traumatic injuries (48%), followed by haemorrhages (23%), tumours (20%) and infections (8%). Eight per cent of patients had a synchronous cranioplasty and craniectomy, mostly for brain tumours. A further 15% had cranioplasty within 3 months of craniectomy, 23% within 3–6 months, 38% within 6–12 months and 24% over 1 year later. The most common cranioplasty material was titanium (53%), followed by autologous bone (26%) and acrylic (15%). Autologous bone has only been used twice since the Human Tissue Act was formally introduced in 2006. Major complications occurred in 23% of patients, including 2 deaths (2%), 6 extradural haemorrhages (7%) and 9 infections (10%). Administration of prophylactic antibiotics was recorded in 97% of cases. A further 10% of cases experienced minor complications or cosmetic problems.
Conclusions. Cranioplasty is often considered a low risk procedure following craniectomy. However, as we perform more craniectomies, particularly within trauma and stroke management, cranioplasty should be considered as a high risk subsequent procedure. In our cohort a 23% risk of major complications, including death, was identified and should be incorporated into the clinical decision making process.

TAMP1 - 7: Emergency neurosurgical referrals in the North East of England – trends over four years 2008–2011

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Objectives. On-call referrals are a considerable part of the neurosurgical workload. Many neurosurgical centres in the United Kingdom have now adopted the practice of maintenance of electronic databases to keep records of on-call activity. We analysed the neurosurgical on-call referrals database maintained at the Newcastle General Hospital/ Royal Victoria Infirmary to assess any trends in the nature of referrals.[1,2]
Design. Analysis of a contemporaneously populated database, observational cross sectional study.
Subjects. Referrals to the regional neurosciences unit.
Methods. Retrospective review and statistical analysis of a contemporaneously populated referrals database, maintained at the Regional Neurosciences Unit in Newcastle. Data were analysed from August 2008 to April 2011. A three point moving average was used to depict trend in the number of referrals. Descriptive statistics were used to display other trends. Analysis was conducted using JMP 8.0.2 (SAS Institute, Cary, NC).
Results. Our analysis reveals that the number of emergency referrals to neurosurgery in the North East of England is increasing year-on-year. Mean number of referrals per day has increased by almost 5 over the study period (9.06 in 2008 compared to 13.93 in 2011). The major diagnoses that account for this increase are lumbar degenerative conditions, intracerebral haematomas, spinal trauma and subarachnoid haemorrhage. Fifty per cent of the patients are referred out of hours and approximately one third are admitted. In contrast, 47% of all referrals to rule out a cauda equina syndrome, need admission for scanning. General practitioners are the single biggest source of referral outside of the parent NHS trust and 47% of the GP referrals are regarding lumbar degenerative conditions and cauda equina syndrome.
Conclusions. Continuously increasing referrals have implications on cost, staffing and sustainability of the service. Alternative referral pathways, especially for referrals from primary care, must be considered to restore the on-call workload to 'true' neurosurgical emergencies.

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TAMP1 - 8: Anatomical dissociation of decision valuation and action signals in the prefrontal cortex

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Objectives. The prefrontal cortex has been shown to be critical for decision-making in humans, as lesions of the prefrontal cortex result in deficits in such decision making.[1] While signals that suggest an evolving decision have been recorded from the prefrontal cortex, the precise mechanism by which decision valuation is converted into an action plan remains unclear. We hypothesised that single neurons in prefrontal areas would preferentially exhibit action-independent value signals, with a transition towards value-independent action signals as neuronal recordings approached the premotor cortex.
Design. Single-neuron electrophysiology.
Methods. The subjects were trained to discriminate cues that predicted juice reward varied along the dimensions of reward probability, reward size (payoff) and effort required to obtain reward. We recorded from three brain areas: the lateral prefrontal cortex (LPFC), the orbitofrontal cortex (OFC) and the anterior cingulate cortex (ACC) using microelectrodes. We used a generalised linear regression model to determine whether neurons were modulated by the value of the choice (value) and/or the action the subject would make to obtain reward. These two regression coefficients were then plotted against the antero-posterior position of the recording site to determine whether value and action signals could be anatomically dissociated.
Results. Consistent with our hypothesis, there was a clear transition from encoding of value information in anterior ACC into encoding of action information in posterior ACC. However, such a pattern was specific to ACC as both value and action signals were more prevalent in posterior sites within LPFC.
Conclusions. These results suggest ACC integrates value-based decision-making signals and generates an action signal for optimal decision-making.

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TAMP1 - 9: Ebrain – the new neuroscience e-learning programme

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Objectives. Ebrain has been established as the world's largest neuroscience e-learning programme. The programme aims to provide content relevant to trainees and consultants across all the clinical specialities that are part of clinical neuroscience.
Design. There are 550 e-learning session, each with 20 minutes of learning. Multimedia rich features within the sessions include videos, interactive case studies and questions. Each session requires the learner to provide feedback before a certificate can be presented.
Subjects. E-brain is available free to all members of the SBNS. It is also available to members of other British and some European neuroscience speciality associations. In all 10 - 15,000 doctors have access.
Methods. Future developments that are proposed include enhanced content for neuroradiology, pain and neuroanaesthetics. A question bank will be developed, a case of the month section, forums and wikis can also be supported.
Results. The programme goes live on 25th Nov 2011. User stats will become available and will be presented at the SBNS meeting in Aberdeen.
Conclusions. Any SBNS members who do not have a password should approach the SBNS office. Non-members of the SBNS should join the SBNS to get free access!

TAMP1 - 10: Acute neurosurgery – how well are GPs doing?

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Objectives. To determine the quality and timing of referrals of emergency neurosurgical patients. To determine the quality and timing of referrals of emergency neurosurgical patients.
Design. Prospective study of consecutive emergency neurosurgical patients admitted to our unit between 25 October and 1 of December 2011.
Subjects. All adult patients with a new diagnosis of spinal cord compression, intracerebral tumour, and spontaneous cerebrovascular event were included. Elective patients and those with existing neurosurgical diagnoses were excluded.
Methods. We collected: age, sex, initial diagnosis, number of presentations to healthcare professionals, presenting symptoms, date of referral and admission, final diagnosis and adverse events. We performed a non parametric analysis of variance using the Kruskal–Wallis test, and a post hoc Mann–Whitney U, using SPSS.

Results. There were 45 admissions; intracerebral tumour: 19, vascular: 19, cord compression: 7. Time to referral was significantly influenced by type of diagnosis $H(2) = 9.569$, $p = 0.008$. Of the 26/45 patients who presented directly to A&E or oncology (tumour 7, vascular 16, cord compression 3), only 1 experienced a delay. Of the 19 patients who attended their GP (tumour 12, vascular 3, cord compression 4), only 4 were appropriately referred for further investigation and management. The remaining 15 (79%) experienced significant delays following incorrect diagnosis, resulting in avoidable adverse events.
Conclusions. Patients with acute vascular neurosurgical events are being managed expediently. Patients presenting to their GP with signs and symptoms of intracranial tumours and cord compression are experiencing significant delays to diagnosis and thus referral. Despite the relative rarity of these conditions, these delays were avoidable and we suggest ways to improve this.

TPMP1 – Trauma Head and Spine

TPMP1 - 1: Bone marrow progenitor cell mobilization as a predictor of outcome in traumatic brain injury

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Objectives. Recent studies suggested an important role of bone marrow progenitor cells (PCs) in functional recovery after traumatic brain injury (TBI). To investigate whether PCs mobilization influences recovery in humans we evaluated changes in the levels of hematopoietic and endothelial PCs in TBI patients with different outcomes.
Subjects. A total of 24 patients (20 males and 4 females; median age 40 years) with moderate to severe head injury (GCS = 12) were investigated. Patients with major accompanying trauma were excluded.
Methods. CD34 + CD45 + hematopoietic precursors (HPs) and CD3-D34 + CD144 + endothelial progenitors (EPs) in peripheral blood were measured by FACS at day 1–3 and day 7–10 after head trauma. The relation between PCs and Glasgow Outcome Score (GOS) at 6 months after injury was studied.
Results. Fifteen patients had unfavourable outcome (GOS 1–3), among them 12 died and 3 had severe disability. Nine patients had good recovery or moderate disability (GOS 4–5). At day1–3 HPs level in the group with favourable outcome was significantly higher than in opposite group (5075 ± 1315 vs 2171 ± 827 cells/mL; $p = 0.028$). The differences in the EPs counts were manifested as trend (313 ± 168 and 173 ± 86 cells/mL; $p = 0.26$). The levels of HPs and EPs at day 7–10 did not differ between the two groups. Using ROC analysis to predict the probability of unfavourable outcome we show that the area under the ROC curve for the HPs was 0.78, the sensitivity was 93% and the specificity was 75%.
Conclusions. Early mobilization of HPs may be used as a novel predictor of outcome in patients with moderate/severe head trauma.

TPMP1 - 2: Does the type of drain matter? Comparison of surgical outcomes with subdural drain to subperiosteal drain in chronic subdural hematoma – a prospective randomized study

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Objectives. To compare the clinical outcomes and recurrence rate of utilizing sub periosteal and subgaleal drain for the treatment of chronic subdural hematoma (CSDH).
Design. Prospective randomized single centre study.
Subjects. A total of 50 patients were included in the study (33 male and 17 female).
Methods. A total of 52 patients were recruited for the study. Two types of drain, subperiosteal and subdural were used on alternate patients presenting to our department with chronic subdural hematoma needing surgical treatment. The drains were left for duration of 48 hours. Two female patients were excluded in the study as the drain was prematurely removed before 48-hour duration. The Modified Rankin Scale was used for outcome measurement at 3 months and 6 months were analysed with recurrence of the CSDH.
Results. Data analysis was performed by unpaired t test with Welch's correction. It was noted that the two types of drain had no recurrence of hematoma at 6 months follow-up and no significant difference was noted in the *p*-values on statistical analysis. Post-operative seizures and wrong placement of the subdural drain into brain parenchyma were the two complications noted.
Conclusions. We conclude both the subdural and subperiosteal drain has no difference in the recurrence of the CSDH. The MRS scale measurement at 3 and 6 months were found to be the same. Subperiosteal drain may prove a technically effective procedure in comparison to subdural drain in reducing the morbidity.

TPMP1 - 3: Skull fractures in patients with traumatic brain injury: when to consider CT venography?

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Objectives. Post-traumatic dural venous sinus thrombosis (DVST) is known to be associated with skull fractures that extend to a venous sinus or jugular bulb. This study aims to report the prevalence of DVST in patients receiving treatment for post-traumatic raised ICP as well as their clinical outcomes.
Design. Retrospective evaluation of prospectively collected data.
Subjects. This single-centre study included 15 consecutive ventilated patients with TBI who underwent CT venography due to the presence of a skull fracture near a dural venous sinus/jugular bulb within a 1 year period.
Methods. Data were extracted from electronic records and departmental databases.
Results. DVST was identified in 5 patients (prevalence 33%). Three patients had occlusive thrombosis. The lateral sinuses (transverse and sigmoid) were implicated in all cases. The CRASH (basic) predicted risks of mortality ($20.6 \pm 10.2\%$ vs. $18.4 \pm 4.3\%$; $p = 0.81$) and poor outcome ($45.3 \pm 15.7\%$ vs. $50.1 \pm 6.6\%$; $p = 0.74$) were not different between the DVST and the non-DVST group. This indicates that the 2 groups were similar with respect to injury severity. Four out of the 5 patients with DVST required advanced measures for ICP control (hypothermia, decompressive craniectomy or barbiturate infusion) compared to 4 out of 10 without thrombosis ($p = 0.28$). Dichotomous outcome (dead/alive) was different between the 2 groups: 3 patients with DVST died within 14 days post-injury, while all patients without DVST were discharged from hospital alive ($p = 0.02$).
Conclusions. The prevalence of DVST on CT venography is high in TBI patients with skull fractures near a dural venous sinus. A larger study is required in order to determine whether DVST is independently associated with mortality/outcome.

TPMP1 - 4: Complications of cranioplasty following decompressive craniectomy for traumatic brain injury

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Objectives. We reviewed a consecutive series of cranioplasties performed after decompressive craniectomy (DC) for TBI at a regional neurosurgical centre to establish the rate of complications.
Design. Retrospective single-centre study.
Subjects. All patients who underwent a cranioplasty following TBI from January 2008 – December 2010.
Methods. Operations were identified and operative details collected from operating theatre registers. Pertinent data were extracted from patient records.
Results. In total, 51 titanium cranioplasty operations were identified (38 M:13 F, median age 27 years). The median time between DC and cranioplasty was 9 months (Q1-Q3: 6–12 months). Eleven cases (21.6%) returned to theatre: 5 for removal of infected plate, 5 for revision (1 after fall, 1 for loose portion, 1 for discomfort, 2 for cosmesis) and 1 for evacuation of an extradural haematoma secondary to therapeutic anticoagulation. The mean time between cranioplasty and infection necessitating removal was 15 weeks (range 4–56 weeks). There was no significant difference in the proportion of non-elective operations (0/5 infected vs. 9/46 non-infected), afternoon operations (3/5 vs. 18/46) or operations with >1 surgeon (2/5 vs. 16/46). Four of the 5 patients who had infection had a pertinent co-morbidity (smoking, diabetes, immunosuppression, previous cranioplasty removal) compared to 15 out of 46 without an infection ($p = 0.058$). Two out of 6 patients who were established on anti-convulsant therapy experienced seizures immediately post-operatively. No patients experienced new-onset seizures after cranioplasty.
Conclusions. The complications of cranioplasty are not insignificant. A prospective national registry has the potential to answer important clinical questions regarding cranioplasty.

TPMP1 - 5: How successful is lumboperitoneal shunt insertion in patients with idiopathic intracranial hypertension

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Objectives. Lumboperitoneal shunting (LPS) is the most common shunting procedure performed for treatment of idiopathic intracranial hypertension after failure of medical therapy.[1] The outcome of LPS is often unsatisfactory with little information on complications in the literature. The aim of this study was to assess the outcome of LPS in a single-surgeon series, identify complications, and evaluate treatment methods used to address the complications.
Design. Retrospective study.
Subjects. How successful is lumbopertioneal shunt insertion on patients with idiopathic intracranial hypertension.
Methods. Medical records of 55 patients with IIH treated by LPS who presented to the Neurosurgery department at James Cook University Hospital between 1998 and 2011 and were examined and all relevant data collected using a predesigned proforma.
Results. Fifty-one patients were female and 4 male. The average age at presentation was 31.5, with a mean BMI of 36.4. The primary procedure was 42 LPS, 9 LPS with ASD/DSV (Dual Switch Valve), 1 DSV, and 3 were revisions of existing LPS. Thirty-three (60%) of these patients required further procedures. In this series, 135 procedures were performed (2.45/patient). Complications included: infection 2 (1.5%), distal end migration/obstruction 22 (16%), proximal end fracture/obstruction 8 (6%), persistent non-specific headache 40 (30%), low pressure (LP) headaches 20 (15%). LP headaches were treated with lengthening of distal catheter in 8 patients and ASD/DSV/GAV insertion in 12.

Conclusions. We found a high failure rate following the first procedure, mainly due to distal end malfunction. LP and persistent headaches were often difficult to treat. The efficacy of ASD/DSV in treating LP headaches is also discussed.

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TPMP1 - 6: Shunting of the over 80s in normal pressure hydrocephalus

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Objectives. A major issue in the treatment of idiopathic normal pressure hydrocephalus is the operative and anaesthetic risk faced by this elderly cohort. This has led to same centres not to treat individuals over 80. We present a single centre experience of treating these patients to assess the safety and efficacy of shunting an over 80s population of Normal Pressure Hydrocephalus patients.
Design. Retrospective analysis of complication and outcome data over the past seven years at a single centre.
Subjects. A total of 29 patients over 80 treated with ventriculoperitoneal shunt for normal pressure hydrocephalus. This was every patient treated over a 7-year period. In total, 26 were treated with Miethke proGAV, 2 Medtronic Strata, 1 Sophysa Polaris. Two patients were recommended not to have surgery.
Methods. We performed a retrospective audit of case notes and imaging to investigate the incidence of complications in this group including subdural haematoma, infection and revision rate. We also assessed change in 10 m walk test and neuropsychological test outcome.
Results. No patients had immediate subdural haematoma on post op CT scan. Five patients had delayed subdural haematoma. Two with Strata valve systems in which the subdural appeared spontaneous. These resolved with a higher valve setting. Three had traumatic subdural (2 proGAV, 1 Polaris) two of which required surgery. One patient required revision. There were no infections or anaesthetic complications. Twenty-one patients had $>10\%$ improvement on walking test. Of the remaining 8, 5 improved subjectively on questioning family.
Conclusions. With effective pre-assessment and valve selection, shunting for NPH is safe and effective in the over 80s group.

TPMP1 - 7: Cranioplasty after brain injury – Ceramic or titanium?

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Objectives. Craniectomy is a well-recognized operation for traumatic brain injury and intracranial infection.[1] After recovery, cranioplasty is necessary both for cosmesis and protection of the underlying brain. Acrylic and titanium have been among the materials used to replace the defect. More recently, we have used a customized porous-hydroxyapatite (ceramic) prosthesis. The theoretical benefit is a better fit and complete osso-integration into bone by 6 months.
Design. More recently, we have used a customized porous-hydroxyapatite (ceramic) prosthesis.[2] The theoretical benefit is a better fit and complete osso-integration into bone by 6 months.
Subjects. Ten patients (9 adults and 1 child) who underwent a ceramic cranioplasty, were followed prospectively. A further 10 patients who had undergone titanium cranioplasty were also followed up for 1 year.
Methods. Outpatient visits and CT scans were carried out periodically. Safety (the incidence of adverse events and fractures of the implant) and clinical performance in the form of cosmetic results were evaluated. All patients were asked to subjectively rate the cosmetic outcome of their operation (excellent, good, fair or poor). They were also asked to rate any residual pain on a visual analogue scale.
Results. No rejection occurred in either group. One case of infection has been recorded in the ceramic cranioplasty group. There have been two cases of infections recorded in the titanium cranioplasty group. One patient with ceramic cranioplasty had a fall and the prosthesis came away from the bone. This was treated with a head bandage for 6 weeks with an acceptable cosmetic result. All patients showed a satisfactory clinical outcome with good cosmetic appearance in the follow-up period. However, the cost of the ceramic cranioplasty is £5000 whereas a titanium cranioplasty costs £700 and can be manufactured in a shorter time frame.
Conclusions. Cranioplasty performed with a customised porous-HA prosthesis gives an appropriate cosmetic result with a possibly less infection rate. However, the cost of the implant and the longer duration of the procedure associated with a more complicated implantation technique may not justify the use of ceramic cranioplasty, especially when a suitable alternative is available for use.

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TPMP1 - 8: Do European and Asian patients randomised to the STITCH (Trauma) trial differ in their type of injury?

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Objectives. Compare injuries in patients randomised to the STITCH (Trauma) trial from Asia and Europe.

Design. STITCH (Trauma) is an international multicentre pragmatic randomised controlled trial comparing early surgery to initial conservative treatment for patients with traumatic intracerebral haemorrhage (TICH).
Subjects. Eligible subjects have 1 or 2 TICH of at least 10 ml and no extradural or subdural haemorrhage requiring surgery and are within 48 hours of injury.
Methods. Injury data is collected at randomisation and 2 weeks. This includes cause of injury, TICH location and volume, GCS, neurological deficits and pupils (on day of randomisation).
Results. In 114 patients, primary haematomas were typically frontal and temporal in 97 Asian patients (50% and 44% respectively) and this was reversed in 17 European patients (29% and 59% respectively). Median primary haematoma volume and median GCS were similar in Asians (22 ml, GCS = 12) and Europeans (24 ml, GCS = 12) and prevalence of a secondary haematoma was 32% and 41% respectively. Cause of injury was available in 110 patients. In Asian patients this was mostly due to RTA (79%) and falls (15%) whereas in Europe this was reversed with 25% of trauma due to RTA and 75% to falls.
Conclusions. While injury cause is quite different in Asian and Europe patients, they still share important factors in common, such as GCS and primary haematoma volume. For further information see www.research.ncl.ac.uk/stich and www.research.ncl.ac.uk/trauma.stitch.

TPMP1 - 9: Decompressive craniectomy for post-traumatic refractory intracranial hypertension: international opinion and practice patterns

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Objectives. To map current opinion and practice patterns in the use of decompressive craniectomy (DC) for post-traumatic refractory intracranial hypertension.
Design. Online survey questionnaire.
Subjects. Full members of the SBNS, members of the BNTA, EANS, NCCNet and the NCS were invited to participate.
Methods. The survey stayed open for 2 months.
Results. The survey was completed by 503 individuals.
Most of the respondents (225/503; 45%) were neutral/undecided regarding the long-term benefits of DC for post-traumatic refractory intracranial hypertension. Similar proportions of neurosurgeons (128/290; 44%) and intensivists (93/207; 45%) were neutral/undecided. However, a higher proportion of UK/Irish (87/142; 61%), as compared with European (34/110; 31%), neurosurgeons were neutral/undecided ($p < 0.001$). A higher proportion of those who had recruited a patient in the RESCUEicp trial were neutral/undecided (62/109; 57%) compared to those who had not (160/384; 42%; $p = 0.006$). The vast majority of the respondents (461/503; 92%) did not change their practice following the DECRA results. Fifty-seven per cent use DC (263/461), while 26% (119/461) continue medical management with barbiturates for refractory intracranial hypertension. The rest (79/461; 17%) would opt for RESCUEicp. Less than 10% of the respondents changed their practice following the DECRA results (42/503; 8%). The majority of those changed their practice from DC to medical therapy with barbiturates (28/42; 66%).
Conclusions. The majority of the respondents opt to manage refractory intracranial hypertension with DC. However, as there remains significant uncertainty regarding the use of DC and there is no class I evidence supporting its use, we believe that DC should ideally be undertaken in the context of ongoing trials.

Acknowledgements

We thank the following societies for distributing the survey to their members: Society of British Neurological Surgeons and British Neurosurgical Trainees Association, European Association of Neurosurgical Societies, NeuroCritical Care Network (UK) and Neurocritical Care Society (US). The RESCUEicp trial is supported by an MRC/NIHR Clinical Trials Grant.

FAM1 – Hydrocephalus/Endoscopy

FAM1 - 1: One year failure rate of *de-novo* ventriculo-peritoneal shunts in children from a small volume paediatric neurosurgical unit

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Objectives. To ascertain our institutions 1-year shunt failure and infection rates for *de-novo* shunts in children. To compare them against the standards set out in the Standards Document as part of the Safe and Sustainable review of Paediatric Neurosurgical Services.
Design. Retrospective case note review of consecutive procedures over a three and a half year period.
Subjects. In total, 63 children under 16 years of age undergoing insertion of *de-novo* ventriculo-peritoneal shunts.
Methods. Identification of patients from theatre logbook and BPNG national audit database. Retrospective review of case notes.
Results. There were 61 patients (2 excluded) with a mean age of 3.8 years. Overal1 17/61 (28%) failed at 1 year and the overall infection rate was 4.9%. Out of all,90% of operations were performed by two surgeons with a failure rate of 27% compared to 50% with only one surgeon. 77% had a consultant paediatric neurosurgeon scrubbed with a failure rate of 21% compared to 43% without a consultant.

Conclusions. Our institution's one year failure and infection rates for *de-novo* ventriculo-peritoneal shunts in children are well within the standards set by the Safe and Sustainable review and comparable with the published literature. Although the numbers in this study are small there appears to be a trend towards improved outcomes when two surgeons are involved in the procedure, especially when one is a consultant paediatric neurosurgeon. The authors feel that these results show that good results can be achieved for this group of children when treated in a small volume paediatric neurosurgical centre.

FAM1 - 2: Endoscopic skull base surgery: Indications and limitations

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Objectives. The traditional boundaries of the transsphenoidal approach can be expanded to include the region from the cribriform plate to the foramen magnum in the antero-posterior plane. The introduction of endoscopy with its improved illumination and wider field of view to transsphenoidal surgery has added a significant further potential for the resection of a variety of cranial base lesions. We review our experience with the expanded endoscopic endonasal approach in a series of 52 patients. Based on our previous experience with a large series of open skull base procedures we discuss our current indications and limitations of this approach.
Design. Prospective case study review.
Subjects. From 2009 to 2011, the expanded endoscopic endonasal approach was performed in 52 patients
Methods. Different Skull Base pathologies were enrolled from craniopharyngiomas, esthesioneuroblastomas, suprasellar Rathke pouch cysts, giant pitiutary adenomas, angiofibromas, meningiomas, paranasal malignancies, encephalocoele and gliomas. This study specifically focuses on the surgical indications, results, complications and the limitations.
Results. Gross total tumor removal as assessed by postoperative magnetic resonance imaging was possible in 39 patients (75%) with the exception of the craniopharyngiomas group where complete resection was possible only rarely. There were no permanent neurological complications with the exception of increased visual disturbance in one patient. Other complications included cerebrospinal fluid fistulae in 4 patients (7.6%) and meningitis in one (1.9%). There was no operative mortality. Large lesions, significant lateral extension, encasement of neurovascular structures and brain invasion in malignant lesions are considered among the contraindications for this technique.
Conclusions. The expanded endoscopic endonasal approach is a promising minimally invasive alternative to open transcranial approaches for selective lesions of the midline anterior skull base. This approach should be in the armamentarium of skull base surgeons.

FAM1 - 3: Endoscopic transnasal external fistulation (ETEF) in recurrent cystic craniopharyngioma – a novel technique

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Objectives. Recurrence of craniopharyngioma is common due to the difficulty to achieving complete resection safely. Cystic areas can re-accumulate rapidly if total capsular clearance is not achieved, resulting in the need for repeated drainage procedures. We designed a technique of persistent external drainage of these intractable cystic recurrences by fashioning an epithelialised fistula (pedicled nasal mucosal flap) connecting the cyst with the epithelium of the nasal cavity. We discuss the long term effectiveness of this procedure in controlling the cystic recurrences in this patient group.
Design. Retrospective observational review.
Subjects. Three male patients aged 8, 12 & 43 with the diagnosis of predominantly cystic craniopharyngioma who had previously received one or more established surgical interventions (craniotomy, resection & radiotherapy; transsphenoidal resection, endoscopic transnasal transphenoidal drainage).
Methods. Retrospective review of three cases that underwent the ETEF procedure for recurrent cystic craniopharyngioma. Clinical presentation, neuroimaging, surgical interventions and follow-up were recorded. The main outcome measure was cyst re-accumulation on MRI.
Results. Three patients had a mean follow up of 3.3 years (2–5) with no cystic recurrence. The follow up MRIs suggested gradual involution of the cysts contrary to the usual recurrent enlargement that we commonly see in this patient group. The long-term theoretical complications of a persistent fistula such as intracranial abscess, meningitis or CSF leak were not observed.
Conclusions. ETEF caused nasalisation of the cystic recurrences. It is safe and effective. It causes long term involution of the cysts and is a definitive procedure.

FAM1 - 4: A single centre, 10 year experience of endoscopic ventricular biopsies

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Objectives. We aimed to audit our experience of establishing a diagnosis by obtaining biopsy specimens via endoscopic means.
Design. Data was retrospectively collected for a 10 year period from January 2001 to January 2011 in a single neurosurgical centre.
Subjects. Within the study period, 133 ventricular endoscopic procedures were performed. In 17 (12.8%) of these a biopsy was performed with a male:female ratio of 2.4:1 and an age range of 3–74 years (median 17 years), 7 patients were under the age of 16 years.

Methods. Data was collated from patient case notes, theatre registers and a pathology results database.
Results. In total, 76% (13/17) of biopsies were performed during endoscopic third ventriculostomies with 24% (4/17) being lateral ventricular biopsies. Biopsy was successful in establishing a diagnosis in 76% of patients. The commonest tumour identified was a germinoma (3/13, 23%). Complications were experienced in 9 patients; 4 patients required ventriculoperitoneal shunting, 2 developed EVD associated infections, 2 developed diabetes insipidus and 1 developed cerebellar swelling. CSF tumour markers were sent in 7 patients (41%) who underwent biopsy. A positive result was obtained in 1 patient identifying a raised ßHCG with germinoma.
Conclusions. Endoscopic biopsy is a valuable tool in use in neurosurgical centres. Tumours particularly of the third ventricle are amenable to endoscopic biopsy with good diagnostic yield. Our success rates in establishing a diagnosis by endoscopic biopsy are comparable with other neurosurgical centres. We have shown a relatively high complication rate associated with this technique, which may be due to the relatively low numbers performed within our unit.

FAM1 - 5: Transnasal endoscopic (TE) resection of pituitary pathology (PP): two years' experience of multidisciplinary skull base team

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Objectives. Describe the advantages of a multidisciplinary team (otolaryngology/neurosurgery) approach to the pituitary pathology. Describe our modifications of technique and share our experience.
Design. Retrospective chart review.
Subjects. All patients who underwent transnasal endoscopic resection of pituitary pathology in our centre.
Methods. The data was collected retrospectively for patients who underwent TE resection of PP from September 2009 to November 2011. Data includes demographics, pre and post-op imaging, surgical indication, technique details including skull base repair, duration of hospital stay and post-op complications and their management.
Results. Forty patients (Males 19, Females 21), with an age range of 6–77 years, were identified. Most common indication was macroadenoma. Others included Pituitary apoplexy, microadenoma craniopharyngioma and Rathke's cleft cyst. The skull base defect was repaired using multilayered acellular dermis, Tissel, Floseal and Naspore. Three intraoperative CSF leak were identified and repaired primarily, three post-operative CSF leaks were encountered and required surgical intervention. The duration of hospital stay ranged from 5 to 30 days.
Conclusions. We feel that multidisciplinary approach offers some distinct advantages by combining expertise of two specialities. We have demonstrated that team approach has worked well even for a new set-up. Even though each speciality can carry out the procedure independently but we advocate a team approach as demonstrated by the safety of the new service.

FAM1 - 6: Lowering shunt opening pressure in normal pressure hydrocephalus

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Objectives. The proGAV anti-siphon valve is known to help prevent over-drainage complications without hampering symptomatic improvement in these patients. Current practice at our centre is to implant the valve with an initial opening pressure of 5 cm H_2O. It is common to lower the valve setting further in clinic with the hope of eliciting greater improvement. This study determines whether lowering opening pressure below 5 cm H_2O in these patients results in improved clinical features without significantly altering the complication rate.
Design. Retrospective case series.
Subjects. INPH patients with the proGAV shunt inserted in our centre from Jan 2007 to Nov 2010. In total, 27 patients were included. Ages ranged from 56–90 years (mean 76 years). Male to female ratio 1.5:1.
Methods. Case note review of iNPH patients with proGAV valve adjusted below 5 cm H_2O. Outcome measures were clinical improvement (gait, cognition and continence) and the presence of complications including subdural haematoma, low pressure symptoms and shunt failure.
Results. The 27 patients included underwent a total of 33 valve adjustments to below 5 cm H_2O. Of the adjustments 20 (61%) resulted in improvements (11 objective gait, 6 subjective mobility and 3 subjective cognitive). Seven (21%) adjustments caused no change and five (15%) resulted in deterioration (3 objective gait, 1 subjective mobility and 1 subjective cognitive). One patient had shunt failure and underwent revision. One (3%) patient developed subdural haematoma following adjustment (resolved with valve readjustment).
Conclusions. These results support lowering the opening pressure for the proGAV shunt in iNPH to improve clinical features without a significant increase in complication rate.

FAM2 – Functional

FAM2 - 1: White matter connections of the supplementary motor area A combined study with post-mortem dissections and DTI tractography

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Objectives. To investigate the white matter connections of the supplementary motor area (SMA). The SMA is frequently involved by brain tumours and surgery in this area can be followed by the SMA syndrome. Knowledge of the connections of the SMA can provide the neurosurgeon with a better understanding of the challenges related to operating in this region.
Design. White matter connections of the SMA were studied with both post-mortem dissection and Diffusion Tensor Imaging (DTI) tractography. The findings obtained with these two modalities were compared.
Subjects. Three human hemispheres were used for the post-mortem dissections. DTI was obtained from four healthy right-handed volunteers.
Methods. Post-mortem dissections were performed according to the Klingler technique. Specimens were fixed in 10% formalin and frozen at -15C for 2 weeks. After defreezing, dissection was performed with blunt dissectors. For DTI tractography, diffusion weighted MR data (70 near-axial slices) were acquired on a Siemens Trio 3.0 Tesla. Whole brain tractography was performed using a spherical deconvolution approach.
Results. Four connections were found: (1) U fibres running in the pre-central sulcus, connecting the precentral gyrus and the SMA-proper; (2) U fibres running in the cingulate sulcus, connecting the SMA with the cingulate gyrus; (3) 'aslant' fascicle directly connecting the pre-SMA with the pars opercularis of the inferior frontal gyrus; (4) medial fibres connecting the SMA with the striatum. Good concordance was observed between post mortem dissections and DTI.
Conclusions. The SMA shows a wide range of white matter connections with motor, language and lymbic areas. The SMA syndrome can be reinterpreted on the basis of these findings.

FAM2 - 2: Progress towards merging neuronal network engineering with semiconductor microelectronics technology: tools for neuroscience and neurosurgery

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Objectives. The human brain is a high-speed biological computer operating in an asynchronous, parallel, fault-tolerant mode. The key functional units are ~86 billion neurons connected by ~100 trillion synapses employing several different neurotransmitters. Synaptomics and connectomics promises to provide a complete neuroanatomical 'wiring diagram'. However, neurons do not function autonomously. To interpret this 'omic' catalogue, dynamic data regarding synchronous activity in networks is imperative. One approach is to engineer neuronal networks *in vitro* and then incorporate methods to stimulate and record from multiple cells simultaneously.
Methods. Parylene-C, a biocompatible polymer, was photolithographically patterned on SiO2 wafers. Chips were activated by treatment with strong acid followed by incubation with calf serum. Primary rodent cerebellar granule cells and HEK293 cells (a cell line with immunocytochemical and electrophysiological characteristics consistent with an early neuronal lineage) were cultured on activated chips. Rationalized activation solutions containing purified extracellular matrix proteins were trialled in place of serum.
Results. We achieved high resolution pattering of primary rodent cerebellar granule cells and HEK 293 cells, and were able to manipulate patterning fidelity by altering chip activation solutions.
Conclusions. The parylene-C/SiO2 platform enables accurate *in vitro* patterning of neurons on semiconductor microelectronic devices. Combined with methods for stimulation and recording (integration with carbon nanotube electrodes is ongoing), this platform will enable interrogation of neuronal networks at a unique spatial and temporal resolution. From a translational perspective, this approach may inform new tools for investigating cortical activity in epilepsy or a basis for novel neuroprosthetics.

FAM2 - 3: Effective management of lower divisional pain in trigeminal neuralgia using balloon traction

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Objectives. Percutaneous balloon compression (PBC) of the trigeminal ganglion uses a differential injury of axons to interfere with the nerve's ability to transmit signals. We described a modification to the technique for lower divisional pain, and present our experience to date.
Design. Retrospective analysis of prospectively collected data.
Subjects. From 1st January, 2000 to 1st January, 2010, 155 procedures were performed on 83 patients with idiopathic trigeminal neuralgia refractory to medical treatment or failure of a previous surgical procedure, using PBC of the trigeminal ganglion.
Methods. In patients with lower divisional pain, controlled traction was applied to the No. 4 Fogarty catheter for the duration of the balloon compression. Meticulous examination for facial numbness was performed on day 1, and at follow-up. Retrospective analysis of prospectively collected data was performed.
Results. In total, 27 males and 56 females, age range 32–87 years old (median 72 years), 17 patients (20%) had multiple sclerosis. Thirteen patients had V3 pain, 35 patients V2 and V3 pain, and all three divisions were affected in 8 patients. Fourty-one patients had previous surgical procedures. Controlled traction was applied in 107 procedures with 74 (69.2%) experiencing V3 numbness and 87% experienced pain relief. This is in contrast to 8 procedures out of 38 (21%) in which no traction was applied, experiencing V3 numbness on day 1 post procedure ($p < 0.001$). Post procedural numbness is associated with a higher incidence of pain relief. The

balloon ruptured in 9 procedures. 10 PBC failed to cannulate the foramen ovale. The mean follow up was 28.7 months, 43 patients (52%) needed more than one PBC, and at last follow up, outcome were excellent or satisfactory in 84% of cases.
Conclusions. Controlled traction in percutaneous balloon compression for trigeminal neuralgia is effective for lower divisional pain relief.

FAM2 - 4: Deep brain stimulation (of the centromedian thalamic nuclei) for the treatment of refractory epilepsy – a blinded controlled study

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Objectives. Deep brain stimulation (DBS) of the thalamus is an emerging surgical option for medically refractory epilepsy sufferers who are not suitable resective surgical candidates, or have failed resective surgery and/or vagal nerve stimulation. For symptomatic generalised epilepsy (SGE), primary generalised epilepsy (PGE) and frontal lobe epilepsy (FLE), we evaluate the efficacy of centromedian (CM) thalamic DBS for seizure control as well as quality-of-life outcome.
Design. Single-blind within-subject control study. Three months control period followed by three months stimulation; patient blinded to order of treatments. Six months open-label stimulation after.
Subjects. Eight patients recruited (7 males, 1 female). Ages at surgery range from 18 to 51 years (mean 39). DBS performed 14 to 46 years (median 32 years) after onset of seizures. Average follow-up period is 3 years. Three patients suffered with SGE, one with PGE, one debated to have SGE or FLE, and three with FLE. Three patients had concurrent removal of their VNS devices.
Methods. Seizure diaries were kept by patients/parents prospectively from enrolment to the current time. Patient reported outcome measures (PROMs) were completed at regular time-points: Seizure severity questionnaire (SSQ), Quality of Life in Epilepsy-31-Patient weighted (QOLIE-31-P), Hospital anxiety disorder score (HADS).
Results. Two patients have been rendered seizure free from the onset of DBS, both of whom suffer with SGE. Four patients have experienced seizure reduction by 50% or more: one with SGE, one with PGE, one debated to have SGE or FLE, and one with FLE; this latter patient required explantation after 6 months because of infection. Two patients with FLE did not see any seizure frequency change with DBS. Both patients achieving seizure freedom and one (also with SGE) showing substantial seizure reduction had significant improvement in all their PROMs. SSQ showed improvement in the two patients with FLE who did not achieve any seizure control.
Conclusions. CM DBS can be a legitimate option in particular epilepsy types such as SGE. Seizure freedom is achieved and PROMs show a significant benefit for these patients. In those with FLE who did not show any improvement in seizure frequency, PROMs suggest patient perceived reduced severity of seizures.

FAM2 - 5: Surgical excision of temporal glioneuronal tumours – an association with psychiatric sequelae?

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Objectives. Gangliogliomas and dysembryoplastic neuroepithelial tumours (DNET) are glioneuronal low-grade tumours occurring most commonly in the temporal lobe and often presenting with medically refractory seizures. Surgical excision plays an important role in achieving seizure freedom which is a significant factor in quality of life benefit. However, it has been suggested that excision of these temporal glioneuronal tumours is associated with the onset of psychotic symptoms[1]. We present data from our surgical series to investigate the association of anxiety and depression with surgical outcome.
Design. Case notes review and contemporary telephone interview.
Subjects. Thirteen patients underwent surgery for resection of temporal glioneuronal tumours. Two patients had gangliogliomas; both male. Eleven patients had DNETs; four male, seven female. Ages at surgery ranged from 11 to 54 (mean age 30). Average follow-up period was 2.7 years.
Methods. The case notes of each patient were studied. Telephone interviews were carried out with patients/carers to complete the Hamilton Anxiety Rating Scale (HARS) and the Becks Depression Inventory (BDI).
Results. Two patients had severe anxiety (HARS score above 30); both had left-sided surgery and continued to experience simple partial seizures post-operatively. Three patients experienced mild to moderate anxiety (HARS score 18–24) of which two had moderate depression (BDI score 21–30); both had left-sided surgery and continued to experience complex partial seizures post-operatively. Seven patients had no anxiety (HARS score below 17) of which only one experienced borderline clinical depression (BDI score 17 - 20) and six of these patients had no depression (BDI score below 17); the latter all had right-sided surgery and have remained seizure-free since surgery.
Conclusions. Over a third of our series appear to have a degree of psychiatric sequelae. This could add plausibility to the argument put forth by Andermann et al.[1] and others. However, we note that all (four) of our patients with post-

operative psychiatric sequelae had left-sided surgery and did not achieve significant seizure improvement. Left side surgery and inadequate seizure control may, conversely, also account for the excess psychiatric morbidity encountered which our group have previously published[2].

References

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FAM2 - 6: Patient satisfaction following microvascular decompression for trigeminal neuralgia for decompressive and wrapping techniques and correlation with outcome of treatment

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Objectives. To establish level of patient satisfaction with microvascular decompression (MVD) for trigeminal neuralgia. To compare satisfaction levels with decompressive and wrapping techniques. To correlate level of satisfaction with outcome of treatment.
Design. Retrospective review of MVD procedures 1993–2010 in single institution. Postal questionnaire sent to all patients.
Outcomes: Level of patient satisfaction and degree of ongoing pain. Fisher exact test used for comparisons.
Subjects. A total of 102 patients responded – 39 male 63 females, age 22–73.
Methods. Patients treated with either traditional decompressive technique as described by Janetta or new technique involving wrapping nerve in foam tubing. A total of 64 underwent decompressive technique, 28 had wrapping, 10 had neither (no causative vessel found).
Results. Satisfaction levels:

Overall – 76 completely, 18 reasonably, 4 slightly, 4 not at all.

Decompressive – 50 completely, 8 reasonably, 3 slightly, 3 not at all.

Wrapping – 20 completely, 6 reasonably, 1 slightly, 1 not at all.

Neither – 6 completely, 4 reasonably.

99/102 glad they underwent procedure, 2 not, 1 undecided.

Pain free (69 total) – 69% of decompressive, 71% of wrapping, 50% for neither.

Ongoing pain (33) – 10 completely satisfied, 15 reasonably, 4 slightly, 4 not at all.

Conclusions. Overall, high levels of patient satisfaction reported – 92% completely or reasonably satisfied with outcome. Satisfaction levels for decompression versus wrapping were not significantly different. On the whole, high level of patient satisfaction achieved even when ongoing pain. Around 76% patients with ongoing pain still completely or reasonably satisfied. However, satisfaction levels significantly poorer if ongoing pain than if pain-free ($p < 0.0001$). Nearly all (97%) were glad they underwent procedure.

FAM2 - 7: Functional MRI in disorders of consciousness – Evaluation of suitable stimulation paradigms in healthy controls

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Objectives. The diagnosis of disorders of consciousness such as coma or vegetative state remains a major challenge for critical care and rehabilitation medicine. Standard clinical tests rely on behavioural assessment and therefore often lead to inaccurate results in unresponsive brain injury patients. In fact, as many as one in six patients diagnosed as vegetative may be consciously aware (Monti et al, 2010).[1] The objective of this study was to evaluate the sensitivity of suitable stimulation paradigms for functional MRI (fMRI).
Design. Blood oxygenation level dependent (BOLD) contrast during stimulation was compared to baseline (no stimulus presented) in each subject. Stimulus paradigms included motor imagery, language comprehension and visual stimuli.
Subjects. Twelve healthy volunteers aged 18–45, in good general health with no history of neurological conditions or other serious systemic illness.
Methods. The Statistical Parametric Mapping (SPM8) software package was used to identify task-specific brain activation at the single-subject level. Contrasts between different conditions (e.g. stimulation versus baseline) were calculated using a general linear model in combination with a two-sided t test. fMRI data were acquired on a 3 Tesla MRI scanner (Philips Achieva) using a standard echo planar imaging (EPI) sequence.
Results. Significant brain activation ($p < 0.05$, family-wise error corrected) could be detected in response to each stimulation paradigm in each individual subject ($n = 12$) demonstrating adequate sensitivity at a single-subject level.
Conclusions. Our results demonstrate adequate sensitivity of the proposed fMRI paradigms at a single-subject level. We anticipate that the application of these paradigms in unresponsive brain injury patients will lead to a better diagnostic and prognostic assessment in the future; a study in brain injury patients is currently underway at our centre.

Reference

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FAM2 - 8: Efficacy of frameless, pinless electromagnetic image-guided navigation in endoscopic skull base surgery: A prospective study

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Background. The concept of 2 surgeons with 4 hands surgical technique in endoscopic skull base surgery limits constant optical based image-guided navigation. Also rigid head fixation hinders endoscopic skull base surgery.
Objective. The authors investigated the efficacy of frameless, pinless electromagnetic image-guided navigation in endoscopic skull base surgery.
Design. A prospective study
Subjects. A total of 42 cases were collected from October 2009 to October 2011.
Methods. Frameless, pinless electromagnetic image-guided navigation using Medtronic Stealth AxiEM was used. Different Skull Base pathologies were enrolled from craniopharyngiomas, esthesioneuroblastomas, suprasellar Rathke pouch cysts, giant pituitary adenomas, angiofibromas, meningiomas, paranasal malignancies, encephalocoele and gliomas. Outcome measures included measure of accuracy, histological yield, extent of tumor resection and navigation related complication rate.
Results. There was no case of non-diagnosis consequent of a registration error and inaccurate trajectory. All cases yielded histological diagnosis. Gross total tumour removal as assessed by post-operative magnetic resonance imaging was possible in 29 patients (69%). There were no permanent neurological complications with the exception of increased visual disturbance in one patient with giant pituitary adenoma. Non navigated related complications were cerebrospinal fluid fistulae in 3 patients (7.1%) and meningitis in one (2.3%). There was no operative mortality.
Conclusions. Frameless, pinless electromagnetic image-guided navigation in endoscopic skull base surgery is proven to be a simple, safe and effective. It allows the 2 surgeons, 4 hands surgical concept with freedom of head movement and constant navigation.

FAM2 - 9: Stem cell electrophysiology in health and disease

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Objectives. Glial cells constitute 90% of the human brain and are subdivided into macro- and micro-glial cell types. Astrocytes, a macroglial subtype, are located within well-circumscribed regions of the brain such as the dentate gyrus. They possess a radial glia (RG)-like morphology and express glial-fibrillary acid protein (GFAP). We and others have shown that these RG-like GFAP cells are stem cells, and play a central role in neurogenesis in the healthy adult brain as well as following epilepitiform like seizures and brain injuries. The properties of these RG-like GFAP cells in the neurogenic zones of the adult brain before and after epileptiform activity and brain injury are poorly understood. Electrophysiologically in the adult brain all RG-like cells express a voltage and time independent current pattern – akin to passive astrocytes, however, juvenile RG-like cells (i.e. with neurogenic potential) express a complex current pattern. We have recently demonstrated that recruitment and proliferation of these RG-like GFAP cells after seizures is AMPA receptor mediated *in-vitro* and that these cells contain mRNA for the AMPA receptor specific subunits GluR1 and GluR2. Using a combination of patch clamp electrophysiological recording and single cell rt-PCR we have now defined the properties of these stem cells in healthy *in vivo* acute mice slices and in cultures. They can be classified into at least 2 groups on the basis of their voltage current relationship. Over 60% of the cells display a passive current response. The soma and processes of these stem cells vary electrophysiologically. The processes contain both glut R receptors and transporters whilst the soma only possesses the transporters. It may be that the long unbranched processes of these cells may convey signals to the nucleus that reflect the state of the local microenvironment, thereby instructing differentiating stem cells to adopt region and context specific phenotype. Collectively, these novel findings highlight the mechanisms underlying the activity dependent coupling between neurotransmission and stem cell proliferation/recruitment and differentiation, which may in turn may lead to the identification of new drug targets for their manipulation in the normal adult hippocampus to enhance learning and memory and in the injured cortex to affect repair.

FAMP1 – Oncology/Radiosurgery

FAMP1 - 1: Factors affecting diagnostic yield in needle biopsy for brain lesions

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Objectives. Needle brain biopsy provides histopathological diagnosis and guides treatment strategies for intracranial lesions. We analyse the factors that are associated with the diagnostic yield of the procedure.
Design. We present a retrospective study of needle biopsy procedures for brain lesions in 30 months period.
Subjects. A series of 124 consecutive patients underwent 126 needle biopsies.

Methods. Patients demographics (age, sex), lesion topography (side, location, depth), lesion characteristics (histology, volume, radiological enhancement), type of procedure (freehand, ultrasound guided, frameless and frame-based stereotactic) and the use of intraoperative histological examination were correlated with the diagnostic yield. Descriptive statistics and a nominal logistic regression model were used to evaluate the factors influencing diagnostic yield.
Results. In total, 63 men and 61 women were included in the study with mean age 58.9 (range: 16 - 86). Of these, 56 were frame-based stereotactic biopsies, 34 were frameless stereotactic biopsies, 29 biopsies were performed under ultrasound guidance and 7 freehand. The diagnostic yield in our series is 93.7%. The sex, lesion topography, biopsy method, use of intraoperative histological examination and enhancement did not correlate with the diagnostic yield. Younger age had a negative impact on diagnostic yield. Six out of eight inconclusive biopsies were in non-glial lesions ($p < 0.05$). The odds of obtaining a positive diagnosis increased sevenfold with every cc increase in volume.
Conclusions. The age of the patient, the volume and the histology of the brain lesion had an impact on the diagnostic yield of needle biopsy. None of the other factors significantly influenced the diagnostic yield.

FAMP1 - 2: Intra-operative fluorescence with 5-aminolevulenic acid seen in non-glial tumours

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Objectives. Fluorescence-guided surgery using 5-aminolevulenic acid (5-ALA) has been shown to improve the extent of resection and progression free survival in high grade gliomas and has been used in our institution since 2009. We recorded the incidence of tumours other than high grade gliomas which fluoresced intra-operatively.
Design. Retrospective review of patients (operative note to confirm fluorescence and pathological report to confirm histology) who underwent Gliolan-guided resection of an intra-axial tumour from April 2010 to November 2011 at a single institution.
Subjects. Total 54 patients, identified from a pharmacy database of Gliolan prescriptions.
Methods. 5-ALA (Gliolan®) was used in patients with established or radiologically suspected high grade glioma in whom maximal debulking was planned. Gliolan was administered orally (20 mg/kg body weight). Surgery was performed with image guidance and a modified microscope (Pentero®, Carl Zeiss) capable of emitting blue light.
Results. The histological diagnoses were glioblastoma (40), other high grade glioma (9), anaplastic ependymoma (1), atypical meningioma (1), T cell lymphoma (1), abscess (1), reactive changes (1). The anaplastic ependymoma, atypical meningioma and T-cell lymphoma fluoresced intra-operatively.
Conclusions. Tumours of non-glial origin have been shown to fluoresce with 5-ALA, suggesting that 5-ALA may be used to aid the resection of a variety of non-glial tumours. Gliolan guidance also brings benefits to individual cases, such as indicating the area within a tumour (especially secondary high grade gliomas) that should be chosen for biopsy.

FAMP1 - 3: Regression of multiple meningiomata after cessation of cyproterone acetate treatment

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Objectives. We report a case of regression of multiple meningiomata after cessation of cyproterone acetate treatment.
Design. Case report and PubMed review of the literature.
Subjects. A 59-year-old male had been on prolonged cyproterone for hypersexuality. He presented with 6 months increasing right sided headaches and right eye proptosis. He also had early signs of right optic nerve oedema. MRI showed multiple meningiomata with the largest being over the right sphenoid wing. Cyproterone was discontinued.
Methods. Patient review in outpatients with serial MRI scans and PubMed search using the terms 'meningioma' and ['cyproterone acetate' or 'hormone'] and 'regression'.
Results. Within 3 months of discontinuing cyproterone, the patient had marked clinical and radiological regression of his meningiomas. He has been reviewed with 3 monthly MRI scans for 1 year and his symptoms have clinically resolved. So far he has not required surgery and his hypersexuality is being effectively managed with Zoladex. Our literature review indicates a clinical association of meningioma formation with long term cyproterone use. There are only two similar cases of tumour regression on cessation of cyproterone treatment.
Conclusions. This case illustrates how cyproterone may result in hormone receptive meningiomatas growth. It also shows how discontinuing the cyproterone has so far resulted in clinical resolution of symptoms and radiological tumour regression in this case.

FAMP1 - 4: Frameless, pinless electromagnetic image-guided navigation in awake craniotomies for brain tumour surgery

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Background. Awake craniotomies ensured maximal resection of eloquent brain lesions with no or minimal morbidity. Image-guided neuronavigation improves intra-operative topographical orientation. Optical navigation necessitates rigid head fixation using Mayfield clamp to maintain no movement between the cranial reference arc

and the target area, which may not be tolerable with Awake craniotomies.
Objectives. The efficacy of frameless, pinless electromagnetic image-guided navigation in Awake craniotomies for brain tumour surgery was investigated.
Design. Prospective study.
Subjects. A total of 10 cases were collected from June 2010 to October 2011.
Methods. Preoperative MRI revealed eloquent-related brain lesions either to motor or speech areas. Preoperative stealth compatible MRI scans were performed. Frameless, pinless electromagnetic image-guided navigation using Medtronic Stealth AxiEM was used in Awake craniotomies for brain tumour surgery with brain mapping for maximal lesion resection. Outcome measures included measure of accuracy, histological yield, extent of tumour resection and navigation related complication rate.
Results. There was no case of non-diagnosis consequent of a registration error and inaccurate trajectory. All cases yielded histological diagnosis. Gross tumour removal as assessed with post-operative magnetic resonance imaging was possible in 8 patients (80%). There was no electromagnetic navigation related complication. No particular changes to the operating theatre set-up were required, and no significant interference from ferromagnetic instruments was experienced. Neurophysiological monitoring was not affected, nor did it affect electromagnetic guidance.
Conclusions. Frameless, pinless electromagnetic image-guided navigation in Awake craniotomies for brain tumour surgery allows freedom of head movement with constant navigation and avoids the need of rigid head.

FAMP1 - 5: Cerebellar pilocytic astrocytomas in adults

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Objectives. Pilocytic astrocytoma is one the commonest subtype of glioma to affect children, however, they are rarely diagnosed in patients over the age of 18 years. In adults, these tumours appear more frequently supra-tentorially than in the cerebellum and some reports suggest a different clinical course in adults. We analysed our institution's experience with respect to these tumours.
Design. Retrospective case note review.
Subjects. Ten patients aged over 18 operated on for cerebellar pilocytic astrocytoma in a single institution.
Methods. Patients were identified from our neuropathology database and a retrospective review of the case notes of 10 patients was performed. Recorded data included of patient demographics, tumour location, presenting features, radiological appearance, extent of surgical resection, tumour recurrence and Ki-67 proliferation index.
Results. Nine patients (90%) were male, one patient (10%) was female. Median follow up is 37.5 months (range 3–322 months). Complete surgical resection was achieved in 9 (90%) of the patients operated in our institution. One patient had prior subtotal resection elsewhere. Tumour recurrence was seen only in the 2 patients with subtotal resection, at 6 and 25 years respectively. Ki-67 ranged from <1 to $<10\%$ and appears to have no correlation to recurrence. No patients in this series underwent adjuvant radiotherapy.
Conclusions. Cerebellar pilocytic astrocytomas in adults should be treated with macroscopic complete surgical resection whenever possible. If this is achieved, long-term progression free survival rates are excellent, whereas subtotal resection carries a high risk of tumour recurrence.

FAMP1 - 6: Malignant transformation of craniopharyngiomas

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Objectives. Craniopharyngiomas (CPs) are successfully managed with surgery and/or adjuvant chemo-radiotherapy, but have been documented to undergo malignant transformation (MT), albeit rarely, with only 24 reported cases. The exact aetiology and pathogenesis of this MT are as yet unknown, though the literature has suggested a possible correlation with radiotherapy. We aim to review these reported cases of malignancy, in particular looking at incidence, tumour characteristics, previous treatment modalities and median survival.
Methods. We conducted PubMed, SCOPUS, OVID SP and INFORMA search with a combination of keywords such as 'craniopharyngioma', 'malignancy', 'transformation', 'neoplasm', 'radiation therapy' and 'anaplastic' and identified 24 cases relevant to our study.
Results. Median age at diagnosis of malignant CP was 32.5 years (10–66). Of all, 52% of the cases were male. Histologically, the most common tumour types were squamous cell carcinoma (76.2%) and ameloblastic (9.5%). Twenty per cent of the cases were diagnosed as malignant CP at first biopsy. Of the rest, the median time from initial benign diagnosis to MT is 8 years (range 3–55 years). Median overall survival post diagnosis of MT was 5 months (2 weeks–5 years). Using Spearman's rank correlation, we found no correlation between radiotherapy (correlation coefficient, CC 0.25, $p < 0.05$) or its dosage (CC 0.26, $p < 0.05$) and MT.
Conclusions. Malignant CPs are rare and associated with a poor prognosis. MT occurs years after the initial benign CP diagnosis and is associated with multiple benign CP recurrence. Our results also show that contrary to widespread belief, radiotherapy does not significantly correlate with MT.

FAMP2 – Spine

FAMP2 - 1: Spinal ependymoma: 62 cases at a single centre

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Objectives. Spinal ependymomas account for 2–6% of CNS tumours with total resection favoured where possible. We characterize demographics and symptoms and assess surgical outcomes in terms of resection extent, subsequent radiotherapy, revision surgery and function.
Design. Retrospective review.
Subjects. Here 60 adults and 2 children with spinal ependymomas were identified presenting to a neurosurgical centre from 1992 to 2010.
Methods. Case notes, pathology reports, and clinical outcomes were reviewed.
Results. Male: female ratio was 1:1. Mean age at surgery was 43.6 years (range 5–76). Region of presentation was commonly lumbar (73%), followed by cervical (19%) and thoracic (8%). Mean duration of symptoms was 17.3 months with descending symptom prevalence of lumbago, sciatica, leg numbness, weakness and sphincter dysfunction. Myxopapillary features were seen in 61% of all and 76% of lumbar ependymomas. Most ependymomas crossed two spinal levels (range 1–9 levels), usually L2. Gross total resection was achieved in 54%, subtotal resection in 36% and biopsy performed in 10%. A total of 31% received adjuvant radiotherapy, while 69% of patients achieved excellent Frankel grading (E) after surgery. There were 18% recurrences and 11% complications. Longer duration of symptoms was not associated with reduced resection extent and poorer functional outcome. Degree of resection was correlated with need for adjuvant radiotherapy not post-operative Frankel grade.
Conclusions. Spinal ependymomas usually present in adults in the lumbar region. Debulking and total surgical excision largely conferred preserved neurological function. Spinal ependymomas remain surgically challenging entities with a fair proportion of patients receiving subtotal resection or biopsy and proceeding to adjuvant radiotherapy.

FAMP2 - 2: Idiopathic syringomyelia – analysis of 30 cases

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Objectives. Syringomyelia without an identifiable underlying cause is commonly termed as idiopathic (IS). With widespread use of MRI, these cases now appear to be more common. However, our understanding of these lesions remains unclear. This study involves 30 cases of IS, examined, treated and followed up at our institution. This is the largest series on this subject to date. It involves evaluation of factors influencing this pathology, its progression and clinical outcome.
Design. Retrospective and prospective analysis.
Subjects. Out of 30 patients,17 male and 13 female patients, ranging in age from 3 to 18 years.
Methods. A retrospective and prospective analysis of 30 patients that were diagnosed as IS was done. Syringomyelia was not associated with any other underlying pathology. Assessment of records, clinical symptoms, response to any treatment given and serial MRI imaging at regular intervals has been performed.
Results. Most common location was thoracic (19), cervical spine (5) and conus (2), 2 patients had cavity extending from C5 to conus and remaining 2 had multiple syrinxes. Majority of syrinxes (25) remained unchanged, 3 decreased, 1 increased and 1 showed resolution of the cavity overtime.
Conclusions. Even with increasing number of cases of IS being reported, knowledge about its natural course remains unclear. Spontaneous resolution has been reported, but this could not hold true for the majority of these lesions. There is also a lack of common consensus regarding treatment and follow-up. This study will show whether there are any changes with prolonged follow-up and an algorithm will be proposed to help manage these patients.

FAMP2 - 3: Minimally invasive versus open surgery for malignant spinal tumours

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Objectives. To review outcomes of patients treated for metastatic spinal cord compression (MSCC), requiring surgical fixation for instability/myelopathy, using minimally invasive (MIS) or open surgery (OPEN).[1]
Design. Retrospective, single-centre, case-control study.
Subjects. There were 27 consecutive patients. MIS group: 12 patients; M:F = 1,4:1; average age = 54.5. OPEN group: 15 patients; M:F = 1.15:1; average age = 49.5. Tokuhashi1 score: MIS = 11.58 VS OPEN = 8.86 (p-value = 0.03).
Methods. Data were collected from the medical notes of all patients who underwent spinal surgical, between 2007 and 2011, at a single institution. For each patient pre-, peri- and post-operative parameters were collected and subsequently a comparison was carried out.
Results. The instrumental levels were comparable between the two groups. The length of the operation (average = 235 minutes) in the MIS group was significantly shorter than in the OPEN group (average = 318 minutes) (p-value = 0.008). The length of stay was also shorter in the MIS group (average = 10.75 days) than in the OPEN group (average = 17.50 days) (p-value = 0.08). There was no significant difference in the duration of the post-operative PCA (MIS < OPEN; p-value = 0.11), in the post-operative pain score and in rate of complications.
Conclusions. Minimally invasive fixation for MSCC offers advantages in term of reduced surgical times and shows to be as safe as open surgical fixation.

Reference

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FAMP2 - 4: A retrospective analysis of neurological outcome in traumatic central cord syndrome as determined by treatment modality

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Objectives. The study aims to determine whether patients with a traumatic central cord syndrome were best treated by surgical or conservative management.
Design. A retrospective case note analysis.
Subjects. All patients (90) admitted to the ASCI unit at Groote Schuur Hospital since opening in 2003 until 2009 with a diagnosis of traumatic central cord syndrome (TCCS) were recruited, of these 67 matched inclusion criteria.
Methods. All patients with a diagnosis of TCCS were searched using the unit's electronic database, data on admission and discharge ASIA impairment scales, motor scores, length of stay, conservative or surgical treatment and mechanism of injury were recorded from patient notes as well as FIM scores, mobility and bowel and bladder function.
Results. There was no difference in outcome between surgical and conservative groups at discharge. There was, however, a strong correlation between age and neurological improvement.
Conclusions. The use of the ASIA impairment scale does not allow for a sufficiently accurate record of improvement in patients with a central cord syndrome injury. A fully randomised trial is recommended to conclusively determine whether surgical treatment is of any benefit.

FAMP2 - 5: Outcome of C-spine injury following surgical intervention-a review of 12 patients

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Objectives. To determine the Functional Impairment Measure (FIM) rating post-surgical intervention for cervical spine injury.
Design. Retrospective Review.
Subjects. Consecutive patients who underwent surgical intervention following C-spine injury.
Methods. Over 18 months (Mar 2010–Sep 2011), 35 patients presented with cervical spine injury. Twelve underwent surgery. These were reviewed retrospectively. Presentations, FIM Rating at intervals were major review parameters. Microsoft Excel software was used for data analysis.
Results. Of these 35 patients, 12 underwent surgery (34%). M: F = 5:1. Mean age 37 years. Motor vehicular accident was culpable in ten (83.3%). Mean time to presentation was 21 days. Seven (58.3%) suffered ASIA A, two each (16.6%) had ASIA B and E while one (8.3%) had ASIA D. Commonest levels were C5/6 and C6/7, with four cases (33.3%) each. Three cases (25%) were C4/5 and one at C1/2 (8.3%). Only one (8.3%) qualified for methyl prednisolone. Mean time to surgery was 20 days. Eleven (91.6%) had anterior cervical fusion while only one (8.3%) had fusion posteriorly following closed reduction. Mean duration of hospital stay was 42days. Average cost of treatment was 10 000 USD. At 12 months review Seven (58.3%) showed gradual improvement towards independent daily activities, four improved but did not attain any reasonable degree of independence, while one (8.3%) died.
Conclusions. Gradual improvement in FIM Rating over the period of observation as recorded in most patients following surgery is an encouragement for adopting this treatment option. However, outcome is probably related also to the ASIA scoring at initial presentation.

FAMP2-6: Instrumented fusion for the treatment of spinal tuberculosis

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Objectives. To review the clinical features and radiological kyphosis after modern spinal instrumentation for patients with spinal tuberculosis (TB).[1]
Design. A retrospective analysis of all patients undergoing surgery for spinal TB between 2002 and 2011 at a single centre.
Subjects. Twenty-six patients had surgery for spinal TB. Clinical details were obtained for 24 patients.
Methods. Patient details were compiled from operating theatre logs, histopathology records and positive microbiological reports for TB at surgery. The clinical features, imaging, operation details (anterior, posterior or 360° fusion), post-operative complications, duration of treatment with TB medication, patient's functional status and the degree of spinal kyphosis were assessed.
Results. Male: 14; Female: 10. Mean age 36.2 (range 22–67) years; 5 (21%) cervical, 15 (63%) thoracic and 4 (16%) lumbosacral.

Anterior instrumentation: average presenting kyphosis: 19.2° (11.5 - 27.2). After surgery 12.6° (7.4–20.9). Correction loss during follow-up: 3.1° (1.2–4.6). Posterior instrumentation: average presenting kyphosis: 32.7° (23.1–40.2). After surgery 13.7° (7.4–18.9). Correction loss: 4.1° (2.3–11.4). 360° fusion: average presenting kyphosis: 42.7° (23.1–50.4). After surgery 17.7° (12.7–24.0). Correction loss: 1.9° (0.7–3.9). There was one death, one episode of lung collapse, recurrent laryngeal nerve palsy and recurrent abscess. At discharge 13 patients were able to walk unaided, 4 with a stick, 1 with a crutch and 1 with a walking-frame. One patient was wheelchair bound. Average length of anti-TB drugs was 11.5 months; hospital stay 20.2 days (range 4–48 days; follow-up 9.4 months (range 3–18 months).
Conclusions. Modern instrumentation techniques for spinal TB result in good stability and can minimise the progression of spinal kyphotic deformity.[2]

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FAMP2 - 7: An investigation into the possible prognostic indicators of cervical myelopathy

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Objectives. Cervical spondylosis occurs with ageing, affecting 10% of those aged 25 and 95% by 65 years. Myelopathy is the resultant clinical presentation.[1] Although much about the disease is understood, prognostic indicators remain contentious. This study aimed to identify possible prognostic indicators of cervical myelopathy.
Design. Retrospective cohort.
Subjects. The study included 20 patients with cervical myelopathy.
Methods. Age, pre-operative symptom duration, operative segments, spinal cord compression ratio, affected segments on MRI, spinal canal diameter at C7 and pre- and post-operative modified Japanese orthopaedic association score (mJOA) were analysed. Mean follow-up time 1.57 months. Correlation between variables and the recovery ratio was evaluated using Pearson's correction. Statistical significance; $p = < 0.05$.
Results. A total of 15 patients showed improvement in symptoms postoperatively. Mean preoperative mJOA score was 8.9. Mean postoperative JOA score was 12.1. The mean recovery ratio from the pre and post-operative mJOA scores was 37.27%, SD of 29.22. Age showed no statistical significance ($p = .79$). Mean cord compression ratio was 39.68. Mean symptom duration preoperatively was 19.45 months. Mean number of surgical segments operated on was 1.5. Mean spinal cord diameter was 14.72 mm. Mean number of levels with signal intensity on T2 weighted MRI images was 2.
Conclusions. There was no correlation between variables and prognosis of patients with cervical myelopathy. This may be due to: retrospective design; small population size; short follow-up time.[2] This study recommends a multicentre prospective study of newly diagnosed patients. MJOA scoring system, detailed patient questionnaires, Pre-operative Motor and Sensory evoked potentials, intra-operative monitoring and multiple follow-ups are recommended methods.

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FAMP2-8: Reduced motion in levels adjacent to anterior cervical disc replacements: Implications for adjacent segment syndrome

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Objectives. Anterior discectomy and fusion is a commonly performed procedure for degenerative cervical spine disease. One complication of fusion is the development of adjacent segment disease, where increased compensatory movement at adjacent levels is thought to generate greater biomechanical stress. Cervical disc replacement was developed to preserve range of motion (ROM). We hypothesised that maintaining ROM at the index level will also ensure its preservation at other levels, hence reducing the risk of adjacent segment syndrome.
Methods. A list of patients who underwent anterior cervical disc replacement was obtained from theatre records. Patients who underwent multilevel or previous fusion were excluded. Where available, the latest postoperative flexion/extension radiographs were used to measure Cobb angles at the treated and adjacent levels. The ROM at each level was then calculated and compared to literature controls. Seven patients were identified with single level cervical disc replacements. There was no significant difference between postoperative ROM in our cohort and that of the literature (6.2 vs. 7.3 degrees, $p = 0.415$). Interestingly, the mean postoperative ROM in adjacent segments was significantly lower than that of the preoperative controls (3.7 vs. 6.4 degrees, $p = 0.017$)
Conclusions. Cervical disc replacement maintains ROM at the treated level. ROM at adjacent segments, however, appears to be reduced. This may decrease the incidence of adjacent segment disease.

FAMP2 - 9: Giant spinal ependymoma – Management challenge?

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Objectives. We describe a case of giant cervical ependymoma of cervical spinal cord extending from C2-T3.The etiopathogenesis and management of this rare occurrence is described.
Design. Case report.
Subjects. A 30-year-old female.
Methods. A 30-year-old female presented with bilateral arms and legs pain, short history of progressive quadriparesis and was wheel-chair bound at presentation associated with urinary retention with overflow incontinence. Physical examination revealed small muscles wasting in upper limbs, paraparesis in the lower limbs, hypertonia, areflexia and diminished sensation to both upper and lower limbs. Magnetic resonance imaging of the cervical spine revealed a single large intradural intramedullary tumour extending

from C2 to T3 with syringomyelia at the cranial and caudal aspects of the tumour. She underwent a cervico-thoracic laminectomy and complete excision of the tumour.
Results. Histopathology revealed a WHO grade II cellular ependymoma. The patient subsequently underwent C2 to T3 laminoplasty following the tumour excision. Her neurological status improved significantly after surgery. Two-weeks following the laminoplasty she had wound infection for which she underwent wound exploration and removal of laminoplasty bone graft. Three-months post operatively, she was able to mobilize independently with minimal aid.
Conclusions. Surgical option remains the best treatment modality in the management of giant spinal ependymoma.[1,2] Long term follow up with spinal neuroimaging is recommended.

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POSTER PRESENTATIONS

Trauma–Head and Spine

P1: Cervical spondyloptosis
B. Ogungbo
Cedarcrest Hospital, Abuja, Nigeria

P2: The management of potential cervical spine injuries in the ventilated patient in a tertiary Neurosurgical Unit: when and how is the cervical spine cleared?
M. Ahmad, K. B. Wong & S. Thomson
Leeds General Infirmary, Leeds, UK

P3: Prospective audit of the management of potential cervical spine injuries in the intubated patient in a tertiary Neurosurgical Unit: when and how is the cervical spine cleared? Comparison of two 90 day-audits over 15 years: 1996 and 2011
M. Ahmad, K. B. Wong & S. Thomson
Leeds General Infirmary, Leeds, UK

P4: Dural AV fistula-A rare complication of ICP bolt insertion
S. Chandrasekaran & A. Pathak
Department of Neurosurgery, Hull Royal Infirmary, Hull, UK

P5: Extradural hematoma – to treat the patient or the scan?
Z. Zakaria, C. Kaliaperumal, G. Kaar, M. O'Sullivan & C. Marks
Cork University Hospital, Wilton, Cork, Republic of Ireland

P6: Predictors of outcome in titanium cranioplasty
C. S. Hill[1], A. M. V. Luoma[2], S. R. Wilson[2] & N. Kitchen[1]
Departments of [1]Neurosurgery and [2]Neuroanaesthesia and Neurocritical Care, National Hospital for Neurology and Neurosurgery, Queen Square, London, UK

P7: Management of acute subdural haematomas: in need of better evidence
L. M. Li[1], A. G. Kolias[1], I. Timofeev[1], T. Santarius[1], E. A. R. Corteen[1], D. K. Menon[2], P. J. Kirkpatrick[1] & P. J. Hutchinson[1]
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Spine

P8: Lumbar interspinous devices – an institutional experience
D. Roy, R. Vemaraju, S. Zygmunt, J. Wasserberg, J. Dhir & N. Hamid
Queen Elizabeth Hospital, Birmingham, UK

P9: Efficacy of treatment of cervical radiculopathy with anterior cervical discectomy and fusion using PEEK cage
A. D. Sharma & P. M. Bhatt
Aberdeen Royal Infirmary, Aberdeen, UK

P10: Use of non-invasive Halo fixation in adults with C2 #
O. A. AlMasri & P. M. Bhatt
Ward 40, Aberdeen Royal Infirmary, Aberdeen UK

P11: Evaluation of post-operative thromboembolism after elective spinal surgery
A. Sheikh, D. Mowle & E. Ballanytyne
Ninewells Hospital, Dundee, UK

P12: An easy and accurate method to determine the size of disc prosthesis required during cervical disc replacement
H. L. Sinar, B. Whitehead, R. Bore, D. Booth & E. J. Sinar
Department of Neurosurgery, The James Cook University Hospital, Middlesbrough, UK

P13: The utility of CT myelography – diagnosis of lumbar canal stenosis
T. P. Eadsforth, J. Ellenbogen & C. Barrett
The Walton Centre for Neurology and Neurosurgery, Liverpool, UK

P14: Spinal epidural haematomas: factors influencing outcome and recommendations for management
N. Mukerji & N. V. Todd
Regional Neurosciences Unit, Royal Victoria Infirmary, Newcastle upon Tyne, UK

P15: Anterior approach to cervicothoracic spine
P. Kulkarni, I. Malik, R. Deshpande & R. Gullan
King's College Hospital NHS Foundation Trust, London, UK

P16: Spinal lymphoma at primary presentation: a case series
L. Roberts, E. Maratos & G. Critchley
Hurstwood Park Neurological Centre, Haywards Heath, UK

P17: Disc size in cauda equina syndrome symptomatology and diagnosis
J. S. Walkden & N. T. Gurusinghe
Royal Preston Hospital, Preston, UK

P18: Audit of intradural tumours from April 2008 and August 2011
P. M. Bhatt, J. Lumsden & A. Forster
Aberdeen Royal Infirmary, Aberdeen, UK

Oncology/Radiosurgery

P19: Management of meningiomas around the optic nerve and visual outcome
R. Kachhara
Bombay Hospital Indore, Indore, MP, India

P20: Early impressions of the use of intraoperative 3D ultrasound neuronavigation in guiding resection of intra-cerebral tumours: a trial survey
A. H. D. Silva, S. M. Joshi, H. El-Maghraby & M. S. Choksey
Department of Neurosurgery, University Hospitals Coventry & Warwickshire NHS Trust, Coventry, UK

P21: Gliadel wafer therapy, our experience
T. Lilo, M. Iqbal, J. Law, A. Ray & C. Davis
Department of Neurosurgery, Royal Preston Hospital, Preston, UK

P22: Solitary Langerhans – cell histiocytosis of the frontal bone: case report and review of literature
C. H. Iliadis[1], D. Papoutsakis[2], G. Kougentakis[2], I. Georgiadis[2] & V. Slatinopoulos[1]
[1]*University of Larissa, Department of Neurosurgery-ESY, Larissa, Greece and* [2]*Neurosurgery Department, Venizelion Hospital, Heraklion, Crete, Greece*

P23: Complications of intracranial reservoirs: a six-year study in a single neurosurgical unit
A. Patel, N. Srikandarajah, K. K. The, M. K. Lee & A. Brodbelt
The Walton Centre, Liverpool, UK

P24: Is whole body imaging necessary in the investigation of primary brain neoplasms?
D. Sayer, S. Al-Rashed & H. Ellamushi
Royal London Hospital, Whitechapel, London, UK

Oncology/Radiosurgery

P25: Auditing subarachnoid hemorrhage (SAH): Can we do it across multiple sites?
L. Dulhanty, D. Holsgrove & H. C. Patel; on behalf of participating Neuroscience centres
[1]*Frenchay Hospital, Bristol, UK,* [2]*Addenbrooke's Hospital, Cambridge, UK,* [3]*Salford Royal Hospital, Manchester, UK,* [4]*The National Hospital for Neurology and Neurosurgery, London, UK and* [5]*The Wessex Neurosciences Centre, Southampton, UK*

P26: Posterior cerebral artery aneurysm causing subarachnoid hemorrhage in Parry–Rhomberg Syndrome
D. Kuecher[1], C. Kaliaperumal[1], A. Hassan[1], N. Fanning[2], G. Wyse[2] & M. O'Sullivan
Departments of [1]*Neurosurgery and* [2]*Neuroradiology, Cork University Hospital, Wilton, Cork, Republic of Ireland*

P27: Intracranial haemorrhage in ventricular assist device patients
F. Vergani[1], C. Tosini[2], N. Ross[1], J. Nissen[1], N. Wrightson[2] & S. Schueler[2]
[1]*Neurosurgical Department, Royal Victoria Infirmary, Newcastle upon Tyne, UK and* [2]*Cardiothoracic Department, Freeman Hospital, Newcastle upon Tyne, UK*

P28: Developmental venous anomalies – two cases with venous thrombosis
M. Teo[1], J. St George[1], S. Jenkins[2] & P. Littlechild[1]
Departments of [1]*Neurosurgery and* [2]*Neuroradiology, Institute of Neurological Science, Glasgow, UK*

P29: Third ventricle cavernoma – an illustrated case report
D. Ferguson & E. J. St. George
Institute of Neurological Sciences, Southern General Hospital, Glasgow, UK

P30: Evolving posterior fossa giant aneurysm: interesting case report
A. Sheikh, D. Mowle & E. Ballantyne
Neurosurgery Department, Ninewells Hospital, Dundee, UK

P31: Does pyrexia following aneurysmal subarachnoid haemorrhage infer risk of vasospasm, or is it a non-specific consequence of blood in the subarachnoid space?
F. Dengu, P. M. Sammon, R. Sellar, M. A. Hughes, & G. Main
Department of Clinical Neurosciences, Edinburgh, UK

Miscellaneous

P32: 'MARTYN' modelled anatomical replica for training young neurosurgeons
D. Baxter, C. Craven, J. Jewel, M. Cooke & M. Murphy
Royal College of Surgeons of England, London, UK

P33: Application of additive layer manufacture in cranioplasty production
D. D'Aquino, M. Cartmill, J. Waton & M. Hatamleh
Queens Medical Center, Nottingham, UK

P34: Acute kidney injury in emergency neurosurgical admissions
M. Khosravi[1], C. S. Hill[2], J. Brugger[2], J. Grieve[2] & C. Lang[1]
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P35: Follow-up of benign intracranial and spinal tumours – 11-year series
N. Kumarasinghe & N. T. Gurusinghe
Department of Neurosurgery, Royal Preston hospital, Preston, UK

P36: Chiari malformation Type 1 – does it run in the family?
D. Ferguson, E. Campbell & E. J. St. George
Institute of Neurological Sciences, Southern General Hospital, Glasgow, UK

Hydrocephalous

P37: The role of intracranial pressure (ICP) monitoring in the evaluation of suspected shunt malfunction
J. Reaper[1], S. Collins[1], J. Robins[2] & J. McMullan[1]
[1]*Royal Hallamshire Hospital, Sheffield, UK and* [2]*University of Sheffield, Sheffield, UK*

P38: External ventricular drain insertion accuracy – is there a learning curve?
B. A. P. Jayasekera, E. A. C. Pereira, M. J. Gillies,
T. P. Lawrence & T. A. D. Cadoux-Hudson
Oxford University Hospitals, Oxford, UK

P39: Colloid cysts: is there a need for closer radiological monitoring of conservatively managed lesions?
B. Zebian. L. Nayeb, L. Bridges & M. C. Papadopoulos
Atkinson Morley Hospital, St George's Healthcare Trust, London, UK

P40: Chronic headache after traumatic brain injury – whose headache is it—Neurosurgeon's or neurologist's?
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P41: An unusual presentation of ventriculoperitoneal shunt dysfunction
J. S. Walkden & M. Donaldson-Hugh
Royal Preston Hospital, Preston, UK

P42: Recurrence of a paediatric arteriovenous malformation nine years post complete excision
C. McCarthy[1], C. Kaliaperumal[1], G. Wyse[2], N. Fanning[2] & M. O'Sullivan[1]
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P43: Spontaneous resolution of radiotherapy induced craniopharyngioma cyst
M. Teo[1], P. Fivey[1], F. Cowie[2] & J. St George[1]
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