

PROCEEDINGS

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

This meeting is being hosted by the Leeds General Infirmary, commencing on 26 September 2012.

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

These papers are published in advance of the meeting – if any papers are subsequently withdrawn or not read to the society – an addendum to this effect will be published in the next issue of the journal.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

PRESENTED ABSTRACTS

WPM1 – Top Papers

WPM1-1: Establishment of an imageable intracranial surgical resection animal model of glioblastoma multiforme

K. J. Sweeney¹, M. Jarzabek², D. O'Brien¹, A. Byrne² & J. Prehn²

¹National Centre for Neurosurgery, Beaumont Hospital, Dublin, Ireland and ²Centre for Systems Medicine, Department of Physiology and Medical Physics, Royal College of Surgeons in Ireland, Dublin, Ireland

Objectives. Prognosis for glioblastoma multiforme (GBM) has remained poor. There is almost always recurrence post-resection and adjuvant treatment, the majority of which is local. Several preclinical models exist that recapitulate the essential features of GBM. The majority of these models treat GBM in the neoadjuvant setting. Here, we describe an imageable intracranial surgical resection model of GBM in the rodent.

Methods. We implanted 106 U87 luciferase-expressing GBM cells into the right hemisphere of 6-week-old female rats at predefined stereotactic coordinates ($n = 10$). When the bioluminescence signal of tumours were in the exponential growth phase, the animals were randomised into surgical ($n = 4$) and non-surgical groups ($n = 4$). Under parenterally delivered anaesthesia, the animals were fixed in a stereotactic frame. A 4.5 mm craniectomy was performed with resection of the tumour using microsurgical techniques. Haemostasis was ensured. The cranial defect was repaired using a modified cranial window technique. No antibiotics were administered.

Results. Immediate post-operative bioluminescence imaging revealed a gross total resection rate of 75%. At 4 weeks follow-up, Kaplan–Myer survival analysis revealed 100% survival in the surgical group compared to 0% in the non-surgical cohort ($p = 0.01$, HR = 25.79). There were no neurological defects or infections in the surgical group. High recurrence rate was observed by 4 weeks.

Conclusions. We have established a novel, reproducible, cost effective, imageable and clinically relevant surgical resection model of intracranial GBM that recapitulates the natural history post-resection. This model can be used in the development of systemic therapeutics in the adjuvant or recurrent setting and in the development of novel therapeutics applied locally to the surgical resection cavity.

WPM1-2: Recommendations for evaluating the quality of reports of surgical interventions in the treatment of trigeminal neuralgia: the Surgical Trigeminal Neuralgia Score (STNS)

H. Akram¹, B. Mirza¹ & J. M. Zakrzewska²

¹The National Hospital for Neurology and Neurosurgery, London, UK and ²Department of Diagnostic, Surgical and Medical Sciences, Eastman Dental Hospital, UCLH NHS Foundation Trust, London, UK

Objectives. The quality of reporting in the surgical treatment of trigeminal neuralgia (TN) remains inconsistent despite the various technical developments in the management of this condition. We present a check list with a scoring system for reporting on studies of surgical interventions for TN and to validate it by a literature review.

Methods. A check list with a scoring system, the Surgical Trigeminal Neuralgia Score (STNS), was devised after a

literature review and then applied to a series of articles identified using a pre-specified Medline and Embase search from 2008 to 2010. Of 584 articles, 60 were studies of interventional procedures, 57 could be obtained in full.

Results. The maximum STNS score came to 30 and was reliable and reproducible when used by all authors. The range of scores was 23.5 to 6 with a mean of 14. Stereotactic radiosurgery ($n = 25$) and MVD ($n = 15$) were the two most commonly reported procedures. The diagnostic criteria were stated in 35% of the studies. Forty-six percent used the recommended knowledge management (KM) methodology for pain outcomes. Follow-up was unclear in 8 studies and 26 reported follow-ups >5 years. Complications were reported consistently, but the temporal course was not always indicated. Two studies used the SF36 to measure quality of life. Only four studies reported pre-operative pain. The Barrow Neurological Institute (BNI) pain questionnaire was the most commonly used outcome measure.

Conclusions. The suggested check list and STNS could help editors and reviewers ensure quality reports are published and prove useful for authors when reporting their results.

WPM1-3: The human brain utilises lactate to generate energy after traumatic brain injury: evidence from an arteriovenous gradient study

I. Jalloh¹, A. Helmy¹, R. J. Shannon²,
K. L. H. Carpenter² & P. J. A. Hutchinson¹

¹Addenbrooke's Hospital, Cambridge, UK and ²Academic Neurosurgery Unit, Addenbrooke's Hospital, Cambridge, UK

Objectives. Glucose is the preferred fuel for the brain. Lactate is normally considered a waste product of anaerobic energy metabolism. Reflecting this, the brain normally exports a net amount of lactate into the blood. After traumatic brain injury (TBI), changes in energy metabolism occur and evidence suggests that the brain may actually use lactate as an alternative fuel. Our aim was to determine the extent of lactate use following TBI.

Design. A prospective observational study.

Subjects. Patients ($n = 19$) with diffuse TBI, monitored with cerebral microdialysis and jugular bulb catheters.

Methods. Serial arteriovenous (AV) concentration differences of glucose and lactate were calculated from arterial and jugular blood samples, providing a measure of net uptake or export by the brain. Positive AV difference indicates net uptake; negative AV difference indicates net export. Microdialysis was used to measure brain extracellular glucose and lactate.

Results. Depressed glucose uptake occurred in most patients. In 18/19 patients there were periods of net lactate uptake into the brain, most frequently on day 3 after injury. Brain microdialysate lactate had a median (IQR) of 2.85 (1.52–3.24) mmol/L. Lactate uptake into the brain occurred at relatively low arterial lactate concentrations with a median (IQR) of 1.34 (0.87–2.02) mmol/L.

Conclusions. Despite relatively high brain lactate compared to arterial lactate concentrations, the brain appears to

up-regulate lactate transport into the brain after TBI. Lactate supplementation may benefit energy generation by the injured brain.

WPM1-4: National audit of ventriculoperitoneal shunt survival in children in the United Kingdom: 30-day failure rate

Y. Z. Al-Tamimi, P. Sinha, R. Mathew
& P. Chumas; on behalf of the British Paediatric Neurosurgical Group (BPNG)

Leeds General Infirmary, Leeds, UK

Objectives. The reporting of outcome following ventriculoperitoneal (VP) shunt procedures is not uniform. We aim to demonstrate the benefit of the 30-day failure rate of VP shunts as a sensitive barometer of surgical outcome.

Design. Retrospective national study of neurosurgical units in the United Kingdom and Ireland.

Subjects. All paediatric patients (<16 years) undergoing any VP shunt operation (insertion of new shunt or revision of existing shunt).

Methods. All paediatric patients (<16 years) undergoing any VP shunt operation (insertion of new shunt or revision of existing shunt) in the period January 2008 to January 2010 were logged onto a central database. Data collected included age, date of operation and seniority/specialist interest of surgeon.

Results. A total of 1047 and 1286 new and revised VP shunts procedures were recorded, respectively. For new shunts, the 30-day failure rate was 13.3%. For the first revision of those shunts, the 30-day failure rate was 24.2%. When comparing procedures performed by paediatric and non-paediatric neurosurgeons, only revision procedures were noted to be significantly different between the two groups. Significant differences in shunt survival were noted when utilising the 30-day failure rate only (not for 1-year failure). Non-paediatric (32.3%) versus paediatric (16%) 30-day failure rate ($p = 0.002$).

Conclusions. Better shunt survival is seen when procedures are performed by consultant paediatric neurosurgeons, although these differences are significant for revised shunts only and only discernible with the 30-day failure rate. The 30-day failure rate may be a better barometer of surgical outcome for patients with VP shunts.

WPM1-5: IL-1 β mediates the reduced production of new neurons from endogenous stem cells in the adult human epileptic hippocampus

M. J. Zaben¹, V. Di Pietro², D. Khan³,
A. L. Ahmed² & W. P. Gray³

¹Department of Neurosurgery, University Hospital of Wales, Cardiff, UK, ²Department of Clinical Neuroscience, University of Southampton, UK, and ³Institute of

*Psychological Medicine and Clinical Neuroscience,
University of Cardiff, Cardiff, UK*

Objectives. The production of new neurons, necessary for hippocampal-dependent learning and memory, is reduced in patients with mesial temporal lobe epilepsy, partly explaining their cognitive deficits. Given the role of neuroinflammation in focal epilepsy, we examined the hypothesis that IL-1 β , an important proinflammatory cytokine in the epileptic brain, reversibly reprogrammes these stem cells.

Design. We isolated neural stem cells from the sclerotic hippocampus and normal cortex.

Subjects. Ten patients undergoing epilepsy surgery.

Methods. Stem cells were grown in a 3D culture under control conditions or in the presence of IL-1 β blockade. ELISA and PCR were used to quantify levels of IL-1 β and its mRNA receptor (IL-1 β R1) expression, respectively. Neurogenesis was quantified using BrdU and NeuN immunostaining.

Results. We show that hippocampal neurogenesis is reduced in sclerotic hippocampal cultures ($3.6 \pm 0.8\%$) compared to those from normal cortex ($13.5 \pm 2.2\%$). We also demonstrate that IL-1 β levels are elevated (24.4 ± 2.3 vs. 3.6 ± 1.4 pg/ml) and IL-1 R1 mRNA expression is 3-fold higher in cultures of sclerotic hippocampus compared to normal cortex. Treating sclerotic hippocampal cultures with IL-1 β R1 antagonist increased the percentage of newly born neurons to $14.23 \pm 1.13\%$ compared to $3.6 \pm 0.8\%$ in untreated cultures.

Conclusions. Our results strongly implicate IL-1 β as a mediator of defective stem cell function in the epileptic hippocampus, and from a therapeutic perspective, show that the effect is pharmacologically reversible.

WPM1-6: Radiation exposure to the surgeon and patient during low thoracic and lumbar spine instrumentation: a prospective comparison of navigated versus freehand technique

A. K. Demetriades¹, J. Villard², Y.-M. Ryang², B. Meyer² & F. Ringel²

¹King's College Hospital, London, UK and

²Technical University Munich, Munich, Germany

Objectives. To assess the difference in radiation exposure to the surgeon and patient during freehand versus navigated pedicle screw placement in the thoracolumbar spine.

Design. A prospective *in vivo* study.

Subjects. Ten navigated (Nav) cases and 10 cases using the freehand technique (FHT).

Methods. Radiation exposure to the surgeon was measured by three digital dosimeters placed at the level of the eye, chest and dominant forearm. Radiation was measured from patient positioning to the end of the procedure. Cumulative radiation to the patient was also recorded. A 3D post-operative scan was routinely performed at

the end of the operation in all navigated cases. During 3D scan acquisitions, the surgeon was outside the operating room.

Results. Patients were distributed evenly in the two groups in terms of sex, age, BMI and operated levels. The two groups were homogeneous in the number of screws per patient (6.5 Nav vs. 5.5 FHT) and transforaminal lumbar interbody fusion (TLIF) cages per patient (0.9 Nav vs. 0.8 FHT). The radiation dose for the surgeon was significantly higher using the FHT: chest 31.7 vs. 20.5 mSv, eye 81.4 vs. 14.6 mSv and forearm 56.6 vs. 7.0 mSv. While the total radiation exposure time of the patient was significantly lower in the FHT (2 min 14 vs. 3 min 21), the cumulative dose for the patient was actually doubled (1256.9 vs. 618.5 cGycm²).

Conclusions. The surgeon's exposure to radiation during pedicle screw placement with the FHT is up to eight times greater compared to the navigated technique. Neuronavigation halves the cumulative dose for the patient.

WPM2 – Hydrocephalus/Functional

WPM2-1: Outcomes of microscopic versus endoscopic trans-sphenoidal surgery for pituitary tumours. A single centre report

J. D. Pesic-Smith & C. L. Nicholson

Royal Victoria Infirmary, Newcastle upon Tyne, UK

Objectives. To evaluate and compare the complication rates of microscopic and endoscopic trans-sphenoidal surgery in a single centre and to see how they compare with previous studies.

Design. A single-centre, retrospective, observational study.

Subjects. Forty-one operations in 37 patients were identified. Two patients were excluded due to being unable to obtain the patient notes. Twenty-three operations were carried out using a microscope and 16 with an endoscope.

Methods. Patient notes, clinic letters, medication lists and discharge letters were retrospectively analysed for documentation of post-operative complications for all patients who underwent surgery for pituitary tumours between March 2009 and September 2011.

Results. Seven cerebrospinal fluid (CSF) leaks requiring repair occurred in the microscopic group (30.4%) and three in the endoscopic group (18.7%). Further complications following a microscopic approach included one haematoma, two large residual tumours, one episode of epistaxis and one patient developed diabetes insipidus. In the endoscopic group there were two large residual tumours and one patient requiring a single dose of DDAVP.

Conclusions. The use of an endoscopic approach to trans-sphenoidal surgery has reduced CSF leaks with no increase in diabetes insipidus. Initial data show a different trend to that reported in previous series. Although we report on a fewer number of cases, this differs from Jalloh et al., who described an increase in diabetes insipidus in endoscopic surgery and no significant difference in the rate of CSF leak.

WPM2-2: Complications of frame-based and frameless stereotactic brain biopsy: 351 consecutive cases

L. J. Livermore, E. A. C. Pereira, R. Ma & S. Bojanic

John Radcliffe Hospital, Oxford, UK

Objectives. To investigate negative biopsy, symptomatic haemorrhage and mortality rates following frame-based and frameless stereotactic brain biopsies.

Design. Retrospective single centre audit.

Subjects. Three hundred and fifty-one biopsies were carried out from July 2006 to March 2011.

Methods. Retrospective data collection from case notes and radiological imaging.

Results. Of the 351 biopsies, 256 were frame-based (73%) and 95 (27%) were frameless. Fifty-seven percent were male; mean age was 57 years (range 18–87). The overall negative biopsy rate was 5.1%; 4.4% with intra-operative smear versus 8.3% without smear. The overall symptomatic haemorrhage rate was 4.8%. The rate of haemorrhage resulting in persistent deficit or requiring surgical intervention was 3.7%. There was neither significant difference between haemorrhage rates in brainstem and thalamic biopsies versus other anatomical locations, nor between high- versus low-grade glioma biopsies. There was a significantly greater haemorrhage rate in lymphoma biopsies (12.5%) versus non-lymphoma biopsies (3.4%) ($\chi^2 = 5.88$, $p < 0.05$). Mortality rates at 7 and 30 days post-operatively were 0.6 and 1.7%, respectively. Death after 7 days was unrelated to surgery.

Conclusions. To our knowledge, this is the largest study of frame-based and frameless biopsies to be reported from a UK neurosurgical unit and the sixth largest in the international literature. When consenting for biopsy, patients should be quoted a 1% risk of mortality, a 4% risk of significant haemorrhage and an 8% negative biopsy risk decreased to 4% if intra-operative smear is available.

WPM2-3: Epilepsy surgery programme – the first four years

V. Josan¹, L. O'Connor², T. C. Roper² & N. Reeves²

¹Salford Royal NHS Foundation Trust and Royal Manchester Children's Hospital, Manchester, UK and ²Manchester Medical School, Manchester, UK

Objectives. Surgery for medically refractory epilepsy is an under-utilised resource. We have reviewed a single surgeon's experience in the first 4 years of an epilepsy surgery programme at our centre.

Design. Data were retrospectively reviewed for all patients who had surgery for medically refractory epilepsy at our centre between 2008 and 2012.

Subjects. The first 126 contiguous patients were included: 39 temporal lobectomies, 32 lesionectomies, 9 hemispherotomies and 46 vagal nerve stimulator (VNS) insertions. Mean age at operation was 27 years (8 months to 64 years).

Methods. Data were analysed using the chi-square test for correlation of seizure outcome with pre-operative variables: age, epilepsy duration, seizure semiology and histology. Seizure outcomes were defined as good, Engel grades I and II, and poor, Engel grades III and IV.

Results. Mean duration of epilepsy, from diagnosis to surgery, was 20.5 years (1–54 years). Mean follow-up was 20.5 months. VNS produced seizure improvement in 68% (28) of cases. Resective procedures produced similar rates of seizure freedom – 62% overall. Good seizure outcome was achieved in 88% (60) of cases. Twelve patients developed permanent neurological sequelae: two hemiparesis, one expressive dysphasia, three cranial nerve palsies, three memory disturbances and three visual field defects.

Conclusions. This series demonstrates that epilepsy surgery can be performed with no mortality, acceptable morbidity and good seizure outcomes in carefully selected patients.

WPM2-4: Is the positioning of ventricular shunt catheters related to their patency?

R. Sinha¹, J. A. D. Morgan², J. R. Wawrzynski², Z. Czosnyka¹, M. Czosnyka¹, S. J. Price¹ & J. D. Pickard¹

¹Addenbrooke's Hospital, Cambridge, UK and

²University of Cambridge Clinical School, Cambridge, UK

Objectives. We investigated the relationship between ventricular shunt catheter position on computed tomography (CT) scans and shunt patency as assessed by infusion studies performed in the same patients.

Design. Retrospective observational cohort study.

Subjects. Two hundred hydrocephalus patients in whom infusion studies were performed due to symptoms of shunt malfunction.

Methods. Three hundred and six infusion studies performed in 200 patients from 2007 to 2011 in our unit also had 306 corresponding CT head scans performed within 3 months of the infusion studies. We analysed the 306 CT head scans to categorise the position of the shunt catheter tip as follows: frontal/parieto-occipital entry, ipsilateral/midline/contralateral tip position and tip position relative to the foramen of Monro/CSF/parenchyma/collapsed ventricles. Nominal logistic regression was used to correlate shunt position on imaging to shunt patency from infusion studies.

Results. Shunt tips completely surrounded by either parenchyma or cerebrospinal fluid (CSF) on CT imaging, are strongly associated with evidence of occlusion or patency from infusion studies, respectively ($X^2 = 51.68$, $p < 0.0001$, $n = 306$ and $X^2 = 31.04$, $p < 0.0001$, $n = 306$). For frontal shunts, optimal shunt tip position (completely surrounded by CSF, anterior to the foramen of Monro in the ipsilateral ventricle) was strongly associated with evidence of patency from infusion studies ($X^2 = 16.25$, $p < 0.0001$, $n = 222$).

Conclusions. Adequate shunt tip positioning is crucial for shunt patency.

WPM2-5: DTI profiles in NPH

N. C. Keong, S. J. Price, J. H. Gillard & J. D. Pickard

Cambridge University Hospitals NHS Foundation Trust,
Cambridge, UK

Objectives. The purpose of this study is to demonstrate the use of diffusion tensor imaging (DTI) to assess white matter injury in normal pressure hydrocephalus (NPH).

Design. Twenty-one participants with NPH were recruited via the cerebrospinal fluid (CSF) clinic. Nineteen patients underwent imaging.

Subjects. Following appropriate exclusions, 16 patients were studied using DTI analysis.

Methods. DTI measures of fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity and radial diffusivity were generated using *a priori* ROI selection of white matter tracts. Patients were compared to nine age-matched controls.

Results. The most affected white matter tracts were the genu and body of the corpus callosum, with all measures significantly different to controls ($p < 0.05$). For the genu, MD, axial and radial diffusivities were +33.9, +21.9 and +92.7% higher than controls. The most preserved were the inferior fronto-occipital/uncinate and the internal capsule tracts. FA in these tracts was not significantly different to normal but MD, axial and radial diffusivities were significantly higher than controls by +9.9, +27.9 and +24.2%.

Conclusions. There is a distinct DTI profile for NPH patients compared to controls. Several patterns of white matter injury were seen dependent on the location of white matter tracts in relation to ventricles.

WPM2-6: Drain associated CSF infection rates in neurosurgical inpatients: a prospective study

R. Zakaria, N. Srikantharajah, S. Tripathy & D. D. Lawson

The Walton Centre, Liverpool, UK

Objectives. External cerebrospinal fluid (CSF) diversion via an external ventricular drain (EVD), lumbar drain or externalised shunt is a common neurosurgical procedure, but is associated with a risk of infection and subsequent morbidity. The aim was to establish the incidence and independent predictors of infection in a single institution.

Methods. Prospective collection of data on adult patients undergoing external CSF diversion procedures over a 12-month period.

Results. The total number of patients without pre-existing CSF infection undergoing procedures was 107, and 18 drain-related infections were observed, an incidence of 13.7 per 1000 drain days (the preferred reporting format in the literature). This is compared to a retrospectively obtained rate from the same institution of 21.5 per 1000 drain days, before the introduction of standardised drain

management practices about who could take samples and how frequently. In a regression model of the prospective data, the only independent prognostic factor was duration of drainage with an odds ratio of 1.20 (95% CI: 1.10, 1.31; $p < 0.005$), suggesting a 20% increase in the odds of infection for each additional drainage day. Diagnosis, age, level of care, concomitant infection, co-morbidities or type of drain were not significant.

Conclusions. Practices to reduce sampling and manipulation of drains may reduce the rate of infection, but whilst antibiotic-coated catheters and prolonged antibiotic prophylaxis are increasingly advocated in this context, duration of drainage remains the biggest modifiable risk factor for infection.

WPMP1 – Paediatrics

WPMP1-1: Paediatric CNS tumours in the UK: early (30-day) and late (1-, 5-, 10-year) mortality

R. Mathew¹, R. O’Kane¹, Y. Al-Tamimi¹, R. Parslow² & P. Chumas¹

¹Leeds General Infirmary, Leeds, UK and

²Paediatric Epidemiology Group, Centre for Epidemiology and Biostatistics, Leeds Institute of Genetics, Health and Therapeutics (LIGHT), Leeds, UK

Objectives. To examine mortality for common paediatric central nervous system (CNS) tumours in the UK. To compare late mortality to the Surveillance Epidemiology and End Result (SEER) registry that covers 28% of US patients. To compare all results with the literature. No such study has previously been reported internationally.

Subjects. Patients with histologically confirmed, malignant (ICD-03 coding), first tumours, with any cause of death within 30 days ($n = 1283$), 1-, 5- or 10-years (UK = 1925, US = 2411) of diagnosis.

Methods. Data from the National Registry of Childhood Tumours (NRCT) were analysed between 2004 and 2007 (early mortality) and from NRCT and SEER between 1996 and 2005 (late mortality), the latter being compared by Kaplan–Meier and log-rank testing. Literature was reviewed between 1995 and 2011.

Results. Overall UK 30-day mortality (>3%) is higher than published (approximately 1%), with especially poor results for certain tumours (3–13%). Late UK mortality (combining pilocytic, anaplastic, glioblastoma multiforme (GBM), primitive neuroectodermal tumour (PNET), medulloblastoma and ependymoma) is significantly higher than in the US (hazard ratio 0.75, $p < 0.000$); and than in the literature. This trend continues for subtypes analysed individually, with no significant difference in diagnosis age.

Conclusions. Interrogating and comparing large, well-recognised and validated registries minimises bias and provides credible data evaluation. The reasons for the poorer outcomes in UK patients are likely to be multifactorial. Future studies need to look at morbidity, and investigate the causes for the differences in survival.

WPMP1-2: The use of computerised tomography versus cranial ultrasound scan in children under the age of one with ventriculoperitoneal shunt

T. T. Mandiwanza, C. Saidlear & D. Crimmins

Department of Paediatric Neurosurgery, Childrens University Hospital, Dublin, Ireland

Objectives. To evaluate the use of computed tomography (CT) brain scans, cranial ultrasound scans (CRUSS) and effective radiation dose in children aged 1 year with a ventriculoperitoneal (VP) shunt.

Design. Retrospective study.

Subjects. Patients aged 1 year or younger with a VP shunt inserted in our unit.

Methods. Data from January 2008 to December 2011 were collected from our operation database and the radiology information system. We excluded patients older than 1 year and scan information on patients after the age of 1. Demographic data and information on the number of CT brain scans and dose information, the number of post shunt CRUSS and the number of shunt revisions were gathered. The effective radiation dose of each scan and total radiation dose for each patient were calculated.

Results. One hundred and thirty-five patients met the inclusion criteria: 51% female, 49% male. Mean age at first shunt was 77.2 days. Average number of CTs per patient was 2 (range 0–14) and the majority of scans were during working hours. A significant association was found between the number of CTs and the number of shunt revisions. Mean post shunt CRUSS was 0.69 (range 0–7). Only one CRUSS was conducted out of hours. The average effective dose for each scan was 2.76 mSv (range 0.67–4.70 mSv) with the total dose per patient ranging from 2.16 to 15.7 mSv.

Conclusions. This cohort of patients had open fontanels and would have been suitable for CRUSS; however, the majority of our patients had CT scanning in preference to USS even during working hours when a radiologist would have been available to conduct a CRUSS. The female additional lifetime risk of cancer would be 0.01% (1 mSv), 0.13% (10 mSv), 0.28% (20 mSv) and in males 0.01% (1 mSv), 0.12% (10 mSv), 0.25% (20 mSv). Knowing this, CRUSS should be the investigation of choice in those with an open fontanel.

WPMP1-3: The effect of germinal matrix haemorrhage on postnatal oligo/neurogenesis

W. Dawes & S. Marino

The Royal London Hospital, London, UK

Objectives. The underlying pathophysiology of the neurological deficit seen following germinal matrix haemorrhage (GMH) is thought to be due to both destructive and developmental mechanisms. This project aims to determine the effect of haemorrhage on postnatal oligo/neurogenesis.

Design. Using a modified Narishige stereotactic frame, we have optimised and validated a mouse model of GMH.

Subjects. C57/Bl6 mouse pups. The three groups used were (i) injected with blood, (ii) needle insertion only and (iii) not injected. Five pups were used in each group.

Methods. Autologous blood, collected from the tail tip, was stereotactically injected into the subventricular zone (SVZ) of newborn pups. Five intraperitoneal injections of EdU on day 1. Perfusion fixation at day 4. Sections of 10µm were analysed with Nissl's and immunohistochemistry (IHC) and quantified with computer-based stereological techniques (CBST).

Results. Stereotactic blood injection causes: (1) disruption of the SVZ with intraventricular spread of blood; (2) minimal disruption to the surrounding cortex and no evidence of subdural extension; (3) reduced weight gain in blood-injected pups at day 4; (4) significant increase in the ventricular size of blood-injected pups measured using CBST; and (5) reduction in the number of EdU positive cells which migrate out of the rostral migratory stream into the cortex.

Conclusions. These preliminary data show that the experimental model we have established recapitulates some of the key features of GMH in the human neonate, namely, the failure of weight gain, the increased ventricular size and the impaired post-lesional cell production in the developing forebrain.

WPMP1-4: Lenticulostriate artery aneurysms in the paediatric population: a treatment conundrum

C. Derham, J. R. Goodden, P. Chumas, T. Goddard & A. Tyagi

Leeds General Infirmary, Leeds, UK

Objectives. Lenticulostriate artery aneurysms are rare with only four reported cases in the literature occurring in the paediatric setting. Paediatric aneurysmal haemorrhage represents a rare disease entity and poses significant challenges on the neuroscience teams involved in managing such patients. We report two unique cases of lenticulostriate artery aneurysm rupture causing intracerebral and intraventricular haemorrhage.

Design. The authors conducted a retrospective review of the cases involved, including a literature survey using PubMed.

Subjects. We present two rare cases of lenticulostriate artery aneurysms in the paediatric population.

Methods. Radiographic work-up included computed tomography (CT), CT angiography and digital subtraction angiography.

Results. Both cases presented acutely to the neurosurgical department following loss of consciousness secondary to intracerebral haemorrhage with intraventricular extension associated with hydrocephalus. The patients were less than 10 years of age and had no risk factors for aneurysm development. External ventricular drains were inserted immediately on admission secondary to obstructive hydrocephalus. CT and digital subtraction angiography confirmed the presence

of lenticulostriate artery aneurysms, one in each case. Both had ruptured, causing the haemorrhage. In the first case, the aneurysm spontaneously obliterated after 3 months. Follow-up angiography for the second case confirmed stable appearances of the aneurysm at 1 month, following a period of conservative treatment. However, the patient re-presented with new onset seizure activity. A CT of the brain confirmed no new haemorrhage, but the lenticulostriate artery aneurysm had increased from 1 to 3 mm on CT angiography. Both patients were discharged home and made a complete functional recovery following a course of conservative treatment and close follow-up monitoring.

Conclusions. These cases illustrate the unique appearance of these anterior circulation aneurysms, stressing the importance of recognising their unusual anatomical location. We have treated both cases conservatively, based on the significant risk of neurological impairment should the feeding vessels have been sacrificed. Follow-up of both patients has resulted in no new motor deficit or re-bleed. Lenticulostriate artery aneurysms present a significant challenge to the paediatric neurovascular surgeon and mandate a multidisciplinary approach in their management.

WPMP1-5: Repair of a large thoracolumbar myelomeningocele with associated lumbar kyphosis

J. C. Duddy & J. Caird

Children's University Hospital, Dublin, Ireland

Objectives. To describe a method of repair for a large thoracolumbar myelomeningocele (MMC) with an associated lumbar kyphosis.

Design. Case report.

Subjects. A caucasian male child, born at term with an antenatal diagnosis of hydrocephalus and spina bifida.

Methods. Review of the medical and operative notes.

Results. A 9 × 7 cm almond-shaped thoracolumbar MMC, leaking cerebrospinal fluid (CSF), was present. On day 3 of life, he was brought to the operating theatre for planned closure of the MMC and correction of lumbar kyphosis. Intra-operatively, there was a large defect from T7 to L3 with a marked gibbus deformity. The cord and sac were dissected free of the posterior longitudinal ligament. A high-speed drill with 8 mm cutting burr was used to remove the vertebral bodies; a periosteal elevator was placed anterior to the gibbus deformity during kyphectomy to protect the anterior structures. A cervical plate was then screwed into the posterior aspect of the vertebral bodies above and below to reduce the gibbus deformity and maintain a rigid construct. An external ventricular drain was then inserted. Due to blood loss, MMC closure was deferred and the patient was transferred to the intensive care unit post-operatively. He returned to the operating theatre on the fifth day of life for MMC closure. Local rotation flaps were elevated and advanced to cover the defect. Closure was with 4-0 Vicryl and 4-0 Nylon.

Conclusions. Repair of large, complex myelomeningoceles remains a challenge and often requires novel surgical approaches.

WPMP1-6: Does patient ethnicity affect site of craniosynostosis?

I. A. Anderson¹, D. T. Bonthron², M. Bellew³, M. I. Liddington¹, J. L. Russell¹ & P. D. Chumas¹

¹*Leeds General Infirmary, Leeds, UK,* ²*Leeds Institute of Molecular Medicine, Leeds, UK, and* ³*St James' University Hospital, Leeds, UK*

Objectives. Craniosynostosis is categorised by: (1) a description of the affected suture, i.e. coronal, lambdoid, metopic, sagittal or complex (multiple sutures); and (2) whether the condition is familial + /- syndromic. While clinical manifestations of primary craniosynostosis potentially include raised intracranial pressure (ICP), many cases are essentially a cosmetic issue. Evidence suggests that craniosynostosis is more common in children born to white, non-Hispanic mothers, and there are no published studies assessing whether the distribution of sutures affected varies with differing patient ethnicity.

Design. Single-centre, retrospective analysis of a prospectively populated database of all patients reviewed in a regional craniofacial clinic over a 4-year time period.

Subjects. Two hundred and seventy-six craniosynostosis patients.

Methods. Patients were identified using admin database of clinic appointments and ethnicity. Lists were cross-checked with electronic databases of clinic letters and operation notes as well as a departmental database.

Results. One hundred and sixteen patients (42%) had sagittal synostosis, 81 (29%) metopic, 58 (21%) coronal, 20 (7%) complex and 1 lambdoid. The most frequently documented ethnicities were: British – 179 (65%) and Asian – 47 (17%). A chi-squared test comparing the site of synostosis for both British and Asian populations showed a significant difference between the two groups; $\chi^2 = 11.8$, $p < 0.05$.

Conclusions. Cases of complex and coronal synostosis are more common in Asian patients than British. The reverse is true for sagittal synostosis. Metopic synostosis rates are similar.

TAM1 – Spine 1

TAM1-1: Cervical skip laminectomy: a cohort analysis

Y. Z. Al-Tamimi¹, P. Sinha¹, O. A. Oladokun², N. Ojukwu² & T. A. Al-Musawi³

¹*Leeds Teaching Hospital NHS Trust, Leeds, UK,*

²*University of Leeds, Leeds, UK, and*

³*University of Bradford, Bradford, UK*

Objectives. Cervical laminectomy in the setting of cervical spondylotic myelopathy is often considered in patients with

multilevel degenerative disease, non-contiguous stenosis and with posterior pathology. This cohort of patients is often elderly with significant co-morbidities. We aim to describe our experience with a modified laminectomy involving minimal disruption to the paraspinal muscle and maximal decompression.

Design. Retrospective cohort study.

Subjects. Seventy-seven patients.

Methods. Patients who have undergone a cervical skip laminectomy over a 10-year period were identified and case notes were utilised to obtain clinical data.

Results. Median age 71 years (interquartile range 62–80 years). Twenty-nine cases were operations on 3 or more levels and 11 cases were on non-contiguous levels. The overall complication rate was 10.4%: infection (5.2%), transient neurological deficit (1.3%), transient neck pain (2.6%) and dural tear (1.3%). Mean length of hospital stay was 5.2 days (95% CI 4.1–6.4 days). Eighty-one percent of patients had a good outcome (Modified Rankin Score 0–2) at post-operative review. Seventy-three percent had improved or remained stable at post-operative review.

Conclusions. Cervical skip laminectomy has been shown to be an effective approach for multilevel and non-contiguous level cervical spondylotic myelopathy. Outcome is similar to that described for myelopathy following anterior surgery and complication rates are acceptable for this cohort of high-risk patients.

TAM1-2: Metastatic spinal cord compression referrals and their management at a UK tertiary centre

A. W. Glover, L. Holliday & M. J. Wilby

The Walton Centre for Neurology and Neurosurgery, Liverpool, UK

Objectives. NICE guidance from 2008 has prompted local cancer networks to develop regional referral pathways for patients presenting with suspected metastatic spinal cord compression (MSCC). We present the first 18 months of patient data following the introduction of a regional MSCC pathway developed by the Cheshire and Merseyside Cancer Network for MSCC cases referred to the Walton Centre in Liverpool.

Design. A prospective cohort analysis.

Methods. Cohort: All patients referred to the Walton Centre with a radiological diagnosis of MSCC between October 2010 and April 2012.

Outcome. Neurological grade, mobility, continence and adverse events.

Results. There were 261 referrals. Sixty-one patients were admitted to the Walton Centre (23.4%). Fifty patients subsequently underwent decompressive surgery \pm surgical fixation (19.2%). Eleven were managed non-operatively with biopsy/halo/palliation (4.2%). Average age was 63 (range 19–89), with thoracic level most common ($n = 35$, 57.4%). Many patients were initially Frankel grade E ($n = 27$, 44.3%) and the median Tokumashi grade was 10

(range 3–14). The most common histological diagnoses were renal ($n = 12$, 19.7%), lung ($n = 9$, 14.8%) and plasmacytoma ($n = 8$, 13.1%). With regard to surgery, 17 patients (34.0%) were stabilised by means of percutaneous pedicle screws and a minimal midline decompression. This was mainly for older patients or patients who had already received prior radiotherapy (RT). Post-operatively, 46 patients showed an improvement in their pain (92.0%) with a 16.4% improvement in ambulatory status. Incontinence increased post-operatively from 9 (14.8%) to 11 (19.0%). There were three deaths (6.3%).

Conclusions. MSCC patients are complex but require rapid decision making. Previously, initial RT precluded patients from surgery; however, the use of minimally invasive techniques greatly reduces risk in these patients.

TAM1-3: Does surgical decompression of the lumbar spine improve low back pain in symptomatic patients?

V. Sekar, S. Selvanathan, D. Pal & S. Thomson

Leeds General Infirmary, Leeds, UK

Objectives. Surgical decompression of the lumbar spine is commonly performed to relieve symptoms of sciatica. Little is known whether this affords improvement in low back pain (LBP) as well.¹

Design. This prospective study followed consecutive patients undergoing lumbar decompressions under a single surgeon at a large tertiary neurosurgical centre.

Subjects. Between September 2009 and September 2011, 270 patients underwent lumbar decompressions. Complete data sets were available in 101 patients (50 men and 51 women). Patients with spondylolisthesis, infections, tumours and those with 're-do' procedures and incomplete data were excluded.

Methods. Surgical procedures included microdiscectomy (48), laminectomy (22), foraminotomy (6) or a combination thereof (35). Patients quantified LBP on a visual analogue scale (VAS) of 0–10 (0–no pain and 10–worst) pre-operatively and at 6 weeks post-operatively.

Results. A significant reduction in self-reported LBP VAS scores from a mean (SD) pre-operatively of 6.72 (2.8) to 3.93 (2.9) post-operatively ($p = 0.002$, paired t -test) was noted. A foraminotomy when done in combination, improved LBP VAS scores (6.15 pre-op to 3.40 post-op): isolated foraminotomies did not improve pain (LBP VAS 6.41 and 6.12 pre-op and post-op, respectively).

Conclusions. Surgical decompression can significantly improve LBP in patients. Isolated foraminotomies whilst improving leg pain, may not improve LBP.

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TAM1-4: Does the technique matter? Comparison of three techniques for lumbar microdiscectomy and incidence of post-operative spondylodiscitis – a retrospective analysis of 3063 patients

C. Kaliaperumal, E. Ogbodo, M. O'Sullivan,
G. Kaar & C. Marks

*Department of Neurological Surgery, Cork University
Hospital, Cork, Ireland*

Objectives. To determine if surgical technique has any influence on the incidence of spondylodiscitis in patients undergoing lumbar microdiscectomy and to compare this to the published rate of spondylodiscitis in the literature.

Design. Retrospective audit over a period of 7 years operated by three groups of surgeons following three different surgical techniques.

Subjects. From 2005 to 2011, 3063 patients were analysed for spondylodiscitis post-operatively.

Methods. The first group used a standard microdiscectomy technique, the second group used antiseptic (Savlon) irrigation at the end of the procedure to irrigate the disc space and the third group used a separate disc apparatus when a discectomy was performed. The number of patients operated in the individual groups was 559, 1122 and 1382.

Results. The total number of patients who had post-operative spondylodiscitis was 3/3063 (0.10%) with an incidence range of 0.07–0.18%. There was one case in each group. The incidence of spondylodiscitis in Groups A, B and C were 0.1, 0.09 and 0.07%, respectively.

Conclusions. This study concludes that the standard microsurgical technique using antiseptic irrigation for the disc space and using a separate disc apparatus has lesser incidence of spondylodiscitis in comparison to a standard microdiscectomy. The overall incidence of spondylodiscitis in our series remains less than the published results. So far, to our knowledge, this is the first study involving the largest number of patients studied to determine the incidence of spondylodiscitis in patients undergoing lumbar microdiscectomy.

TAM1-5: Craniocervical decompression with simple durotomy is an effective method of treating syrinx associated with Chiari malformation

M. Tonkins¹, N. Farooqi², A. Saxena²,
S. Sinha², T. Carroll² & D. Bhattacharyya²

¹*The Medical School, University of Sheffield, Sheffield, UK and*
²*Department of Neurosurgery, Royal Hallamshire Hospital, Sheffield, UK*

Objectives. This study compares the rate of syrinx decompression in Chiari patients treated with craniocervical decompression (CCD), simple durotomy and dural hitching, to patients in whom the dura was closed by formal augmentation.

Design. Retrospective analysis of data collected from case notes. Patients who had undergone CCD were grouped by method of dural closure. Rates of syrinx decompression were compared between these groups.

Subjects. We identified 41 adult patients, 18 female and 23 male, with a mean age of 36 years (range 17–64) from our database. All were treated for symptomatic Chiari malformation and associated syrinx with CCD and either dural hitching ($n = 21$) or dural augmentation ($n = 20$).

Methods. Syrinx decompression was assessed by magnetic resonance imaging at 1-year follow-up. Statistical analysis of the data (Spearman's rho, Pearson's chi-squared and backwards logistic regression) was conducted using SPSS v19.

Results. There is a statistically significant association between the method of decompression and radiological syrinx resolution. Syrinx resolution occurred in 85.7% ($n = 18$) of the hitching group compared to 25.0% ($n = 5$) of the augmentation group: $\chi^2(1) = 12.97$, $p < 0.001$. Backwards logistic regression, accounting for age, gender, type of syrinx and symptom duration, derived an odds ratio (ExpB) of 27.0 (95% CI 4.57–159.66), $p < 0.001$.

Conclusions. In patients with symptomatic Chiari malformation and associated syringomyelia, syrinx resolution is significantly more likely if the dura is hitched open rather than closed by dural augmentation.

TAM1-6: Vertebroctomy via XLIF approach – Leeds experience

P. Sinha, Y. Al Tamimi, D. Pal & J. Timothy

Leeds Teaching Hospitals NHS Trust, Leeds, UK

Objectives. Traditionally, vertebral body pathology is approached via anterior approach. However, this can lead to damage to vital structures, extensive blood loss and prolonged hospital stay. The aim of our study was to assess the safety of performing a vertebroctomy via the minimally invasive extreme lateral interbody fusion (XLIF) approach.

Methods. Retrospective case note review of all patients undergoing a vertebroctomy via the XLIF approach. The patient demographics, indication, complications, hospital stay and blood loss were assessed.

Results. Between September 2010 and December 2011, nine patients underwent a vertebroctomy via the XLIF approach with a total of ten levels treated. Six (66.66%) were male. The mean age was 60.5 years (range 52–69). The levels treated were L3 (4), T6 (1), T7 (1), T10 (1), T11 (1), L1 (1) and L2 (1). In eight patients, the procedure was augmented with posterior fixation, of which two had a staged procedure. The mean hospital stay was 8.7 days (range 3–19). The pathology treated included metastatic collapse 6 (66.66%), infection 2 (22.2%) and osteoporotic collapse 1 (11.33%). Mean blood loss was 500 ml. One patient developed a superficial wound infection that was treated with oral antibiotics while another had a mal-positioned cage requiring revision.

Conclusions. Our initial experience with XLIF has been positive and shows that a wide range of vertebral body pathology can be successfully treated with this approach.

TAM1-7: Validation of the novel pedicle screw scoring system – the HEY score

T. D. Sanusi, O. Yaseen & G. Spink

Department of Neurosurgery, Hull Royal Infirmary, Hull and East Yorkshire NHS Trusts, Hull, UK

Objectives. Quality assessment of pedicle screws insertion is poorly documented.¹ This paper validates a novel pedicle screw scoring system. It allows measurement of screw accuracy, which will assist skills development and competency assessment. We proposed that the lower the HEY score, the less likely that the screw would need revision or be associated with an operative complication.

Methods. Retrospective study of 110 patients who had 410 pedicle screws inserted to C7–S1 over a 2-year period. Pathologies included degenerative disease, trauma and tumour.

Results. Seventy-two screws were inserted percutaneously. Three hundred and thirty-eight screws were inserted via open technique. In general, 73.6% had an angle score of 1 or 2, 93.7% achieved a width score of 1 or 2, while 87.1% obtained a length score of 1 or 2. The overall average HEY score (AWL) was 4.29. The average HEY score across the pathologies was 4.74 (degenerative), 4.28 (trauma), 3.74 (tumour) and breach rate 0.39, 0.26 and 0.28, respectively. In the trauma series, open versus percutaneous were 4.59 and 3.99 with respective breaching rates of 0.26 and 0.23 and this corroborated the previous findings of a higher complication open technique.

Conclusions. Most screws that breached or were associated with a complication had a HEY score of >5 in both techniques. We recommend the HEY score for training and competence assessment.

Reference

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TAM1-8: C2 Translaminar screw fixation. A useful alternative

J. M. Hempenstall & E. Shenouda

Wessex Neurological Centre, Southampton, UK

Objectives. We describe our experience with this relatively new technique. This technique confers several safety benefits in comparison to alternate C2 fixation techniques. We present our data and review the clinical and biomechanical studies available in the literature on this subject.

Design. Retrospective analysis of case notes of a single surgeon series. Medline search and analysis of the available literature describing the use of C2 translaminar screws.

Subjects. In our series, 8 patients had a total of 15 C2 translaminar screws placed. They were used within a

number of different constructs; two occipital-cervical fixations, five C1/C2 fixations and one C2–C4 fixation.

Methods. Outcomes assessed; reason for use, incidence of neurological or vertebral artery injury. Screw sizes, construct failure and clinical follow-up.

Results. Reasons for use included high-riding vertebral artery, C2 pedicle fracture and unfavourable C2 pedicle diameter. No construct failures, mean follow-up of 14 months. The screw diameter placed was 3.5mm and the mean screw length was 24.6mm. There were no cases of vascular or neurological injury. Literature search reveals 169 cases of C2 translaminar screws use, a combined fusion rate of 95.3%, 8 cases of pseudoarthroses or instrumentation failure and no reported cases of vertebral artery injury.

Conclusions. When choosing a method for C2 fixation, the anatomical practicality, technical ease, risk of damage to neurovascular structures and biomechanical characteristics must be carefully considered and balanced.

TAM2 – Neurovascular

TAM2-1: Microsurgical excision of Spetzler–Martin grades I and II: clinical and angiographic outcomes

R. Al-Mahfoudh¹, H. Nahser¹ & M. Javadpour²

¹The Walton Centre for Neurology and Neurosurgery, Liverpool, UK and ²Beaumont Hospital, Dublin, Ireland

Objectives. To assess the outcome of microsurgical excision of grades I and II arteriovenous malformations (AVMs). We also compared patients who had surgical excision of embolised AVMs to those who had surgery as the primary treatment.

Design. Analysis of prospectively collected data on patients undergoing surgical excision of brain AVMs operated on by a single surgeon.

Results. Fifty-one patients (age range 4–64 years) with Spetzler–Martin I and II AVMs underwent surgical excision between January 2005 and January 2012 by this surgeon. Haemorrhage was the mode of presentation in 70%. Eleven patients had surgery following one or more stages of embolisation. There were no post-operative deaths. New neurological deficits occurred in two (4%) patients (one patient with cerebellar AVM developed ataxia and prolonged nausea; one child with motor cortex AVM developed upper limb monoparesis). In all patients, complete excision of the AVM was confirmed on post-operative catheter angiography. No post-operative haemorrhage has occurred during the follow-up period.

Conclusions. Microsurgical excision of grades I and II AVMs can be performed with low complication rates and high cure rates in selected patients. These outcomes support surgical excision as the primary treatment modality for accessible grades I and II AVMs. We also share our technical experience on microsurgical excision of partially embolised AVMs.

TAM 2-2: The Glasgow Coma Scale alone performs as well as prognostic scoring systems for predicting 30-day mortality in a large cohort of patients with acute intracerebral haemorrhage

K. A. Abid, A. R. Parry-Jones, A. Vail, H. C. Patel, P. J. Tyrrell & A. T. King

Salford Royal Hospital, Salford, UK

Objectives. A number of prognostic scores predicting survival after intracerebral haemorrhage (ICH) have been described. We aimed to test how well three scores predicted survival in a large cohort of patients.

Design. Prospective clinical data collection; retrospective imaging and survival analysis.

Subjects. A total of 1364 consecutive ICH cases referred between 1 January 2008 and 17 October 2010.

Methods. Clinical details were prospectively recorded and the first computed tomography (CT) brain scan after presentation was retrospectively reviewed and analysed. The ICH score, the ICH grading scale (ICH-GS) and the MICH score were calculated. Receiver operating characteristic (ROC) curves for 30-day mortality were generated.

Results. A total of 1181 patients were included in the final analysis. Mortality was 41.3% at 30 days and 52.4% at 1 year. The area under the ROC curve (AUC) was similar for the ICH score (0.863; 95% CI 0.841–0.885), ICH-GS (0.872; 95% CI 0.851–0.893) and the MICH score (0.859; 95% CI 0.837–0.881). The Glasgow Coma Scale (GCS) alone performs as well as the scores (Figure: AUC 0.871; 95% CI 0.849–0.892). ICH volume was less predictive (AUC 0.776; 95% CI 0.749–0.803), and age very much less predictive (AUC 0.570; 95% CI 0.537–0.603), than GCS or the scores.

Conclusions. Though existing prognostic scores are highly predictive of 30-day mortality, GCS alone was as good in our cohort and may provide a reasonable and quick method for prognosticating at the time of diagnosis. The negligible influence of age on 30-day mortality suggests this variable should be given minimal weight when prognosticating.

TAM 2-3: Clinical and biochemical predictors of outcome following aneurysmal subarachnoid haemorrhage

Y. Z. Al-Tamimi

Leeds General Infirmary, Leeds, UK

Objectives. Clinical predictors of outcome following aneurysmal subarachnoid haemorrhage (aSAH) are well described. Biochemical markers are less clearly understood. We hypothesise that early peripheral blood parameters have a predictive power of subsequent development of delayed ischaemic neurological deficit (DIND) and long-term outcome.

Design. Prospective cohort study.

Subjects. One hundred and ninety-nine patients, M:F = 41:158, median age 55 years (interquartile range 45–63). DIND and poor outcome occurred in 30 and 19% of patients, respectively.

Methods. Patients with aSAH World Federation of Neurological Surgeons (WFNS) grade 1–3, full blood count (FBC), white cell count (WCC), platelets, C-reactive protein (CRP), sodium, activated partial thromboplastin time (aPTT) and albumin taken on admission and days 5 and 7 post-ictus were recorded. Binary logistic regression analysis utilised DIND and poor outcome at 6 months (Modified Rankin Score [MRS] 3–6) as the outcome variables. Known predictors were initially placed into the model (age, sex, WFNS grade and Fisher grade). Univariate analysis of the blood parameters at each time-point was used to highlight potential biochemical predictors. These highlighted parameters were placed into a two-stage multivariate analysis with clinical parameters.

Results. With DIND as the outcome variable, only Fisher grade was predictive (odds ratio [OR] 2.34, $p = 0.031$). As part of the multivariate analysis, a higher albumin on admission and lower haemoglobin on day 5 were independent predictors of DIND (OR 1.16, $p = 0.031$ and 0.55, $p = 0.009$, respectively). With poor outcome as the outcome variable, only the WFNS and Fisher grades were predictive, although this was lost when DIND was added to the model (OR 0.157, $p < 0.0001$). Day CRP was an independent predictor of poor outcome (OR 1.03, $p = 0.001$).

Conclusions. A robust regression model has demonstrated possible predictive qualities of albumin and haemoglobin for insipient DIND and CRP for poor outcome. The implications of this study will be discussed.

TAM 2-4: Is it unsafe to have a subarachnoid haemorrhage during weekends?: a retrospective study carried out within two neurosurgical units

F. Olubajo¹, P. Sayal², V. Bagga¹, A. Lawson², T. Carroll¹, P. Maliakal², T. Hodgson¹, S. Coley¹ & U. Patel¹

¹Department of Neurosurgery - Royal Hallamshire Hospital, Sheffield, UK and ²Department of Neurosurgery - Hull Royal Infirmary, Hull, UK

Objectives. Since the Illinois Standards Achievement Test (ISAT), coiling of aneurysmal subarachnoid haemorrhage (ASAH) has become the preferred option. Society of British Neurological Surgeons (SBNS) guidelines advocate treatment within 48h of admission. However, in a proportion of UK centres, the coiling service during weekends is limited.

Design. A retrospective analysis of ASAH patients over a 2-year period in two neurosurgical centres was conducted.

Subjects. Fifty-one patients were admitted over weekends and 70 over weekdays in centre A compared to 66 and 97, respectively, in centre B.

Methods. Data collated were used to compare weekend and weekday admissions and highlight timing of treatment, re-bleeds and outcomes.

Results. During the weekends in centre A, 39.5% were treated within 24h but 22.5% were treated more than 48h after admission. During weekdays, this was 60 and 10%,

respectively. In centre B, during the weekends, 12% were treated within 24 h with 57% treated after 48 h of admission, in contrast to weekday figures of 23 and 32%, respectively. Re-bleed rates in centre A were 6.2% on weekends and 0% on weekdays. In centre B, these were 4.9 and 2.1%, respectively. The data have been analysed to reflect time lags according to grade of ASAH and outcomes.

Conclusions. We have identified delays in the treatment of ASAH patients admitted over weekends with potential implications on outcomes. On the basis of this data and the volume of good grade ASAH patients admitted in two centres, we advocate a requirement for an inter-regional coiling service over weekends, but also highlight the potential pitfalls of implementing such a service.

TAM2-5: Surgical disconnection of cranial dural arteriovenous fistulas

R. Al-Mahfoudh¹ H. Nahser¹ & M. Javadpour²

¹The Walton Centre for Neurology and Neurosurgery, Liverpool, UK and ²Beaumont Hospital, Dublin, Ireland

Objectives. To assess the clinical outcome, complications and angiographic outcomes following surgical disconnection of dural arteriovenous fistulas (DAVFs).

Design. Analysis of prospectively collected data including clinical presentation, pre-operative angiographic findings, post-operative complications, clinical and angiographic outcomes.

Results. Between January 2005 and January 2012, 17 patients underwent surgery for DAVFs. The anatomical locations included tentorial (7), ethmoidal (7), foramen magnum (1), middle fossa (1) and torcular (1). All had cortical venous reflux (CVR) and all were treated with craniotomy and disconnection of CVR. Two patients required repeat surgery for residual CVR. One patient had a post-operative seizure. There were no other complications. All patients had complete disconnection of CVR confirmed by digital subtraction angiography. None of the patients have had haemorrhage or recurrence of CVR on follow-up.

Conclusions. Surgical disconnection of CVR in cranial DAVFs can be performed with very low complication rates. Where embolisation cannot be performed safely, surgical disconnection is the treatment of choice for DAVFs with CVR.

TAM2-6: STICH II: plans for the close down of the trial

B. A. Gregson, E. N. Rowan & A. D. Mendelow

Neurosurgical Trials Unit, Newcastle University, Newcastle upon Tyne, UK

Objectives. To establish whether a policy of early surgery for lobar intracerebral haemorrhage gives a better outcome compared with a policy of initial conservative treatment.

Design. International, multicentre, randomised parallel group trial with primary outcome measured at 6 months.

Subjects. Six hundred patients with superficial lobar intracerebral haemorrhage (within 1 cm of the cortex surface) and no intraventricular haemorrhage, who were within 48 h of ictus. Size of the haematoma was between 10 and 100 ml and the patients motor Glasgow Coma Scale (GCS) was 5 or 6.

Methods. Patients were randomised via an independent telephone/web-based randomisation service to early surgery within 12 h of initial conservative treatment. Extended Glasgow Outcome Scale, Rankin and EuroQoL were measured at 6 months via a postal questionnaire.

Results. Patient recruitment began in autumn 2006 and the final patient will have been recruited in the summer of 2012. This paper will present details of the baseline characteristics of the patients in the trial and outline the timetable and plans for publication of the results.

Conclusions. The results of the STICH II trial are eagerly awaited by those planning the next round of guidelines for the management of patients with intracerebral haemorrhage. These are due for publication at conferences in spring 2013. For further information see <http://research.ncl.ac.uk/stich>.

TAM2-7: CT angiography sensitivity and need for catheter angiography

K. T. Tsang, E. Broughton & L. H. Pobereskin

Derriford Hospital, Plymouth, UK

Objectives. The risks of a cranial digital subtraction angiography (DSA) are well documented, including that of stroke and prolonged hospital stay.¹ However, it is still performed regularly in cases of suspected vascular abnormality even when computed tomography angiography (CTA) is negative. This study aims to look at the possibility of using CTA alone to exclude vascular abnormalities.

Design. Retrospective review of all CTA and DSA in the past year to estimate the negative predictive value of CTA.

Subjects. All patients who have undergone either CTA, DSA or both between June 2011 and May 2012 for suspected intracranial vascular abnormality.

Methods. The CTA and DSA results between the above dates were reviewed and compared. The negative predictive value and false negative rate of CTA were calculated.

Results. One hundred and seventy-eight CTA were identified with 40.5% showing no vascular abnormalities. Only one subsequently had a positive DSA. Retrospective review of this CTA identified the aneurysm, missed by the reporter. Therefore, the negative predictive value of CTA is 100% when appropriately reported. Of the positive CTA, 3.8% had additional aneurysms found on DSA. These were all <3 mm and none were deemed relevant to the haemorrhage.

Conclusions. In our series, CTA had no false negatives. Given the risks of DSA, a negative CTA alone may be accepted

provided it is of a good enough quality and reported by an appropriate expert in the field.

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TAM2-8: Angio-negative subarachnoid haemorrhage, outcomes and the role of repeat angiography

A. A. Khan, J. D. Shand Smith, K. Wong, F. Robertson, L. D. Watkins, N. Kitchen & J. Grieve

National Hospital for Neurology and Neurosurgery, London, UK

Objectives. The study looks at the clinical course of patients with confirmed subarachnoid haemorrhage (SAH) on computerised tomography (CT) or lumbar puncture (LP), but negative digital subtraction angiography (DSA).

Design. Retrospective analysis of imaging, outcome and complication data from 2008 to 2012 at a single centre.

Subjects. Fifty patients meeting the inclusion criteria were admitted. Ages ranged from 25 to 84 years. Thirty were male.

Methods. Our inclusion criteria were patients admitted with SAH (CT or LP positive) but with negative initial DSA. Scans were reviewed separately by two qualified radiologists. Outcomes were assessed by Glasgow Outcome Score (GOS) at 6 months.

Results. Subdivided into perimesencephalic, non-perimesencephalic and LP positive/CT negative groups. *Perimesencephalic.* Seventeen patients. Median length of stay was 5 days (3–29). One complicated with hydrocephalus requiring external ventricular drain (EVD). Six months GOS were Grade 5 for all patients. Four had repeat DSA. The reasons for repeating the DSAs was suspicion of aneurysm on the initial DSA but no abnormality was identified. Ten underwent magnetic resonance imaging (MRI) of which one was found to have an infundibulum, one showed a possible small developmental venous anomaly (DVA) and one patient was found to have a spinal arteriovenous malformation (AVM). *Non-perimesencephalic.* Twenty-three patients. Median length of stay was 10 days (2–60). Five were complicated with hydrocephalus requiring EVD and two by vasospasm. Six months GOS were: Grade 3:3, Grade 4:4 and Grade 5:16. Six had repeat DSA, none of which had new findings. The reasons for repeating the DSA were vasospasm on initial DSA, large SAH or the possibility of an aneurysm. Nineteen underwent MRI of which one showed a cavernoma.

LP positive/CT negative. Ten patients. Median length of stay was 5 days (3–12). Six months GOS were all Grade 5. None had repeat DSA. Eight underwent MRI of which one showed an infundibulum.

Conclusions. While repeat DSA is often recommended in angio-negative SAH, in those patients of our series it proved to be of limited usefulness. Presentation scores and

GOS were generally good across this group as previously shown.

TAM2-9: The utility of digital subtraction angiography for long-term follow-up of coiled aneurysms

R. Jones¹, A. Helmy¹, D. Barone¹, M. R. Guilfoyle¹, J. N. P. Higgins², R. W. Kirollos¹ & P. J. Kirkpatrick¹

¹Department of Neurosurgery, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK and ²Department of Radiology, Addenbrooke's Hospital, Cambridge, UK

Objectives. Endovascular coiling of ruptured intracranial aneurysms is becoming the intervention of choice for preventing re-bleeding in most patients.¹ The length and frequency of follow-up vascular imaging post-coiling is contentious and recent evidence suggests that long-term follow-up with MR angiography has a low pick-up rate for progression or *de novo* aneurysm formation.² This study aims to determine the utility of the gold standard of digital subtraction angiography (DSA) in this context.

Methods. All patients with coiled intracranial aneurysms in the period 2005–2008 were retrospectively reviewed: a total of 221 patients. Follow-up DSA at 6, 18 and 60 months were reviewed in order to identify recurrences and re-intervention.

Results. Ninety percent of patients had 6-month follow-up, 83% had 18-month follow-up and 71% had 60-month follow-up. Of late recurrences requiring re-intervention, eight were identified at 18-month follow-up and five at 60-month follow-up. Overall, 19 aneurysms were clipped after coiling. No patients had peri-procedure neurological complications in this cohort.

Conclusions. DSA remains a useful investigation for post-coiling follow-up and identifies late recurrences requiring intervention.

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TPM1 – Head Injury

TPM1-1: RESCUEicp study – a randomised controlled trial of decompressive craniectomy for refractory post-traumatic intracranial hypertension: a progress report

P. J. Hutchinson, A. G. Koliass, I. Timofeev, E. A. Corteen, L. M. Li, S. C. Ingham, M. Czosnyka, J. D. Pickard & D. K. Menon; P. J. Kirkpatrick on behalf of the RESCUEicp investigators

Division of Neurosurgery, Addenbrooke's Hospital, Cambridge, UK and University of Cambridge, Cambridge, UK

Objectives. The DECRA study showed a lack of beneficial effect from early/neuroprotective decompressive craniectomy for diffuse traumatic brain injury (TBI). Contrary to DECRA, the RESCUEicp study attempts to answer whether decompressive craniectomy (DC) is effective as a last-tier therapy for refractory raised intracranial pressure (ICP) following TBI.

Design. Prospective randomised two-arm trial.

Subjects. Head-injured patients aged 10–65 years are eligible for randomisation if their ICP is refractory to medical management (excluding barbiturates) and raised >25 mmHg for at least 1 h. Standard criteria that exclude patients with unsurvivable/devastating injuries apply.

Methods. Patients are randomised to DC or continuation of medical therapy (with the allowance of barbiturate infusion). Primary endpoint is the extended Glasgow Outcome Scale at 6 months.

Results. Analysis of the characteristics of the first 323 participants shows that the mean age of group A is 31.7 years and that of group B is 35.8. Similar proportions of patients in both groups have a pre-intubation Glasgow Coma Score (GCS) \leq 8 (group A: 70.2% and group B: 69.3%) and pupillary abnormalities (group A: 20.1% and group B: 19.6%). Diffuse injury (Marshall grades 2–4) was present in 79.2% of patients in group A and 73.7% of patients in group B. Less than 60 patients are now needed to reach the recruitment target of 400.

Conclusions. DC following TBI remains an unproven therapy. It is important that RESCUEicp meets its recruitment target in order to obtain a statistically secure answer.

Acknowledgement. The trial is funded by the MRC/NIHR (EME).

TPM1-2: STITCH (Trauma): plans for the future

E. N. Rowan, R. Francis, B. A. Gregson,
P. Mitchell & A. D. Mendelow

*Neurosurgical Trials Unit, Newcastle University,
Newcastle upon Tyne, UK*

Objectives. To establish whether a policy of early surgery for traumatic intracerebral haemorrhage improves outcome compared with a policy of initial conservative treatment.

Design. International, multicentre, pragmatic, randomised parallel group trial with primary outcome measured at 6 months.

Subjects. This study planned to recruit 840 adult patients with traumatic intracerebral haemorrhage. Patients should have no more than two haematomas greater than 10 ml and be within 48 h of head injury.

Methods. Patients are randomised via an independent telephone/web-based randomisation service to early surgery within 12 h of initial conservative treatment. Extended Glasgow Outcome Scale, Rankin and EuroQoL are measured at 6 and 12 months via a postal questionnaire.

Results. Patient recruitment began in 2010, but recruitment was slower than expected especially in the UK. The HTA therefore decided not to continue funding the trial and recruitment under HTA funding will cease on 30 September

2012. This paper will present details of the baseline characteristics of the patients in the trial so far and outline the timetable and plans for obtaining further funding and publication of the results.

Conclusions. Multicentre trials can be difficult to undertake especially in rare diseases and when management of the condition is in a state of change. It may only be possible to undertake this study in low- and middle-income countries where the disease is more common.

TPM1-3: Incidence of coagulopathy and its effect on outcome of patients with moderate to severe head injury

U. P. Devkota & A. Shrestha

*National Institute of Neurological and Allied Sciences,
Kathmandu, Nepal*

Objectives. To analyse the effect of coagulopathy on the outcome of patients with moderate to severe head injury.

Design. Prospective, single-centre study from July 2009 to June 2011.

Subjects. All patients with moderate to severe head injuries.

Methods. Platelet count (PC), bleeding time (BT), clotting time (CT), prothrombin time (PT, INR), activated partial thromboplastin time (aPTT) and fibrin degradation product (FDP) were measured at admission and every 12 h for the first 7 days. Patients with coagulopathy were evaluated for disseminated intravascular coagulation (DIC) with D-dimer every 24 h. The Glasgow Outcome Score at 6 months was evaluated in relation to coagulation parameters.

Results. A total of 118 consecutive patients were enrolled in the study. Among them, 18 died within 2 days of admission and hence were excluded from the study. Among the remaining 100 patients, 43% had severe and 57% had moderate head injury. Coagulopathy was present in 63% patients out of which 61.9% had an unfavourable outcome at 6 months compared to 5.4% among 37 patients with normal clotting parameters. Stepwise logistic regression analysis showed blood transfusion, surgical intervention, polytrauma and severity of head injury as independent variables responsible for the development of coagulopathy. PT, aPTT and FDP were found to prognosticate an unfavourable outcome in patients with head injury.

Conclusions. Coagulopathy is more common in severe head injury patients and is associated with an unfavourable outcome in such patients. PT, aPTT and FDP can prognosticate an unfavourable outcome in patients with head injury.

TPM1-4: Delays in discharge following chronic subdural surgery

S. K. Alexander, A. F. Fois, A. Helmy & R. A. Trivedi

Addenbrooke's Hospital, Cambridge, UK

Objectives. Chronic subdural haematoma (CSDH) is one of the commonest emergency procedures in neurosurgical

practice. Patients are often elderly and have several associated co-morbidities. Although not technically demanding, this places a significant burden on neurosurgical resources.

Methods. A retrospective case review of length of stay of 92 patients with surgically treated CSDH in 2011 in a single neurosurgical unit. The delays to discharge were identified.

Results. Mean length of stay following CSDH was 8.3 days (SD 6.7) with 34 patients (37%) repatriated to their referring hospital. In this patient group, mean time to referral was 6.0 days (SD 3.0) and mean time to discharge was 12.7 days (SD 6.5). The commonest reasons for delay of discharge were delayed transfer ($n = 15$); delayed referral ($n = 7$) to the regional hospital; and delay to operation ($n = 10$). The commonest medical complications delaying discharge included hyponatraemia ($n = 6$), pneumocephalus ($n = 6$), seizures ($n = 5$) and infections ($n = 4$). Of the total inpatient days audited, 237/767 (31%) were by patients awaiting repatriation. The range of waiting time for repatriation was 0–16 days; mean 6.6 days.

Conclusions. A substantial cost is accrued as a result of bed occupancy following evacuation of CSDH, much of which is accounted for by patients awaiting repatriation. Healthcare Resource Group (HRG) codes do not allow additional funding for stays up to 40 days. Increasing discharge efficiency for these patients can minimise inpatient costs and release beds for elective neurosurgery.

TPM1-5: Incidence and outcomes of referrals of acute traumatic subdural and extradural haematomas; do we achieve the 'four-hour rule' standard?

J. Wilson & J. Timothy

Department of Neurosurgery, Leeds General Infirmary, Leeds, UK

Objectives. To investigate the incidence and outcome of referrals of traumatic acute subdural/extradural haematomas (SDH/EDH) to a large neurosurgical unit to elucidate adherence to the four-hour rule.¹

Design. Prospective audit.

Subjects. Adult acute traumatic and subdural haematomas referred from May 2011 to May 2012.

Methods. A year-long audit of all referrals for acute traumatic SDH/EDH were recorded. Of those accepted, data on the operative intervention, post-operative course and eventual Glasgow Coma Scale (GCS) were recorded.

Results. One hundred and nine referrals were recorded; 59 were accepted. Twenty-seven were classified as severe traumatic brain injury (TBI) (GCS 3–8), 9 were moderate (GCS 9–12) and 23 were mild (GCS 13–15). Forty-two patients underwent surgery after transfer; however only two received intervention within 4h of injury. Twenty-two patients who received surgery experienced delays with transfers from peripheral hospitals. Seven mortalities were recorded in the operative group.

Conclusions. Age, GCS and pupillary response were the main factors in the decision to accept acute SDH/EDH referrals.

Very few patients fulfil the 'four-hour rule' standard for operative treatment; however, difficulties in recording time of injury can affect these outcome measures. Efforts to improve speed of transfer from peripheral hospitals may improve patient outcomes.

Reference

1. Seelig JM, Becker DP, Miller JD, Greenberg RP, Ward JD, Choi SC. Traumatic acute subdural hematoma: Major mortality reduction in comatose patients treated within four hours. *N Engl J Med* 1981;304:1511–18.

TAMP1 – Oncology/Radiotherapy

TAMP1-1: The changing face of acoustic neuroma practice over 22 years

R. Mathew & P. van Hille

Leeds General Infirmary, Leeds, UK

Objectives. To report the changes in management of acoustic neuromas over two decades.

Design. Single-centre analysis of a prospectively collected database from 1990 to 2011 inclusive.

Subjects. All patients radiologically or histologically diagnosed with acoustic neuromas seen and followed up in a multidisciplinary clinic ($n = 763$).

Methods. Data collected included age, number seen/year, size of tumour when first seen and at surgery, initial intention to treat, surgical approach, progression and change in treatment, morbidity (House–Brackmann (HB) grade) and mortality.

Results. Mean age was 55 years (range 14–87 years). Patient numbers and those with small tumours (<2 cm) have increased. Nearly half (47.4%) were managed conservatively, with the majority being stable (74.4%). Of the remainder, 17.6% underwent radiosurgery (mean time to progression 25.7 months, range 2–78 months) and 8% underwent surgery (mean time to progression 21.5 months, range 1–77 months). Over time, initial intention to treat surgically has been reserved for those with large tumours (>3 cm). Of all patients undergoing surgery ($n = 393$), 96.7% remained stable, with good outcomes in 67.9% (HB I–II) and mortality <1%.

Conclusions. Our study demonstrates the evolution of acoustic neuroma practice over more than two decades – from surgery to watchful waiting. Our figures may imply that the number of tumours that grow has been overstated. However, dilemmas persist in the optimum pathway for preservation of hearing in small tumours and the treatment of large tumours.

TAMP1-2: Ophthalmological outcome after resection of pineal gland tumours

M. G. Hart, N. Sarkies, T. Santarius & R. Kirollos

Addenbrooke's Hospital, Cambridge, UK

Objectives. To determine the incidence, risk factors and pathophysiology of visual disorders after resection of pineal gland tumours.

Design. Retrospective case series.

Subjects. Patients who had resection of a tumour focused on the pineal gland (2002–2011); other pineal region tumours and biopsies were excluded.

Methods. Visual disorders were classified by a consultant neuro-ophthalmologist. Risk factors were identified with multivariate analysis.

Results. Twenty patients underwent resection of pineal gland tumours (90% supracerebellar infratentorial). Complete resection was obtained in 85% and there was no peri-operative mortality. Various ophthalmological abnormalities were present in 45% at presentation. Overall residual ophthalmological deficits were present in 55%; however, in those with normal vision pre-operatively, 78% remained normal post-operatively. Although upward gaze tended to improve, persistent visual symptoms reflected dyscoordinated chaotic eye movements. Often, this was refractory to prism treatment as the gaze disorder did not reflect a single external ocular muscle palsy, but rather the supranuclear control of eye movements, creating a dynamic or variable degree of ocular asynchrony. Visual outcome in relation to tumour size, adherence to the tectum, extent of resection or histology was capricious.

Conclusions. Long-term visual morbidity after pineal gland tumour resection is more common than previously appreciated: detailed description allows a pathophysiological insight into midbrain gaze dysfunction.

TAMP1-3: Gamma knife radiosurgery for trigeminal neuralgia – a single unit experience

M. Srinivas, H. I. Sabin, P. N. Plowman, J. Wadley & T. P. D. Blackburn

St Bartholomew's Hospital, London, UK

Objectives. To evaluate the effectiveness and safety of gamma knife radiosurgery for the treatment of trigeminal neuralgia (TN).^{1,2}

Design. Clinical outcome of patients with TN treated with gamma knife over an 11-year period (1999–2010) was assessed with questionnaires.

Subjects. One hundred and twenty-two patients with TN, refractory to medication and sometimes also to prior surgical procedures, had 134 gamma knife stereotactic radiosurgery (GKSRS) procedures. Primary TN was the diagnosis in 110 cases. The remaining 12 were associated with demyelinating disease ($n = 7$) or neoplasms adjacent to the Vth nerve ($n = 5$).

Methods. The radiosurgical target was the retrogasserian portion of the nerve at the front of the prepontine cistern. Radiation dose was 90 Gy to the 100% isodose using a single 4 mm shot; for re-treatments, 60 Gy was given to the 100% isodose.

Results. Twelve patients were lost to follow-up and eight died from unrelated causes. Thirty patients were able to stop medications and a further 49 were able to reduce

medication whilst maintaining good pain control. Complications reported: none ($n = 56$), partial facial numbness ($n = 24$), dysesthesia ($n = 5$) and eye related ($n = 1$).

Conclusions. Patients who had initially responded favourably but later experienced a recurrence of pain were considered for repeat radiosurgery. GKSRS is a good and safe option for patients who represent a high surgical risk, or who are unwilling to undergo surgical treatment.

References

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TAMP1-4: Can the prognosis of an individual patient with glioblastoma be predicted using an on-line calculator?

J. B. Heald, C. Parks, G. Hall & I. Kamaly-Asl

Salford Royal NHS Foundation Trust, Salford, UK and Royal Preston Hospital, Preston, UK

Objectives. In 2008, a 'GBM calculator' designed to predict the survival times of patients with newly diagnosed glioblastoma multiforme (GBM) was made available on-line by the European Organisation for Research and Treatment of Cancer (EORTC). By comparing actual and predicted patient survival times, our aim was to assess the suitability of the GBM calculator for use in clinical practice.

Design. External validation of an on-line prognosis calculator. **Subjects.** One hundred and eighty-seven patients from two UK neurosurgical units with histologically confirmed GBM (WHO grade IV) were retrospectively included in the study. All patients had received treatment and subsequently died.

Methods. Patient information at diagnosis was entered into model 1 of the calculator. The accuracy, precision, bias and discrimination of the calculator were all assessed, as was the degree of correlation between actual and predicted patient survival times.

Results. A weak correlation between actual and predicted patient survival times was demonstrated by a Pearson's correlation coefficient of 0.27. Only 23% of predicted survival times were within 25% of the actual patient survival times. The discrimination of the calculator was inadequate, as evidenced by a concordance index of 0.62.

Conclusions. The EORTC GBM calculator did not accurately predict patient survival times in our series. Its use would have led to the majority of the patients being misinformed of their prognosis. The authors would therefore not recommend the use of this tool in patient counselling.

TAMP1-5: A novel mouldable matrix for neurosurgical chemotherapy delivery: anti-tumour activity *in vivo*

S. Smith¹, C. Rahman², P. Morgan³, K. Langmack³ & D. Macarthur¹

¹Department of Neurosurgery, Nottingham University Hospitals, Nottingham, UK, ²School of Pharmacy, University of Nottingham, Nottingham, UK, and ³Radiation Physics, Nottingham University Hospitals, Nottingham, UK

Objectives. Administering chemotherapy at brain tumour resection circumvents the blood brain barrier, with effective dosage to the brain, but low systemic doses. We aim to evaluate a novel biodegradable polymer, based on poly(lactico-glycolic acid) (PLGA) and poly(ethylene glycol) (PEG) microparticles (FDA approved), for local chemotherapy release.

Design. *In vitro* and *in vivo* laboratory investigation.

Methods. UV absorbance was used to determine the release of etoposide, methotrexate and the histone deacetylase inhibitor trichostatin A (TSA). Cytotoxicity was evaluated using Alamar blue assay. Surgical application to a brain resection cavity was in an *ex vivo* ovine model. A dose of 60 Gy of radiotherapy was administered in 30 fractions. *In vivo* testing was in flank xenograft partial resection and orthotopic pseudo-resection murine models.

Results. Microparticles were applied as paste at room temperature and solidified into a malleable matrix. Blank PLGA/PEG matrices were non-toxic. Drug release was sustained for over 3 weeks and followed zero-order kinetics after an initial burst. Released drugs retained cytotoxicity. Surgical application was achieved in 10 min, with radiation not affecting material microstructure. *In vivo*, tumours showed significant necrosis around the drug-loaded PLGA/PEG, indicating anti-cancer effects in a living system. Neurotoxicity was assessed.

Conclusions. PLGA/PEG microparticle-based mouldable matrices allow persistent tissue contact with sustained multiple drug release, targeting residual neoplastic cells.

TAMP1-6: The use of ultrasound elastography to characterise adherence at the brain–tumour interface

C. Uff¹, A. Chakraborty², J. Bamber³ & N. Dorward¹

¹Royal Free Hospital, London, UK, ²Great Ormond Street Hospital, London, UK, and ³Institute of Cancer Research, London, UK

Objectives. Computer simulation and laboratory experiments have identified various phenomena (strain concentrations at the boundary, strain heterogeneity adjacent to the boundary) observed on strain imaging that predict a mobile boundary. The current study is an investigation into which of these

criteria are most applicable to *in vivo* scans with reference to brain tumour surgery.

Design. Prospective observational study for proof-of-principle.

Subjects. Forty-eight patients undergoing surgery for brain tumours. All were consented for research scanning. Appropriate ethical and R&D approvals were obtained.

Methods. Scans were acquired prior to tumour resection using both 2D and 3D elastography systems and were interpreted by observers off line. These data were compared to the surgeon's opinion of adherence at the boundary over either the whole tumour or over a discrete region of the interface if the whole interface was not visible. Receiver operator characteristic (ROC) curves were generated for individual features to identify those that reliably predict mobility.

Results. ROC area under the curve (AUC) values ranging from 0.822 ($p = 0.0066$) for strain heterogeneity, to 0.867 ($p = 0.0002$) for objective assessment of the images, were obtained.

Conclusions. Elastography can predict tumour adherence with reasonable accuracy and it is likely that this will increase considerably if pre-operative imaging is considered. Interpretation of elastograms does not require formal training other than an awareness that the above criteria are associated with mobility.

TAMP1-7: Extent of resection as an outcome measure in pituitary surgery

N. I. Phillips

Leeds Teaching Hospitals, Leeds, UK

Objectives. The aim of this study is to develop a new method to measure the extent of resection (EOR) in pituitary tumours as an outcome measure.

Design. The technique is based on manual segmentation of tumours in T1 contrast-enhanced magnetic resonance imaging (MRI) and the calculation of the tumour volume using Cavalieri's principle.

Subjects. Patients having microscope-assisted and endonasal transsphenoidal pituitary surgery in 2010 in Leeds had their pre- and post-operative tumour volumes assessed, as well as the maximum dimension.

Methods. Standard dicom image datasets from pre- and post-operative MRI scans were imported into Osirix software running on a MacPro (Apple Computer Inc.). In the axial plane, tumours were manually outlined using a region of interest tool and the volume computed. The volumes were compared with the maximum linear dimension of the tumour to establish the relationship between volume and linear dimension.

Results. Twenty-five patients had 27 operations in 2010. The range of pre-operative tumour size was 0.6–14.5 cm³. The range of pre-operative maximum dimension was 0.7–4.3 cm. The mean EOR overall was 57%. There were no significant differences in EOR between the approach used or the surgeon.

Conclusions. This simple method provides comparative data for different surgeons, techniques and units for outcome purposes. It relies on a discrete tumour margin and has application in other tumours. We hope it will facilitate EOR as an outcome measure in pituitary surgery in conjunction with other outcome measures.

TAMP1-8: Streamlining the management of malignant spinal cord compression

R. Corns, J. Johnson & P. Minhas

St George's Hospital, London, UK

Objectives. To assess the impact of introducing a regional co-ordinator and a pathway for patients with malignant spinal cord compression (MSCC). A region-wide pathway for the management of MSCC was introduced on 1 December 2011 by South West London Cancer network together with the spinal surgeons at St George's Hospital, London. During office hours, a dedicated MSCC co-ordinator collects the relevant clinical information and scans and presents it to the consultant spinal surgeon on-call. Out of office hours, the traditional referral route via the on-call neurosurgical SpR is employed.

Design. Prospective audit.

Subjects. Seventy patients were referred to the regional neurosurgical centre with suspected MSCC between 1 November 2011 and 30 May 2012.

Methods. Data are entered into a prospective database by the MSCC co-ordinator and the neuro-oncology administrator.

Results. Twenty-two patients were referred via the MSCC co-ordinator and 48 via the on-call neurosurgical SpR. Sixteen had surgery, 46 had radiotherapy, 3 had chemotherapy and 5 were managed palliatively. The mean time from referral to definite management decision was 0.05 (range 0–1) days via the MSCC pathway and 0.25 (range 0–5) days via the on-call SpR ($p < 0.05$). The mean time from referral to definitive treatment was 2.5 (range 0–12) days and 5.4 (0–48) days ($p < 0.05$). There was no significant difference between the two groups in those patients undergoing surgery.

Conclusions. The introduction of an MSCC co-ordinator and pathway has significantly reduced the delays in treating these patients.

TAMP2 – Short Orals

TAMP2-1: Temporal lobe low-grade gliomas show higher-grade transformation predominantly in parasylvian and medial temporal tumorous areas: an observation from a six-year retrospective study. Implication on patient management plan and consent

S. Muquit, M. Hogan & S. Basu

Queens Medical Centre, Nottingham, UK

Objectives. A large proportion of temporal lobe low-grade gliomas (LGG) transform into higher-grade lesions. It was

observed that this transformation (on contrast magnetic resonance imaging [MRI]) was more often located in parasylvian or medial temporal areas. Our study aims to examine this observation.

Design. Retrospective review of clinical records and imaging.

Subjects. All patients who underwent temporal lobe surgery at our unit in a 6-year period (May 2006 to May 2012) were selected.

Methods. We reviewed images and clinical data to select our cohort. The loci of high-grade areas on pre-operative MRI were categorised according to a parcelled temporal lobe model. The parcelled areas were: (a) parasylvian, (b) medial temporal, (c) basal temporal, (d) lateral temporal and (e) temporal white-matter.

Results. Twenty-two out of a total of 70 temporal surgeries were performed on transforming LGGs. Seventeen patients had an enhancing area. In 16 cases (94.1%), the enhancing area was parasylvian (76.5%) or medial temporal (17.6%). The histology in 62% was WHO Gr. III and 31% WHO Gr. IV. None of the patients presented with enhancement in the lateral or basal temporal areas; one patient had enhancement in the temporal white-matter.

Conclusions. In patients with temporal LGG, the parasylvian and medial temporal tumor areas are likely to show early higher-grade transformation. This finding should influence the option of resection, as total resectability is improbable on transformation. Those who opt to 'wait and watch' should select 'voxels' on surveillance MRS from these areas to detect early transformation.

TAMP2-2: Minimally invasive spinal fixation for spinal infection

M. F. Hassan, M. B. Mohamed & G. A. Wynne-Jones

Royal Victoria Infirmary, Newcastle, UK

Objectives. Most cases of spinal infection are treated conservatively with antibiotics; however, in certain circumstances, spinal fixation has a role, such as a neurological deficit or failure to respond to conservative treatment. A minimally invasive approach with percutaneous pedicle screw fixation may advantage this group of patients. We report our initial experience with this approach in patients deteriorating on antibiotic therapy.

Design. A retrospective study of cases performed by a single surgeon over a 12-month period.

Results. Eight patients were treated with percutaneous pedicle screw fixation (Viper 2, DePuy Spine, Raynham, MA), mean age at surgery was 60.4 years (range 24–85 years). All patients were on appropriate antimicrobial therapy and had either deteriorating neurological status and/or needed Level 3 support for septicaemia. In total, there were 43 instrumented levels. Mean follow-up was 6.6 months (range 4–11 months). On last review, there had been an improvement in pain and recovery in neurological function in all patients. Also at this review, post-operative radiological study showed satisfactory pedicle

screw position and evidence in some patients of fusion at the site of infection. Furthermore, there was a reduction in Cobb angle and normalisation of C-reactive protein (CRP) values. There was one post-operative complication of a wound infection that required further debridement.

Conclusions. We believe that this small limited study shows that minimally invasive spinal fixation is safe in this highly selected group of patients with spinal infection. The technique minimises the physiological insult of surgery to otherwise compromised patients and the benefit of spinal stabilisation leads to accelerated healing.

TAMP2-3: Gender does not predict poor outcome after aneurysmal subarachnoid haemorrhage

A. Hamdan, J. Barnes & P. Mitchell

Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, UK and Royal Victoria Infirmary, Newcastle upon Tyne, UK

Objectives. The pathophysiology of aneurysmal subarachnoid haemorrhage (aSAH) is unclear. Gender may play an important role in determining the outcomes of aSAH patients.

Design. Retrospective study.

Subjects. All aSAH patients admitted to our unit from April 2005 to February 2010.

Methods. We identified 617 aSAH patients (69.0% female) from our database and analysed gender differences in risk factors (age, hypertension, smoking, alcohol consumption and family history), admission-related factors (World Federation of Neurosurgeons [WFNS] grade and admission delay), aneurysmal characteristics (site, side and multiplicity) and outcomes (treatment modalities [coiling/clipping/both/conservative], complications [vasospasm and hydrocephalus], length of stay and MRS grade at 3 months).

Results. Females with aSAH were older than males (mean age 56.6 vs. 52.5 years, $p < 0.05$), with more females presenting at >50 years of age compared to males (66.4 vs. 51.8%, $p < 0.05$). Females exhibited more bilateral (6.8 vs. 2.6%, $p < 0.05$), multiple (11.5 vs. 5.2%, $p < 0.05$) and ICA aneurysms (27.3 vs. 9.0%, $p < 0.05$) and less ACA aneurysms (21.1 vs. 42.3%, $p < 0.05$) compared to males, but no side (left/right) differences were noted. There were no gender differences in risk factors, admission-related factors and all outcome measures. Using multivariate regression, odds ratio of poor outcome (MRS 4–6) in females versus males after adjusting for age, WFNS grade and aneurysm location, was 0.76 (95% CI 0.48–1.13, $p > 0.05$).

Conclusions. The overall outcomes after ruptured aSAH between females and males are similar.

TAMP2-4: Multidisciplinary treatment of intracranial dural arteriovenous fistulas (DAVF) with pulsatile tinnitus: single institute experience in 18 cases

H. El-Maghraby¹, S. Nair², S. Nagaraj² & D. Rejali¹

¹Department of Neurosurgery, University Hospital, Coventry, UK and ²Department of Interventional Neuroradiology, University Hospital, Coventry, UK

Background. Intracranial dural arteriovenous fistulas (DAVF) are rare vascular anomalies. There are few reports in the literature of intracranial DAVFs with pulsatile tinnitus.

Objectives. To describe the clinical presentation, radiological classification (Cognard classification) and role of multidisciplinary treatment of these intracranial DAVFs with pulsatile tinnitus.

Design. Review of prospectively collected data of 18 cases with confirmed DVAF and pulsatile tinnitus from April 2009 to April 2012.

Outcome measures. Radiological classification (Cognard classification) with influence on clinical presentation and treatment modularity.

Methods. Eighteen patients with mean age 54 (28–72 years) had pulsatile tinnitus with two presenting with intracranial haemorrhages. Intracranial DAVFs were confirmed angiographically. Eight of eighteen (44%) were Cognard I & II. Ten of eighteen (56%) were Cognard III & IV with two of ten (20%) presenting with intracranial haemorrhages.

Results. Multidisciplinary treatment was tailored according to Cognard classification and clinical presentation. Four of eighteen were Cognard I, one underwent endovascular occlusion of DAVF, two were observed and one had complete spontaneous resolution of DAVF and tinnitus. Fourteen of eighteen had cortical venous reflux and underwent treatment, twelve of fourteen had endovascular occlusion and two of twelve had microsurgical excision after failed endovascular occlusion.

Conclusions. Pulsatile tinnitus is a rare presentation of intracranial DAVF. Cortical venous reflux in intracranial dural arteriovenous fistulas is associated with a risk of intracranial haemorrhages and mortality. A multidisciplinary treatment of DAVF tailored to Cognard classification is required for the management of DVAF and pulsatile tinnitus.

TAMP2-5: Delayed magnetic resonance imaging in angiogram negative subarachnoid haemorrhage

J. Woodfield, N. Rane, J. V. Byrne & S. Cudlip

John Radcliffe Hospital, Oxford, UK

Objectives. To investigate the diagnostic yield of delayed magnetic resonance imaging (MRI) in digital subtraction angiogram (DSA) negative subarachnoid haemorrhage (AN-SAH).

Design. A single-centre, retrospective review of imaging performed in patients with AN-SAH.

Subjects. All DSAs performed at a single centre between July 2006 and March 2012 were identified from the radiology department records. Reports were screened to identify DSAs performed following an acute subarachnoid

haemorrhage (SAH). Patients with a negative computed tomography angiography (CTA) and DSA were included.

Methods. Imaging in patients after AN-SAH was retrospectively analysed and subsequent MRIs were reviewed.

Results. Over the 6-year study period, 240 of 1023 DSAs performed after acute SAH revealed no cause for the SAH. Delayed MRI was performed in 102 (42.5%) patients. A cavernoma was identified as the cause of SAH in one patient (0.98%). In retrospect, the cavernoma was visible on previous CT imaging. No vascular abnormality was identified in 43 (48.3%) of 89 patients with perimesencephalic SAH who underwent delayed MRI. Of the 240 patients presenting with AN-SAH, none subsequently re-presented with haemorrhage to our centre during the study period.

Conclusions. Delayed MRI following AN-SAH has a low yield in identifying a cause for the initial event. We propose that it is excluded from the routine investigative process for these patients. However, delayed MRI may still play a role in confirmation or further characterisation of causes of SAH identified on prior imaging.

TAMP2-6: Poor grade subarachnoid haemorrhage: outcomes in older age patients

R. Mathew, H. Macrorie, L. Sansom, Y. Al-Tamimi & S. Ross

Leeds General Infirmary, Leeds, UK

Objectives. To determine whether there is an age beyond which significantly worse outcomes are observed in poor grade patients following aneurysmal subarachnoid haemorrhage (SAH).

Design. Single-centre, retrospective case note and database data collection from January 2008 to December 2009 inclusive.

Subjects. Aneurysmal SAH patients with World Federation of Neurosurgeons (WFNS) grade IV ($n = 18$) or V ($n = 30$).

Methods. Data collected included age, gender, WFNS grade, aneurysm treatment modality (conservative/endovascular/clipping) and mortality rates (30-day and 6-month). Patients were grouped by age (25–50, 51–55, 56–60, 61–65, 66–70 and 71–75 years) and statistical analysis performed using chi-square testing ($p < 0.05$).

Results. Mean age was 54 years (range 25–71 years), with an overall female preponderance. The majority of patients underwent endovascular coiling. Total mortality was 50.0%. Significantly higher mortality was found in patients over the age of 65 years than those below 65 years (77.8 vs. 43.6%) at 30 days (chi-square test, $p = 0.035$). No patients over 65 years survived beyond 30 days.

Conclusions. Age is an important predictor of outcome in poor grade subarachnoid patients, with those over the age of 65 years having significantly worse mortality. Further studies need to identify factors other than age alone of poor outcome amongst these older patients.

TAMP2-7: Suprameatal tubercle and incisura: novel anatomical landmarks to guide the unroofing of the internal auditory canal

Z. Zador

Department of Neurosurgery, Royal Preston Hospital, Preston, UK

Objectives. The subtemporal approach to the internal auditory canal (IAC) uses the greater superficial petrosal nerve (GSPN) or the superior semicircular canal (SSC) as anatomical landmarks for locating and unroofing the IAC.¹ Cadaver studies and our most recent radioanatomical analysis revealed great variability in the orientations of these structures in relation to the IAC axis. To identify more constant and reliable landmarks, we characterised the relations of the suprameatal tubercle (SMT) and the adjacent suprameatal incisura (SMI) as potential candidates for more efficient localisation of the IAC.

Design. Retrospective audit.

Subjects. High-resolution CT scans.

Methods. Three-dimensional reconstructions of 25 disease-free temporal bone scans were reviewed. The relations of the SMT and the adjacent incisura were analysed using a 3D morphometry tool.

Results. The SMT base overlaid the meatus of the IAC in almost all specimens (48/50, 96%). In relation to the centre of the meatus, the apex of the suprameatal tuberculum was displaced anteriorly in 38/50 (76%) specimens (average distance 6.75 ± 1.62 mm) and posteriorly in 12/50 (24%) specimens (average distance 7.75 ± 1.78 mm). The SMI overlaid the meatus in only 3/50 specimens (6%) and was displaced antero-medially by 7.75 ± 1.78 mm to the meatus center.

Conclusions. Our data demonstrate close and constant relationships between the IAC and the structures SMT and SMI. These results propose them as reliable landmarks for unroofing the IAC via the subtemporal approach.

Reference

1. Zador Z. Subtemporal access to the internal auditory meatus: A radio-anatomical characterization of surgical landmarks in three-dimensional models. *Br J Neurosurg* 2012;26:143 [Abstract].

TAMP2-8: Spontaneous angiographic obliteration of brain arteriovenous malformations

P. D'Urso, H. Hasegawa, K. Deniz, M. Poitelea, J. Hart, N. Deasy & D. Walsh

King's College Hospital, London, UK

Objectives. To study the incidence and characteristics of spontaneous angiographic obliteration of brain arteriovenous malformations (AVM) in one institution.¹

Design. Retrospective review.

Subjects. One hundred and seventy-two patients with brain AVMs.

Methods. The reports of all cerebral angiograms performed in our department from August 2008 to May 2012 were reviewed. One hundred and seventy-two patients with brain AVMs were identified. The case records were studied to identify AVMs that had thrombosed spontaneously without prior intervention.

Results. Spontaneous angiographic obliteration of the AVM occurred in four patients, giving an incidence rate in our population of 2.3%. The median age at presentation was 45 (range 24–53) years. Two were female, two were male. Two AVMs presented with haemorrhage. Two AVMs that had not bled presented with seizures. The Spetzler–Martin grades were 1 ($n = 1$), 2 ($n = 2$) and 3 ($n = 1$). Two had superficial venous drainage, one had deep drainage and one had both. Three of four had multiple draining veins. The mean duration between angiograms demonstrating the AVM and its obliteration was 6 (range 1–10) months.

Conclusions. Repeating angiography ahead of scheduled surgery for symptomatic AVMs is prudent. Autothrombosis occurred slightly more than predicted by the literature in our series. The natural history of autothrombosed AVMs is not yet understood.

Reference

1. Patel MC, Hodgson TJ, Kemeny AA, Forster DM. Spontaneous obliteration of pial arteriovenous malformations: A review of 27 cases. *Am J Neuroradiol* 2001;22:531–6.

TAMP2-9: C1/C2 joint jamming as a treatment for basilar invagination in patients with rheumatoid arthritis

J. M. Hempenstall & E. Shenouda

Wessex Neurological Centre, Southampton, UK

Objectives. We describe an occiput sparing C1/C2 fusion technique that also allows direct reduction of basilar invagination in patients with rheumatoid arthritis.

Design. Technical note, case series.

Subjects. A two-patient series, both with advanced basilar invagination secondary to rheumatoid arthritis.

Methods. Through a posterior midline incision, the posterior elements of C1 and C2 are exposed. The standard Harms technique for C1 and C2 screws are used. With minimum distraction exerted via the connecting rods, the C1/C2 joint is opened and entered, the endplates are drilled under the microscope. Polyetheretherketone (PEEK) cages of a height required to achieve reduction are inserted into the joint space. The screws are secured to the rods. Pre- and post-operative clinical and radiological outcomes are assessed.

Results. Clinical improvement from Ranawat II to I, radiological improvement from Clark station II to I, average inpatient stay 3 days. At 12-month follow-up there were signs of fusion on imaging with no construct failure.

Conclusions. We believe that this technique produces a direct reduction of basilar invagination while holding it firm within a safe fixation construct. It has several advantages in comparison to some alternative techniques. The reduction and fixation are achieved using a single posterior procedure without the need for pre-operative Halo traction, the loss of motion associated with craniocervical fusion or the potential destabilising effect of an odontoidectomy. It uses an adaptation of techniques many are already familiar with.

TAMP2-10: Frontal lobe connectivity between anterior language and motor networks

V. Wykes, A. Miserocchi, A. Lemisiou, J. S. Duncan & B. Diehl

The National Hospital for Neurology and Neurosurgery, London, UK

Objectives. To investigate connectivity of the anterior language area using cortico-cortical-evoked potentials (CCEPS) in patients with focal epilepsy due to inferior frontal gyrus focal cortical dysplasias (IFG FCD).

Design. Extra-operative cortical stimulation was performed to identify anterior cortical language electrodes (ACLE).

Subjects. Three patients (with either middle, posterior or diffuse IFG FCD) underwent invasive monitoring with subdural electrodes for pre-surgical evaluation of medically intractable epilepsy.

Methods. Single pulse electrical stimuli were delivered to the language electrodes and CCEPs obtained by averaging 15–30 electrocorticograms, time-locked to the stimulus.

Results. Early and late CCEPS occurred at and in close proximity to the particular language electrode. In patients with anterior or middle IFG FCD, CCEPs were recorded from a large area over the middle and posterior, superior and middle frontal gyri including supplementary motor cortex (SMA), pre-SMA cortex. In the patient with a large posterior IFG FCD, ACLE stimulation resulted in a much smaller field of CCEPS.

Conclusions. Our work suggests that there are direct connections between the anterior language area and supplementary motor areas in a widespread cortico-cortical network. Lesions within this area may lead to a reorganisation of functional connectivity.

TAMP2-11: Microscope-assisted minimal access insertion of spinal cord stimulation paddle leads with novel positioning and anchoring technique

I. Ughratdar & S. Basu

Nottingham University Hospital, Nottingham, UK

Objectives. Insertion of wide paddle leads for spinal cord stimulation (SCS) requires generous exposure to obtain

satisfactory position and to achieve fixation of the lead. We describe a minimal access, microscope-assisted implantation technique in association with a novel anchoring technique, which has improved patient experience.

Design. Retrospective review.

Subjects. To date, this procedure has been performed in nine patients with a mean age 44 years. All patients had initially been reviewed by a multidisciplinary team and had successful percutaneous trial of stimulation.

Methods. All patients had the paddle implanted using a modified 'microdiscectomy' approach, with a typical incision length of 2.5 cm. We developed a novel way of handling the lead to manipulate it into the sublamina space and an anchoring technique using 4 mm titanium screws with the manufacturer-supplied sleeve to the exposed lamina. The technique did not breach the manufacturer's guidelines on anchoring. We reviewed our clinical outcome.

Results. All patients underwent successful implantation of the paddle leads without the need to extend the length of the incision. The procedure was well tolerated with an average length of stay of 1.75 days (range 1–4). Average length of operation was 108 min (range 90–120). There were no cases of lead migration.

Conclusions. We report a safe technique to minimise the operative exposure for implantation of paddle leads for SCS. The procedure is well received and reduces the length of hospital stay, making it comparable with total percutaneous techniques.

TAMP2-12: In patients with hydrocephalus treated with shunts, are programmable valves superior to nonprogrammable valves?

F. T. Rasul¹, H. J. Marcus², A. K. Toma¹,
L. Thorne¹ & L. D. Watkins¹

¹The National Hospital for Neurology and Neurosurgery, London, UK and ²Charing Cross Hospital, London, UK

Objectives. Adjustable valves allow clinicians to theoretically optimise the control of intracranial pressure without surgical intervention. We investigated the evidence that programmable valves (PV) are superior to non-programmable valves (NPV).

Design. Systematic review and meta-analysis in accordance with PRISMA guidelines.

Subjects. Paediatric and adult patients with hydrocephalus treated with a shunt.

Methods. The Cochrane Central Register of Controlled Trials (CENTRAL) and Medline databases were searched between January 1990 and May 2012. We included all studies of patients with hydrocephalus that compared failure rates in those treated with NPV and PV.

Results. Of 271 articles identified, 10 were selected for further review and one additional study identified through other sources. Eight studies were included in the meta-analysis. Five paediatric studies were identified with a total of 645 patients treated with a PV and 919 patients with an NPV.

PVs were associated with a non-significant increase in shunt failure using the random effects model (OR = 1.544, 95% CI 0.323–7.393). Three adult studies were identified with a total of 601 patients treated with a PV and 414 patients with an NPV. PVs were associated with a non-significant reduction in failure using the random effects model (OR 0.671, 95% CI 0.417–1.079).

Conclusions. There is no evidence to suggest that PVs have a higher failure rate than NPVs. PVs have a theoretical advantage in the management of hydrocephalus, and concern regarding failure should not be used as a reason for not using them.

TAMP2-13: A simple practical device to practise microvascular anastomoses using an *in vitro* device and chicken thigh vessels for cerebral revascularisation

U. J. Patel

Sheffield Teaching Hospitals NHS Trust, Sheffield, UK

Objectives. The performance of microvascular anastomoses requires practice because of vessel sizes, field depths, occlusion time and complication avoidance. Numerous impractical and unrealistic methods are used for practise.

Design. A simple practical device to mimic conditions required for bypass was devised and evaluated with harvested chicken thigh vessels.

Methods. Vessels were harvested from chicken thighs. The device had a cylindrical base for saline and on either inner end a 2 mm nozzle. The 'recipient' vessel was slipped over the nozzles and secured with ties. The cylinder could be rotated and had variable vertical flanges on either side to mimic *in vivo* conditions. A 'donor' vessel was prepared with a 10/0 Ethilon stitch in situ on opposite ends of its ostium. The arteriotomy was then performed and the sutures stitched to its ends. One end of the uncut tied stitch was then continued as the next stitch and cut to tie it before repeating the manoeuvre. The time to perform the anastomosis and whether it leaked was evaluated in 20 procedures.

Results. The vessels were ideal and mimicked and matched the vessels used in patients. The time for the anastomoses improved from 50–70 to 30–40 min with practise and the method used.

Conclusions. The device is simple and use of chicken vessels mimics the norm. With few resources and practice, microvascular anastomoses can be perfected. Thus, ischemic times are reduced and complications avoided.

Acknowledgement. I thank Sosan Aataie Dolatabadi for harvesting the chicken vessels.

TAMP2-14: Stereotactic radiosurgery for brain metastasis patients: are we over selective?

M. Sitaraman¹, J. Yousaf¹, B. J. Haylock², D. J. Husband² & M. D. Jenkinson¹

¹The Walton Centre, Liverpool, UK and ²Clatterbridge Cancer Centre, Wirral, UK

Objectives. To assess the outcome of brain metastasis treated with stereotactic radiosurgery (SRS) according to current primary care trust (PCT) commissioning guidelines: performance status (PS) ≥ 70 , ≤ 30 mm maximum diameter, \leq three metastases (four if good prognosis), primary tumour/extracranial disease controlled or slowly progressing (or radically treatable primary tumour without extracranial metastases in a newly diagnosed patient).¹

Design. Audit.

Subjects. All brain metastasis patients treated with SRS.

Methods. Retrospective case review. Primary tumour, number of metastases, PS, recursive partitioning analysis (RPA) class, treatment and outcomes assessed.

Results. Thirty-seven patients (median age 60 years) were treated. Primary tumour: breast 15, lung 10, melanoma 5, renal 4, colorectal 2, oesophageal cancer 1, unknown primary 1. PS 0-1 ($n = 31$); PS 2 ($n = 6$). RPA I ($n = 11$), RPA II ($n = 26$). Number of metastases: single ($n = 19$), two ($n = 7$), three ($n = 9$), $>$ three ($n = 2$). Twelve had metastasis excision pre-SRS, one had biopsy. Twenty-eight patients had whole brain radiation therapy (WBRT) pre-SRS. Median cranial progression-free survival was 6 months. Median overall survival was 14 months.

Conclusions. SRS-treated patients have better disease control than those in the literature. This represents a highly selected group. Other patients who do not fulfil the criteria may also benefit from SRS. National commissioning groups should collate outcome data to inform future guidelines.

Reference

1. Kocher M, Soffiatti R, Abacioglu U, et al. Adjuvant whole-brain radiotherapy versus observation after radiosurgery or surgical resection of one to three cerebral metastases. *J Clin Oncol* 2011;29:134-41.

TAMP2-15: Complications following prone positioning for spinal surgery

L. Meilak, V. Luoma, V. Nagaratnam, J. Taylor, E. Bayley & U. Reddy

The National Hospital for Neurology and Neurosurgery, London, UK

Objectives. To measure the incidence of complications following prone positioning for spinal surgery.

Design. A prospective clinical audit.

Subjects. Fifty-eight consecutive adult neurosurgical patients undergoing spinal surgery in prone position over 6 weeks.

Methods. Data collected included patient demographics, operative details, intra-operative and immediate postoperative complications. Biochemical markers suggestive of organ hypoperfusion (liver and renal function, amylase

and creatine kinase) were measured at twenty-four hours post-operatively if blood sampling was indicated.

Results. Sixty percent ($n = 35$) complication rate; 5% ($n = 3$) severe: one permanent nerve injury, one acute renal failure, one pneumothorax; no correlation between age or BMI and complications. Thirty-five blood samples analysed: 68% had a biochemical abnormality suggesting tissue hypoperfusion; 6% ($n = 2$) severe. Mean (SD) prone duration: 210.9 (122.5) min. There appeared to be a non-significant correlation between duration of proning and complications (238.1 (135.8)) or biochemical abnormalities suggestive of tissue hypoperfusion (248.1 (148.6)). Patients with complications or abnormal biochemistry were more likely to have intra-operative blood loss >500 ml.

Conclusions. Complications are common but mostly minor. An elevation in the biochemical markers of tissue hypoperfusion was more common than expected. Although our sample size is small, it does not detract from the importance of careful patient positioning and adequate tissue perfusion during prone position. These results are preliminary findings from an ongoing audit.

TAMP2-16: Incidence of dural lesion during lumbar surgery and effect on patient-reported outcome in one large unit

T. Pigott; on behalf of the Liverpool Spine Group

The Walton Centre Spinal Service, Liverpool, UK

Objectives. To determine whether dural tear during primary lumbar spinal surgery had an effect on patient-reported outcome.

Design. A prospectively collected database with pre- and post-operative patient-reported outcomes measures (PROMs).

Subjects. Data were prospectively collected on all patients undergoing primary non-instrumented lumbar spinal surgery from March to December 2011.

Methods. Pre- and post-operative (3 months) PROMs, specifically the Core Outcome Measure Index (COMI) data were collected.¹ Analysis was undertaken on patients with a complete data set. Demographic and complication data were collected. The results for those with and without dural tears were compared. The COMI scores were automatically calculated by the Spine Tango system.

Results. A total of 897 procedures were performed, 609 of these were simple primary lumbar surgeries with 14 dural tears within this group (1.3%). Two hundred and forty-five patients had complete data sets, including seven patients with a dural tear. As a group, COMI scores improved from 7.93 to 4.54 following surgery. For the dural lesion group, scores improved from 8.21 to 5.76. There was no clinically relevant difference in COMI scores between the two groups. Statistical analysis of significance was not possible because of the small size of the dural tear group.

Conclusions. We have demonstrated a clinically relevant improvement in PROMs for patients undergoing lumbar surgery, with no obvious difference between those with and without a dural tear.

Reference

1. Mannion AF, Elfering A, Staerke R, et al. Outcome assessment in low back pain: How low can you go? *Eur Spine J* 2005;14:1014–26.

TAMP2-17: Medication overuse headache – an under diagnosed problem in shunted pseudotumour cerebri patients

R.-M. de Souza, A. Toma & L. Watkins

National Hospital for Neurology and Neurosurgery, London, UK

Objectives. The relationship between medication overuse headache in the setting of pseudotumor cerebri (PTC) patients with cerebrospinal fluid shunts in place has been described. We present our series of PTC patients with medication overuse headache and discuss the role of careful pain management in this group of patients.

Design. Retrospective review.

Subjects. PTC patients with a ventricular shunt and intracranial pressure monitoring data and medication overuse headache.

Methods. Retrospective review of PTC patient with cerebrospinal fluid shunt whose shunt function was verified with measurements of intracranial pressure and a diagnosis of medication overuse headache. Medical records were reviewed focusing on time to diagnosis, co-morbidities, length of hospital stay and other primary headache diagnoses.

Results. Fifteen patients were identified. The time between diagnosis of PTC and diagnosis of medication overuse headache was a mean of 6 years (SD 4.9, range 2–18 years). The mean inpatient hospital stay was 9 days (range 2–17 days). The majority of patients in this group (12/15) were complex shunt patients with multiple shunt revisions. Almost all patients (14/15) had a diagnosis of migraine.

Conclusions. Medication overuse headache and migraine can coexist in shunted PTC patients, leading to hospital encounters. We suggest that opiates and NSAIDs are used for a specified duration post-operatively only. We suggest that patients are counselled regarding medication overuse headache in a multidisciplinary setting.

TAMP2-18: Endoscopic third ventriculostomy for the treatment of hydrocephalus following foramen magnum decompression in patients with Chiari I malformation

B. Vaqas, H. M. Samarage & D. Peterson

Charing Cross Hospital, London, UK

Objectives. Obstructive hydrocephalus following a foramen magnum decompression (FMD) for Chiari I malformation is an infrequent complication occurring in around 8.7% of patients. We present the first cases in the literature of three patients who were managed using endoscopic third ventriculostomy (ETV) as the sole treatment. We propose that ETV can be utilised as a safe and effective alternative to shunt

insertion in managing this complication of craniovertebral decompression in Chiari I malformation.

Design. Retrospective case series analysis.

Subjects. Three patients (2F:1M, mean age 28 years) with diagnosed Chiari I malformation who developed hydrocephalus following FMD and who underwent ETV between 2004 and 2012.

Methods. Charts were reviewed for pre- and post-operative clinical features and outcomes and the cases were followed up in the outpatient clinic.

Results. None of the patients had hydrocephalus as an initial presenting feature prior to FMD and two patients had associated syrinxes. All patients had prompt resolution of symptoms along with radiological and clinical improvement of hydrocephalus following ETV and remain well with a mean follow-up period of 19 months.

Conclusions. ETV can be considered as a safe and effective alternative to other CSF diversionary procedures such as shunts in treating acute hydrocephalus following craniovertebral decompression surgeries in patients with Chiari I malformation.

TPMP1 – Miscellaneous 1

TPMP1-1: An audit of the coding of mortality, diagnosis and treatment over a 5-year period

T. A. Mostafa & J. J. Nissen

The Royal Victoria Infirmary, Newcastle upon Tyne, UK

Objectives. Our aim was to identify errors in coding of consultant, diagnosis, elective versus emergency admission and procedure, and thereby assess the accuracy of the coding of consultant deaths and highlight their related clinical implications.

Design. A retrospective case note review and imaging review (PACS) was performed for all patients identified by the coding department to have died under the care of a single consultant neurosurgeon, within the last 5 years.

Subjects. Single consultant's deaths (elective and emergency) over a 5-year period (59 patients).

Methods. The data collected included patient demographics and the specifics of coding: assigned consultant, diagnosis, elective versus emergency admission and procedure. Each case was examined to identify coding errors from patient's notes.

Results. Fifty-six deaths occurred in emergency admissions (out of 1158 patients RATE) and three were in elective cases (out of 1249 patients RATE). All patients were coded correctly as emergency 56 versus elective 3. Data were unavailable for four of the patients. Out of 59 patients, 7 (11%) were incorrectly identified as having been under the care of the consultant studied. Diagnosis coding was incorrect in 3 patients out of 59 (5%) and treatment coding was incorrect in 8 patients out of 59 (13.5%).

Conclusions. There was a significant coding error of 29.5% of all the coded patients. Current methods for coding data alone is not an accurate method for assessing consultant

deaths, or for obtaining numbers of the diagnoses and treatment of patients.

TPMP1-2: National survey of ST1-3 neurosurgical trainees; rotations and exposure to theatre and outpatients

M. A. Hussain, S. Metcalfe, F. Hassan & N. Ross

Royal Victoria Infirmary, Newcastle upon Tyne, UK

Objectives. Since the introduction of modernising medical careers (MMC) in 2005, neurosurgical training has changed. Trainees are now on the specialist register earlier and neurosurgical departments are responsible for trainees continuously from the ST1 level to the completion of the ST8 year. This survey aimed to look at the current training of ST1-3, to establish what rotations were being undertaken, and trainees' exposure to theatre and outpatients in the initial stage. Is there, or should there be, a national standard and are we making the best use of the early years of training?

Design. National online questionnaire.

Subjects. Neurosurgical training, modernising medical careers, national survey.

Methods. The British National Trainees Association (BNTA) email group was utilised to contact all members currently in training. Members were asked to complete the online questionnaire if they started training as an ST1.

Results. Twenty-five responses from 10 neurosurgical centres were received. As an ST1, all trainees spent at least 4 months in neurosurgery at senior house officer (SHO) level, 58% did a rotation in neurology, of which one-third found it of little benefit, and 45% in intensive treatment units (ITU). At ST2, 60% of trainees spent time in an allied speciality and 40% found this of little benefit. At ST3, 70% of trainees spent at least 4 months on the registrar rota, which was highly recommended. All trainees completed 4 months in A&E and ITU. Forty-eight percent of ST1, 45% of ST2 and 24% ST3 trainees found their exposure to theatre and outpatients insufficient.

Conclusions. There is a variation in training rotations for neurosurgical trainees between deaneries in the initial stage. The exposure to theatre and outpatients is inadequate in ST1 and ST2. By addressing these points, we can optimise ST1-3 training, reducing the risk of trainees entering the final stage of training with inadequate clinical neurosurgical experience, and prevent the need for the addition of a ST9 year to the current training curriculum.

TPMP1-3: The benefits of a dedicated daytime emergency neurosurgery theatre

A. Khan & A. T. King

Department of Neurosurgery, Salford, UK

Objectives. To analyse the benefits of the development of a dedicated daytime emergency neurosurgery theatre. At a

previous Society of British Neurological Surgeons (SBNS) meeting, we presented the case for a dedicated daytime emergency neurosurgery theatre. This was based on our analysis of inappropriate out of hours emergency neurosurgery in the single generic emergency theatre at our hospital. We now have this daytime theatre.

Design. Retrospective analysis of prospectively collected data.

Subjects. All patients on the emergency list in January 2011, before the dedicated daytime neurosurgery emergency theatre and in November 2011, after the development of this theatre.

Methods. Data for all the emergency procedures were collected, including the time of procedure, the pre- and post-operative length of stay (LOS) and whether a consultant was present. This process was repeated in November 2011 and compared.

Results. The advent of a dedicated daytime emergency theatre increased the number of procedures performed in daytime hours from 45 to 75% ($p < 0.001$), decreased the pre-operative LOS from 3.3 to 1.6 days ($p = 0.01$) and the post-operative LOS from 22.3 to 12.9 days ($p = 0.03$). Consultant input increased from 19 to 31% ($p = 0.01$).

Conclusions. The dedicated daytime emergency neurosurgery theatre significantly improves daytime surgery and reduces inappropriate out of hours surgery. LOS reductions, both pre- and post-operative, are strong surrogate measures of improved patient outcome and improved efficiency of use of emergency neurosurgical beds. Increased consultant input improves training opportunities.

TPMP1-4: Does pre-operative lumbar drainage prolong the time spent in hospital after surgery?

S. A. Hassan & H. Marsh

Atkinson Morley Wing, St George's Hospital, London, UK

Objectives. To assess the effect of using lumbar drains on the length of hospital stay for patients who underwent microvascular decompression (MVD).

Design. Retrospective case study.

Subjects. Inclusion: patients who underwent MVD for trigeminal neuralgia between the period 1991 and 2012. Exclusion: prolonged admission as a result of another reason.

Methods. The data were collected from patients' notes. The cases (184) were divided into two groups: Group 1 (G1) 137 cases (before 2008) – a lumbar drain (LD) was used to help relax the posterior fossa, reduce cerebellar retraction and visualisation of the cerebello-pontine angle. Group 2 (G2) 47 cases (2008 onwards) – careful aspiration of cerebrospinal fluid (CSF) was used instead of lumbar drainage. G1 and G2 were further subdivided into three age groups.

Results. There was a statistically significant difference between the two groups: p value was 0.000000013. The mean hospital stay time was 5.43 days for G1 and 3.8 days for G2. No complications were observed in G2 as a result of relying on gentle cerebellar retraction and CSF aspiration.

One G1 patient developed cauda equina compression due to subdural haematoma formation, two patients developed bilateral sciatica and four patients developed long-term back pain, which may or may not have been related to LD.

Conclusions. The use of gentle cerebellar retraction and CSF aspiration will significantly reduce the length of hospital stay for patients who undergo uncomplicated MVDs by 30% and will prevent LD-related morbidities.

TPMP1-5: Delays in emergency neurosurgical transfers

K. T. Tsang, B. Jordan & A. Moore

Derriford Hospital, Plymouth, UK

Objectives. In a recent study, only 14% of patients requiring emergency neurosurgical intervention has an operation within 4 h of injury. We sought to identify delays in this process and their potential impact on the final outcome.

Design. One-year prospective data collection and analysis.

Subjects. Consecutive adult neurosurgical patients transferred to neurosurgery for either an emergency operation or intensive treatment unit (ITU) admission from February 2011 to January 2012.

Methods. Prospective recruitment of all emergency transfers between the above dates. The timings of 999 call, arrival in the district general hospital (DGH), imaging, referral to neurosurgery and acceptance, departure from the DGH and arrival in neurosurgery were recorded. The patients' initial Glasgow Coma Scale (GCS) and on admission to neurosurgery were documented along with the final outcome.

Results. During this 1-year period, a total of 152 patients were identified. On average, it took 54.8 min for patients to arrive in the DGH and 165.4 min before imaging was obtained. Referral to neurosurgery was made within 26.5 min and took 13.5 min for acceptance. It then took 122.5 min before the patient would leave the DGH and 93.7 min before arrival in the neurosurgical unit. This gave an average of 476.4 min for arrival in neurosurgery after the initial 999 call. Twenty deaths were recorded, none of whom made the 4-h target.

Conclusions. Patients are experiencing significant delays, mainly associated with initial imaging and organising transport to neurosurgery. A new audit is necessary to determine whether this has improved with the new trauma network.

FAM1 – Spine 2

FAM1-1: Perioperative accidental durotomy: does a longer period of post-operative bed rest reduce the incidence of complication?

J. C. M. Low, S. A. Rutherford & A. T. King

Salford Royal NHS Foundation Trust, Salford, UK

Objectives. An accidental durotomy is a recognised and not infrequent complication of lumbar spine surgery. Conventional post-operative management involves a period of flat

bed rest; however, there is no agreement as to the need for and duration of this proposition. This study aims to determine if the duration of flat bed rest alters the rate of these complications.

Design. A retrospective case review.

Subjects. All patients who had undergone surgery for degenerative spinal disease between May 2009 and May 2010 were reviewed. All patients who incurred an accidental durotomy and were repaired using fibrin glue were included.

Methods. Patient notes were reviewed for evidence of complications for a minimum of 12 months after surgery. The following complications were identified: postural headache, pseudomeningocele, cerebrospinal fluid (CSF) leak and subdural haematoma.

Results. Eight hundred and ninety-two patients underwent lumbar spine surgery. Sixty-one (6.8%) patients suffered an accidental durotomy. Twenty-six patients were mobilised on post-operative day 1, nine patients on day 2 and twenty-six patients were mobilised on day 3 or later. The overall incidence of complications related to the durotomy was 18%. There was no statistical significance between patients mobilised on the first post-operative day and patients mobilised on the third post-operative day or later ($p = 0.433$).

Conclusions. A longer period of mandatory bed rest does not decrease the rate of complications. Patients should be mobilised as soon as they are able. This could potentially reduce the length of hospital stay and the cost of aftercare.

FAM1-2: Re-operation rate after pedicle screw-based posterior dynamic stabilisation of the thoracolumbar spine with the COSMIC® System

A. K. Demetriades¹, M. Behr², F. Ringel², B. Meyer² & M. Stoffel²

¹King's College Hospital, London, UK and ²Technical University Munich, Munich, Germany

Objectives. Revision rates due to adjacent level disease after thoracolumbar fusion can reach up to 20–30%. We determined to assess the revision rate of the alternative technique of posterior dynamic stabilisation for degenerative instability.

Design. Prospective cohort study at a single tertiary institution.

Subjects. Patients receiving this treatment over a period of 56 months (April 2006 to December 2010).

Methods. Prospective data collection during inpatient stay and outpatient follow-up. Analysis using electronic patient records, pre- and post-operative imaging.

Results. Three hundred and forty-six patients were included, with a mean follow-up of 30 months. Median age was 67 (39–78). Eighty-three motion segments were instrumented. Eighteen patients had monosegmental, twenty-five bisegmental and five trisegmental procedures. Forty-eight (13.9%) underwent revision surgery. Median time from primary to revision procedure was 14 (3–41) months. Indications for re-operation within/adjacent to the stabilised segments

were: 0.6% spondylodiscitis, 0.3% osteoporotic fracture, 2.9% screw-loosening, 1.4% persistent/new back pain, 1.4% symptomatic protrusion/stenosis within the stabilised segment and 7.2% symptomatic adjacent segment degeneration.

Conclusions. The overall revision rate of 13.9% after posterior dynamic stabilisation, as shown in this respectably large series with a long observation period, is acceptable. The 7.2% revision rate due to symptomatic adjacent segment degeneration is encouraging. Posterior dynamic stabilisation can be considered to be at least equivalent to fusion procedures in a well-selected cohort.

FAM1-3: A novel, pragmatic spinal outcome score reduces clinic burden and predicts patients requiring clinician review

E. A. C. Pereira, D. Wright, Z. Voysey, K. Patel,
T. A. D. Cadoux-Hudson & S. A. Cudlip

Oxford University Hospitals, Oxford, UK

Objectives. To replace neurosurgeon-led clinic follow-up of degenerative spinal operations with pre- and post-operative follow-up using a novel outcome score (OSS).

Design. Prospective, single-centre audit.

Subjects. All adults receiving elective cervical and lumbar spinal surgery during 1 year from March 2011 to March 2012.

Methods. A patient-reported outcome measure (PROM) was designed incorporating the modified Japanese Orthopaedic Association myelopathy score (JOAS), a quality-of-life measure and numeric pain scores (NPS) for axial and appendicular pain. It was administered to approximately 550 adults at pre-operative assessment and 6 weeks after surgery. Score changes with surgery were analysed and those patients requiring clinic follow-up were scrutinised.

Results. Twenty percent of pre-operatively assessed patients proceeded to surgery and post-operative scoring during the year. Forty-six had cervical and 62 lumbar surgery. Most were uninstrumented lumbar decompressions (49%) and anterior cervical discectomies with fusion (27%). Mean age was 57 years. JOAS, NPS and OSS improved significantly with cervical (8.4, 27.7 and 18.6%, respectively) and lumbar (4.6, 30.6 and 20.2%, respectively) surgery. Fifty-five percent of lumbar and 64% of cervical patients required clinician review. OSS predicted patients requiring clinician review significantly better than NPS and JOAS.

Conclusions. OSS is a novel, pragmatic PROM that can be swiftly administered, saves clinic time and predicts patients requiring clinician review better than NPS or JOAS.

FAM1-4: Does excess posterior spinal fat lead to more perioperative complications in lumbar spine surgery?

P. Grover, S. Pushpanathan, H. M. Samarage &
N. D. Mendoza

Charing Cross Hospital, London, UK

Objectives. To determine whether posterior spinal fat content is a risk factor for intra-operative complications in spine surgery.

Design. Retrospective case note review.

Subjects. All patients over the age of 17 who had lumbar spine surgery in a single centre between October 2009 and 2010.

Methods. Of 135 patients who underwent lumbar spine surgery in a 1-year period at our centre, 101 had complete case notes that were retrospectively studied. Posterior spinal fat content was measured as the perpendicular distance from the skin to the spinous process at the level of pathology on T2-weighted magnetic resonance imaging (MRI). Intra-operative and post-operative complications, operating time, blood loss, length of stay and BMI were recorded from patient's notes. Data were analysed by multiple logistic regression in Minitab v13.1.

Results. Mean posterior spinal fat distance was 22.9mm (SD 11.7). Nine intra-operative complications showed no association with spinal fat content on binary logistic regression (Coeff = 0.011, $p = 0.721$). Posterior spinal fat content also did not correlate significantly with the overall incidence of perioperative complications ($p = 0.205$), operating time ($p = 0.865$), blood loss ($p = 0.820$) or length of stay ($p = 0.057$), but it did correlate significantly with BMI (Coeff = 0.259, $p < 0.005$). BMI also did not correlate significantly with the above dependent variables except for length of stay (Coeff = 0.04, $p = 0.001$).

Conclusions. Increased posterior spinal fat does not lead to an increase in surgery-specific complications in lumbar spine operations.

FAM1-5: Outcome after cervical disc replacement: complications, adjacent disease and motion preservation compared to anterior cervical fusion in a single surgeon series

A. Solth¹, N. Mukerji² & F. P. Nath¹

¹*James Cook University Hospital, Middlesbrough, UK and*

²*Royal Victoria Infirmary, Newcastle upon Tyne, UK*

Objectives. To assess complications, outcome and adjacent disease in cervical disc replacement (CDR) and compare to anterior cervical discectomy and fusion (ACDF) in a series by a single surgeon.

Design. Retrospective case note review.

Subjects. Sixty patients had CDR, 168 had ACDF.

Methods. Data for ACDF were taken from a previous study.¹ Motion preservation was assessed by measuring the interspinous distance in flexion and extension in post-operative cervical spine radiographs of CDR patients.

Results. Outcome was good in both groups, but appeared significantly better in CDR for sensory-motor symptoms (73 vs. 54% in ACDF) and neck pain (69 vs. 49%). The complication rate for CDR was 7% (all prosthesis-related complications with the same implant) and 2% for ACDF ($p = 0.15$). Surgery was offered for adjacent disease in 4% of patients with ACDF and 7% of CDR patients. Radiographic assessment

revealed an average difference in interspinous distance of 5.1 ± 3.7 mm.

Conclusions. CDR had a similar risk profile to ACDF, but there were specific graft-related complications. Improvement of symptoms was significantly higher in patients with CDR, but assessment of outcome is likely to be biased as it is performed by different analyses. There was no significant difference in total subsequent operations for complications or adjacent disease. Radiographic interpretation revealed good preservation of motion on average. CDR appears to be a safe and successful procedure, but superiority regarding adjacent disease could not be shown in this study.

FAM1-6: Transplantation of olfactory ensheathing cells in transected dorsal roots restores electrophysiological synaptic responses in the cord dorsum and the cuneate nucleus

A. Ibrahim¹, Y. Li² & G. Raisman²

¹*UCL Institute of Neurology, Queen Square, London, UK and*
²*Brain Repair Unit, UCL Institute of Neurology, London, UK*

Objectives. This study was carried out to investigate the potential for transplanted olfactory ensheathing cells (OEC) to restore synaptic reconnections.¹

Design. An experimental study in a cohort of laboratory rats.

Subjects. Sixteen female Abino Swiss strain rats.

Methods. Four rats had acute lesions and four had chronic lesions of C5 to T1 dorsal roots flush against the spinal cord. Another eight animals underwent transection and transplantation of OECs. The median nerve of each rat was electrically stimulated while recordings of action potentials at the cord dorsum (CD) and in some animals at the cuneate nucleus were made.

Results. All four chronically lesioned rats without OEC transplant showed complete abolition of CD and cuneate potentials. Two of the four acutely lesioned rats without OECs, also showed complete abolition of all cord dorsum potential (CDP) and cuneate potentials while the other two had a negligibly small potential. Six to eight weeks after transplanting OECs, seven out of eight rats showed significant negatively deflected CDP responses. All four rats where cuneate recording was made, showed synaptic responses. Functional recovery was assessed by ipsilateral paw grasping function over 8 weeks. Six of the eight OEC-transplanted rats showed functional recovery, of which five had clear evidence of negative CDP wave. Three of four rats had functional recovery and showed relatively large cuneate-evoked potential responses.

Conclusions. Transplantation of OECs induces functional recovery in paw grasping and restoration of synaptic responses in the cord dorsum and the cuneate.

Reference

1. Ibrahim A, Raisman G, Li Y. Permanent loss of fore-paw grasping requires complete deprivation of afferent input from a minimum of four dorsal roots of the rat brachial plexus. *Exp Neurol* 2009;215:142-5.

FAM1-7: Does intra-operative disc space lavage reduce the re-operation rate following primary lumbar microdiscectomy surgery?

J. R. Ellenbogen¹, W. Marlow¹, B. E. Fischer¹,
M. Tsegaye² & M. J. Wilby¹

¹*The Walton Centre for Neurology and Neurosurgery, Liverpool, UK and* ²*Queens Medical Centre, Nottingham, UK*

Objectives. To investigate the re-operation rate following elective primary lumbar microdiscectomy and to determine whether disc space lavage and/or principal surgeon grade is a factor in recurrence.

Design. Retrospective case review.

Subjects. Patients who underwent elective primary lumbar microdiscectomy over a 3-year period ($n = 971$).

Methods. We undertook two separate retrospective reviews of patients who underwent elective primary lumbar microdiscectomy over a 3-year period. We examined whether intra-operative lavage of the intervertebral disc space and/or principal surgeon grade had an effect on the rate of re-operation.

Results. The overall re-operation rate for primary elective microdiscectomy was 3.8%, consistent with the published literature. The relative risk of re-operation in the 'non-lavage' group was 2.15 times the risk in the 'lavage' group (95% CI 0.63, 7.34), but did not reach significance ($p = 0.222$). The risk of re-operation in patients primarily operated by registrar surgeons was 1.2-fold the risk in patients operated by consultants (95% CI 0.62, 2.35) although not statistically significant ($p = 0.568$).

Conclusions. Principal surgeon grade was not a factor in recurrence. This information is useful to reassure patients that their outcome from such surgery is not dependent on the grade of surgeon performing the operation. There is a trend towards intervertebral disc lavage reducing the rate of recurrence. The authors recommend disc space lavage as a routine part of lumbar microdiscectomy surgery.

FAM1-8: Foramen magnum decompression for Chiari I malformation: a single institution experience

J. C. Duddy, D. Allcutt, D. Crimmins, D. O'Brien,
D. F. O'Brien, D. Rawluk, M. T. Sattar,
S. Young & J. Caird

Beaumont Hospital, Dublin, Ireland

Objectives. To determine the number and type of complications occurring after foramen magnum decompression for Chiari I malformation.

Design. Retrospective review of medical records for patients who had foramen magnum decompression performed for Chiari I malformation between January 2009 and December 2011.

Subjects. Fifty-four patients including children were eligible for inclusion in this study.

Methods. Operative logbooks, and electronic and hard copies of patient medical records were reviewed. Post-operative outcomes were recorded and analysed. Demographic details and other relevant medical conditions were also noted.

Results. Between January 2009 and December 2011, 54 foramen magnum decompressions were performed for Chiari I malformation. Forty (74%) patients were female and 14 (26%) were male. The majority of patients (42.59%) were aged 16–39 years and 24.07% of patients were children aged <16 years. Thirty (55.6%) patients had documented evidence of a syring pre-operatively. Twenty-one patients (38.9%) developed complications: twelve had multiple complications while nine had a single problem. There was one mortality. Eight patients (14.8%) developed hydrocephalus requiring shunting and there were two cerebrospinal fluid (CSF) leaks. There were four central nervous system (CNS) infections and four other infections. Five had ongoing or worsening symptoms and there were three intracranial haemorrhages.

Conclusions. Foramen magnum decompression for Chiari I malformation is a procedure that carries significant risk. In particular, the risk of developing post-operative hydrocephalus requiring permanent shunting is relatively high.

FAMP1 – Miscellaneous 2

FAMP1-1: An algorithm for reanimation of the paralysed face

K. G. Krishnan^{1,2} & P. M. Richardson²

¹Justus Liebig University, Giessen, Germany and

²The London Clinic, London, UK

Objectives. The human face may be seen as a multifaceted functional organ, the mimic function being one of them. Mimic is effectuated by several morphological subunits that function in a coordinated manner to reflect the mental status of a person. Loss of mimic plays an impressive role for patients, such that the treatment of facial paralysis (FP) has been in the spotlight for centuries. Mimic reanimation is not only a reconstructive challenge but also an aesthetic one. The surgical treatment of facial palsy is based on various factors, such as aetiology, level of lesion, age/compliance of the patient and, importantly, the latency between the onset and treatment. If indicated, a surgical solution is possible for any of these lesions.^{1,2}

Methods. In all, 57 patients (12–87 years) were surgically treated for unilateral FP. Fifty-three FPs after vestibular schwannomas or brain stem cavernoma surgery and four had Möbius syndrome. Sixteen presented within 6 months of lesion, where nerve transfers from the hypoglossal nerve were performed. Among 41 late presentations (FP 2+ years), dynamic microneurovascular reanimation (DMNVR) was done in 29 cases and macrosurgical reanimation or static slinging in 12 elderly patients. Follow-up ranges from 12 to 96 months.

Results. Static symmetry of the face could be achieved in all patients. Movement of the oral commissure was observed in 14/16 (88%) and 27/29 (93%) patients undergoing nerve transfers and DMNVR, respectively. Among the DMNVR

patients, normalisation occurred in 55% (16/29), improvement in 38% (11/29) and failure in 7% (2/29). Only 13% (6/45) of the patients overcame synkinesis. Parotid fistula and infection in 1/57 (2%) each. Patients' self-evaluation was higher than objective indices.

Conclusions. Primary nerve reconstruction, static and DMNV reanimation strategies are capable of producing favourable results in a differentially selected patient cohort with FP. Despite inadequate results (19%) and complications (2%), all patients evaluate themselves more favourably, probably owing to restored dignity of symmetrically appearing faces.

References

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FAMP1-2: Medical students' and junior doctors' perceptions of neurosurgery as a career

J. Frantzas¹, S. Acharya², Y. Chowdhury³ & A. Lawson-Mclean¹

¹University of Edinburgh, Edinburgh, UK, ²Barts and the London School of Medicine, London, UK, and ³National Hospital for Neurology and Neurosurgery, Queen Square, London, UK

Objectives. There has been a falling trend in the number of applicants for neurosurgery in recent years, while the number of female applicants remains low relative to the proportion of female medical students. Our objective was to identify perceptions about neurosurgery, and assess factors that affect career choice. We hypothesised that a 1-day careers event is a good intervention to increase the interest in the specialty.

Design. Questionnaire-based cohort study.

Subjects. Medical students and junior doctors.

Methods. In collaboration with the Society of British Neurological Surgeons, we organised a neurosurgery careers day for medical students and junior doctors. We asked all participants to fill in the same questionnaire both before and after the event. Results were compared using a paired, two-tailed *t*-test.

Results. 55% of participants, including 69% of females, identified poor work-life balance as the main disadvantage of neurosurgery. Only 35% agreed/strongly agreed that they have a good understanding of the specialty. Significantly less attendants perceived neurosurgery as a male-dominated specialty [$t(92)=4.4$, $p < 0.001$], and significantly more were interested in pursuing it as a specialty [$t(92) = -3.5$, $p < 0.001$] after the event.

Conclusions. Little exposure and misconceptions about the specialty are the main reasons for discouraging potential applicants, particularly female, from pursuing a career in neurosurgery. Such careers events have significantly increased interest in neurosurgery.

FAMP1-3: Reanimation of the shoulder using free functional muscle transplantation (FFMT) in irreparable circumflex axillary nerve (CAN) lesions

K. G. Krishnan^{1,2} & P. M. Richardson²

¹Justus Liebig University, Giessen, Germany and

²The London Clinic, London, UK

Objectives. Primary reconstruction of the brachial plexus and peripheral nerves results in favourable outcomes only when performed within a given time frame, when the target muscles still possess the capability to be reinnervated. In long-standing lesions, secondary reanimation surgery has come to play an important role. Free functional muscle transplantation (FFMT) for flaccid brachial plexus lesions was first described by Doi for the reanimation of wrist and elbow flexion. Here, we analyse the results of FFMT in shoulder reanimation.^{1,2}

Design. A retrospective analysis of function in FFMT to improve shoulder stability and movement.

Methods. Among the 192 patients who underwent various secondary reanimation surgeries for brachial plexus injuries, 42 patients received FFMT for shoulder reanimation. Patients with flaccid shoulders can be further classified into two categories: (Group A) circumflex axillary nerve (CAN) lesion only ($n = 11$) and (Group B) CAN lesion combined with suprascapular nerve (SSN) lesion ($n = 31$). All patients underwent the same surgical procedure: transplantation of a free vascularised and innervated gracilis muscle for the reanimation of arm abduction. Innervation of the FFMT flap was through the end branch of the spinal accessory nerve. Revascularisation was through the thoraco-acromial vessels. The mean follow-up was 18 months (range 9–48 months).

Results. Visible and volitional reinnervation of the FFMT flap occurred at 3–5 months after surgery. Ten of the eleven patients in Group A were able to volitionally stabilise their shoulders using the FFMT neo-deltoid. Eight of eleven patients could abduct the arm against gravity (6/11 against resistance) to 90° according to the Neutral-Null Scale. In Group B, the results were less encouraging. Although all patients achieved good to satisfactory stability of the shoulder and freedom from pain, none was capable of abducting the net weight of the arm using the neo-deltoid alone. There were no anastomosis failures; failure to innervate occurred in 1/11 in Group A and in 5/31 in Group B. No infections; detethering of the tendon in none; donor site morbidity in none.

Conclusions. (1) FFMT of the shoulder functions well only when supported by intact muscles of the neighbourhood (e.g. pectoralis major, supra and infraspinati muscles). (2) FFMT as a stand-alone procedure in combined CAN and SSN (which is more often the case) can offer only to stabilise the shoulder and relief from instability pain.

References

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FAMP1-4: Neurosurgical decision making in intracerebral haemorrhage: an analysis of patients referred to a regional UK neurosurgical centre

K. A. Abid, A. R. Parry-Jones, A. Vail, H. C. Patel, P. J. Tyrell & A. T. King

Salford Royal Hospital, Salford, Greater Manchester, UK

Objectives. The role of surgery in the management of intracerebral haemorrhage (ICH) remains uncertain. We analysed the practice at a regional UK neurosurgical centre to determine the factors that influence management decisions following acute referral.

Design. Retrospective case note and imaging-based review of patient records and survival data.

Subjects. A total of 1364 spontaneous ICH cases were referred from 1 January 2008 to 17 October 2010.

Methods. Clinical details were prospectively recorded and the first computed tomography (CT) brain scan was retrospectively reviewed. Survival status was obtained on 21 October 2011. Primary outcome was acute neurosurgery and secondary outcomes were transfer to the centre and death at 30 days. Logistic regression was performed to determine odds ratios.

Results. A total of 1175 cases were included in the final analysis. 140 (12%) were transferred and 75 (6%) had surgery. Management decisions were made by one of 19 consultant neurosurgeons. Surgery was less likely with increasing age (OR 0.47; 0.39–0.56), decreasing GCS (OR 0.923; 0.88–0.97) and supratentorial location (OR 0.41; 0.23–0.727). Transfer was also less likely with increasing age, a decreased GCS, supratentorial bleed location and smaller haematomas. Hydrocephalus was associated with surgery but not with transfer. Medical treatment was associated with a lower chance of mortality at 30 days (OR 0.31; 0.12–0.78) but surgery was not (OR 0.50; 0.24–1.01).

Conclusions. Younger age and infratentorial location are strong predictors of decisions to transfer and to operate on ICH patients at our centre. The decreased mortality in transferred patients provides evidence that dedicated neurosurgical care may make a significant difference in a select subset of patients.

FAMP1-5: Capturing the keyhole effect in eyebrow craniotomies: a novel application of the 'working volume'

Z. Zador, D. J. Coope & K. K. Gnanalingham

Department of Neurosurgery, Salford Royal Hospital, Manchester, UK

Objectives. Minimally invasive approaches utilise the 'keyhole effect' to access deep surgical targets exceeding

craniotomy window size. Using the recently developed parameter of 'working volume', we assessed surgical corridor volumes created by the 'keyhole effect' in eyebrow craniotomies.

Design. Prospective audit and surgical simulations.

Subjects. Surgical phantom and operative cases.

Methods. Craniotomies of equal areas were simulated in surgical phantom with targets measuring 3.1, 7.1 and 12.6 cm². 'Working volume' was extracted from reference coordinates acquired with frameless neuronavigation. Acquisition was replicated in clinical cases undergoing eyebrow craniotomy for suprasellar lesions of different sizes. Data were analysed using ball pivoting algorithm and R statistics.

Results. Simulated working volumes were 15.2 ± 1 , 34.5 ± 2 and 48.5 ± 3 cm³ in linear co-relation to increments of surgical target sizes ($AVR \pm STDEV$, $n = 3$, $r^2 = 0.97$). Intra-operative working volume range was 15.6–58.4 cm³ ($n = 4$) correlating with coronal tumor cross sections of 1.4–10.7 cm² ($r^2 = 0.93$). Analysis of covariance showed no statistical difference in regression characteristics of simulated versus intra-operative data ($F = 1.96$, $p = 0.19$).

Conclusions. The novel parameter "working volume" successfully captures the advantages of the "keyhole effect" in the eyebrow craniotomy. Our simulations allow accurate estimations of surgical corridor dimensions, demonstrating its potential as an operative planning tool.

FAMP1-6: Analysis of variations of far lateral approaches of the foramen magnum

S. Sfikas, N. Gkekakos, A. Vyziotis, N. Georgakoulas, G. Orfanides & A. Jenkins

Department of Neurosurgery, General Hospital of Athens, Athens, Greece and Department of Neurosurgery, Royal Victoria Infirmary, Newcastle upon Tyne, UK

Objectives. The selection of the appropriate variation of far lateral approaches of the foramen magnum requires thorough analysis and understanding of the relationships between the occipital condyle, the jugular tubercle and the hypoglossal canal.

Design. Six patients with lesions in the area of the foramen magnum in which different approaches were selected.

Subjects. Skull base.

Methods. We explain how the anatomic relations of these three basic structures helped us to select the appropriate approach.

Results. The study of the foramen magnum consists of the analysis of the relationship of the tumour with the anterior or anterolateral margin of the foramen, with the vertebral and basilar arteries, with the jugular bulb, the jugular and hypoglossal foramina. Furthermore, studying whether a vertebral artery or a sigmoid sinus is dominant with digital subtraction angiography (DSA) or magnetic resonance (MR) angiography increases the safety of the approaches. Finally, high-resolution 3D computerised tomography (CT) is

possible to reveal the extent of bone involvement in the case of osteolytic lesions. The decision to stabilise or not the occipitocervical area was made on the intra-operative findings of transcondylar drilling or tumor erosion.

Conclusions. The transcondylar approach is useful for aneurysms of the posterior inferior cerebellar artery (PICA) and the vertebrobasilar as well as for small tumours of the area. A more useful approach is the transtuberular approach with the removal of the bone bridge between the jugular bulb and hypoglossal canal. The transjugular approach is reserved for extra-axial tumours, when the removal of the condyle is necessary for the removal of the tumour.

FAMP1-7: Safe entry into the floor of the fourth ventricle

F. Nath

Middlesbrough Neurosurgical Unit, Middlesbrough, UK

Objectives. I cannot escape the feeling that when I was young (in neurosurgical terms), I was always so certain. I was so sure that I was right and that I knew the truth of it. Now, as the curtain begins to close on my career, I realise how little I do know and where the grey areas lurk. And there are many grey areas. Removal of lesions in the brainstem is one of these. The objective of this presentation is to inform the Society of a 'safe' way to accomplish this.

Design. A presentation of the anatomical areas of safety in the floor of the fourth ventricle, illustrated by diagrams and video.

Subjects. Two safe routes into the brainstem exist, described in detail by Kyoshima.¹ Modern British practice seems ignorant of this fact. By using the anatomy and landmarks visible in the floor of the fourth ventricle, brainstem cavernomas can be removed minimising damage and with a low mortality.

Methods. The anatomy and approaches are discussed and illustrated with diagrams and video.

Conclusions. It is possible to enter the floor of the fourth ventricle safely, although the risks are high and disability is common.

Reference

1. Shigeaki Kobayashi, Atul Goel, Kazuhiro Hongo. *Neurosurgery of complex tumors and vascular lesions*. New York: Churchill Livingstone, 1997.

FAMP1-8: Neurosurgery in octogenarians: an age old problem

M. G. Stovell & M. D. Jenkinson

The Walton Centre for Neurology and Neurosurgery, Liverpool, UK

Objectives. To assess outcome and complications in patients >80 years old undergoing neurosurgery, in response to the

2010 NCEPOD report: 'Elective & Emergency Surgery in the Elderly: An Age Old Problem.'

Design. Audit.

Subjects. Elective and emergency patients >80 years admitted to a regional neurosurgery unit between 1 January and 30 June 2010.

Methods. Retrospective case review: admission type and category, length of stay (LoS), co-morbidity, medication, complications, discharge destination and functional outcome.

Results. A total of 2707 neurosurgery admissions; 62 patients (2.3%) >80 years old (range 80–94). Elective 28; emergency 34. Median LoS 6 days (range 1–49). Admission category: cranial trauma 22; cranial tumour 5; functional 4; degenerative spine 19; spine trauma 7; spine tumour 3; other 2. Forty-four (71%) had >1 significant co-morbidity; 16 (26%) on anticoagulation/antiplatelet medication. Thirty-nine (63%) had good outcome/improvement at discharge; 22 (35%) unfavourable outcome/no improvement ($n = 1$ no data). Five (8.1%) post-operative surgical complications; 10 (16.1%) medical complications. Discharge destination: home ($n = 33$), referring hospital ($n = 25$), nursing home ($n = 2$). Thirty-day mortality was 3 (4.8%).

Conclusions. Octogenarians undergoing neurosurgery have significant co-morbidity, but the outcomes, complication rate and the 30-day mortality are reasonable. However, this cohort represents those deemed suitable for neurosurgical intervention and does not account for the octogenarian population that declined neurosurgery.

POSTER PRESENTATIONS

Trauma (Head and Spine)

P1: Double folded large pericranial flap for repair of anterior skull base defects: the Plug and Pad technique

H. El-Maghraby¹, G. Walton² & J. Stocker³

¹Department of Neurosurgery, University Hospital, Coventry, UK, ²Department of Head and Neck Surgery, University Hospital, Coventry, UK, and ³Department of Maxillofacial Surgery, University Hospital, Coventry, UK

P2: Non-surgical management of odontoid fractures as the main line of treatment

M. Delour Fam, P. Bhatt & E. Labram

Aberdeen Royal Infirmary, Aberdeen, UK

P3: The neuroprotective effects of post-injury vitamin treatment in traumatic brain injury

S. R. Hall¹, M. Gatherer¹, A. K. Pringle¹ & A. Belli²

¹Division of Clinical Neurosciences, Southampton General Hospital, Southampton, UK and ²School of Clinical and Experimental Medicine, University of Birmingham, Birmingham, UK

Spine

P4: Outcome of halo jacket immobilisation for cervical spine injury – a single unit's experience

M. B. Mohamed, F. Hassan & G. Wynne-Jones

Department of Neurosurgery, Royal Victoria Infirmary, Newcastle upon Tyne, UK

P5: Is pre-operative or early post-operative outcome score a reliable prognosticator in patients undergoing spinal surgery?

S. K. Selvanathan, K. B. Wong & D. Pal

Leeds General Infirmary, Leeds, UK

P6: Novel versus standard percutaneous vertebroplasty

R. Mathew, W. Cheong Soon & J. Timothy

Leeds General Infirmary, Leeds, UK

P7: Description of a novel pedicle screw scoring system – the HEY score

O. Yaseen, T. D. Sanusi & G. Spink

Department of Neurosurgery, Hull Royal Infirmary,

Hull and East Yorkshire NHS Trusts, UK

P8: High body mass index may affect outcome in primary lumbar disc surgery

J. R. Ellenbogen, K. Java & C. Barrett

The Walton Centre for Neurology and Neurosurgery, Liverpool, UK

P9: Early clinical experience of the first ACDF cage made purely from nanocrystalline hydroxyapatite

O. Richards¹, A. Shah² & J. Timothy¹

¹Department of Neurosurgery, Leeds General Infirmary, UK and ²Department of Neurosurgery, University Hospital, Coventry, UK

P10: An audit of regional open access lumbar spine MRI requests and its impact on neurosurgical services

A. Sheikh, M. Tang & E. Ballantyne

Department of Neurosurgery, Ninewells Hospital, Dundee, UK

P11: Lessons for better post-operative imaging of pedicle screw implants

J. R. Ellenbogen, A. A. Razzaq, E. Harrison, S. Niven & R. Pillay

The Walton Centre for Neurology and Neurosurgery, Liverpool, UK

P12: The occult nature of intramedullary spinal cord metastases from renal cell carcinoma

Z. Zakaria, E. Fenton, D. O'Brien & M. Jansen

Department of Neurosurgery, Beaumont Hospital, Dublin, Ireland

P13: A review of spinal level localisation techniques

I. Coulter¹ & N. Todd²

¹James Cook University Hospital, Middlesbrough, UK and ²The Walton Centre, Liverpool, UK

P14: Consensus in the optimal management of sciatica – can we ever agree?

R. C. Morris¹, A. Hussein² & M. Wilson²

¹King's College Hospital, London, UK and ²St Mary's Hospital, London, UK

Oncology/Radiosurgery

P15: Replicating tumour heterogeneity *in vivo*: moving into the third dimension

S. Smith¹, J. Ward², C. Rahman³, M. Wilson⁴ & F. Rose³

¹Department of Neurosurgery, Nottingham University Hospitals, Nottingham, UK, ²Children's Brain Tumour Research Centre, University of Nottingham, Nottingham, UK, ³School of Pharmacy, University of Nottingham, Nottingham, UK, and ⁴School of Cancer Sciences, University of Birmingham, Birmingham, UK

P16: The quality of facial nerve function after acoustic neuroma surgery

M. A. Langford^{1,2}, M. R. Macfarlane^{1,2} & P. M. Bhatt²

¹Christchurch Public Hospital, Christchurch, New Zealand and ²Aberdeen Royal Infirmary, Aberdeen, UK

P17: Diagnostic yield and complication rates for brain biopsies using different modalities. Single centre experience

O. A. Sobowale, K. Karabatsou, A. Sofat & J. Leggate
Department of Neurosurgery, Greater Manchester Neurosciences Centre, Salford, UK

P18: Challenges in craniopharyngioma

U. P. Devkota & K. C. Bidur
National Institute of Neurological and Allied Sciences, Kathmandu, Nepal

P19: Delayed recurrence of medulloblastoma: an exception to Collins' law

S. Mccarthy
Department of Neurosurgery, Cork University Hospital, Cork, Ireland

P20: Immediate titanium cranioplasty for brain tumours invading the skull

P. I. D'Urso¹, R. Morris¹, E. Albanese¹, R. Bentley², N. Cavale² & R. Bhangoo¹

¹Department of Neurosurgery, King's College Hospital, London, UK and ²Department of Maxillofacial Surgery, King's College Hospital, London, UK

P21: A decade analysis of the two-week wait rule for brain tumours

A. Hamdan^{1,2} & P. Mitchell²

¹Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, UK and ²Royal Victoria Infirmary, Newcastle upon Tyne, UK

P22: The role of NG2/CSPG4 in resistance to radiotherapy in glioblastoma cells

R. Heywood¹ & C. Watts²

¹Cambridge Centre for Brain Repair, Cambridge, UK and ²Department of Neurosurgery, Cambridge, UK

P23: Functional genomic analysis defines a novel three-compartment model of GBM

C. Watts¹, S. Tavaré², S. Piccirillo³, A. Sottoriva² & I. Spitieri²

¹University of Cambridge, Cambridge, UK, ²CRUK CRI, Cambridge, UK, and ³Department of Clinical Neurosciences, Cambridge, UK

Neurovascular

P24: Outcome of spontaneous subarachnoid haemorrhage with negative angiographic studies

A. Tasiou, I. Siasios, K. Paterakis, E. Kapsalaki & K. Fountas
University Hospital of Larissa, Larissa, Greece

P25: Cerebral revascularisation surgery: a single centre's experience in the era of GOSS and flow diverters

K. Deniz, A. Elyas, T. Hampton & C. Tolia
King's College Hospital, London, UK

P26: Poor grade subarachnoid haemorrhage: should we treat it?

M. Lazukova & P. Gan
Queen Elizabeth Hospital, Birmingham, UK

P27: Stent assisted coiling, a feasible alternative?

I. Djoukhar, R. Mathew, S. Ross, T. Goddard & T. Patankar
Neuroradiology Unit, Leeds Radiology Academy, Leeds General Infirmary, Leeds, UK

P28: Subarachnoid haemorrhage – when to stop investigating?

B. Roy Chaudhary, A. Ansari & L. Chumas
Addenbrooke's Hospital, Cambridge, UK

P29: Aneurysmal endovascular coiling following subarachnoid haemorrhage: account of a single unit's experience

B. Dhamija, M. Williams, H. Ali & H. L. Brydon
University Hospital of North Staffordshire, Stoke-On-Trent, UK

P30: The hemodynamics of a recurrent coiled intracranial aneurysm

C. Nobel, A. Marzo, P. Lawford, D. R. Rose, S. C. Coley & U. J. Patel
University of Sheffield, Sheffield, UK and Sheffield Teaching Hospitals NHS Trust, Sheffield, UK

Hydrocephalus

P31: *In vivo* study of the relationship of CSF dynamics and Virchow–Robin spaces in idiopathic normal pressure hydrocephalus

W. A. Mohamed¹, A. Tarnaris¹, H. Murphy¹, M. Czosnyka² & G. Flint¹

¹Department of Neurosurgery, Queen Elizabeth Hospital, Birmingham, UK and ²Academic Department of Neurosurgery, University of Cambridge, Cambridge, UK

P32: Amyloid beta and tau biomarkers in normal pressure hydrocephalus

L. Meilak, J. D. Shand Smith, A. K. Toma,
L. D. Watkins & N. D. Kitchen
*The National Hospital for Neurology and Neurosurgery,
London, UK*

Miscellaneous: e.g. Outcomes/IT in Neurosurgery

P33: Re-evaluation of three session theatre efficiency

A. S. Nadig & I. Kamaly-Asi
*Greater Manchester Neurosciences Centre, Salford,
Manchester, UK*

P34: Efficacy of regional scalp block for post-craniotomy pain: systematic review and meta-analysis

M. R. Guilfoyle, A. Helmy,
D. Duane & P. J. A. Hutchinson
Addenbrooke's Hospital, Cambridge, UK

P35: The impact of a neurosurgical placement on career aspirations in doctors at senior house officer (SHO) equivalent grades

A. S. Takhar, P. Coyle, B. Zebian & S. R. Stapleton
*Department of Neurosurgery, Atkinson Morley, St George's
Hospital, London, UK*

P36: Community consultation in emergency neurosurgical research: lessons from a new trial in traumatic brain injury

A. G. Kolas, D. J. Clark, S. C. Ingham, E. A. Corteen,
P. J. Kirkpatrick, D. K. Menon & P. J. Hutchinson; on behalf
of the Rescue-ASDH investigators
*Division of Neurosurgery, Addenbrooke's Hospital,
Cambridge, UK and University of Cambridge, Cambridge, UK*

P37: Chemothromboprophylaxis following neurosurgery

S. Alexander, A. Helmy, S. Chapman,
L. Marsland & R. Trivedi
Addenbrooke's Hospital, Cambridge, UK

P38: Neurosurgery in East Africa: a trainee's experience

A. E. Henderson
Queen's Medical Centre, Nottingham, UK

P39: Assessing procedural practices of trainees performing diagnostic lumbar punctures: are neurosurgery trainees more knowledgeable?

J. A. Emelifeonwu, J. L. Lang & P. Leach
*Department of Neurosurgery, University Hospital of Wales,
Cardiff, UK*

P40: Intrathecal vancomycin prophylaxis for external ventricular drains (EVDs): a two-year observational study

R. Z. Fu, J. T. Laban, P. S. Minhas & A. J. Martin
*Department of Neurosurgery, Atkinson Morley Wing,
St George's Hospital, London, UK*

P41: Does the insertion of an intra-operative lumbar drain improve outcome in CSF leak repairs?

S. Sciacca, A. Borg & J. Pollock
*Department of Neurosurgery – Barking, Havering and
Redbridge University Hospitals NHS Trust,
Queen's Hospital, Romford, UK*

P42: Pre-operative skin preparation and intra-operative drape stapling practices; an audit of the neurosurgical units in the UK and Ireland

J. Wilson, S. Thomson & P. T. van Hille
*Department of Neurosurgery, Leeds General Infirmary,
Leeds, UK*

Functional/Image Guidance/Stereotaxy

P43: Epilepsy surgery from 1896 to 2012 – has anything really changed?

R. C. Morris¹ & N. Kitchen²
¹*King's College Hospital, London, UK and*
²*The National Hospital for Neurology and
Neurosurgery, London, UK*

P44: Cortical correlates of contrast perceptual asynchronies in foveal and peripheral presentations

S. Lammy
*Department of Neurobiology, University College,
London, UK*