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PROCEEDINGS

Proceedings of the 155th meeting of the Society of British Neurological Surgeons

The meeting is being held at Queen's College, Cambridge 24th–26th March 2010 and is hosted by the Department of Neurosurgery, Addenbrooke's Hospital, Cambridge, UK.

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

These abstracts are published in advance of the meeting. If any papers are subsequently not read to the Society or are withdrawn, an addendum to this effect will be published in the next issue of the Journal.

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

PRESENTED ABSTRACTS

General:

FH W4-01: SILVER Trial

N. C. Keong, D. Bulters, H. Richards, M. Farringdon, O. Sparrow, P. J. Hutchinson, J. D. Pickard & P. J. Kirkpatrick (Divisions of Neurosurgery and Microbiology, Cambridge University Hospitals NHS Foundation Trust, Department of Neurosurgery, Southampton)

Objectives: The SILVER Trial (Silver Impregnated Line Versus EVD Randomised Trial) was designed to assess the clinical effectiveness of silver-impregnated EVDs against infection.
Design: This was a double-blind randomised controlled trial comparing silver-impregnated EVDs to plain EVDs.
Subjects: Patients who were admitted for the management of their intracranial pathology were considered for the trial according to inclusion and exclusion criteria. Patients who required an EVD were randomised to receive either a silver-impregnated EVD or a plain EVD.
Methods: The chosen primary end-point for this trial was cerebrospinal fluid infection as defined by organisms seen on microscopy or culture. Secondary end-points included the duration of EVD placement and requirement for ventriculo-peritoneal shunting.
Results: Results from 278 patients were available for analysis (140 in Study Arm A, 138 in Study Arm B). The overall infection rate was 16.9 % (47/278). Study Arm A had an infection rate of 21.4% (30/140) whilst Study Arm B had an infection rate of 12.3% (17/138). This was found to be a significant difference ($p < 0.05$).
Conclusions: This randomised trial has been concluded and the results are awaiting ratification by the Data Monitoring Committee prior to unblinding of the study arms.

FH W4-02: The natural history of cranial dural arteriovenous fistulae with cortical venous reflux

D. O. Bulters, N. Mathad, J. Millar & O. C. Sparrow (Wessex Neurological Centre, Southampton, United Kingdom)

Objectives: There are wide variations in the quoted risk of haemorrhage for dural arteriovenous fistulae with cortical venous reflux. We investigated the risk of haemorrhage and considered predictors of aggressive behaviour, which may explain differences between these studies and to help estimate the risk of specific fistulae.
Design: Case note and angiogram review of fistulae seen in our AVM clinic between 1992 and 2007.
Subjects: 70 patients harbouring 75 dural arteriovenous fistulae with cortical venous reflux.
Methods: We assessed the time at risk of the fistulae and the incidence of haemorrhage and non-haemorrhagic deficit during this period to calculate the event rates for dural fistulae. We then considered the differences between Borden and Cognard grades, presentation and the effect of partial treatment.
Results: There were 8 haemorrhages in 90.1 years of follow up. The crude annual risk of haemorrhage was 8.9%. Untreated lesions had a risk of 12.7%. Partial treatment reduced the risk of haemorrhage to 4.7%, although this relationship was complex. The presence of a varix increased the risk of haemorrhage seven fold (3.5% versus 26.6%). Patients presenting with a haemorrhage (20.4%) or non-haemorrhagic neurological deficit (22.2%) had a higher risk of haemorrhage than those with a benign presentation (4.3%).
Conclusions: Dural arteriovenous fistulae are a complex and heterogeneous group of lesions. Overall untreated lesions have a 12.7% annual risk of haemorrhage. This is higher than recent reports and likely due to differences in study populations.

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Thus each lesion must be considered individually to assess the risk of haemorrhage.

FH W4-03: Treatment of Cerebral Metastases with Shaped Beam Stereotactic Radiosurgery

A. McCormack, P. C. Whitfield, S. Kelly, W. M. Adams, S. Pascoe, J. D. Palmer, A. Gwillam & J. Pearn on behalf of the South West Stereotactic Radiosurgery Group (South West Neurosurgery Centre, Derriford Hospital, Plymouth)

Objectives: To report the radiological and survival outcomes in patients with cerebral metastases treated with shaped beam stereotactic radiosurgery (SRS).
Design: Observational with prospectively recorded volumetric and survival data.
Subjects: 74 patients with metastatic brain tumours from a variety of primary sites.
Methods: SRS was considered in the management of patients with 1–3 metastatic brain tumours. A recursive partitioning analysis approach facilitated decision making. Day case frame-based stereotactic radiosurgery was delivered using a multileaf M3 collimator adapted LINAC (Brainlab). MRI was used as the principal modality for target delineation. Most patients received 18Gy to the encompassing isodose. Large volume tumours, or lesions in close proximity to organs at risk, received a reduced dose. Radiological follow-up was performed, where clinically appropriate, at 3 month intervals. Kaplan-Meier survival analysis was recorded.
Results: 50 patients underwent one SRS treatment. 24 patients underwent two or more SRS treatments for new lesions; no recurrent lesions have been treated. In total 114 lesions (median volume 4.175cm^3) were treated (median dose of 18Gy to the encompassing isodose). Complete radiological follow-up was available for 49 patients revealing tumour control in 85% of lesions. Overall the median survival was 11 months, with 6 month and 12 month survival rates of 62% and 48% respectively.
Conclusions: Survival rates are favourable compared with published data. Shaped beam SRS is an effective modality in the treatment of cerebral metastases and should be considered as an important treatment option in this group of patients.

Reference

1 Gaspar L, Scott C, Rotman M, Asbell S, Phillips T, Wasserman *et al. Int J Radiat Oncol Biol Phys* 1997;37:745–51.

FH W4-04: Neurosurgical Research in the UK: Current state and barriers to progress

R. M. deSouza, N. Shlomo & W. P. Gray (Department of Neurosurgery, Southampton General Hospital, Southampton, UK)

Objectives: National neurosurgical research networks are well established in the US and Australia to coordinate research activity and provide information on funding. Our objectives were to describe the current state of neurosurgical research in the UK and to identify the major barriers.
Design: Comprehensive online survey.
Subjects: 179 UK consultant neurosurgeons (80%) responded. 104 are current researchers, 61 past researchers, 50 of whom would return to research if barriers were addressed. Of the current researchers, 58 perform purely clinical research and 43 do basic/translational research. All respondents perform clinical audit. Only 2% were members of a national research network.
Methods: Confidential online survey designed by the Department of Neurosurgery and the School of Health Sciences at Southampton University.
Results: Current researchers felt supported by their units but not the NHS ($P < 0.05$). 12% of current researchers have income $>$£500k. These are translational workers (67%) doing original work (83%) in a formal infrastructure (100%) and prefer leadership roles (100%). 70% of current researchers have income $<$£100k and apply less to the NIHR or Research Council ($P < 0.01$).
Conclusions: There is a significant lack of knowledge of, and engagement with, clinical research structures and funding by academic neurosurgeons in the UK. Many of these issues can be addressed by forming a national neurosurgical research network.

Reference

1 http://www.nrf.com.au/ Neurosurgery Research and Education Foundation.

FH W4-05: An algorithm to permit the safe, EWTD and New Deal compliant preservation of the registrar on-call system: a 1 year prospective study

N. Haliasos, G. Prezerakos, H. Akram, S. Shaw & J. E. Brecknell (Queen's Hospital, Romford, UK)

Objectives: There is a growing need to look at different strategies to deal with out of hours referrals in neurosurgical centres to prevent less than emergency calls disturbing the on-call trainee and their necessary rest periods[1]. Here we present a neurosurgical referral algorithm and its application to the out of hours period.
Design: Data collected from 1-11-2008 prospectively for 12 months.
Subjects: On-call referrals.
Methods: After a pilot study a set of hierarchical questions (algorithm) was devised and tested. The junior member of the on-call team - already on a full-shift working pattern - used this algorithm to

filter referrals received between 21:00 and 08:00. Based on the outcome of the algorithm the junior member would either wake the on-call registrar or discuss the referral with him/her in the morning.
Results: From 2678 referrals, 695(25.1%) where made out of hours. The average maximum length of uninterrupted sleep was 7.05 hrs vs 5.4 hrs predicted without the algorithm ($p < 0.01$) while the new deal target of 5 hrs consecutive rest was achieved on 83% of days vs 52% ($p < 0.01$). The number of calls disturbing the on-call registrar fell by 45%.No adverse events were reported resulting in patient harm.
Conclusions: There is considerable evidence that the full shift system does not improve patient care or the trainees/trainers work/life balance and detracts from training[2]. Here we present a tool, the implementation of which has allowed the safe preservation of an on-call working pattern which is compliant with both the new deal and EWTD in one neurosurgical unit.

References

1 Philip Van Hille (President of SBNS), Newsletter, Society of British Neurorological Surgeons, Summer 2009.
2 J Black (President of RCSE), WTD - Implications and Practical Suggestions to Achieve Compliance Report, Joint Royal College of Anaesthetists and Royal College of Surgeons of England WTD 2009 Project.

FH W4-06: Radiotherapy and an oncolytic herpes simplex virus synergistically kill glioma stem cells

D. S. Jeyaretna, K. Palanichamy, Z. Barnard, H. Wakimoto, S. Kesari, W. T. Curry, A. Chakravarti, S. Rabkin, P. C. Whitfield & R. L. Martuza (Derriford Hospital, Plymouth, UK & Massachusetts General Hospital, Boston, Massachusetts. USA)

Objectives: The resistance of glioblastomas to radiotherapy may be mediated by Glioma Stem Cells (GSCs), a subset of cells with enhanced DNA repair machinery. The genetically engineered G47delta herpes simplex virus has been developed to exploit the up-regulation of DNA repair machinery in GSCs. The hypothesis that treatment of irradiated GSCs with G47delta, enhances glioma stem cell death compared with radiotherapy or G47delta infection alone, was investigated.
Methods: GSCs were isolated from GBM surgical specimens. Irradiated GSCs cultures were infected with G47delta to determine the cytotoxic effect of this combination treatment. Appropriate controls were used. Cytotoxic efficacy was assessed using a Chou-Talalay analysis. Western blotting and flow cytometric analysis of irradiated GSCs were used to evaluate mechanisms of enhanced viral efficacy. *In vivo*, stereotactically implanted GSC tumours were developed. The efficacy of radiotherapy and implanted G47delta was evaluated with appropriate controls.
Results: The efficacy of radiotherapy varied among the GSC cultures (EC50 2-20Gy). All GSC lines were susceptible to infection and killing by G47delta. *In vitro*, radiation therapy and G47delta had synergistic cytotoxic effects (combination index <0.7). *In vivo*, radiation combined with G47delta therapy extended survival compared to either single treatment group ($p < 0.05$). Analysis of irradiated GSCs suggests that G47delta exploits GSC repair mechanisms, induced by radiotherapy, to enhance its viral oncolytic potency.
Conclusions: A synergistic treatment effect of G47delta with radiation treatment was observed *in vitro* and *in vivo*, compared with single agent treatment. G47delta is able to capitalise on the DNA repair machinery response of GSCs resistant to radiotherapy.

FH W4-07: An update on the RESCUEicp Decompressive Craniectomy Trial

P. J. Hutchinson, I. Timofeev, E. Corteen, S. Grainger, M. Czosynka, D. Menon, J. Pickard & P. J. Kirkpatrick (Academic Division of Neurosurgery, University of Cambridge, UK)

Objectives: The RESCUEicp study(randomised evaluation of surgery with craniectomy for uncontrollable elevation of intra-cranial pressure)aims to provide class 1 evidence as to whether decompressive craniectomy is effective for the management of patients with raised and refractory intra-cranial pressure following TBI.
Design: An international multi-centre randomised trial comparing decompressive craniectomy with medical management (including barbiturate therapy) versus surgery (decompressive craniectomy).
Subjects: Patients with traumatic brain injury and raised intra-cranial pressure (>25mmHg) refractory to medical treatment are eligible. Inclusion criteria: TBI, age 10–65, abnormal CT scan. Exclusion criteria: bilateral fixed and dilated pupils, bleeding diathesis, devastating injury.
Methods: Patients are randomised to one of two arms: continuation of optimal medical management (including barbiturate therapy) versus surgery (decompressive craniectomy). Outcome is assessed using the extended Glasgow Outcome Score and the SF-36 quality of life questionnaire at 6 months,1 and 2 years.
Results: Over 220 patients have been recruited to date with 96% follow up at 6 months.To date evaluation of the first 120 patients shows equal distribution of characteristics between the two arms. Overall 80% of patients are male, 5% were hypoxic and 13% hypotensive at initial presentation. 73% were initially GCS 3–8,16% GCS 9–12 and 12% GCS 13–15.

Conclusions: Randomising patients with traumatic brain injury to decompressive craniectomy versus optimal medical management is feasible. Whether this operation is effective or safe remains to be seen. We welcome the participation of more centres.

References

1 Timofeev I, Czosnyka M, Nortje J, Smielewski P, Kirkpatrick P, Gupta A, *et al*. Effect of decompressive craniectomy on intracranial pressure and cerebrospinal compensation following traumatic brain injury. *J Neurosurg* 2008;108:66–73.
2 Sahuquillo J, Arikan F. Decompressive Craniectomy for the treatment of refractory high intra-cranial pressure in TBI. *Cochrane Database Syst Rev* 2006 Jan 25;(1):CD003983. Review.

Neurovascular:

FH T2-01: The utility of Indocyanine Green Fluorescence Angiography in bypass surgery

D. O. Bulters, R. A. Trivedi & P. J. Kirkpatrick (Addenbrookes Hospital, Cambridge, UK)

Objectives: Indocyanine Green Fluorescence (ICG) Angiography is a new and powerful tool for quality control during aneurysm surgery. Our objective was to evaluate its value during cerebral revascularisation.
Design: Retrospective case note, digital subtraction angiogram and ICG angiogram review.
Subjects: All patients undergoing bypass surgery in the year following introduction of ICG angiography.
Methods: All patients underwent bypass surgery following which an ICG angiogram was acquired. These patients later underwent follow up angiography. The graft survival rate and clinical outcome were analysed and ICG images reviewed to identify predictors of graft failure and poor outcome.
Results: 10 bypass procedures were performed over the period of one year. We present the ICG images and the outcomes of these patients.
Conclusions: There are many factors contributing to graft failure. ICG angiography can identify retrograde flow, stenosis and delayed filling accounting for a significant proportion of these failures and hence improve outcomes from surgery.

FH T2-02: Shaped beam radiosurgery(SRS) for the treatment of cerebral AVMs; early experience

P. C. Whitfield, S. Kelly, W. M. Adams, S. Pascoe, J. D. Palmer, A. Gwillam & J. Pearn on behalf of the South West Stereotactic Radiosurgery Group (South West Neurosurgery Centre, Derriford Hospital, Plymouth, UK)

Objectives: To report our early experience with conformal beam SRS in the management of patients with cerebral AVMs.
Design: Data was collected prospectively and reported as an observational audit.
Subjects: 22 patients with cerebral AVMs: 8 frontal; 3 occipital; 2 temporal; 2 thalamic; 2 occipito-parietal; 2 parietal; 1 temporo-parietal; 1 callosal; 1 cerebellar. Pollock-Flickinger scores were recorded (1).
Methods: Treatment planning was performed using CT angiography, MRI and angiography. Manual target delineation was performed by consensus between a neurosurgeon, neuroradiologist and radiotherapist. A stereotactic frame was used for localisation in all cases. Dynamic arc shaped beam treatment (M3 LINAC, Brainlab) was delivered in a single fraction in 19 cases (SRS). In 3 cases, with large AVMs, hypofractionation was employed (SRT).
Results: 19 cerebral AVM patients with a mean volume of 3.11 cm^3 (range 0.13–12.5 ml3 received SRS using 18–22Gy to the encompassing isodose. 3 patients with large volume AVMs (10.41, 12.86 and 37.71 cm^3) received hypofractionated SRT (8 to 11 #; 4.5 to 5.4 Gy per #). No haemorrhages occurred during the follow period. Partial AVM obliteration was seen in all but 1 case with a post-treatment MRI >1 year. All cases proceeding to angiography (6/6) showed complete obliteration at 24–36 months post-treatment.
Conclusions: CT angiography was valuable in the delineation of the target lesion. Early results indicate that M3 LINAC delivered SRS is an effective treatment for cerebral AVMs. Hypofractionation is a promising treatment option in the management of large AVMs. Continued follow-up with MRI and angiography is required to establish long-term results.

Reference

1 Pollock BE, Flinkinger JC. *Neurosurgery* 2008;63:239–43.

FH T2-03: Treatment of Cerebral Arteriovenous Malformations; A Single Centre Experience

M. A. Hussain, K. S. Manjunath Prasad & F. P. Nath (The James Cook University Hospital, Middlesborough, United Kingdom)

Objectives: Reflective analysis of a single centre experience of cerebral arteriovenous malformations (AVM), reporting on treatment modalities and outcomes.
Design: Retrospective and observational.
Subjects: Patients admitted for treatment of an AVM over a 15 year period.
Methods: Case notes were recovered and reviewed along side radiological imaging, and Spetzler grade recorded for each AVM. Using follow up letters the Glasgow outcome score was recorded for each patient.
Results: Over a 15 year period there were 41 patients who underwent treatment for an AVM.

The predominant primary presentation was with an intracranial bleed (61%) and headache (44%). The AVMs were treated with endovascular intervention (24%), surgery (22%), stereotactic radio-surgery (15%), or a combination of two or more treatment modalities (39%). 27% of patients had residual AVM on follow up imaging after treatment. However there was no significant difference in the number of patients with residual lesion when a comparison was made between the different treatment modalities ($p > 0.05$, Chi squared test). AVMs with higher Spetzler grades had poorer outcome; 36 patients had a Glasgow outcome score(GOS) of >4 within a minimum follow up period of 2 years, the remainder of patients scoring 3. However of the 27 patients scoring a 5 on the GOS, 37% had continued neurological symptoms including visual disturbance (11%) and seizures (11%).
Conclusions: Surgery and endovascular treatment continue to play an equal role in the treatment of AVMs, but a majority of patients undergo combined therapy with two or more treatment modalities. The outcome following treatment of AVMs within this centre is comparable to published data.

FH T2-04: Surgical Treatment of Previously Coiled Cerebral Aneurysms: Experience and Lessons from 18 Cases

M. R. Guilfoyle, S. Thomson, A. Waters, P. J. Kirkpatrick & R. W. Kirollos (Addenbrooke's Hospital, Cambridge, UK)

Objectives: Clipping of recurrent aneurysms after primary coiling offers definitive occlusion but presents additional challenges. We have examined our experience of clipping aneurysms with coils in situ to identify factors associated with favourable outcome.
Methods: Retrospective review of patients undergoing craniotomy for residual or recurrent coiled aneurysms from 2003 to 2009.
Results: 18 patients (12 Female) aged 32–74 years (median 50) were identified. Aneurysm locations were anterior communicating (6, ACoA), posterior communicating (3), posterior inferior cerebellar (3), middle cerebral (2, MCA), basilar (1), anterior cerebral (1), pericallosal (1), and ophthalmic (1). Three patients presented with rebleeding and 15 were detected on surveillance angiography; 3 patients had been recoiled previously. Surgery was performed 2 days - 12 years following first coiling, after multidisciplinary discussion.
Clipping was possible in 15 cases, with good neurological outcome in 14; there were no deaths. Of the patients successfully clipped one had previously been recoiled and all had either sufficient neck recurrence amenable to direct clip application or the coils were removed to refashion a neck.
The three cases in which clipping was attempted but unsuccessful included a serially coiled giant MCA aneurysm with incompressible neck that necessitated excision and repair, a large basilar aneurysm with incompressible neck due to coils, and a serially coiled giant ACoA aneurysm where dissection of parent vessels and neck were unsafe due to the large coil ball.
Conclusion: Clipping before suitable neck recurrence or following serial coiling is associated with unsuccessful outcome. Surgery should be given early consideration if aneurysms recanalize after embolisation.

FH T2-05: Microsurgical vascular bypass and reconstruction in the management of complex middle cerebral artery aneurysms

A .Visca, R. J. Nelson, S. A. Renowden & M. Milne (Frenchay Hospital, Bristol, UK)

Objectives: To describe and evaluate surgical strategies for the management of complex MCA aneurysms.
Design: Single institution, non-randomised descriptive cohort study.
Subjects: 20 consecutive patients, treated between 1990 and 2008, mean age 43 yrs (range 11–61); 14 males, 6 females.
Methods: Analysis of vascular database and retrospective review of case records to include aneurysm site, size and morphology; clinical features; surgical strategy; adjunctive endovascular treatment; complications; and outcomes (vascular and clinical).
Results: There were 14 fusiform; 5 saccular and 1 serpentine aneurysms (9 giant aneurysms) involving the M1 (6/20), MCA bifurcation (8/20) and M2 (6/20). The surgical strategies were: EC-M2 bypass (3/20); single or multiple STA-M2 bypasses (11/20); microvascular reconstruction (5/20). The long-term vascular patency rate was 90%. Good long term outcomes (mRS I/II) were achieved in 17 patients.
Conclusions: Good clinical outcomes may be achieved with microsurgical vascular bypasses and reconstruction for patients with complex MCA aneurysms that are otherwise untreatable and have a poor natural history.

FH T2-06: Effects of Systemic Hypertonic Saline Therapy on Cerebral Blood Flow, Tissue Oxygenation and Chemistry in Patients with Poor Grade Subarachnoid Haemorrhage.

P. G. Al-Rawi, M.-Y. Tseng, J. Nortje, I. Timofeev, B. F. Matta, P. J. Hutchinson & P. J. Kirkpatrick (University Departments of Neurosurgery and Anaesthesia, Addenbrooke's Hospital, Cambridge, UK)

Objectives: To explore whether CBF enhancement with hypertonic saline (HS) in poor grade SAH patients is associated with an improved cerebral tissue oxygenation and metabolic profile.

Design: ABP, ICP, CPP, middle cerebral artery flow velocity (FV), brain tissue oxygen (PbO^2), carbon dioxide ($PbCO^2$), pH, and microdialysis were continuously monitored. XeCT was performed before and after infusion of 23.5% HS. CBF in a region of interest around the brain tissue oxygen and microdialysis probes was calculated (rCBF). Data is presented as a mean followed by $\pm$ SE.
Subjects: 44 patients presenting with poor grade SAH. Average age = 52 (range 34–74). Male: Female ratio = 23:21.
Results: 30 minutes post infusion a significant increase in ABP, CPP, FV, pH and PbO^2 was seen, together with a decrease in ICP ($p < 0.05$). At 60 minutes a significant increase in glucose, lactate, pyruvate and glycerol was seen ($p < 0.05$). ICP remained reduced for >300mins and FV elevated for >240 minutes. The increase in PbO^2 and glucose persisted for up to 240 minutes. In 51% of patients, a decrease in lactate-pyruvate ratio was seen at 60 minutes. Baseline rCBF was 33.9 $\pm$ 13.5 ml/100g/min, rising by 20.3 $\pm$ 37.4% ($p < 0.05$) following HS. Patients with favourable outcome responded better to HS, in terms of increased CBF, PbO^2 and pH, and reduced ICP, compared to those with unfavourable outcome. A sustained increase in PbO^2 was associated with favourable outcome ($p < 0.023$).
Conclusions: HS augments CBF in poor grade SAH patients and significantly improves cerebral oxygenation and glucose. An improvement in cerebral metabolic status in terms of lactate-pyruvate ratio and pHb was also seen. Favourable outcome is associated with an improvement in PbO^2 beyond 210 minutes.

FH T2-07: Haemodynamics in intracranial aneurysms of the anterior and posterior circulation and its association with rupture

A. H. Pitt, A. Marzo, P. Singh, M. Aguilar, I. Larrabide, R. Lycett, A. Frangi, D. R. Hose, P. Lawford, S. C. Coley & U. J. Patel (The Royal Hallamshire Hospital, Sheffield, UK)

Objectives: Intracranial aneurysms (IAs) of the posterior circulation are more prone to rupture, whereas IA incidence is higher in the anterior circulation[1]. Aim: Use Computational Fluid Dynamics (CFD) to investigate and compare the role of haemodynamics in the natural history of IAs of the posterior and anterior circulation.
Design: A European multi-centre retrospective study. Software developed within the European project @neurIST was used to extract relevant haemodynamic indices from ruptured and unruptured IAs.
Subjects: From the initial patient group, those with a genetic predisposition and/or a previous history of subarachnoid haemorrhage (SAH) were excluded, leaving a cohort of 55 patients with 65 aneurysms (recruitment age = 30–91 years, median age = 57.3 years, 21 male, 44 female; 59 anterior, 6 posterior).
Methods: The @neurIST software was used to reconstruct the neurovasculature of the region of interest and compute areas of the aneurysmal endothelium exposed to infra-physiological (<0.4Pa [2]) and supra-physiological wall shear stress (WSS) (>1.5Pa). Other risk factors commonly associated with IAs (age, gender, smoking, hypertension etc) were covariates in the statistical analysis. Analysis of Covariance (ANCOVA) was used to compare data from the anterior and posterior circulation.
Results: Risk of IA rupture was higher in the posterior circulation (0.75 posterior, 0.5 anterior). Areas of infra-physiological WSS were larger ($p = 0.003$) in the ruptured IAs of the posterior circulation (percentage mean values: 7.9% anterior, 27.86% posterior). Areas of supra-physiological WSS were significantly larger ($p = 0.015$) in the ruptured aneurysms of the anterior circulation (70.20% anterior, 48.96% posterior).
Conclusions: The results correlate with established studies on the risk of rupture[1]. There are significant differences between the levels of WSS in the anterior and posterior circulation, which accords with published studies[1]. These areas of infra-physiological WSS might be correlated with endothelial disruption[2], whereas those areas associated with supra-physiological WSS may be associated with IA initiation.

References

1 Wiebers DO, Whisnant JP, Huston J, 3rd, Meissner I, Brown RD, Jr., Piepgras DG, *et al.* Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. *Lancet* 2003;362:103–110.
2 Malek AM, Alper SL, Izumo S. Hemodynamic shear stress and its role in atherosclerosis. *JAMA* 1999;282:2035–2042

FH T2-08: Variations in Intracranial Aneurysm Follow-Up between UK Centres

N. D. Park & M. Javadpour (The Walton Centre for Neurology and Neurosurgery, Liverpool, UK)

Objectives: There are no established guidelines with regards to the modality, frequency or duration of follow-up of treated ruptured aneurysms or untreated unruptured aneurysms. We have conducted a survey to examine existing practice in UK and Ireland.
Design: Nationwide survey.
Subjects: Uk Neurovascular units.
Methods: An email questionnaire was sent to all 34 UK and Ireland neurovascular units, with 23 units responding. The duration and frequency of follow-up after treatment of ruptured intracranial aneurysms (RIAs) was requested, as was the follow-up (if any) of asymptomatic, unruptured intracranial

aneurysms (UIAs) managed conservatively. Use of MRA, CTA and/or catheter angiography (DSA) was recorded.
Results: 22 units follow up coiled RIAs for at least 2 years. At this point 10 units cease follow-up if appearances are stable while 7 units continue for 5 or more years. 5 units perform 1 DSA as part of routine follow-up. After clipping of RIAs, 6 units perform 1 routine DSA while 16 do not. 19 units perform surveillance imaging for UIAs, with longer durations for patients under 60, and with aneurysms >7mm.
Conclusions: Considerable variation exists between centres regarding duration, frequency and radiological modality of follow-up of aneurysms. Future research needs to address the optimum duration of follow-up for coiled aneurysms of different occlusion grades and whether imaging follow-up of UIAs is of clinical benefit. A consensus opinion on follow-up is required to guide current clinical practice.

FH T2-09: Stereotactic Radiosurgery of Deep-seated Cavernous Malformations: A Move towards More Active Early Intervention

G. Gábor Nagy, A. Razak, J. G. Rowe, T. J. Hodgson, S. C. Coley, M. W. R. Radatz, U. J. Patel & A. A. Kemeny (The Royal Hallamshire Hospital, Sheffield, UK)

Objectives: Radiosurgery is generally recommended only for inoperable cavernous malformations that have bled at least twice. Rehaemorrhage may however carry a substantial risk of morbidity. We reviewed our practice to assess whether a more active earlier intervention is justified in managing this condition.
Design: Retrospective analysis.
Subjects: 113 patients with 79 brainstem and 39 thalamic/basal ganglia cavernous malformations.
Methods: Gamma knife radiosurgery.
Results: Forty-one malformations had multiple symptomatic haemorrhages before radiosurgery with a rate of first ever bleed of 2.9%/lesion/year, a rebleed rate of 30.5% and a median time between the first and second bleeds of 1.5 years. The rebleed rate fell to 15 % for the first two years after radiosurgery, and declined further to 2.4% thereafter. Pre-treatment multiple bleeds led to persisting deficits in 72% of the patients.
Seventy-seven lesions had no more than one symptomatic bleed before radiosurgery: the lifetime bleed rate being 2.2%. The short period between presenting bleed and treatment (median 1 year) makes the natural history in this group uncertain. The rate of haemorrhage in the first two years after treatment was 5.1%, and 1.3% thereafter. Pre-treatment haemorrhages resulted in permanent deficits in 43% of the patients in this group.
Post-treatment haemorrhages resulted in persisting deficits only in 7.3% of the patients. Permanent adverse radiation effects were rare (7.3%) and minor in both groups.
Conclusions: Stereotactic radiosurgery is a safe management strategy for eloquent cavernous malformations with marked advantage of reducing rebleed risk in patients with repeated haemorrhages. The benefit in treating cavernous malformations with a single bleed is less clear. However, repeated haemorrhage carries a significant risk of increased morbidity far in excess of any radiosurgery related morbidity. This we feel justifies early active management of deep seated cavernous malformations.

Paediatric:

FH T4-01: Frequency of Unilateral Subdural Haematoma in Non-Accidental Head Injury

B. Pettorini, S. Chapman, G. Debelle & G. Solanki (Birmingham Children's Hospital, Birmingham, United Kingdom)

Objectives: The aim of this study was to review a series of children treated between 2000 and 2008 for NAHI.
Design: Evaluate the laterality of their subdural haematoma.
Subjects: We analysed any relationship to relevant factors including history and examination, retinal haemorrhages and radiological findings.
Methods: Seventy-four children with NAHI with available imaging were reviewed. There were 29 girls and 45 boys ranging from 3 days to 5.5 years of age.
Results: Skull fractures occurred in 13/74 children, and retinal haemorrhages in 32/74. SDH were found in 45/74 patients: bilateral SDH occurred in 34/45 cases, while unilateral SDH occurred in 11/45 patients. Unilateral SDH were associated with ipsilateral fractures in 9 cases, and in no cases with retinal haemorrhages, while bilateral SDH occurred in 22/32 cases with retinal haemorrhages.
Conclusions: The classic intracranial haemorrhage seen in Shaken Baby Syndrome is the subdural haemorrhage. In this setting, we identified a 14.8% of cases with unilateral SDH associated to an ipsilateral fracture and with no retinal haemorrhages. These findings could suggest an impact origin, most likely traumatic, of the SDH rather than a shaken baby NAHI.

References

1 Togioka BM, Arnold MA, Bathurst MA, Ziegfeld SM, Nabaweesi R, Colombani PM, *et al*. Retinal hemorrhages and shaken baby syndrome: an evidence-based review. *J Emerg Med*. 2009;37(1):98–106.
2 Foerster BR, Petrou M, Lin D, Thurnher MM, Carlson MD, Strouse PJ, *et al*. Neuroimaging evaluation of non-accidental head trauma with correlation to clinical outcomes: a review of 57 cases. *J Pediatr* 2009;154(4):573–7.
3 Jaspan T. Current controversies in the interpretation of non-accidental head injury. *Pediatr Radiol* 2008;38 Suppl 3:S378–87.

FH T4-02: When does the Metopic Suture fuse? A Review of 337 children

B. Pettorini, D. Srinivasan, H. Nishikawa, S. Dover & G. Solanki (Birmingham Chldren's Hospital, Birmingham, UK)

Objectives: Variation in the timing of physiological metopic suture closure is well known. Widely accepted closure time is approximated at 2 years of age. This study aims to report the variability in the timing of physiological metopic suture closure.
Design: Retrospective study.
Subjects: Children with CT Brain scan performed between 2003–2009.
Methods: Children with CT Brain performed between 2003–2009 were identified. Inclusion criteria: CT scan for trauma, seizures or CNS infection. Exclusions: older than 18-months; Craniofacial cases; hydrocephalus; poor quality; tumours; skull fractures through metopic suture. The metopic suture was assessed on axial CT bony window and classified as being patent, partially fused or completely fused.
Results: 337(204 boys, 133 girls) met the criteria. Median age for partially fused suture was 6 months (95% CI 4.5 - 7.7). Median age for complete suture fusion was 9.24 months (95% CI 8.37 - 10.22). 95% of all patients had a partially fused or fused suture between 0.42 and 11.49 months of age. 95% of all patients had a completely fused suture between 3.05 and 15.43 months.
Conclusions: Metopic fusion starts normally at 3 months with complete fusion occurring around 9 months. This study establishes that physiological metopic suture closure occurs much earlier than 2 years.

FH T4-03: Subependymal giant cell astrocytoma: a decade's experience

Jayasekera, E. A. C. Pereira, M. J. Gillies, S. Magdum, J. Jayamohan & P. G. Richards (Paediatric Neurosurgery Division, Oxford Children's Hospital, Oxford, UK)

Objectives: Subependymal giant cell astrocytoma (SEGA) is a rare paediatric brain tumour. Most literature is from case reports and small series. We review nine patients presenting over a decade.
Subjects: Nine consecutive patients diagnosed with histologically confirmed SEGA from November 1998 to April 2009.
Methods: Retrospective review of prospectively collected data. Male:female ratio was 2:1. Mean age of symptom onset was 9 years 7 months (range 5 months to 18 years 5 months).
Results: 44% of patients presented with seizures and 56% with hydrocephalus. 44% had tuberous sclerosis stigmata. Foramen of Monro obstruction occurred in 44%. 56% of patients received debulking surgery - by transcortical approach in 60% and transcallosal in 40%. 80% of operated patients had CSF diversion procedures. Median surgeries in the reoperated group was 6.
Conclusions: Approximately one SEGA per annum presents to our centre serving 600,000 children. Surgical resection relieves hydrocephalus when combined with cerebrospinal fluid diversion and provides excellent seizure control together with anti-epileptic medication. The majority of those treated for hydrocephalus require multiple external ventricular drains prior to shunting.

FH T4-04: Asymptomatic lumbosacral lipomas - to operate or not? The controversy continues.

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Objectives: Inevitable deterioration due to mechanical tethering is perceived as the natural history for complex congenital lumbosacral lipomas, even if asymptomatic at presentation (1). There has been recent debate as to whether prophylactic surgical untethering improves outcome (2). In this study we examine the natural history of un-operated patients with lumbosacral lipomas.
Design: Retrospective search of clinical letters, imaging and urological investigations from 07/1998-12/2009 identified a cohort of children diagnosed at Great Ormond Street Hospital with lumbosacral lipomas. Filar lipomas and children with less than 1 year follow up were excluded.
Subjects: Children presenting to a single clinician (DT) with a new confirmed diagnosis of complex lumbosacral lipoma on spinal MRI, and were initially asymptomatic on assessment of neurological and urological systems were recruited.
Methods: All clinical records and letters for this asymptomatic cohort were assessed, documenting the salient clinical features and outcome. Further statistical analysis was then performed using Matlab and SPSS software.
Results: 56 children (36 female: 20 male) were identified with asymptomatic lumbosacral lipomas. The mean follow up period was 5.9 years (range 1.0 - 19.3 years).
Deterioration occurred in 16 children (28.6%) whose median age was 1.9 years and of whom 80 % were female. 45 % had a Chapman classification of transitional lumbosacral lipoma.
Conclusions: Complex lumbosacral lipomas pose a significant surgical challenge. The risk of both early and late deterioration is recognised in all published series. This study suggests the natural history of this subgroup of dysraphic patients may be more benign than hitherto considered.

References

1 La Marca F, Grant JA, Tomita T, McLone DG. Spinal lipomas in children: Outcome of 270 procedures. *Pediatr Neurosurg* 1997;26:8–16.
2 Kulkarni HV, Pierre-Kahn A, Zerah M. Conservative management of asymptomatic spinal lipomas of the conus. *Neurosurgery* 2004;54:868–875.

FH T4-05: Outcome from surgery for vestibular schwannomas in children

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Objectives: A review of sporadic and NF2-related vestibular schwannoma surgery in children (under 18 years of age) with a specific interest in resection rates, recurrence, facial nerve outcomes, hearing preservation, hearing rehabilitation and genetic analysis.
Design: A retrospective analysis of prospectively collected data.
Subjects: 35 consecutively operated vestibular schwannomas in 29 paediatric patients that underwent 38 operations between 1992 and 2007.
Methods: Pre- and post-operative radiology, facial nerve function, pure tone audiogram and speech discrimination tests were performed with a mean follow-up of 4.5 years. Tumour and blood mutations were analysed in 86% of patients.
Results: Total resection was achieved in all sporadic cases and 68% of NF2 cases. Near total resection led to tumour recurrence in 5 out of 10 cases. The facial nerve was anatomically preserved in 92%. Facial nerve function was excellent to good (Grades 1–3) in 88% with outcome related to tumour size. Hearing preservation was successful in 3 of 11 cases.
Conclusions: Surgery with complete resection results in excellent tumour control. It is more difficult to attain total resection in NF2 with a relatively high recurrence rate. A better facial outcome is associated with smaller tumours, near-total resection and first time surgery. Hearing preservation is possible in a minority.

FH T4-06: Cerebellar injury and cognitive impairment in children with malignant posterior fossa tumours

M. R. Garnett, S. Puget, J. Grill & C. Sainte-Rose (Addenbrookes Hospital, Cambridge and Hopital Necker – Enfants Malades, Paris)

Objectives: To define possible correlations between anatomical injury and neurological deficits in children with a malignant posterior fossa tumour.
Design: Retrospective cohort study.
Subjects: 61 children with a median interval from diagnosis of 4.7 years.
Methods: Neurological examination, intelligence quotient (IQ) evaluation (verbal and performance) and a post-operative MRI scan (looking for evidence of injury to anatomical structures) undertaken at least 6 months after completion of treatment. Statistical analysis used regression models.
Results: Verbal IQ was within normal range (87 ± 18.3), performance IQ was below normal (74 ± 18.2). The presence of cerebellar signs significantly correlated with low IQ scores ($P = 0.02$), evidence of injury to the dentate nuclei ($P < 0.001$) and the inferior vermis ($P = 0.004$). Low IQ scores significantly correlated with injury to the dentate nuclei and inferior vermis ($P = 0.01$, $P = 0.005$ respectively).
Conclusions: The severity of persistent clinical cerebellar signs and IQ scores was significantly related to the extent of injury to both the inferior vermis and the dentate nuclei.

FH T4-07: Managing Chiari I Malformation in Craniosynostosis: Effect of fixed posterior calvarial augmentation

G. Solanki, B. Pettorini, N. White, H. Nishikawa & S. Dover (Birmingham Chldren's Hospital, Birmingham, UK)

Objectives: Syndromic craniosynostosis may lead to the development of progressive Chiari type I hindbrain herniation and raised intracranial pressure. We report our experience with fixed posterior calvarial augmentation in the management of hindbrain herniation in multisutural and syndromic craniosynostosis.
Design: Retrospective study.
Subjects: Twenty patients (12 boys, 8 girls) with an age ranging from 15 months to 8.5 years (average 2.3 years) with raised intracranial pressure and or hindbrain hernia underwent a fixed posterior augmentation.
Methods: We developed a set of 10 radiological criteria to evaluate Surgical Outcome. The criteria included CSF distribution in sulci, venous hypertension, tentorial angle, bowing of corpus callosum, ventriculomegaly, cervicomedullary kink, the ''standing-up'' cerebellum, CSF flow at CCJ, tonsillar descent and syrinx.
Results: Lambdoid synostosis(5) and pansynostosis(5) were most frequent followed by Crouzon(3), Aperts(3), Saethre-Chotzen(2), other(2). Median follow-up was 2 years. 13 cases had hindbrain hernia. All children improved symptomatically. 92% had improved radiological criteria. Hindbrain hernia regressed in 75%. Regression-time averaged 27-months. There was no progression to syrinx and no mortality.
Conclusions: Radiological criteria are useful to standardize surgical assessment after calvarial

augmentation. Fixed posterior calvarial augmentation is effective in the management of raised ICP and leads to regression of the hindbrain hernia in craniosynostosis. It is now preferred over foramen magnum decompression for this group of patients.

FH T4-08: A guiding SIGN for managing paediatric head injury: results of an audit

I. Coulter, G. Duthie, A. McCabe, J. Steers & A. Baxter (Royal Hospital for Sick Children, Edinburgh, UK)

Objectives: We have audited the management of children with minor head injuries admitted locally under paediatric surgery to determine if practices are complying with the recommendations of SIGN (Scottish Intercollegiate Guidelines Network).
Subjects: The ICD-10 coding system was utilised to identify consecutive cases admitted during 2007 from the hospital's patient registry.
Methods: Retrospective data were collected from patient records. Recommendations from SIGN Guideline 46 (2000) and the recently updated version SIGN Guideline 110 (May 2009) - Early Management of Patients with a Head Injury, were utilised as standards to which we compared the practices observed.
Results: 200 cases were analysed. SIGN 2000 suggests that a computed tomograph (CT) was indicated in 146 cases, but of these only 16% of cases were imaged. Following SIGN 2009, a CT was indicated in 24 cases, but only 50% of cases were imaged. A neurosurgical review was indicated in 13 cases but only 31% of these were reviewed. Only 28% of cases received followed-up following a significant head injury.
Conclusions: There appears to be a reluctance to adhere to the SIGN guidelines at our centre with preference instead given to clinical acumen when deciding the need for imaging, neurosurgical review and follow-up. We suggest further investigation is required to determine whether closer adherence with the guidelines improves clinical outcomes.

Trauma:

FH T6-01: Mortality in long term follow up of patients with repeated head injury

S. Copstick & L. Pobereskin, J. (St George Institute of Neurological Sciences, Glasgow, UK)

Objectives: To determine the mortality risk in a cohort of patients with repeated traumatic brain injury (TBI).
Design: All admissions with TBI in Inverclyde 1992–2002 were identified and followed up for a period of 7–17 years.
Subjects: 3101 patients were admitted over the period of study (2182 males and 919 females).
Methods: Demographic details, mechanism of injury, admission GCS, imaging findings, seizure occurrence, alcohol and drug history and length of hospital stay were noted from individual records. Death certificates were reviewed and causes of death categorised.
Results: The multiple HI group had more alcohol related head injuries of ''unspecified cause'' (71%). There were more irregular discharges and less information about mechanism of injury. The most common type of scan abnormality noted in the group was brain atrophy. Mortality was significantly higher in the group with repeated HI (49% vs. 27.2%, with deaths more likely to be external causes.
Conclusions: Patients who present with repeated HI are an at risk group. Deprivation, self neglect and risk taking are clinically difficult to address. Increased investment in public education is advocated.

Reference

1 McMillan TM, Teasdale GM. *Brain*. 2007;130(10):2520–7.

FH T6-02: Epidemiology of Traumatic Brain Injury (TBI) in the Republic of Ireland

L. McEvoy[1], N. Collins[2], L. Geoghegan[3], F. Taleb[1] & J. Phillips[1] ([1]Department of Neurosurgery, Beaumont Hospital, Dublin 9, Ireland; [2]Emergency Department, Beaumont Hospital, Dublin 9, Ireland; [3]Department of Public Health, Dublin, Ireland)

Objectives: TBI is the leading cause of death and disability among young adults in the developed world with trauma being the fourth most frequent cause of overall mortality in Ireland and the leading cause of death in the Irish population under the age of 45 years.
Design: The Beaumont Hospital TBI research group was established to undertake an epidemiology study on the prevalence of TBI within the Republic of Ireland. Data was collected over a two year period from the National Neurosurgical Hospital in Beaumont Hospital and over a 12 month period in the Neurosurgical Centre in Cork University Hospital.
Results: In total 2095 patients were registered. Men were three times more likely to sustain TBI compared to women. The overall mean age was 43 years with the median age for men 40.8 years and 47.3 for women Falls were responsible for the majority of TBI 59%, with road users accounting for 22% of patients registered. 38% of all injuries occurred in the home, 15% occurred whilst commuting and 14% while participating in recreational activities. 69% were registered with a mild head injury, 10% had a moderate head injury and 20% patients had a severe head injury. 41% of patients required admission to a Neurosurgical Centre, of these 44% underwent surgery, with a further 13% having ICP monitoring only.

Conclusions: This national study has identified two ''at risks'' groups for TBI; young men aged 16–24 and older patients. Falls have super ceded road injuries as the major cause of injury. Falls affect an older population. The home is predominant place of injury. Assaults are increasing in frequency and are responsible for one in nine TBI in this database. They directly affect young men aged 16–24 and were heavily associated with alcohol consumption. Targeting fall prevention, improving home safety and reducing interpersonal violence should be key tenets of injury prevention strategies.

FH T6-03: Effect of introduction of aseptic non touch technique in reducing EVD infection rate

R. Bethanabatla & I. Kamaly-Asl (Greater Manchester Neurosciences Centre, Salford, UK)

Objectives: EVD infection is a potentially devastating morbidity. We wished to examine the effect that introducing a hospital wide policy of aseptic non touch technique(ANTT) would have on EVD infection rate.
Design: Retrospective audit.
Subjects: 249 patients with EVDs implanted.
Methods: We looked at all EVDs implanted in the department over a 4 year period from 2005 to 2008, around the introduction of ANTT in January 2007. The electronic records were examined for signs of infection defined as either positive cultures or raised csf white cell count necessitating antibiotics.
Results: There was no drop in infection rate following the introduction of ANTT. Culture positive infection rates were 29% in 2005, 27% in 2006, 20% in 2007, and 36% in 2008. Cases of raised white cells were 4% in 2005, 17% in 2006, 16% in 2007, and 14% in 2008.
Conclusions: Using very low threshold definition of infection our rates were high before and after the introduction of ANTT. The lack of benefit may reflect the discrepancy between a hospital policy of ANTT and its adequate implementation.

FH T6-04: Comparative Performance of CRASH and IMPACT Models for Predicting Outcome from Traumatic Brain Injury

M. R. Guilfoyle, C. Harkin, E. Corteen, I. Timofeev, D. K. Menon, P. J. Kirkpatrick & P. J. Hutchinson (Addenbrooke's Hospital, Cambridge, UK)

Objectives: To evaluate performance of prognostic models for traumatic brain injury in a regional neurosurgical centre.
Methods: Data were extracted from a prospective neurotrauma database and mortality obtained from the National Tracing Service. Individual risk of 14 day mortality was calculated using CRASH-Basic and -CT models, and risk of 6 month mortality calculated with IMPACT-Core and -Extended (including CT findings) models.
Model accuracy was determined by standardised mortality ratio (SMR = observed/expected deaths), discrimination was evaluated as the area under the receiver operating curve (AUROC), and calibration assessed using the Hosmer-Lemeshow Chi^2 test.
Results: From 2005–2008 462 patients were admitted to the Neurocritical Care Unit following head injury. Outcome was available for 445 patients; mortality was 18.4% at 14 days and 22.7% at 6 months. For CRASH-Basic SMR = 1.19 (n = 424) and both calibration ($Chi^2 = 10.9$ $p = 0.21$) and discrimination (AUROC = 0.79) were good.
For IMPACT-Core SMR = 0.79 (n = 389) and the model was also well calibrated ($Chi^2 = 13.0$ $p = 0.11$) and had good discrimination (AUROC = 0.79).
For the subset of patients for whom initial CT imaging was available CRASH-Basic was more accurate (SMR 1.05 vs. 0.77) and better calibrated ($Chi^2 = 5.8$ $p = 0.67$ vs. $Chi^2 = 15.4$ $p = 0.051$) than CRASH-CT, but discrimination was greater for the CT model (AUROC 0.80 vs. 0.85) Conversely, IMPACT-Extended showed improved accuracy (SMR 0.76 vs. 0.72), calibration ($Chi^2 = 13.1$ $p = 0.11$ vs. $Chi^2 = 17.0$ $p = 0.03$), and discrimination (AUROC 0.82 vs. 0.78) over IMPACT-Core.
Conclusion: CRASH-Basic is a good model of early mortality in the present series. CRASH-CT and both IMPACT models predicted higher mortality than observed, but had good discrimination.

FH T6-05: Subcutaneously Preserved Autologous Cranioplasty: are one's own bones better?

W. B. Lo, N. Mundil & A. Saxena (Department of Neurosrugery, University Hospital, Coventry, UK)

Objectives: Cranioplasty following a decompressive craniectomy is carried out to restore cranial integrity, expedite rehabilitation and improve cosmetic appearance. Three implants are routinely used in our department: acrylic, subcutaneously preserved autologous bone flap and titanium. The aim of this study was to compare the clinical outcome in the three groups.
Design: Retrospective review of case notes and images.
Subjects: 62 adult patients who had a cranioplasty in our institution between August 07 and November 09 were identified from theatre log books. 50 patients were included in the study. 8 patients had to be excluded due to lack of clinical details (which should be available by the time of presentation) and 4 patients were excluded due to the primary diagnosis of empyema.
Methods: Discharge letters and clinic letters from CRRS, and radiological images on the PACS, were reviewed. Our primary outcome measures were complications (in particular infection), cost and cosmetic appearance.

Results: 57 cranioplasties were included, out of which 21 were autologous bone flaps (16 patients, 5 bilateral), 27 acrylic (25 patients) and 9 titanium (9 patients). The primary conditions were trauma in 35, tumour in 5, vascular in 7 and ischaemia in 3 cases. No infection was recorded in the autologous bone group as opposed to infection in 6 cases (22%) in acrylic group and 2 (22%) in titanium group.
Conclusions: Our study suggests that autologous bone cranioplasty has lower infection rate compared to the other two groups. The other advantages of autologous bone are no financial implications, and perfect cosmetic restoration particularly in bilateral cases. In our opinion autologous cranioplasty is the best option in the environment of financially constrained NHS and also from the clinical point of view.

FH T6-06: Observations on penetrating cranial wounds – one surgeon's accumulated experience over the past two years in the Afghanistan conflict.

M. H. Christie (Frontier Medical, Micheldean, Gloucestershire, UK)

Objectives: To analyse the experience gained from treating the injured in the current conflict in Afghanistan.
Design: A retrospective study of those with penetrating cranial wounds from various causative agents treated by the author during four tours of duty over the period from 2007 to 2009.
Subjects: Soldiers of the contributing Coalition Forces, soldiers of the Afghan Army and Police, civilians injured as a result of the conflict, and the Taliban.
Methods: Reference to the author's personal records is used, together with CT scans where relevant.
Results: Correlation of early battlefield neurosurgical interventions with long-term outcome remains problematic because of disposal to differing health systems in multiple countries.
Conclusions: Penetrating cranial wounds can be successfully treated in front line hospitals, particularly as a result of the availability of the CT scanner on the battlefield.

Reference

1 Meirowsky AM (Editor). *Neurological Surgery of Trauma, Office of the Surgeon General*. 1965

Spine section:

FH F2-01: Is Surgeon Grade A Factor In The Re-Operation Rate Following Elective Lumbar Microdiscectomy?

J. R. Ellenbogen, B. E. Fischer, A. W. Hewitt, M. D. Jenkinson & P. May (The Walton Centre for Neurology and Neurosurgery, Liverpool, United Kingdom)

Objectives: The elective re-operation rate for lumbar disc prolape is 3–19% in the literature[1]. The re-operation rate following elective primary lumbar microdiscectomy was investigated to determine whether principal surgeon grade was a factor in recurrence.
Methods: Retrospective case note review between April 2006 and August 2008. Those requiring elective re-operation at the same level as the original surgery were included; disc prolapse causing cauda equina syndrome or primary surgery performed elsewhere were excluded.
Results: 619 primary microdiscectomy operations were performed: The principal surgeon was a consultant in 34% (n = 210) and registrar trainee in 66% (n = 409). A consultant was also scrubbed for 55% of registrar trainee operations. 39 revision microdiscectomies were performed (revision rate 6.3%). In the recurrent cases the primary microdiscectomy had been performed by a Consultant in 12 cases (31%) and by registrar trainee in 27 (69%). There was no difference in recurrence rate by surgeon grade (Chi-square test; P = 0.69). Median time between primary surgery and symptom recurrence was 1 month (range 0–14 months). Recurrent disc prolapse was found in all but 4 patients.
Conclusions: Re-operation rate for primary elective microdiscectomy was 6.3% consistent with the published literature. Principal surgeon grade was not a factor in recurrence.

Reference

1 Heron L. Recurrent lumbar disc herniation: results of repeat laminectomy and discectomy. *J Spinal Disord* 1994; 7(2):161–6.

FH F2-02: A comparision of two techniques for percutaneous pedicle screw insertion using image guidance

R. J. Mannion & M. J. Wood (Addenbrookes Hospital, Cambridge UK and the Princess Alexandra Hospital, Brisbane, Australia)

Objectives: To determine the relative accuracy of minimally invasive lumbar pedicle screw placement using 2 different CT-based image-guided techniques.
Design: A comparison of 2 surgical techniques.
Subjects: Sixty-seven patients undergoing minimally-invasive placement of lumbar pedicle screws (296 screws) using a navigated, image-guided technique. EMG monitoring of lumbar nerve roots was used in all.
Methods: Group 1: 24 patients in whom a preoperative CT scan was merged with intra-operative 2D fluoroscopy images on the image-guidance system. Group 2: 43 patients using intra-operative 3D fluoroscopy images (O-arm) as the source for the image guidance system. The frequencies of pedicle

breach and EMG warnings (indicating potentially unsafe screw placement) in each group were recorded.
Results: The rate of pedicle screw misplacement was 6.4% in group 1vs 1.6% in group 2 ($p = 0.03$). There were no cases of neurological injury from sub-optimal placement of screws. Additionally, the incidence of EMG warnings was significantly lower in group 2 (3.7% vs 10% ($p = 0.03$)).
Conclusions: The use of an intra-operative 3D fluoroscopy system with an image-guidance system results in greater accuracy of pedicle screw placement than the use of pre-operative CT scans, although potentially dangerous placement of pedicle screws can be prevented by the use of EMG monitoring of lumbar nerve roots.

FH F2-03: The Posterior Trans-Pedicular Approach For Circumferential Decompression And Instrumented Stabilisation For Thoraco-Lumbar Neoplastic Disease: A Case Series Of 48 Patients

S. Metcalfe, H. Gbejuade & N. R. Patel (Frenchay Hospital, Bristol, UK)

Objectives: Patients with three-column neoplastic disease, with or without kyphotic vertebral collapse, may require palliative circumferential decompression and instrumented stabilisation. This is commonly performed through combined anterior trans-cavitary and posterior surgical approaches, but may also be achieved through a single postero-lateral costo-tranversectomy or the posterior transpedicular approach (TPA).
Design: Retrospective case note review.
Subjects: 48 patients with a mean age of 55.6yrs (25–79) with neoplastic disease, who underwent TPA circumferential surgery by the senior author between 2003–2009.
Methods: All patients presented with spinal instability pain and/or neurological disability with two or three-column involvement. Single or multi-level subtotal vertebrectomy (36 thoracic, 12 lumbar) and stabilisation with an interbody titanium cage and pedicle screw fixation was performed.
Results: Immediate three-column instrumented stabilisation was achieved in all patients. Mean operating time was 4.3hrs and mean blood loss was 1774mls. There were 5 significant perioperative complications and 1 death within 60 days of surgery. 3 patients developed self-limiting cage subsidence, all managed conservatively, and there were no wound complications. Pre-operative neurological status was Frankel Grade B in 1 patient, C in 8, D in 17 and E in 22. Postoperative neurological status was maintained or improved in all patients. At follow-up (2–48 months), 24 patients had died from systemic progression of their underlying disease, with a mean survival of 24 months.
Conclusions: The single-stage posterior TPA provides sufficient access for circumferential decompression and rigid three-column spinal instrumentation for neoplastic thoraco-lumbar disease. The technique is less invasive than combined anterior and posterior approaches, and avoids the morbidity of anterior procedures.

FH F2-04: Improved fusion in minimally invasive lumbar interbody stabilisation with low dose BMP-2, but at what cost?

R. J. Mannion, A. M. Nowitzke & M. J. Wood (Addenbrookes Hospital, Cambridge UK and the Princess Alexandra Hospital, Brisbane, Australia)

Objectives: Here we compare rates of fusion in minimally invasive image guided lumbar interbody fusion with percutaneous pedicle screws, using BMP-2 with autologous bone graft versus autologous bone graft alone.
Design: Comparison of two surgical groups of patients.
Subjects: Thirty six patients, mean age 54 yrs, all undergoing minimally invasive image guided lumbar interbody fusion with percutaneous pedicle screws. Thirty six patients, mean age 54 yrs, all undergoing minimally invasive image guided lumbar interbody fusion with percutaneous pedicle screws.
Methods: Group 1: In 17 patients (22 spinal levels) the interbody cage was augmented with local bone graft from the facet joint and BMP-2 (1.4mg per level). Group 2: In 19 patients (20 spinal levels) the interbody cage was augmented with autologous bone graft alone, harvested from the iliac crest. Thin slice lumbar CT scanning with multiplanar reconstruction was obtained at 6 & 12 months post-operative.
Results: In group 1, 21/22 levels were fused post-operatively (mean 7.1 months). In group 2, fusion levels were significantly lower ($p = 0.001$), with 10 levels showing complete fusion and 9 partial fusion (mean 12.4 months). Despite very low dose BMP-2, 2 cases of asymptomatic heterotopic ossification were observed as were two cases of perineural cyst formation, one of whom required revision.
Conclusions: The use of BMP with autograft in the disc space during minimally invasive lumbar interbody fusion is associated with a higher rate of fusion. Even with very low dose BMP used in this study, complications related to BMP usage were observed.

FH F2-05: One year institutional experience with intra-operative SSEP monitoring during complex spine surgery.

V. Petrik, R. Knight, M. Koltzenburg, J. Allibone & D. Choi (The National Hospital for Neurology and Neurosurgery, London, UK)

Objectives: One year institutional review of intra-operative SSEP monitoring during complex spine surgery.
Design: Retrospective analysis.
Subjects: 168 complex spinal procedures were performed on 155 patients (79 females) with average age $\pm$ STDEV 54.6 $\pm$ 16.6 years. There were 52 lumbo-sacral, 42 thoracic, 64 cervical and 10 occipito-cervical procedures, 117 procedures were instrumented. There were 142 extradural decompressions, 10 operations for intradural pathologies and 6 for intramedullary tumours.
Methods: Events of minimal 25% drop in SSEP amplitudes were compared with occurrence of post-operative permanent and transient neurological deterioration.
Results: Altogether 16 surgical cases with deteriorations in SSEP amplitudes independent from alteration in level of anaesthesia were detected. After appropriate surgical intervention one permanent and three transient neurological deteriorations occurred in this group. Further 6 transient neurological deteriorations occurred without alterations in SSEP.
Conclusions: We recommend the use of SSEP for complex spine surgery as an early warning system, particularly for deformity surgery. SSEP, however, are not completely reliable, but act as a guide for the surgeon during the case.

Reference

1 Cruccu G, Aminoff MJ, Curio G, Guerit JM, Kakigi R, Mauguiere F, *et al*. Recommendation for the clinical use of somatosensory-evoked potentials. *Clinical Neurophysiology* 2008;119:1705–19.

FH F2-06: Going round the houses? What treatments do people receive prior to nerve root decompression for sciatica and brachalgia?

A. C. Dias, D. S. Jeyaretna, J. C. Hobart & T. J. Germon (Department of Neurosurgery, Derriford Hospital, Plymouth, UK)

Objectives: To determine the treatments received by people with sciatica and brachalgia prior to a specialist suggesting nerve root decompression.
Subjects: 514 people undergoing consecutive cervical or lumbar nerve root decompression between March 2007 to October 2009.
Methods: People completed questionnaires pre- and post-operatively. Pre-operatively we recorded: - duration of symptoms - details of previous treatments - pain severity (visual analogue scale, VAS) - functional limitations caused by their symptoms. Post-operatively we recorded: - pain severity (VAS) - change in functional limitations.
Results: Prior to surgery the mean duration of symptoms was 23 months (range 1 to 360). 83% had tried one or more manipulation therapy, 24% received injection therapy and 91% took regular analgesia. The commonly reported functional limitations were in walking, sleep and work. Surgery improved pain scores (mean pre-op 7.3; post-op 3.0), and the majority (78%) reported improvements in functional limitations.
Conclusions: Surgical nerve root decompression is effective. However, the majority of patients spend months ''going round the houses'' before obtaining a specialist opinion and are subjected to an array of non evidence-based treatments with potential side-effects. Early referral for specialist opinion will reduce the personal, social and economic burden of sciatica and brachalgia, and avoid unproven treatments.

FH F2-07: Clinical outcome following minimally invasive lumbar canal decompression

M. Guilfoyle, A. M. Nowitzke, R. J. C. Laing, M. J. Wood & R. J. Mannion (Addenbrookes Hospital, Cambridge UK and the Princess Alexandra Hospital, Brisbane, Australia)

Objectives: Minimally invasive techniques in degenerative lumbar spine conditions are becoming more popular though concerns exist over efficacy, safety and practicality. Here we review clinical outcome in 50 patients who underwent surgery with this approach.
Design: Prospective cohort study.
Subjects: 50 patients who underwent minimally invasive lumbar canal decompression between 2003 and 2008 at one institution.
Methods: All patients received single level lumbar canal decompression through a muscle splitting, tube assisted approach with unilateral hemilaminotomy. Pre- and post-operative Oswestry and SF-36 data were collected. Patients were followed up for a minimum of one year.
Results: Significant improvements in both Oswestry and SF-36 data were observed at 3 months, sustained at 1 year. Interestingly, efficacy increased through the series, representing a learning curve with the technique. These are compared to a similar cohort of patients operated on with a traditional open midline approach from another institution. Both efficacy and complications were comparable.
Conclusions: Minimally invasive lumbar canal decompression is safe and efficacious though there is a learning curve to the technique which will be discussed. There are potential benefits to the patient through reduced post-operative pain, reduced blood loss and a possible reduction in long term iatrogenic spondylolisthesis when compared to open lumbar decompression.

FH F2-08: Stand-alone self-locking cervical cages: Results in 88 consecutive operated levels

N. Mundil, H. El-Maghraby, S. Joshi & A. Shad (Department of Neurosurgery, University Hospital Coventry & Warwick, Coventry, UK)

Objectives: Cervical disc disease at C2/3, C3/4 and C7/T1 is less common. Fusion with cages & plating is the standard treatment at these levels and in multi-level disc disease. This is not without significant risks related to the need of larger exposure and anterior muscular dissection. Stand-alone self-locking cages obviate the need for plating and larger exposure.
Design: Retrospective chart review. To assess the exposure/cage related morbidities and fusion rates in stand-alone self-locking cervical cages.
Subjects: 88 levels were operated in 65 patients from February 2008 to August 2009.
Methods: Single and multilevel cages were performed in 45 and 20 patients respectively. 25 of the 45 patients underwent single level discectomy with stand-alone self-locking cage insertion at C3/4 and C7/T1 levels. 20 patients underwent 43 multi-level discectomies with stand-alone self-locking cage insertion.
Results: Operative time was shorter. There was no reported permanent exposure/cage related morbidities in all operated levels. One patient with traumatic disc disruption required further surgery for lateral mass fixation. Fusion rates were 94% at single level and 88% at multi-level discectomies at the last follow up. No patient required cage related surgical revision.
Conclusions: The current results support the use of stand-alone self-locking cage especially at C3/4 and C7/T1 and in multi-level discectomies as it obviate the need for plating and larger exposure.

Reference

1 Scholz M, Reyes PM, Schleicher P, Sawa AG, Baek S, Kandziora F *et al*. A new stand-alone cervical anterior interbody fusion device: biomechanical comparison with established anterior cervical fixation devices. *Spine* 2009;34(2):156–60.

FH F2-09: Stand-alone intervertebral cages for three and four level anterior cervical discectomy and fusion

E. A. C. Pereira, J. Hempenstall, A. A. Kamat, J. C. D. Leach, H. Chandran & T. A. D. Cadoux-Hudson (Department of Neurological Surgery, The West Wing, John Radcliffe Hospital, Oxford, UK)

Objectives: Multi-level anterior cervical discectomy and fusion (ACDF) using stand-alone intervertebral cages is an increasingly performed procedure yet reports of outcomes are sparse. We present our experience of 3- and 4-level ACDFs.
Design: Prospective evaluation of clinical and radiological outcomes.
Subjects: 30 adults with degenerative cervical spine changes receiving 3- and 4-level ACDFs undertaken by a single surgeon (TCH) using the Stryker Solis cage over six years from October 2003 to June 2009.
Methods: Prospective clinical and radiological outcome data collection. Of 16 males and 14 females, 12 had radiculopathy, 7 myelopathy and 11 myeloradiculopathy. Mean age at surgery was 58 years and average interval between pain onset and surgery 2.8 years.
Results: 23 3-level (77%) and 7 4-level (23%) ACDFs were performed. All 4-level ACDFs were from C3-C7, 19 3-level procedures were from C4-C7 and 4 from C3-C6. After follow-up from 6 months to 5 years (average 20 months), clinical outcomes, assessed using a visual analogue scale and a modified JOA scale for myelopathy, showed significant improvements. X-rays changes were described.
Conclusions: Multi-level ACDF with stand-alone intervertebral cages is a safe and efficacious procedure that avoids the risks of harvesting donor sites and those of external fixation.

Oncology (Surgery):

FH F3-01: Resection of supratentorial intra-ventricular meningiomas. Anatomical considerations and outcome

S. A. Alavi & R. W. Kirollos (Addenbrooke's Hospital, Cambridge, UK)

Objectives: Resection of intra-ventricular meningiomas [IVM] is a challenge for neurosurgeons. The safest surgical trans-sulcal approach and the trajectory through white matter tracts remain uncertain and correlate with the outcome of IVM resection.
Design: Retrospective case note review of patients who underwent resection of IVM by single surgeon and in the same neurosurgical unit between 2002 & 2009.
Subjects: Patients with intraventricular meningioma in single institue.
Methods: Retrospective study,using a data base, medical & op notes and clinic letters. 11 cases, 7 females-4 males [mean age of 44 yrs] were identified. Data collected including clinical and imaging information, operative approach, extent of resection and outcome. Correlation between the operative trajectory, approach and neurological deficits was emphasised. Length of follow up was between 7 months to 8 yrs.
Results: Lateral ventricle 9 and third ventricle 2. Approaches: Superior temporal sulcus [5], distal Trans-sylvian [1], Inter parietal sulcus [3], Inter-hemispheric-Transcallosal-transforaminal[1] and the Subfornical - transchoroidal [1]. Image guidance [8]. 10 Complete resections & 1 small residual. 2 CSF leak & 6 transient hemianopia. 3 Transient dysphasia in 5 approaches through dominant hemisphere. 1 VP shunt.

Conclusions: Modified Rankin score of 0–2 in 10 cases [91%] at the time of discharge. In the first follow-up [3 months] 10 cases [91%] had MRS of 0–1 and only one who had MRS of 3 pre-op, remained the same post-op. There was no recurrence. 9 cases were WHO grade I & 2 were II with no adjuvant treatment. With good pre-operative planning and anatomical consideration, achieving a good outcome is feasible.

FH F3-02: Analysis of survival and performance status of patients operated for cerebellar metastasis

A. Varma, Y. Khan & A. Brodbelt (The Walton Centre for Neurology and Neurosurgery, Liverpool, UK)

Objectives: To assess the survival and performance status of patients operated for cerebellar metastasis.
Design: Retrospective analysis over 18 month period after surgical excision. Performance status(ECOG), location, number of mets, details of status of primary disease including traetment, TTP, postoperative outcome including performance status and survival details over 18 month period was analysed.
Subjects: 28 patients operated in the unit during 2007 and early 2008.
Methods: Case note analysis, clinic letters, communication from GP and Oncologist, physiotherapy and occupational therapy assessments were looked into.
Results: Cereballar mets constituted 22% of operated cases of metastasis. Male female ratio was 1:1.8 with mean age of 58.6 yrs. Mets from lung contributed to 31.8% followed by breast (18.8%) and bowel (13.6%). 18.8% of patients survived 18 months. 9% survived 12 months. Best survival was for breast and endometrial carcinoma. Worst was for lung primary. Clinical and performance status details are discussed.
Conclusions: Survival and performance status were better for patients who had breast primary. They correlated well with the status of control of primary disease. Surgery helped to maintain and occassionally improve the performance level (ECOG) compared to the status at the time of diagnosis; enabling better prospect for adjuvant treatment and quality of survival.

Reference

1 Allen K Sills. Current treatment approaches to surgery for brain metastases. *Neurosurgery* 2005;57:S4:24–32

FH F3-03: Neurological Deficits with Awake Craniotomy for Tumours near Eloquent Brain: A Retrospective Case-Controlled Study in 40 Patients

V. A. van Vugt, I. Timofeev, D. Duane, C. Watts & S. J. Price (Addenbrooke's Hospital, Cambridge, UK)

Objectives: To assess the rate of neurological deficits in a group of patients undergoing awake craniotomy for tumours near eloquent brain.
Design: Retrospective, case-controlled study from a single neurosurgical centre.
Subjects: 40 patients with intrinsic brain tumours (8 metastases, 8 low grade gliomas and 23 high grade gliomas) undergoing awake craniotomies (median [IQR] age 56[41:71]) were matched to 40 patients of similar tumour grade, amount of resection, age and gender who underwent tumour resection under general anaesthesia (GA).
Methods: Standard technique of awake craniotomy, with GA stopped on opening of the dura, was used. Factors assessed included pre-operative deficits, 30 day mortality, length of stay, neurological status at discharge and at one month's follow up. The extent of surgical resection was evaluated by MRI within 72 hours of surgery.
Results: There were no deaths in the awake craniotomy group and 1 in the GA group. Ten (25%) patients in the awake group had neurological deterioration at the time of operation. In 7 patients deficit has improved at follow up, with only 3 (7.5%) patient remaining unchanged. In the GA group 2 (5%) patients were worse post-operatively. Length of stay was not significantly different between the two cohorts.
Conclusions: Although the immediate risks from surgery in the vicinity of eloquent cortex are higher in the awake craniotomy group, the overall risk of long-term neurological deficit is low and comparable to operations under GA in non-eloquent areas. No obvious risk factors for developing perioperative neurological deficit were identified.

FH F3-04: Spheno-Orbital Meningiomas: Surgical management, selective radiotherapy and clinical outcomes

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Objectives: Assessment of presentation, imaging characteristics, surgical management, histopathology features, selective radiotherapy and clinical outcomes for patients with spheno-orbital meningiomas (SOM).
Design: Retrospective chart review.
Subjects: Retrospective analysis of 20 patients with SOM.
Methods: Retrospective chart review.
Results: Sixteen patients without prior treatment and 4 with recurrent tumors. Eighteen patients were female and 2 were male with a mean age of 48 years (median 47 years, range 16–70). Mean follow-up was 49 months (range 0–106). Pertinent literature was reviewed.

Proptosis and impaired visual acuity were the predominant symptoms at presentation. At 6 months postoperatively, functional status was equivalent to or better than preoperatively for 17 patients, worse for 1, and there were 2 perioperative deaths. Visual acuity was improved in 12, stable in 5, worsened in 1, and unknown in 2 (early postoperative death). There was one cerebellar infarction. Histologically, World Health Organization (WHO)26 meningioma grade was I for 15 patients and II for 5 (1 with Neurofibromatosis type II - NF2). Bone involvement with hyperostosis with tumor invasion was shown histologically in 18 patients. Twelve of 14 anterior clinoid processes analyzed separately demonstrated evidence of tumor invasion. Seven patients (35%) underwent irradiation as part of their initial or salvage treatment. Five patients received postoperative fractionated radiation after surgery. Three additional patients have had local disease recurrence, one underwent further surgery (recurrence at 5 years) and the remaining two, had radiation treatment (recurrences at 18 and 48 months).
Conclusions: Patients with SOM present with proptosis and vision loss. Optimal surgical treatment includes aggressive removal of hyperostotic and tumor infiltrated bone including the anterior clinoid process in addition to soft tumor. Reconstructive techniques reduce exophthalmos and other cosmetic deformities. Long-term follow-up is necessary to monitor for recurrence, and radiation is advisable in selected cases.

FH F3-05: Thirty-seven consecutive spinal cord ependymomas: Correlation of extent of surgical resection with operative morbidity, recurrence and survival rates

G. S. McKenna, S. Short, S. Brandner, N. Kitchen & G. Samandouras (The National Hospital for Neurology and Neurosurgery, London, UK)

Objectives: To assess the efficacy of biopsy, debulking or total surgical excision of spinal ependymomas. Primary outcome measures were immediate postoperative morbidity (McCormick's Score), need for adjuvant radiotherapy, recurrence rate and survival.
Design: Retrospective review.
Subjects: Thirty-seven consecutive patients harbouring spinal ependymomas treated surgically between 1999 and 2009; 19 male,18 female; mean age 45 (range 19–77); mean follow up 44.4 months (range 5–124). Two patients underwent biopsy, 17 debulking and 18 total macroscopic excision. There were 26 WHO Grade II ependymomas, 10 Grade 1 (myxopapillary) and one Grade III (anaplastic).
Methods: Patients were identified on the pathology database. Medical notes and imaging studies analysed; outcome measures recorded.
Results: Postoperative McCormick's Score was same or improved in the total excision (89%) and debulking groups (77%). In the total excision group 2 patients received adjuvant radiotherapy, 2 recurrences were recorded (median 47 months) and survival rate was 100%. In the debulking group 11 patients required adjuvant radiotherapy, 10 recurrences were recorded (median 15 months) and survival rate was 94%.
Conclusions: Debulking and total surgical excision of ependymomas are associated with preserved or improved neurological function. Attempt of total surgical excision as opposed to debulking may be associated with reduced requirement for radiotherapy, lower recurrence rate and improved survival, without increased risk of neurological deficits.

FH F3-06: Safety and efficacy of intradural extramedullary spinal tumour removal using a minimally invasive approach

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Objectives: Minimally invasive surgery for intradural tumours offers the potential benefits over open surgery with multilevel laminectomy, but there are concerns over safety and efficacy. Here we review our early experience with minimally invasive techniques for intradural tumours in the spine.
Design: Prospective cohort study.
Subjects: 11 patients with 13 intradural extramedullary spinal tumours undergoing surgery.
Methods: All cases were operated upon using a a muscle splitting, tube-assisted para-median approach with hemilaminectomy to access the spinal canal. Fluoroscopy and navigation were used to determine the surgical level in all cases. All patients were followed clinically and radiologically.
Results: Satisfactory tumour resection was achieved in all but one case, when the surgery was converted to open after the tumour could not be found. Surgical time and intra-operative blood loss were favourable compared to open techniques. There was no postoperative morbidity in any of the minimally invasive cases.
Conclusions: Intradural extramedullary tumours can be safely and effectively removed using minimally invasive techniques, though these approaches highlight even more the importance of correct level exposure. The pros and cons of minimally invasive versus open surgery are discussed.

Oncology (Radiotherapy):

FH F4-01: Management of cranial meningiomata: guidance for follow up

J. Shapey, A. K. Demetriades, S. Al-Sarraj, C. L. Chandler, K. Ashkan, N. W. Thomas, R. S. Bhangoo & R. W. Gullan (Department of Neurosurgery, King's College Hospital, London, UK)

Objectives: To assess recurrence rates and establish a reasonable length of post-operative follow-up.
Design: 10 year retrospective review for all patients operated on between 1999–2003. Analysis of recurrence in relation to location, resection, histology and follow-up.
Subjects: 176 adult patients were included. Exclusion criteria included incomplete records, lack of follow-up, absent pertinent surgical information, multiple meningiomata.
Demographics: n = 176; M:F = 51:125, mean age 56 (3–87).
Results: Primary vs revision operation: 11% (20/176) had prior surgery. Overall recurrence was 18% (32/176), with 13% (21/156) in primary presentations, 52% (11/20) in re-operated patients. Detection of recurrence: at a mean of 23 months (2–102). Length of follow up: minimum 5 years (60–120; median 104 months).
Resection and Grade: Recurrence after primary macroscopic clearance (Simpson grade 1/2) was 8% for WHO grade I, 15% for grade II and 100% for grade III tumours. Meningiomata that did not undergo macroscopic clearance recurred earlier (25 vs 36 months).
Location: 10% convexity; 26% dural reflection (falx, tentorium, venous sinuses) and 16% of skull base tumours recurred.
Recurrence in macroscopically cleared grade I tumours was location dependent: 3% convexity; 9% dural reflection; 10% for skull base meningiomas. Time to recurrence was also location dependent: 19 months convexity; 31.3 months dual reflection; 57.3 months for skull base.
Conclusion: Recurrence depends on extent of resection and location. It is significantly lower at convexity locations. It is suggested that follow-up for convexity meningiomata can be safely reduced to 2 years. Skull base and dural reflection meningiomata should be monitored for at least 5 years.

FH F4-02: A Comparative Study of Outcomes from Grade 3 Anaplastic Astrocytomas between 1990–95 and 2000–05

Y. P. Kelly & J. C. Marks (Cork University Hospital, Wilton, Cork, Ireland)

Objectives: Anaplastic astrocytomas are considered enigmatic tumours due to their variable biological behaviour. It is debatable whether changes in treatment have altered patient outcome. This study investigated whether death, progression and recurrence improved over time and compared the impact of treatment on these outcomes with age and Karnofsky Performance Status (established prognostic factors).
Design: A retrospective comparative study.
Subjects: Patients diagnosed with a Grade 3 anaplastic astrocytoma between 1990–95 and 2000–05 in Cork University Hospital.
Methods: The medical records of a cohort of fifty-six patients were studied; noting pre-treatment factors, types of treatment received and outcomes from same. Patient GPs were also contacted for further information.
Results: There was no significant difference in endogenous factors and types of treatment received, apart from combined surgery, radiotherapy and BCNU chemotherapy. Progression and death decreased significantly over time ($P < 0.05$). Age ($P < 0.05$), ECOG status ($P = 0.01$) and some treatment modalities ($P < 0.05$) were significantly correlated with time-to-death; age also with progression-free-survival.
Conclusions: Although treatments had advanced, length of survival remained unchanged, despite fewer progressions and deaths. Some treatment modalities were as strongly correlated with patient outcomes as age and functional status ($r = -0.3$–4), thus demonstrating their significant contribution to prognosis. More individualised, targeted therapy will be required to increase future survival time.

References

1 Compostella A, Tosoni A, Blatt V, Franceschi E, Brandes AAl. Prognostic factors for anaplastic astrocytomas. *J Neurooncol* 2007;81(3):295–303.
2 Smith SF, Simpson JM, Sekhon LHS. What progress has been made in surgical management of patients with astrocytoma and oligodendroglioma in Australia over the last two decades? *Neuroscience* 2005;12(8):915–920.

FH F4-03: Implementation of National Guidelines for Neuro-Oncology Referral and Management

R. A. Weerakkody, M. R. Guilfoyle, C. Jeffrey, P. J. Kullar, A. Oswal, S. J. Price, S. Thomson & C. Watts (Addenbrooke's Hospital, Cambridge, UK)

Objectives: To evaluate the implementation and effectiveness of the National Institute of Health and Clinical Excellence (NICE) report on Improving Outcomes Guidance for Patients with Brain Tumours, published June 2006.
Methods: Retrospective study of patients with newly diagnosed glioblastoma multiforme (GBM) treated February-July 2006 (Period 1), compared with patients managed April-November 2008 (Period 2), and April-November 2009 (Period 3). Statistical analysis employed Kruskal-Wallis tests for dichotomous and continuous variables, respectively.
Results: Thirty-five patients were diagnosed with GBM during period 1 increasing to 49 and 45 in periods 2 and 3, respectively (total n = 129). The proportion of cases reviewed at a multidisciplinary team (MDT) meeting prior to surgery significantly increased (66% to 87%, $p = 0.027$). Median length of stay was 8 days in period 1, decreasing to 4.5 days in period 3 ($p = 0.004$).

Median time for histopathology reporting decreased from 6 to 3 days ($p < 0.001$); all cases and results were reviewed at a post-operative MDT meeting. Overall time from referral imaging to post-operative MDT remained unchanged (median 23 days; $p = 0.61$).
The proportion of patients receiving their diagnosis in a local specialist neuro-oncology clinic increased from 65% to 100% ($p < 0.001$) and the time from operation to outpatient review significantly decreased (median 17 vs. 10 days; $p < 0.001$). The proportion of patients undergoing MRI within 72 hours of tumour debulking increased from 17% to 91% ($p < 0.001$).
Conclusions: Subspecialisation and service development in accordance with NICE recommendations has successfully improved the standard of patient care and reduced hospital stay.

FH F4-04: Stereotactic Radiosurgery for Pineal Tumours

J. Yianni, G. Nagy, M. Radatz, J. Rowe & A. Kemeny (The National Centre for Stereotactic Radiosurgery, Royal Hallamshire Hospital, Sheffield, UK)

Objectives: Pineal tumours continue to present considerable clinical dilemmas and challenges. We were therefore interested to review our cumulative experience.
Design: Retrospective analysis of all patients treated with Radiosurgery for pineal tumours in one centre between 1987–2009.
Subjects: 44 patients (66% male) with pineal tumours treated radiosurgically (mean age 33.6 $\pm$ 16.4yrs). 11 had biopsy-proven pineal parenchymal tumours, 6 astrocytomas, 3 ependymomas, 2 papillary epithelial tumours and 2 germ cell tumours. 20(45%) patients had no definitive histology despite attempted surgical biopsy in 11. Prior to radiosurgery 17 had undergone craniotomy, 10 radiotherapy and 4 chemotherapy.
Methods: Retrospective case analysis. Routine clinical and MRI assessments were reviewed to calculate control rates.
Results: All values are mean $\pm$ 1sd. There were 50 Gamma knife treatments on 44 patients prescribing 18.1 $\pm$ 4.2Gy with a treatment volume of 3.8 $\pm$ 3.8cc. Mean follow up was 62.5 $\pm$ 52.9months. 5 patients (2 ependymomas, 3 pineal parenchymal tumours) died at 36.2 $\pm$ 36.7months after initial radiosurgical treatment. Outcomes in terms progression free survival were 95% at 1year, 82% at 5years, 80% at 10 and 20 years. No persistent complications were attributable to the radiosurgical treatment.
Conclusions: These results further demonstrate the increasingly significant role played by radiosurgery in the treatment of pineal tumours. A re-examination of the role of surgery in this patient group may also be warranted.

References

1 Mori Y, Kobayashi T, Hasegawa T, Yoshida K, Kida Y. Stereotactic Radiosurgery for Pineal and Related Tumours. *Prog Neurol Surg.* 2009;23:106–18.
2 Kano H, Niranjan A, Kondziolka D, Flickinger JC, Lunsford D. Role of Stereotactic Radiosurgery in the Management of Pineal Parenchymal Tumours. 2009;23:44–58.

FH F4-05: Primary gliosarcoma outcomes from a single centre experience

E. A. C. Pereira, R. Ma, D. Alexe, S.J. Griffiths, O. Ansorge & T. A. D. Cadoux-Hudson (Department of Neurological Surgery, The West Wing, John Radcliffe Hospital, Oxford, UK)

Objectives: Gliosarcoma is a rare glioblastoma variant. Most literature is from small case series. To appraise the dogma that it confers the poorest prognosis, we review outcomes from 33 patients over twelve years, the largest ever reported series.[1]
Design: Single-centre, consecutive case-series.
Subjects: 33 consecutive adults diagnosed with histologically confirmed gliosarcoma from August 1997 to July 2009.
Methods: Retrospective review of prospectively collected data. Male:female ratio was 1.7:1. Mean age at presentation was 59 years (range 28–80).
Results: Tumours were all supratentorial: 36% parietal, 33% frontal, 21% temporal and 9% occipital. 73% received radiotherapy and 18% chemotherapy. 30% had repeat debulking for recurrence. Mean survival from symptom onset was 17.2 months and 14.3 months from first surgery. This was increased to 17.5 months with radiotherapy and 22.3 months with revision surgery.
Conclusions: Approximately 3 gliosarcomas present per annum to our centre serving three million people. Males had increased risk and radiotherapy improved outcome. However, our predominant location was parietal and our mean survival nearly twice that reported in literature from the preceding decade.[1] This may reflect earlier detection, improved management and a less dismal prognosis than glioblastomas.

Reference

1 Han SJ, Yang I, Tihan T, Prados MD, Parsa AT. Primary gliosarcoma: key clinical and pathologic distinctions from glioblastoma with implications as a unique oncologic entity. *J Neurooncol* 2010;96(3):313–20.

FH F4-06: Stereotactic radiotherapy and radiosurgery in paediatric patients. Analysis of indications and outcome

B. Mirza, A. Mønsted, J. Harding, L. Ohlhues, H. Roed & M. Juhler (Department of Neurosurgery, Rigshospitalet, Copenhagen, UK)

Objectives: To describe the main indications, outcomes and risk profiles of SRT and SRS in paediatric

patients compared to the adult population and evaluate the causal role of SRS and SRT in inducing new neurological complications.
Design: Since the establishment of our unit for stereotactic radiation in 1996, all treated cases have been consecutively registered in a clinical treatment register. From this register, we defined all paediatric cases. Inclusion criteria were age < 15 years at the time of SRS/T and duration of follow-up > 2 years.
Subjects: 18 paediatric patients with mean age of 9 years ($\pm$ 4 years S.D.). Pathological entities included AVM, craniopharyngioma, ependymoma, gliomas of the optic nerve, hypothalamus and the pons, medulloblastoma, mixed astrocytoma, neuroblastoma, pinealoblastoma, pinealocytoma and pituitary adenoma.
Methods: Retropective analysis of medical reports for assessment of overall survival, progression free survival, control of pathology and specified neurological complications.
Results: In tumor patients the median overall survival time was 45 months (range 5–103) and the median progression free survival time was 35 months (range 5–98). Control or regression of the tumor was obtained in 83% of patients with neoplastic disease. Three patients with malignant tumors died due to disease progression. In AVMs the median time follow-up was 52 months (range 27–100). Complete obliteration of all AVMs was achieved. new neurological deficits were reported in 67% of patients overall. SRT/S was considered the direct cause of new deficits in 25%. All the neurological deficiencies related to SRT/S were focal and related to irradiated target areas. At long term follow-up new neurological deficits were reported in 67% of patients overall. SRT/S was considered the direct cause of new deficits in 25%. All the neurological deficiencies related to SRT/S were focal and related to irradiated target areas.
Conclusions: Continued treatment with SRT/S is justified as the risks of uncontrolled tumor disease and risk of haemorrhage of non-obliterated AVM are balanced against the overall benefits with SRT/S. Following SRT/S the risk of worsening all ready existing deficits and symptoms is relatively high. The risk of inducing new deficits at long term is relatively low.

References

1 Kondziolka D, Lunsford LD, Flickinger JC. Stereotactic radiosurgery in children and adolescents. *Pediatr Neurosurg* 1990;16(4–5):219–221.
2 Eder HG, Leber KA, Eustacchio S, Pendl G. The role of gamma knife radiosurgery in children. *Childs Nerv Syst* 2001;17(6):341–346.
3 Kiran NA, Kale SS, Vaishya S, Kasliwal MK, Gupta A, Sharma MS, Sharma BS, Mahapatra AK. Gamma Knife surgery for intracranial arteriovenous malformations in children: a retrospective study in 103 patients. *J Neurosurg* 2007;107(6 Suppl):479–484.

Miscellaneous:

FH F6-01: The Ethics of Treatment Withdrawal in Unconscious Patients. A Comparison of Attitudes in a Scottish and South African Neurosurgical Unit

M. Bernardotto & D. Currie (Neuroscience Unit, Aberdeen Royal Infirmary, Aberdeen, Scotland, UK)

Objectives: Modern technology allows us to preserve life beyond its natural course, paving the way for numerous ethical dilemmas. As clinical end-of-life decisions have become common, this study characterised the attitudes of health professional towards treatment withdrawal in unconscious patients assessing the factors influencing them, including cultural and socio-economic.
Design: Two study groups were recruited among staff at the Aberdeen (Scotland) and Cape Town (South Africa) neurosurgical units. All participants completed a questionnaire characterising their attitudes toward treatment cessation in unconscious patients.
Subjects: A total of 44 health professionals in a Scottish and South African neurosurgical unit.
Methods: The questionnaires completed by participants were analysed against current guidelines and regulations. Statistical tests were used to assess significant differences between groups.
Results: All participants showed to be in favour of treatment withdrawal, but uncertainty increased with unclear states of unconsciousness (eg PVS). South African participants highlighted concerns regarding costs and resources. Still, all agreed on fundamental ethical principles. Nonetheless, divisive responses were obtained regarding active euthanasia and the withdrawal of food and fluids.
Conclusions: Many factors shape attitudes towards treatment withdrawal, making characterisation problematic. However, there are indications that ethical principles can be trans-cultural in nature. The controversy of treatment withdrawal, and our limited understanding of consciousness, call for a constant debate among neurosurgeons, ensuring that ethically coherent decisions are made for each patient.

References

1 Orentlicher D, Callahan CM. Feeding Tubes, Slippery Slopes, and Physician-Assisted Suicide. *J L Med* 2004; 25: 389–409.
2 Boly M, Coleman MR, Davis MH, Hampshire A, Bor D, Moonen G, *et al*. When Thoughts Become Action: an fMRI paradigm to study volitional brain activity in non-communicative brain injured patients. *Neuro Imaging* 2007; 36: 972–992.

FH F6-02: Image transfer in neurosurgery: targets and aspirations but continued failure

M. Crocker, W. Cato-Addison, T. L. Jones, J. Anderson, M. C. Papadopoulos & B. A. Bell (Academic Neurosurgery Unit, St George's University of London, London, UK)

Objectives: To reassess local and national digital image transfer from a neurosurgical perspective.
Design: Prospective study of image transfer and associated delays in a single neurosurgical unit. Survey of national image transfer provision, compared with two previous assessments.
Subjects: Referrals to a single neurosurgical unit during a six week period: survey of all UK neurosurgical units.
Methods: We prospectively assessed 143 referrals to our neurosurgical unit for delays in reviewing imaging and the provision within our department to interact with the PACS systems of all the referring units, in both elective and emergency contexts. We then extended this assessment to review provision for emergency image transfer in all neurosurgery units in the UK.
Results: PACS access gives rapid image review, image links are prone to occasionally severe delay, and CD-ROM transfer incurs a mean delay of 5.8 hours. Of the 317 hospitals making emergency neurosurgical referrals, 51% are linked to regional units by direct PACS access, 31% by image link, 6% by image link not supporting MRI and 12% by no link. Of 33 neurosurgical units, 20 report routine use of couriers. Nationally, images are rarely available for consultant opinions out of hours.
Conclusions: Progress in UK digital image access has slowed: these results are comparable to those seen at the start of 2008. A number of solutions have been proposed but are still not implemented.[1] Our local experience is reflected nationally and is likely to be responsible for extensive diagnostic and treatment delays.

Reference

1 NHS Modernisation Agency/Department of Health. Progress in Developing Services: The Neuroscience Critical Care report. 2004.

FH F6-03: Preliminary Clinical Experience with the Use of Ceiling Mounted Mobile High Field Intraoperative Magnetic Resonance Imaging Between 2 Operating Rooms

C. Lim, M. R. Chicoine, J. A. Evans, A. Singla, G. J. Zipfel, K. M. Rich, J. L. Dowling, J. R. Leonard, M. D. Smyth, P.Santiago, E. C. Leuthardt, D. D. Limbrick, R. G. Dacey Jr. & D. F. O'Brien (Department of Neurological Surgery, Washington University School of Medicine, St. Louis, MO, 63110, USA and Department of Neurosurgery, Beaumont Hospital, Dublin, Ireland)

Objectives: Intraoperative magnetic resonance imaging (iMRI) provides immediate feedback and quality assurance enabling the neurosurgeon to improve the quality of a range of neurosurgical procedures. Implementation of iMRI is a complex and costly process. We describe our preliminary 18 months experience with the integration of an IMRIS movable ceiling mounted high field (1.5 T) iMRI setup with two operating rooms.
Design: Retrospective chart review.
Subjects: Aspects of implementation of our iMRI and our initial 18 months of clinical experience in 213 consecutive patients were reviewed.
Methods: Retrospective chart review.
Results: The installation of a ceiling mounted movable iMRI between 2 operating rooms was completed in April 2008 at Barnes-Jewish Hospital in St. Louis. Experience with 213 neurosurgical cases (M:F - 123:90, age range 1–80 years, 86 gliomas, 65 pituitary adenomas, 9 metastases, 16 other tumor cases, 4 Chiari decompressions, 7 epilepsy resections and 26 other miscellaneous procedures demonstrated that this device effectively provided high quality real-time intraoperative imaging. In 90 of all 213 cases (42%) and in 44 of 86 glioma resections (51%), the surgeon modified the procedure based upon the iMRI. 92% of iMRI glioma cases achieved gross/near total resection compared to 65% of non iMRI glioma cases in this time frame.
Conclusions: A movable high field strength iMRI can be safely integrated between 2 neurosurgical operating rooms. This strategy leads to modification of the surgical procedure in a significant number of cases, particularly for glioma surgery. Long-term follow up is needed to evaluate the clinical and financial impact of this technology in the field of neurosurgery.

FH F6-04: Venous Thromboembolism in neurosurgery: is there a role for more aggressive thromboprophylaxis?

R. M. Browne, D. S. Jeyaretna, K. T. Tsang & P. W. Whitfield (Derriford Hospital, Plymouth, UK)

Objectives: Untreated venous thromboembolic events (VTE) carry a 30% risk of mortality. Pharmacological prophylaxis in neurosurgical patients carries theoretical risks of adverse bleeding. This study examined the recent incidence of VTE in our unit and looked to identify a group of patients within which there may be a role for more aggressive intervention.
Design: A retrospective study of unselected consecutive admissions over a 2-month period to the regional neurosurgical unit.
Subjects: A total of 298 patients were admitted. Complete review of notes was conducted in 140 patients and incidence of VTE.
Methods: Case note review recording patient demographics, admission diagnosis, presence and method of VTE prophylaxis and incidence of VTE.
Results: 42.7 % of emergency and 54% of elective cases received enoxaparin. 9 patients (3%) sustained

a VTE. None of the 36 patients receiving enoxaparin from the day of admission had a VTE. Of the 24 patients receiving delayed enoxaparin (>48h delay), 6 (25%) developed VTE (relative risk 9, CI 1.16–70.16, $p = 0.01$). Emergency patients were 10 times (CI 1.25–78.6, $p = 0.009$) more likely to develop VTE.

Conclusions: There is a significant risk of PE in neurosurgical patients. The group most at risk comprises emergency admissions and patients not receiving enoxaparin within 48 hours of admission. Options to minimise risk should be targeted at these patients and include early chemical thromboprophylaxis and proactive use of IVC filters.

Reference

1 Rosenthal D, Wellons ED, Levitt AB, Shuler FW, O'Conner RE, Henderson VJ. Role of prophylactic temporary inferior vena cava filters placed at the ICU bedside under intravascular ultrasound guidance in patients with multiple trauma. *J Vasc Surg*. 2004; 40:958–64.

FH F6-05: Dr Foster intelligence?

T. J. D. Byrnes, K. Skogen & J. Norris (Hurstwood Park Neurological Centre, Hayward's Heath, Sussex)

Objectives: In addition to analysing variations in mortality rates and producing an annual Hospital Report Dr Foster intelligence also supplies commercial haelthcare analysis software to NHS trusts. This software identifies differences between Trust coding data and their peergroup average, including mortality rates for a number of Healthcare groupings.

Design: We outline an Alert within our Trust regarding Clip/Coil Aneurysm Healthcare group.

Subjects: The Alert identified 11 deaths in the Clip/Coil Aneurysm between April 2008 and March 2009. A mortality rate of 9.4% ($n = 117$) compared to the expected Mortality Rate of 4.5% for the group.

Methods: Retrospective analysis showed only 5 of the 11 had been diagnosed with spontaneous subarachnoid haemorrhage, only 3 had undergone clipping or coiling of an aneurysm.

Results: The 6 other patients' diagnoses included, AVM, ICH, cerebral lymphoma, mucomycosis and 2 infarctions. The incorrect inclusion of 8 of these 11 patients into the Clip/Coil Aneurysm group appears to be the cause of the spurious Alert. The inclusion of these 8 patients within the wrong grouping was performed by the Dr Foster intelligence Software.

Conclusions: The accurate analysis of data in an automated manner is dependant upon correctly constructed algorithms. There is nothing to suggest that these inaccuracies are anything more than an isolated event nor that any other part of Dr Foster intelligence is prone to these dramatic miscalculations.

FH F6-06: Retrosigmoid Craniotomy achieved less Postoperative Headache

M. K. Teo, J. Bowness & M. S. Eljamel (Ninewells Hospital, Dundee, UK)

Objectives: The retrosigmoid (RS) approach provides excellent access to the cerebellopontine angle (CPA). As the morbidity and mortality associated with the surgery dramatically reduced over the last 40 years, functional outcome and quality of life became the major issues. Up to 80% of the patients suffered from postoperative headache. Several mechanisms were proposed and would be examined.

Design: Retrospective data collection 2000–2003 Prospective data collection 2003–2008.

Subjects: 105 patients (mean age 56 years, 43 males and 62 females) with RS surgery were included; 30 underwent craniectomy and 75 craniotomy. The patients' demographic including age, sex distribution, pathological diagnosis and length of hospital stay were not statistically significant between the two groups.

Methods: Since 2003, craniotomy (bone flap replacement) instead of craniectomy became our standard approach to retrosigmoid procedures, and prospective data including patients' demographic, management and outcome for at least 12 months were collected. Retrospective data analysis was performed from 2000 with comparison made on postoperative headache outcome and possible risk factors.

Results: At discharge, postoperative headache was noted in 19% (14/75) of patients with craniotomy; and 43% (13/30) with craniectomy ($p = 0.01$). The incidence of headache decreased at 12 months follow up (1% (1/75) craniotomy vs 10% (3/30) craniectomy) ($p = 0.1$). Subgroup analysis of 56 patients who underwent retrosigmoid craniotomy from Jan04-Mar08, 75% (3/4) of patients with postoperative CSF leak, & all patients with CSF infection/wound infection had postop headache ($p = 0.005$, $p = 0.001$, $p = 0.01$ respectively). Of the 27 cases of acoustic neuroma excision, 14% (2/14) of cases with intraoperative drilling as compared to 15% (2/13) without had postoperative headache ($p = 0.67$).

Conclusions: Less patients with craniotomy after retrosigmoid operation had headache at discharge. This data also showed that postop CSF leak, CSF sepsis and wound infection are very important risk factors for postop headache. Despite the popular belief that intraop drilling as a major risk factor due to chemical meningitis secondary to bone dusk obtained, we did not find such correlation.

FH F6-07: Spinal meningiomata: lessons for follow up

A. K. Demetriades, J. Shapey, S. Al-Sarraj, R. S. Bhangoo, N. W. Thomas & R. W. Gullan (King's College Hospital, London, UK)

Objectives: Assess recurrence rates and establish a reasonable length of follow-up.
Design: 10 year retrospective review.
Subjects: 31 adult patients were included. Exclusion criteria included incomplete records; imprecise surgical information; multiple meningiomata.
Methods: Cases treated 1999–2003, ensuring >5 year follow-up, analysed for recurrence regarding location, resection, histology.
Results: Demographics: n = 31; M : F = 2 : 29, Mean age 63 (22–88). Location: Cervical: Cervicothoracic: Thoracic: Thoracolumbar: Lumbar: Lumbosacral: Sacral = 5:3:21:0:1:1:0 Primary vs revision operation: Two cases (6.5% – 2/31) had prior surgery. Degree of resection: 79% cases with Simpson grade 1/2 resection; 21% Simpson grade 3/4. Histology: 93.5% (29/31) were WHO Grade I, the remainder being atypical (Grade II). Only 1 patient had Neurofibromatosis, with Grade I histology and not recurring. Recurrence: overall recurrence rate was 6.5% (2/31), with 3.4% (1/29) in primary presentations and 50% (1/2) in re-operated patients. The case that recurred for the second time, at 1 year, was a grade II lumbo-sacral Simpson 4 resection, that had further radiosurgery. The other recurrence, at 6 years, was a WHO I Simpson 2 cervical meningioma. Length of follow up: mean 74 months (60–122).
Conclusions: 1. We confirm regrowth relates to the extent of resection and grade of tumour. The vast majority do not recur; continued surveillance is potentially costly, unnecessary and may provoke long-term anxiety. However, in WHO Grade II or higher tumours regrowth/recurrence is likely. In technically demanding cases, with grade 1/2 resection unachievable, continued clinicoradiological monitoring may identify candidates for adjuvant treatment before a recurrence is too extensive and symptoms deteriorate.

Oncology – Imaging and outcome:

OH T2-01: Diffusion Tensor Imaging Patterns in Cerebral White Matter Tracts: A Comparison between the Effects of High-Grade and Low-Grade Gliomas on Adjacent White Matter Tracts

H. Taylor, D. J. Coope, S. J. Mills, G. Thompson & K. Herholz (Biomedical Imaging Institute, University of Manchester, Manchester, UK)

Objectives: To compare the alterations to white matter (WM) tracts, seen on DTI directional colour maps of high-grade gliomas to those seen on directional colour maps of low-grade gliomas.
Subjects: Diffusion tensor imaging (DTI) was obtained from 17 patients, 7 of whom had low-grade gliomas (WHO grade II) and 10 of whom had high-grade gliomas (WHO grade IV).
Methods: Maps of fractional anisotropy (FA), mean diffusivity (MD) and the major eigenvector direction were generated, and a directional colour map produced. Patterns of WM tract alterations on the directional colour maps were recorded and compared between the two groups.
Results: In the low-grade gliomas, the predominant pattern observed was that of a normally located and orientated tract with decreased FA. In the high-grade gliomas, the predominant patterns observed were those of tract displacement and tract disruption.
Conclusions: On comparison of the low-grade to the high-grade images, we observed a difference in the DT directional colour maps produced with respect to the patterns of WM tract alterations.

OH T2-02: Cell lines derived under serum-free conditions have the potential to screen multiple therapeutic targets in patients with Glioblastoma

E. M. Kenney-Herbert, S. L. R. Ball, M. T. Fael al-Mayhani & C. Watts (Addenbrookes Hospital, Cambridge, UK)

Objectives: The aim of this study was to determine if GBM stem-like cells have any potential for screening drugs and individualising patient therapies.
Subjects: Tissue was used from 6 patients with GBM.
Methods: Methods TICs were cultured using serum free conditions with the mitogens EGF and FGF and screened for VEGF and PDGF signalling activity. The effects of inhibitory antibodies were assayed using MTS assay for cell proliferation. Presence of ligand and receptor was shown using RT-PCR and ligand secretion was demonstrated using ELISA. TICs were confirmed to be tumour initiating *in vivo*.
Results: Results Our results show that cell lines derived under identical serum-free conditions from different patients with GBM have distinct patterns of growth factor secretion and receptor expression. Interrogation of putative autocrine signalling mechanisms identified a differential pattern of response between patients. This response profile was not modulated by exogenous growth factor expression.
Conclusions: Conclusion Antibody based interrogation of growth factor signalling pathways can reveal different patterns of response between different cell lines and identify putative mechanisms for further pre-clinical evaluation.

OH T2-03: Volumetric Analysis Of Brain Tumour Resection By Intraoperative High-Field Magnestic Resonanace Imaging

M. S. A. Dherijha , A. Mcevoy, L. Zrinzo, C. Micallef & N. D. Kitchen (The National Hospital for Neurology and Neurosurgery, London)

Objectives: To asses impact of intraoperative MR imaging in estimating extent of resection in brain tumour surgery.

Design: Retrospective analysis of all patients who underwent craniotomy for brain tumour resection in Imri suite from April 2009-Dec 2009 using neuronavigation. Tumours were resected in all patients to the point at which surgeons were satisfied with their resection. Intraoperative scans were done to confirm extent of resection. Further resection were performed when considered appropriate.
Subjects: Volumetric analysis and extent of resections were assessed with post contrast T1 weighted images for tumour showing contrast enhancement, T2 Weighted images and FLAIR for non enhancing tumours.
Methods: Volumetric assessment of tumours was conducted using Vector Vision2 (BrainLab) software. The area of tumours was manually segmented and volume measured by an independent qualified neuroradialogist and neurosurgeon.
Results: A Total of 15 tumour cases were operated during this period of time (7 low grade glioma, 4 high grade glioma, 2 meningioma, 2 other). Surgery was terminated after intraoperative MR scan in 9 patients (60%). No residual tumour was seen on the intraoperative scan in any of these patients. In 6 patients (40%), intraoperative MR scan showed residual tumour in 2 no further resection was performed because of residual tumour infiltration in eloquent areas. In 4 further resection was done to obtain gross total resection this was confirmed by a second intraoperative scan in all 4 cases. Overall 13 patients (87%) experienced gross total resection and in 4 (30%) Imri intraoperative scanning guided further resection.
Conclusions: Conclusion High field Intraoperative MRI is safe and reliable technique and its use optimizes the extent of brain tumour resection.

OH T2-04: Blood flow in glioblastoma measured by stable Xenon CT predicts tumour necrosis but not microvessel density: a combined imaging and immunohistochemical study.

M. Crocker, M. C. Papadopoulos & B. A. Bell (Academic Neurosurgery Unit, St George's University of London, London, UK)

Objectives: To determine whether blood flow in glioblastomas reflects the extent of tumour necrosis and microvessel density.
Design: Prospective observational study.
Subjects: 21 patients who underwent surgery for glioblastoma.
Methods: Patients with a radiological diagnosis of glioblastoma underwent 6-level stable Xenon CT regional cerebral blood flow measurements preoperatively. Markers of high and low tumour blood flow were identified. The pathological specimens from surgery were examined for the degree of necrosis by two independent correlative techniques. They were stained for the endothelial marker CD31 and microvessel density (MVD) was assessed with an automated segmentation process.
Results: There is consistent correlation between the preoperative tumour blood flow map and the degree of necrosis present in the tumour samples ($R = 0.40$). There is no clear relationship between MVD and the preoperative tumour blood flow map. Discrepancies may be explained by the high sampling variability (mean percentage necrosis 20 ± 24, mean MVD 216 ± 132). This raises two concerns with imaging as a marker of tumour biology: that the precise relationship of neovascularisation to measureable blood flow in solid tumours is very complex, and that the heterogeneous distribution of blood flow within individual tumours makes relating small samples to accurate anatomical locations key.
Conclusions: The tumour blood flow correlates with the degree of necrosis present in glioblastoma samples. The tumour blood flow does not however reflect blood vessel density. This suggests that the relationship of tumour blood flow to brain tumour biology is more complex than widely recognized.

OH T2-05: Application of a novel MRI diffusion tensor algorithm in the delineation of low grade glioma

T. L. Jones, B. A. Bell & T. R. Barrick (Academic Neurosurgery Unit, St George's University of London, London, UK)

Objectives: Low grade gliomas (LGG) account for 10–15% of primary brain tumours. They typically infiltrate white matter and ultimately progress to malignancy. Radiotherapy and surgical resection relies on accurate delineation of tumour. Timing of intervention in many cases is directed by changes in appearances on MRI FLAIR sequences. Diffusion MRI (DTI) provides information about white matter tissue architecture and when applied to LGG may provide insight into patterns of tumour infiltration.
Methods: DTI Scans were acquired from 10 LGG patients prior to surgery or radiotherapy. These scans were segmented using a novel k-medians algorithm, clustering voxels of similar diffusion characteristics to create an image delineating tumour. This tumour region was semi-automatically selected using in-house software. The size of the selected region was compared to the size of tumour defined manually from coregistered axial FLAIR scans acquired at the same time. 5 of the subjects underwent a second scan after 9 months.
Results: The size of the tumour region obtained using our semi-automatic DTI segmentation method was significantly larger than that defined by the FLAIR sequence ($p = 0.007$). In each of the 5 subjects scanned again after 9 months, both methods identified a significant increase in tumour volume ($p = 0.046$) however the magnitude of increase seen was greatest with our semi-automatic method (17% vs. 9%).

Conclusions: DTI provides more information about local tissue micro architecture than conventional tumour imaging methods. In the context of LGG surveillance, our method is more sensitive in detecting subtle changes in overall size. These changes may represent tumour cell infiltration and may have implications in patient follow up and subsequent treatment planning.

OH T2-06: The Use of Microdialysis in a Pharmacokinetic Study of Boronophenylalanine (BPA) To Facilitate Boron Neutron Capture Therapy (BNCT) for High Grade Glioma.

D. Ngoga, G. S. Cruickshank, A. Detta, S. Green, N. D. James, C. Wojnecki, J. Doran, N. Grahamm, Z. Ghani, G. Halbert, M. Elliot, S. Ford, R. Braithwaite, T. M. T. Sheehan, J. Vickerman, N. Lockyer, H. Steinfeldt, G. Croswell, R. Sugar & A. Boddy (University Hospitals Birmingham, UK, CR-UK Formulation Unit, University of Strathclyde, Glasgow, UK, Regional Laboratory for Toxicology, Sandwell & West Birmingham Hospitals Trust, Birmingham UK, Surface Analysis Research Centre, The University of Manchester, Manchester, UK, CR-UK Drug Development Office, London, UK, Northern Institute for Cancer Research, University of Newcastle, Newcastle-Upon-Tyne, UK)

Objectives: Boron neutron capture therapy (BNCT) is a binary treatment modality based on the nuclear reaction undergone by Boron (10B) which when irradiated with a low energy neutron beam yields a highly localized radiation dose. We examine the role of microdialysis in investigating BPA pharmacokinetics in the context of a clinical trial for future BNCT.
Design: *In-Vitro* studies laboratory analysis of microdialysis recovery of the BPA-Mannitol formulation. A Cancer research UK pharmacokinetic study incorporating microdialysis was set up to optimise the dose and uptake parameters for BPA-mannitol for use in future clinical trials of BNCT.
Subjects: Patients with radiological diagnoses of high grade glioma.
Methods: The two types of microdialysis catheter were examined *in-vitro* perfused with CNS Perfusion Fluid with and without out mannitol at 0.3 μl/min. 7 Patients with a radiological diagnosis of high grade glioma were recruited into the clinical trial of BPA. Measurements of 10B concentration were made in ECF, blood and urine, collected over a 48 after BPA infusion via different routes of infusion.
Results: *In-Vitro* BPA recovery was initially low (mean 0.3%) with both catheter types but significantly enhanced by equalization of the mannitol (mean 131%). Clinical trial indicated a peak in bioavailability of BPA at a time 6 h after infusion. This was enhanced by the addition of mannitol. Administration via the intra-arterial route (Cohort 2) showed enhancement in bioavailability with the peak level after 2 h peaking after blood BPA levels.
Conclusions: BNCT represents the potential of a biologically targeted means of radiation dose escalation beyond the current 60Gy maximum.1 It offered insight into boron bioavailability for eventual incorporation into the final BPA pharmacokinetic model.

Reference

1 Cruickshank GS, *et al*. A cancer research UK pharmacokinetic study of BPA-mannitol in patients with high grade glioma to optimise uptake parameters for clinical trials of BNCT. *Appl Radiat Isot*. 2009;67(7–8 Suppl):S31–3.

OH T2-07: An Evaluation of the management of newly diagnosed high grade glioma in the UK: Interim Analysis

G. S. Cruickshank on behalf of a UK HGG study group (University Hospitals Birmingham NHS Foundation Trust)

Objectives: To audit current management of newly diagnosed high grade glioma with carmustine implants (Gliadel©, Archimedes) against NICE technology guidance TA121. To describe current management of these patients who have undergone surgeon defined maximal resection.
Design: A multicentre prospective cohort, non-interventional observational, study to record defined management data for patients with high grade glioma.
Subjects: Adult patients with newly diagnosed high-grade glioma in whom maximal resection was considered achievable by the Multidisciplinary Team (MDT) at each participating centre.
Methods MREC and local management approval at each centre were obtained. Patient data was recorded anonymously by a member of the MDT according to an agreed study protocol.
Results: Data will be presented to show compliance with NICE guidance (n = 150). In addition data at 48 hour and 6 week follow up assessments explore surgical complications, wound difficulties, steroid use, lengths of stay and readmissions, as well as radiotherapy and concomitant temozolomide. Data encompassing performance levels at the three time points will allow some description of management impact.
Conclusions: First evidence suggests that few units are wholly NICE compliant in a way that allows patients access to the choices of treatment afforded by the NICE guidance, and that a number of grade 3 glioma patients fail to be offered carmustine implants.

Reference

1 Carmustine implants and Temozolomide for the treatment of newly diagnosed high grade glioma. NICE Technology Guidance TA121 BNOS, Hull, (June 2007).

OH T2-08: Can all brain tumours be treated by designated surgeons and be discussed pre-operatively through MDT meetings? An audit of compliance with NICE guidance ''Improving Outcomes for People with Brain and other CNS Tumours''

S. E. Harrisson, D. Shooman & P. L. Grundy (Wessex Neurological Centre, Southampton, UK)

Objectives: NICE (2006) made a number of specific recommendations with regard to the management of brain and CNS tumours. It was advised that all patients were managed and discussed through appropriate Multi-Disciplinary Teams (MDT) prior to surgery in all but emergency situations. Neurosurgeons carrying out oncology surgery were also precisely defined. However, there remains a marked discrepancy of opinion and practice in the UK. We audited our practice after adopting these guidelines to establish whether it is possible to realistically achieve compliance.
Design: A retrospective review of the operative logs.
Subjects: All adult cranial oncology cases operated on within our unit over a six-month period (Dec '08 – May '09).
Methods: All cases were then analysed with reference to MDT documentation and sub-specialist interest of surgeon.
Results: Neuro-oncology (n-onc) MDTMs were held weekly, skull-base (SB) and pituitary (pit) monthly. 224 cases were identified: 139 n-onc, 53 SB and 32 pit. Percentage discussed pre-op/post op were: 95/99 n-onc; 51/34 SB; 31/69 pit. Of the cases not discussed pre-operatively, 6/7 n-onc; 8/26 SB and 5/22 pit were emergencies. All 205 of the non-emergency cases were performed by one of the designated specialist surgeons.
Conclusions: The study demonstrates that it is possible for a regional neuro-oncology service to comply with NICE guidelines for the vast majority of cases. We identified problems with compliance for SB and pit, possibly due to less frequent meetings and a more recently formed formal MDTM. This area will be addressed and re-audited. We would encourage all units in the UK to immediately adopt these guidelines that have multiple advantages to patients and neuroscience units.

Reference

1 National Collaborating Centre for Cancer. *Improving outcomes for people with brain and other CNS tumours.* London (UK): National Institute for Health and Clinical Excellence (NICE); 2006 Jun. 180 p.

OH T2-09: Restoring hearing in neurofibromatosis type II patients with auditory brainstem implantation

R. J. Mannion, N. Donnelly, P. R. Axon, D. A. Moffat & R. Macfarlane (Addenbrookes Hospital, Cambridge, UK)

Objectives: Bilateral vestibular schwannomas is characteristic of neurofibromatosis type II (NF2) and a key management strategy emphasises hearing preservation for as long as possible. The auditory brainstem implant (ABI) has revolutionised hearing rehabilitation in individuals deafened by NF2. We review our series of ABIs, reporting the outcomes and factors associated with a successful implant.
Design: Prospective observational study.
Subjects: Ten patients with NF-2 undergoing translabrynthine resection of the tumour.
Methods: Since 2004, 10 individuals with NF2 have undergone insertion of a Nucleus multichannel ABI in our institution. Intra-operative EABR ensures optimal electrode array placement. Steinhouse pitch ranking has aided post-operative device programming.
Results: Nine patients received hearing sensation from their ABI. Four use their ABI daily and have auditory visual BKB scores ranging from 54% to 90%. Two are able to use a mobile phone. Five patients currently have the devices as a 'sleeper' due to well preserved contra-lateral hearing. A bandaging technique to secure the magnet has enabled continued MRI surveillance of remaining tumours.
Conclusions: The multichannel ABI is an effective means of providing improved communication and access to environmental sounds in patients deafened by NF2. Selection criteria and key operative steps will be discussed.

Functional:

OH T4-01: Effectiveness of performance of bilateral subthalamic stimulation under general anaesthesia

A. M. Harries, J. Kauser, H. S. Pall & R. D. Mitchell (Queen Elizabeth Hospital, Birmingham, UK)

Objectives: To determine patient outcome following bilateral subthalamic (STN) stimulation for Parkinson's disease under general anaesthesia.
Design: A retrospective review of case notes between 2002 and 2009.
Subjects: 85 patients, age range 36 to 61 years.
Results: The data was analysed and outcome assessed by patient UPDRS score pre and post surgery, electrophysiological data obtained during surgery, medication reduction and body mass index.
Conclusions: Bilateral STN stimulation for Parkinson's disease is safe and effective under general anaesthesia.

OH T4-02: Microvascular Decompression to Treat Hemifacial Spasm: Results for a Series of 45 Patients

A. W. Hewitt, J. Osman-Farah & P. R. Eldridge (The Walton Centre for Neurology and Neurosugery, Liverpool, UK)

Objectives: To present the results for a series of Microvascular Decompression operations for Hemifacial Spasm performed at the Walton Centre, Liverpool.
Design: Retrospective case note analysis of operative case series with long term follow up.
Subjects: A total of 45 identified cases of Microvascular Decompression for Hemifacial Spasm performed between 1996 and 2007 at the Walton Centre were included.
Methods: A retrospective analysis of case notes and microfiche records. The hospital activity statistics and theatre logbooks were examined to detect Microvascular Decompression operations for Hemifacial Spasm performed between 1996 and 2007. 45 patients were identified. Records were examined for outcomes including relief of spasm and complications.
Results: Long term follow up was available (mean 9.6 years). At this time 89% of patients remained free of spasm.87% of patients were spasm free in the immediate post operative period increasing to 96% at six months. Complications included 3 cases of unilateral hearing loss. In all cases brainstem auditory evoked potential recording was used. 2 cases of temporary facial weakness occurred.
Conclusions: Complete suppression of spasm was achieved in 95% of patients at six months in our series with complete suppression sustained in 89% with long term follow up (mean 9.6 years). Hearing loss was uncommon with routine use of brainstem auditory evoked potential recording.

Reference

1 Samii M, Günther T, Iaconetta G, Muehling M, Vorkapic P, Samii A. Microvascular decompression to treat hemifacial spasm: long term results for a consecutive series of 143 patients. *Neurosurgery* 2002; 50(2):276–285.

OH T4-03: Long-term outcomes of deep brain stimulation for cluster headache

E. A. C. Pereira, A. L. Green, L. Moir, P. T. G. Davies & T. Z. Aziz (Oxford Functional Neurosurgery, Nuffield Department of Surgery, University of Oxford and Department of Neurological Surgery, The West Wing, John Radcliffe Hospital, Oxford, UK)

Objectives: Cluster headache is an excruciating primary headache syndrome with 0.2% prevalence. Up to 20% of cases are drug refractory[1]. Here we evaluate outcomes from treatment by deep brain stimulation (DBS) of the ipsilateral posterior hypothalamus.
Design: Prospective case series.
Subjects: Four consecutive patients with cluster headache treated by DBS between April 2005 and July 2008 evaluated up to December 2009.
Methods: Evaluation was undertaken at a single centre with 18 months to four years of follow-up. Visual Analogue Scale (VAS), McGill Pain Questionnaire (MPQ) and EQ5D quality of life assessments were completed before and after surgery, at six months and annually thereafter.
Results: Male:female ratio was 3:1. Mean age at surgery was 54 years. Mean symptom duration was 13 years. Stimulation was bipolar at frequency of at 180 Hz with mean amplitude 3.6 V (s.d. 1.3) and mean pulse width 83 Hz (s.d. 28.7). 50% required battery revision. One patient had lead revision. 75% of patients became headache free. Significant improvements in VAS and MPQ and EQ5D were seen.
Conclusions: DBS is both safe and efficacious in refractory cluster headache, offering cost-benefit over intensive medical treatment.

Reference

1 Grover PJ, Pereira EAC, Green AL, Owen SL, Brittain JS, Schweder PM, *et al.* Deep brain stimulation for cluster headache. *J Clin Neurosci.* 2009;16:861–866.

OH T4-04: Intracranial EEG recording and stimulation mapping in patients with medically intractable epilepsy

C. Downham, M. J. A. Zaben, P. Ariyaratnam & W. P. Gray (Wessex Neurological Centre, Southampton, UK)

Objectives: To assess the outcome of patients with medically refractive epilepsy of any aetiology and equivocal foci location, who underwent intracranial EEG recording in the Wessex Neurological Centre.
Design: A retrospective audit of patient notes provided the data for this study.
Subjects: Twenty-six patients fulfilling the criteria underwent recording between November 2003 and July 2009. 11 cases were paediatric. Each had at least one of: subdural grid, strip or depth electrodes, inserted via craniotomy and/or burr hole. 18 underwent extraoperative stimulation for mapping of eloquent cortex.
Methods: A proforma was designed with reference to previous studies and case-series, and completed from the medical notes for each patient. Additional information was obtained from pathology results and imaging.
Results: 22 patients underwent surgery following recording, of whom 15 had extraoperative stimulation. 16 (72.7%) were Engel I at least 3 months post operatively. Four (18.2%) patients were Engel II at greater than 1 year, and one each Engel III and IV. Histology confirmed 7 tumours, 5 focal cortical dysplasias, 8 glioses/scleroses and 2 mixed. Loci remained unclear in 3 patients. 1 declined surgery.
Conclusions: These results are comparable to those of patients undergoing epilepsy surgery for whom the foci are more readily identifiable. Intracranial EEG recording and extraoperative stimulation is a safe and reliable adjunct for locating

seizure foci and eloquent cortex prior to surgical resection in complex patients.

References

1 Téllez-Zenteno JF, Dhar R, Wiebe S. Long-term seizure outcomes following epilepsy surgery: a systematic review and meta-analysis. *Brain* 2005;128(5):1188–98.
2 MacDougall KW, Burneo JG, McLachlan RS, Steven DA. Outcome of epilepsy surgery in patients investigated with subdural electrodes. *Epilepsy Res* 2009;85(2–3):235–42.

OH T4-05: Percutaneous balloon compression for trigeminal neuralgia – our experience

K. Ghosh, N. Ansar, A. Ray & A. Golash (Royal Preston Hospital, Preston, UK)

Objectives: Percutaneous balloon compression is an established treatment option for trigeminal neuralgia. This study reviews the outcomes and complications of the procedure, based on our experience.
Design: A retrospective analysis of all patients who underwent balloon compression for trigeminal neuralgia over a 32 month period.
Subjects: Twenty-one patients (8M, 13F), age range 36–83 years (mean 64.2 years) had balloon compression between January 2006 & August 2008. Duration of symptoms was 2–20 years (mean 9.7 years).Ten patients had previous treatment with either balloon compression(8)or microvascular decompression(2). Pain distribution was in V2(14.3%, n = 3), V3(33.3%, n = 7), V2 & V3(9.5%, n = 2) and hemifacial (47.6%, n = 9).
Methods: Balloon inflation duration was 60 - 120 seconds, being longer in five revisional cases. Inflation volume was 0.25 to 1.9 mls, majority (n = 16) had 0.7 mls. The position of the balloon was documented. Twenty patients (95%) were pain free at twelve weeks follow-up, one patient had no improvement. One patient had recurrent pain after 14 months, requiring a repeat procedure.
Results: Most patients were discharged on the same day (n = 11) or the next day (n = 7). Two patients were treated conservatively for post-operative facial swelling. One patient developed anaesthesia dolorosa. Pain medication was reduced in all patients except one.
Conclusions: In our experience, balloon compression is a safe and effective treatment method with minimal complications and short hospital stay. There was no correlation of the position of the balloon with outcome.

OH T4-06: Intrathecal Baclofen therapy- A review of 164 patients managed by a single Multi Disciplinary Team

D. Ngoga, R. Mitchell, B. Panagamuwa, A. Mahmood, G. Solanki & I. Soryal (University Hospitals Birmingham NHS Trust, Birmingham, UK and West Midlands Rehabilitation Centre, Birmingham, UK)

Objectives: Intrathecal Baclofen (ITB) therapy is an established management option for spasticity refractory to conventional therapy. We reviewed our experience of ITB therapy at University Hospital Birmingham over the last 8 years.
Design: Retrospective case review.
Subjects: Intrathecal Baclofen therapy.
Methods: A review of a dedicated patient database and case notes of patients managed by one team at our institution from 2001 to 2009. We analysed patient demographics, diagnoses, catheter tip positions, surgical and long term complications, dose titration regimes and patient outcome.
Results: 164 intrathecal Baclofen pumps were implanted in 146 patients. 106 currently receive ITB. A strict goal oriented approach is used in case selection. When stabilised, ITB daily dose requirements ranged from 45 and 1400 mcg/day (Mean 300mcg/day). 22 patients required more than double the mean dose. The most frequently occurring complication was catheter fracture (5.4%) and pump extrusion (5.4%).
Conclusions: Intrathecal Baclofen has been safe and effective in our case series. Treatment goals in 93% of patients were improvement in sitting posture and ease of care, for which an overall success rate of $>90\%$ has been recorded. Attention to detail by an accredited team and continual review of guidelines contributes to the high compliance and low complications in this series.

Reference

1 Albright AL, Gilmartin R, Swift D, Krach LE, Ivanhoe CB, McLaughlin JF. Long-term intrathecal baclofen therapy for severe spasticity of cerebral origin. *J Neurosurg* 2003;98(2):291–5.

OH T4-07: The Mamillothalamic Tract: A New Landmark For Targeting The Subthalamic Nucleus During Deep Brain Stimulation

O. Al Helli, L. Zrinzo & T. Yousry (The National Hospital for Neurology and Neurosurgery, London, UK and Department of Brain Repair, UCL Institute of Neurology, London, UK)

Objectives: To determine a possible role of the mamillothalamic tract (MTT) in identifying the position of the subthalamic nucleus (STN) in individual patients.
Design: Pre-operative stereotactic T2-weighted MR images were obtained for patients with Parkinson's disease undergoing DBS of the STN. The following were measured on scans of the axial section that show the red nucleus (RN) at its maximal transverse diameter: the lateral and the A-P distances between the anteromedial lip of the STN.
Subjects: Patients with Parkinson's disease undergoing DBS of the STN.

Methods: Pre-operative stereotactic T2-weighted MR images were obtained for patients with Parkinson's disease undergoing DBS of the STN. The following were measured on scans of the axial section that show the red nucleus (RN) at its maximal transverse diameter: the lateral and the A-P distances between the anteromedial lip of the STN.
Results: The mean distance from the STN anteromedial lip to the centre of ipsilateral MTT along the x-axis was 4.4mm (SD = 0.13) on the right side and 4.3mm (SD = 0.06) on the left side. In all of the studied cases, the distance between the STN anteromedial lip and the MTT was invariably 0.0mm along the y-axis.
Conclusions: the distance between the two structures along the x-axis shows little variation. The MTT can, therefore, be used as a reliable anatomical landmark for identifying the STN anteromedial lip.

References

1 Hamani C, Saint-Cyr J A, Fraser J, Kaplitt M, Lozano AM. The subthalamic nucleus in the context of movement disorders. *Brain* 2004;127(1):4–20.
2 Nieuwenhuys R, Voogd J, van Huijzen C. *The Human Central Nervous System: a synopsis and atlas.* 3rd revised ed. Springer-Verlag, Germany:1988.
3 Yelnik J, Damier P, Demeret S, Gervais D, Bardinet E, Bejjani BP, *et al.* Localization of stimulating electrodes in patients with Parkinson disease by using a three-dimensional atlas-magnetic resonance imaging coregistration method. *J Neurosurg.* 2003;99(1):89–99.

Hydrocephalus:

OH T6-01: Use of proGAV® shunt valve reduces the risks of overdrainage complications in normal pressure hydrocephalus

A. Toma, A. Tarnaris, N. Kitchen & L. Watkins (The National Hospital for Neurology and Neurosurgery, London, UK)

Objectives: Introduction: Overdrainage is a common complication associated with shunting in normal pressure hydrocephalus patients (NPH). Adjustable valves, with antigravity devices, have been shown to reduce its incidence. The optimal starting setting of an adjustable shunt valve in normal pressure NPH is debatable. In this study we audited our centre practice.
Methods: A retrospective review of clinical records of all NPH patients treated in our unit between 2006 and 2009 by the insertion of proGAV® valve was performed, recording demographic and clinical data, shunt complications and revision rates.
Radiological reports of postoperative follow up CT scans of the brain were reviewed for detected subdural haematomas.
Results: proGAV adjustable valve was inserted in 50 probable NPH patients between July 2006 and November 2009. Age was 76 + 7 years. Mean fellow up period was 12 months. Initial shunt setting was 6 + 3 cm H2O. Thirty-eight (76%) patients had no complications; six (12%) had shunt malfunction necessitating revision or exploration. One patient (2%) developed delayed bilateral subdural haematoma following readjustment of his shunt valve setting as an outpatient.
Conclusions: Use of proGAV® valve is associated with low overdrainage complication rate, probably as a result of the incorporation of the ''shunt assistant'' and its antigravity properties.
Starting with low opening pressure setting on proGAV® adjustable shunt valve does not increase the chances of overdrainage complications.

OH T6-02: Incidence and predictive factors for ventriculo-peritoneal shunt placement in subarachnoid haemorrhage in a case series of 52 patients

A. L. C. Dias, L. Collinson, A. Macdonald, S. Akmal & D. Peterson (Charing Cross Hospital, Imperial College NHS Trust, London, UK)

Objectives: Hydrocephalus is a known sequel of aneurysmal subarachnoid haemorrhage (SAH). It may occur acutely or later and a number will require definitive management of this. Vale et al. showed a high clinical correlation between post SAH chronic hydrocephalus and admission Hunt and Hess grades and Fisher grades.
Design: We aimed in our study to highlight the incidence, management and outcome of post SAH hydrocephalus and verify whether WFNS (as Hunt and Hess is no longer widely used) and Fisher grades are possible predictive factors for ventriculo-peritoneal (VP) shunt requirement in post SAH hydrocephalus.
Subjects: All patients with acute subarachnoid haemorrhage (excluding traumatic).
Methods: Retrospective analysis of case notes and image review of patients admitted with acute subarachnoid haemorrhage over a 6 month period (excluding traumatic SAH).
Results: A total of 52 patients were included. 32.7% of patients had hydrocephalus on the presenting scan with an Evans ratio ranging between 0.25 and 0.37 (mean 0.303). 8 (15.4%) patients required extra ventricular drain placement and 5 (9.6%) required ventriculo-peritoneal (VP) shunts. These 5 patients had a mean, median and mode Glasgow outcome scale score of 4. WFNS and Fisher grade was generally high in those requiring VP shunts. Evans ratios of patients undergoing EVD were Mean 0.301 Median 0.31 and those undergoing VP shunt were Mean 0.327 Median 0.33. 14/52 (22.6%) had evidence of hydrocephalus on scan but had no EVD, Shunt or lumbar puncture. There was no correlation between VP shunt and patient age, gender, race or aneurysm type.

Conclusions: In our series of 52 patients 1. Incidence of hydrocephalus is just above a third of the group. 2. There may be a radiological predilection to the development of hydrocephalus and subsequent shunting. In our series hydrocephalus and EVD and shunt placement was associated with higher Fisher and WFNS grades. 3. The incidence of external ventricular drain placement and VP shunting is low overall. There is however a significant number of patients who develop hydrocephalus post SAH who are currently being managed conservatively. In our series this did not appear to alter outcome (Glasgow outcome score and disability rating scale).

Reference

1 Vale FL, Edwin MD, Bradley L, Fisher WS. The relationship of subarachnoid haemorrhage and the need for postoperative shunting. *J Neurosurg* 1997; 86:462–466.

OH T6-03: The ventricular infusion test (VIT) as an adjunct for evaluating endoscopic third ventriculostomy (ETV) function in patients with persisting ventriculomegaly and recurrent symptoms

K. Aquilina, J. Sacree, M. R. Carter, I. K. Pople & R. J. Edwards (Department of Neurosurgery, Frenchay Hospital, Bristol, UK)

Objectives: To determine the usefulness of the ventricular infusion test (VIT) in the evaluation of ETV function in symptomatic patients without a change in ventricular size.
Design: Retrospective clinical study.
Subjects: 38 patients, age 1.5 to 82 years, who underwent ETV for obstructive (n = 31) and communicating (n = 7) hydrocephalus and subsequently developed recurrent symptoms, most commonly headache or ataxia, at a median of 13.5 (1–131) months post-ETV.
Methods: 42 VIT's were carried out through an Ommaya reservoir, inserted routinely at ETV. 24 patients underwent cranial magnetic resonance imaging at the same time.
Results: 13 patients had Rout > 13mmHg/mL min or prominent B waves on infusion; 2 underwent re-ETV and 11 were shunted. Symptoms improved in all (median follow up 12 months; 2–30). On 29 infusions, Rout was < 13mmHg/mL min or no B waves were identified; symptoms resolved without shunting (median 17 months; 2–52). 3 patients had high Rout and improved on shunting despite stoma flow void on MRI.
Conclusions: In this series, VIT was useful in evaluating stoma function in both adults and children. A patent stoma on MRI did not necessarily imply restoration of normal CSF dynamics.

OH T6-04: Time dependence of lumbar infusion test estimates in hydrocephalic patients

S. K. Piechnik, M. Czosnyka, J. D. Pickard & K. Cieslicki (Dept. of Cardiovascular Medicine, Oxford University, Oxford, UK, Academic Neurosurgery Unit, Cambridge, UK, Laboratory of Bioflows, Institute of Automatic Control and Robotics, Warsaw University of Technology, Poland)

Objectives: Lumbar infusion test is an invasive technique commonly used to assess the resistance to cerebrospinal fluid (CSF) outflow (Rout) as a predictive parameter for shunting in hydrocephalic patients. We investigate the improvement in reliability of estimates in time to weight against the patient safety and comfort.
Design: This is retrospective analysis of data collected during standard clinical procedures.
Subjects: The patient group consisted of 13 males and 17 females aged 37–81 (65 ± 10) years.
Methods: We analysed ICP responses to the 2ml/min tests lasting 5.7–20 (12 ± 10) minutes. Dynamic identification of the Rout and intracranial compliance (elastance index, E, and reference pressure P0) was used based on the 20% − 100% of the available test length to assess the stability of estimates with respect to their final values [1].
Results: Final Rout estimates were method independent with individual values in range 4–40 (12 ± 6) mmHg/(ml/min) and typically converged within ± 10% in under 15 minutes. Compliance parameters depended somewhat on the specific method used and seem to require longer than available infusion periods.
Conclusions: It is possible to obtain ± 10% consistency of Rout in just 10–15 minutes of infusion test. However, accurate estimation of compliance parameters requires longer infusion periods than available in this study.

Reference

1 Cieslicki K, Czepko R. *Neurol Neurochir* 2004;38:189–195.

OH T6-05: Outcome from performing endoscopic third ventriculostomies in children and adults

P. Tharmarajah, M. Garnett & H. Fernandes (Addenbrooke's Hospital, Cambridge, UK)

Objectives: Endoscopic third ventriculostomy (ETV) is seen as a potential treatment of choice for hydrocephalus, particularly in the paediatric population, avoiding the need for VP shunt insertion. The objective is to investigate the outcome of performing ETVs in children and adults in our Unit.
Design: Retrospective cohort study, analyzing the indications and outcome for patients who underwent ETVs.

Subjects: Patients, who underwent ETV in the last 18 months. Subjects divided into: age groups (<1y, 1–16y and >16y); and further subdivided into tumour and non-tumour pathology.
Methods: Retrospective analysis of theatre records, medical case notes and radiological imaging identified 36 patients. Primary outcome measure was the complication rate (including infection, conversion to VP shunt or other further surgery). Secondary outcome measures included hospital admissions related to complications and final patient outcome.
Results: <1y group: 5/7 patients (71%) developed complications from ETV, requiring conversion to VP shunt. 1–16y non-tumour group: 4/7 (57%) developed complications which required VP shunt insertion. 1–16y tumour group: 1/8 (12.5%) developed complications requiring a VP shunt. Adult non-tumour group: No complications (11 patients). Adult tumour group: No complications (2 patients).
Conclusions: Complication rate from ETV is high in children, compared to adults, when performed for non-tumour pathology. Although ETV is used to treat hydrocephalus in children, given its high complication (including failure) rate, an alternate method, such as VP shunt insertion, may be appropriate. Appropriate selection of patient criteria including age and pathology is required before embarking on ETV.

Reference

1 Schroeder HWS, Niendorf WR, Gaab M., Complications of endoscopic third ventriculostomy. *J Neurosur* 2002;96(6): 1032–40.

Miscellaneous e.g. Outcomes/IT in neurosurgery:

OH F2-01: The ''No-Drill'' Technique of Anterior Clinoidectomy: A Cranial Base Approach to the Paraclinoid and Parasellar Region

D. J. Chang, MD, FRCS (C) (Illinois Neurosciences Institute, Rockford, Illinois, United States of America)

Objectives: Power drilling technique of anterior clinoidectomy is advocated in all publications on paraclinoid region surgery. This approach can be hazardous because of the exposure of neurovascular structures to the entire length of the power drill in the operative field, engendering mechanical and/or thermal risk as a consequence.
Design: Retrospective review.
Subjects: 65 consecutive patients who underwent anterior clinoidectomy utilizing the ''no drill'' technique of anterior clinoidectomy for neurovascular lesions in the paraclinoid, parasellar, and paracavernous sinus region.
Methods: Retrospective review of a cerebrovascular/skull base fellowship-trained neurosurgeon's 65 consecutive cases of anterior clinoidectomy using the ''no drill'' technique is presented. A trans-orbital roof corridor is utilized after completion of the standard pterional craniotomy, with piecemeal epidural resection of the anterior clinoid process.
Results: No power drill was used in this surgical series of anterior clinoidectomy. Optimal microsurgical exposure was obtained in all cases to facilitate complete aneurysm clippings and lesionectomies of tumorous pathologies. There were no cases of direct injury to surrounding neurovascular structures from the use of the ''no drill'' technique.
Conclusions: Power drilling is generally not necessary for removal of the anterior clinoid process, optic canal roof, and optic strut. The ''no drill'' technique eliminates the risks of direct power-drilling mechanical/thermal injury and the risks of ultrasound-associated cranial neuropathies.

Reference

1 Chang DJ. The ''No-Drill'' Technique of Anterior Clinoidectomy-A Cranial Base Approach to the Paraclinoid and Parasellar Region. *Neurosurgery* 2009;64:96–106.

OH F2-02: Long term results after micro-vascular decompression for trigeminal neuralgia

C. Oesman & J. J. A. Mooij (Department of Neurosurgery, University Medical Centre, Groningen, The Netherlands)

Objectives: Evaluation of characteristic of patients with trigeminal neuralgia and to evaluate factors associated with long term results of microvascular decompression.
Design: A retrospective analysis of long-term result of microvascular decompression in patient with Trigeminal Neuralgia. A retrospective observational study.
Subjects: 156 patients with trigeminal neuralgia,90 female,66 male median follow-up of 9.7 years. The average age at the time of the occurrence of the pain was 51 years. The average duration of symptoms was 58 months.
Methods: 156 patients with trigeminal neuralgia treated with micro-vascular decompression by 4 neurosurgeons in MSF were evaluated before surgery. Baseline data were Assed from 1983 to 2003. Post Operative outcomes were from medical records. Baseline data divided in post-operative outcome were analyzed with univariate and multivariate analysis.
Results: 82% of patients with typical symptoms before operation had good operation results.
A typical symptom pattern or trigeminal neuralgia and immediate post-operative relief of symptoms were, in univariate analysis, significantly associated

with long term results. Immediate relief was an independent predictor of good long term results.
Conclusions: The long-term results of microvascular decompression in the majority of patients was good with little morbidity and mortality. Patients with a typical pattern of complaints had better long-term outcomes and fewer recurrences.

References

1 Dandy WE. Concerning the cause of trigeminal neuralgia. *Am J Surg* 1934;24:447–55.
2 Janetta PJ. Arterial compression of the trigeminal nerve at the pons in patient with trigeminal neuralgia. *J Neurosurgery* 1967;26:159–62.

OH F2-03: Percutaneous endoscopic gastrostomy and ventriculoperitoneal shunts: a dangerous combination?

J. M. Evans, A. Cairns, C. Babbs, J. Thorne & A. T. King (Dept of Neurosurgery, Salford Royal Foundation Trust, Manchester UK)

Objectives: To quantify the risk of VP shunt infection in patients who undergo insertion of a PEG feeding tube.
Design: Retrospective study.
Subjects: 302 patients who had a VP shunt inserted.
Methods: The records of 302 patients who had a VP shunt inserted at Salford Royal between 2002 and 2007 were reviewed.
Results: 24 patients with VP shunts had 26 PEGs inserted. 13 PEGs were inserted in 11 patients with a pre-existing VP shunt. 5 patients developed a shunt infection (20.8%) compared to the overall rate of VP shunt infection for our hospital of 7% ($P = 0.017$). The increase in number of VP shunt infections when the procedures were done more than 10 days apart (2/14) was not significant ($P = 0.25$).
Conclusions: Insertion of a percutaneous endoscopic feeding tube within 10 days of VP Shunt insertion increases the risk of shunt infection. In patients who have had a VP shunt inserted on previous hospital admissions PEG insertion need not be avoided because of concern regarding shunt infection.

OH F2-04: Utility and cost effectiveness of portable CT in neurosurgical practice

B. R. Chaudhary, D. Bulters, A. Sinclair & P. J. Kirkpatrick (Addenbrookes Hospital, Cambridge, UK)

Objectives: Obtaining CT scans of critically ill patients conventionally requires transport to the radiology department, which is associated with significant delays and clinical risks.[1] We assessed the clinical safety, utility and cost effectiveness of the use of a mobile CT scanner as a potentially expedient and effective solution.
Methods: We evaluated the use of the Neurologica CereTom portable 8 slice CT scanner in all patients undergoing mobile CT scanning between April 2009 and October 2009 in the NeuroCritical Care Unit totalling 175 scans. In addition mobile and static CT scans were radiologically compared in 25 patients.
Results: CT scan time was reduced to 21 minutes compared to 50 minutes for a conventional scan. The radiation scatter was clinically safe and there were no adverse incidents reported related to the use of the mobile CT scanner. The images obtained were at par with those obtained from static CT scanners. Use of mobile CT translates into a per scan minimum personnel cost reduction of approximately £19.16 with additional cost savings gained by increasing throughput via the static CT scanner.
Conclusions: Mobile CT scanning is an extremely useful diagnostic tool for a neurosurgical unit, which is also cost effective with a potential full return of investment in 26 months.

Reference

1 Braman S, Dunn S, Amico C. Complications of intra-hospital transport in critically ill patients. *Ann Intern Med* 1987;107: 469–473.

OH F2-05: Surgical trials in intracerebral haemorrhage - spontaneous and traumatic

B. A. Gregson & A. D. Mendelow for the STICH II and STITCH(Trauma) (Investigators Newcastle University)

Objectives: To establish whether a policy of early surgery improves outcome compared to a policy of initial conservative treatment in spontaneous and traumatic ICH.
Design: International multicentre randomised trials.
Subjects: STICH II patients have superficial lobar haematomas, a GCS motor score ≥ 5, eye score $\geq$ of 2 and are within 48 hours of ictus. STITCH(Trauma) patients are within 24 hours of injury with haematoma volume $\geq$10mls. Neurosurgeons should be in clinical equipoise. The primary outcome is extended Glasgow Outcome Scale at six months.
Methods: Patients randomised to surgery should have the operation within 12 hours.
Results: On 30 November 2009, 242 patients had been randomised to STICH II from 83 centres in 20 countries; 8 centres in the UK had recruited $\geq$1 patient. Patients had a median age of 65 years, median GCS of 13, haematoma volume of 35 ml and a depth of 1mm. STITCH(Trauma) had 33 sites applied; 3 sites with ethical approval; 1 site able to recruit. Further details will be presented.
Conclusions: These two studies are essential to define the most appropriate treatment for patients with these two conditions. In order to succeed in finding an answer more sites are needed.

OH F2-06: Implementation of the European Working Time Directive in neurosurgery reduces continuity of care and training opportunities

A. J. Maxwell, M. Crocker, T. L. Jones, D. Bhagawati, M. C. Papadopoulos & B. A. Bell (Academic Neurosurgery Unit, St George's University of London, London, UK)

Objectives: To assess the impact of the European Working Time Directive (EWTD) implementation on continuity of care and training opportunities in a neurosurgical unit.
Design: Retrospective review of operated cases.
Subjects: 200 emergency and elective admissions.
Methods: Casenotes for 50 emergency and 50 elective operative admissions were randomly selected before and after implementation of an EWTD compliant SpR rota. Each case was scored for pre and post operative continuity of care of the operating surgeon. Rotas from 3 months before and after implementation were compared to assess preservation of firm structure and training opportunities available to the SpRs.
Results: There is a reduction in the continuity of emergency care after introduction of EWTD compliant working practices ($P = 0.009$). Elective continuity is maintained preoperatively but a reduction in continuity of postoperative care was seen ($P < 0.0001$). Training for SpRs is affected with reduced involvement in outpatient (72% vs. 60%) and theatre sessions (79% vs. 63%) with their nominated consultant.
Conclusions: The EWTD has had a marked negative impact on continuity of care for neurosurgical patients in St. George's Hospital. Training opportunities for SpRs have also been reduced.

OH F2-07: The Role of Ulnar Nerve Transposition in Ulnar Entrapment Neuropathy

M. K. Teo, R. Trivedi & A. Waters (Addenbrooke's Hospital, Cambridge, UK)

Objectives: Ulnar entrapment neuropathy at the elbow is frequently encountered in medical practice and is the second most common nerve compression syndrome in the upper limb. The main objective of this study was to analyse the surgical outcome of patients managed at our institution.
Design: Retrospective study.
Subjects: 57 patients with ulnar neuropathy from Jan 1997 - Dec 2006 in our institution was included.
Methods: Preop assessment (demographics, clinical features, investigations), and surgical outcome was recorded. 43 male (75%) and 14 female (25%), and age range 16 to 94 years (mean age 55 years). Preoperatively, 12 patients (21%) were classified as having McGowan Grade I (mild) lesions, 38 (67%) had Grade II (moderate) lesions, and 7 (12%) had Grade III(severe) lesions.
Results: The majority of patients (93%, 53/57) had transposition procedures, while 2 had medial epicondylectomy, and 2 had simple decompression. The mean follow up was 3months (1 month to 2 years), 1 patient was lost to follow up. There was improvement of at least one McGowan grade in 55% (31/56) of patients; 14% (8/56) of patients were asymptomatic postoperatively. No patients were worse postoperatively.
Conclusions: Surgery for ulnar neuropathy at the elbow is effective in preventing further neurological deterioration. In our institute, we favour ulnar nerve transposition. Neurological deficits were reversible in over half of our patients, and 14% were symptoms free postoperatively.

OH F2-08: Preliminary *in vitro* and *in vivo* evaluation of a novel capacitive implantable intracranial pressure monitor with telemetric capability

K. Aquilina, M. Frishholz, E. Chakkarapani, M. Thoresen, I. Pople, H. Coakham & R. Edwards (Department of Neurosurgery, Frenchay Hospital, Bristol, UK and Clinical Science at South Bristol, Bristol, UK)

Objectives: Preliminary evaluation of a capacitive telemetric implantable ICP monitor.
Design: *In vitro* and *in vivo* study.
Methods: (a) 5 devices were tested in pressure chambers; long-term capacitance-pressure curves were obtained; (b) 5 devices implanted in a gel phantom and in a piglet were placed in a 3 Tesla magnetic resonance (MR) scanner; (c) 5 devices were implanted in a piglet neonatal hydrocephalus model; output was compared to ICP obtained through a ventricular access device.
Results: (a) Capacitance-pressure was constant suggesting minimal zero drift (b) signal loss at the sensor was minimal (c) over 114 000 measurements, difference between mean capacitive ICP and fluid-transduced ICP was 1.8 ± 1.42 mmHg. Correlation was excellent(Pearson $r = 0.97$, $p < 0.0001$). *In vivo* monitoring was restricted due robustness in the clinical environment.
Conclusions: This preliminary study demonstrates minimal long-term zero drift *in vitro*, good MR compatibility and good correlation with other methods of ICP monitoring *in vivo* in the short term. Further long-term *in vivo* study is required.

OH F2-09: Perceptions of Neurosurgery amongst Medical Students

Y. Chowdhury & K. Ashkan (King's College London, London, UK and King's College Hospital, London, UK)

Objectives: The study aimed to assess the anecdotal idea that medical students feel that becoming a neurosurgeon is too difficult.

Design: Volunteer sampling was used via an e-mail sent out to the study group. Data was blindly collected from responses made within four weeks of the e-mail being circulated.
Subjects: Data was sampled from final year students at a UK medical school. 106 students responded to the questionnaire.
Methods: Students were asked to rate their clinical knowledge and perceived difficulty of different surgical specialities. Further questions expanded on their ideas regarding careers and neurosurgery. Quantitative data was analysed using t-tests to assess significance. Qualitative data was stratified into common themes.
Results: The perception of difficultly in neurosurgery was significantly higher then other specialities. Neurosurgery scored 4.58 out of 5 [where 5 is most difficult] compared to the overall average of 3.66. 96% of students considered lifestyle to be a major factor influencing their career. 89% of students believed neurosurgery to be far more complex then other forms of surgery. The majority considered difficult training and lifestyle to be limiting factors. Only 36% of students had observed neurosurgery, however, of those who did 94% found it a positive experience. The perception of difficulty was significantly less in those who had seen surgery compared to those who had not.
Conclusions: The enigma of neurosurgery exists amongst medical students. It is perceived to be a difficult speciality due to its complexities and demanding lifestyle. The lack of clinical exposure heightens these ideas. Neurosurgeons must encourage students to join them in theatre. The intriguing experience of watching neurosurgery may attract talented neurosurgeons of the future.

Spine:

OH F3-01: Feasability of Magnetic Resonance Diffusion and Spectroscopy in Lumbar Discs

T. P. Eadsforth, T. Smith, T. J. Nurmikko & C. C. Wigfield (The Walton Centre for Neurology & Neurosurgery)

Objectives: To test the feasability of using diffusion weighted imaging in the assessment of the water content of non-degenerate and degenerate lumbar discs as well as applying MR spectroscopy to assess the biochemical content of non-degenerate and degenerate discs.
Design: A methodological *in vivo* study investigating both normal and degenerate lumbar discs from asymptomatic volunteers and patients with mechanical back pain.
Subjects: 10 asymptomatic volunteers and 7 patients with mechanical low back pain recruited from neurosurgical and pain clinics.
Methods: Patients were administered standard pain questionnaires and subjected to clinical examination and pressure algometer testing. All subjects were scanned on a 3T MR scanner to acquire T2 weighted images, diffusion-weighted sequences and MR spectroscopy sequences. Statistics were descriptive.
Results: A total of 85 lumbar discs were imaged. On T2 imaging water content tended to be higher in asymptomatic volunteers compared to patients even when studying degenerate discs. DWI values were higher in normal discs compared to patients. The spectrum was dominated by the water peak.
Conclusions: The methodology for investigating the lumbar disc with MR spectroscopy and diffusion needs to be developed further. There is the potential to analyse the spectra in lumbar discs further. Differences in the DWI and ADC between asymptomatic volunteers and patients may represent different physiological states within discs.

Reference

1 Keshari KR, Lotz JC, Link TM, Hu S, Majumdar S, Kurhanewicz J. Lactic acid and proteoglycans as metabolic markers for discogenic back pain. *Spine* 2008;33:312–317.

OH F3-02: Atlanto-axial fixation using C1 lateral mass and C1/2 transarticular screws in a rheumatoid population

J. Hempenstall, J. C. D. Leach, E. A. C. Pereira & T. A. D. Cadoux-Hudson (John Radcliffe Hospital, Oxford, UK)

Objectives: To define how pre-operative evaluation guides surgical planning in patients with atlanto-axial subluxation secondary to rheumatoid arthritis and to measure clinical outcome for the same group.
Design: Prospective evaluation of surgical series.
Subjects: A consecutive cohort of 26 patients undergoing C1/2 fixation over 5 years (2004–2009).
Methods: Outcome measures were 1) Pre-operative evaluation of posterior atlanto-dens interval (PADI), C1 lateral mass and C2 pedicle dimensions. 2) Pre- and post-op Ranawat scores and visual analogue scores for neck and C2 pain 3) Complications.
Results: C1 lateral mass mean height 4.4mm, C2 pedicle mean height 5.1mm and mean width 3.4mm (30% width <3mm). Ranawat scale improved Grade II to Grade I ($p = 0.07$). Neck pain (pre-op mean 5.5, s.d. 2.8; post-op mean 1.6, s.d. 2.1, $t < 0.05$) and C2 pain (pre-op mean 2.1, s.d. 3.3; post-op mean 0.5, s.d. 1.2, $t < 0.05$) improved. No instrumentation failure. 3 patients had C2 numbness.
Conclusions: In a rheumatoid population, pre-operative evaluation often precludes the use of C2 pedicle screws. As an alternative to a Harms-type C1/2 fusion, rigid fixation with C1 lateral mass and C1/2 transarticular screws is associated with good clinical outcomes.

Reference

1 Boden SD. Rheumatoid arthritis of the cervical spine: surgical decision making based on predictors of paralysis and recovery. *Spine* 1994;19:2275–2280.

OH F3P-03: Our Initial Experience with Percutaneous Balloon Kyphoplasty in the Treatment of Painful Vertebral Compression Fractures. An Outcome Study

S. Murahari & K. M. David (Queens Hospital, Romford, UK)

Objectives: To audit the benefit of percutaneous balloon kyphoplasty procedure in osteoporotic and malignant vertebral body fractures.
Design: Patients were selected whose pain from vertebral body collapse secondary to osteoporosis, myeloma, and metastasis were not controlled after at least 6 weeks of conservative measures. Patients at least had 6 months life expectancy.
Subjects: Data of 22 consecutive patients who underwent percutaneous balloon kyphoplasty between March 2008 and July 2009 were analysed. Age range: 38–86, male female ratio 6:19. 50 vertebrae were treated (28 thoracic and 22 lumbar).
Methods: Outcome questionnaires before and 2–3 months after the procedure: SF36v2 scores, visual analogue scores (Brief Pain Inventory - BPI) and Oswestry Disability Index (ODI).
Results: The results of BPI showed improvement of pain in 15 of 20 osteoporotic patients. There was improvement in the ODI scores in 14 of the 20 osteoporotic patients. There was some improvement in the SF36v2 scores in both bodily pain and mental component scores. There was no mortality related to the procedure, but there was 1 patient who had nerve root injury due to kyphoplasty.
Conclusions: Procedure has been helpful in treatment of painful (mainly osteoporotic) vertebral fractures.

References

1 Wardlaw D, Cummings SR, Van Meirhaeghe J, Bastian L, Tillman JB, Ranstam J, *et al*. Efficacy and safety of balloon kyphoplasty compared with non surgical care for vertebral compression fractures (FREE): a randomised controlled trial. *Lancet*. 2009;373(9668):1016–24.
2 Taylor RS, Fritzell P, Taylor RJ. Baloon kyphoplasty in the management of vertebral compression fractures: an updated systematic review and meta-analysis. *Eur Spine J*. 2007;16(8): 1085–100.

OH F3-04: Comparison of CT myelography and MRI findings in neurosurgical practice and it's correlation with intraoperative findings

A. Kanwar, M. Al-jumaily & N. Buxton (Walton Centre for Neurology and Neurosurgery, Liverpool, UK)

Objectives: In this study we tried outlining the indications of the CT-myelogram (CTM) in current spinal neurosurgical practice in the era of the non-invasive MRI scan.
Methods: 54 patients who had CTM following an MRI scan for symptoms related to their cervical, thoracic, lumbar or to more than one region of their spine. The indications for the CTM were analysed. The outcomes of both MRI/CTM were compared. The intraoperative findings for patients undergoing surgery were compared with the CTM.
Results: The indications for the CTM were, unclear results obtained from the MRI images in 4, investigation of central canal stenosis in 25, lateral recess stenosis in 24, and intradural cyst in 1 patients. In all patients with unclear MRI results, the CT-myelogram gave the required information however none required surgery. There was additional information obtained by the CTM in 11 patients out of the 25 patients who had central canal stenosis, and 9 out of the 24 patients with lateral recess stenosis. All patients with additional information on the CTM and central canal stenosis, and all but one of those with lateral recess stenosis went for surgery. In these patients who had surgery, the surgical findings confirmed the CTM results.
Conclusions: We advise that in all patients where there are symptoms that are unexplained by the MRI or inconsistency between symptoms and MRI findings, a CTM should be offered to exclude any surgical indication.

OH F3-05: Analysis of hospital cost differences between Minimally invasive TLIF and PLIF

R. A. Trivedi, S. Woodrow & M. Y. Wang (Addenbrookes Hospital, Cambridge)

Objectives: To ascertain hospital cost differences between MIS TLIF vs open PLIF for surgically treated lumbar spine pathologies.
Design: A retrospective analysis of of hospital costs for minimally invasive transforaminal interbody fusion (MIS-TLIF)versus posterior lumbar interbody fusion (PLIF).
Subjects: A consecutive series of patients treated operatively for lumbar spondlytic disease, degenerative disc disease, and lumbar spondylolisthesis.
Methods: Overall Hospital charges and surgical episode related charges were obtained from the Hospital finance department, and adjusted for multi/single level surgeries. Hospital stay was obtained from case note review. Patients were grouped into MIS TLIF or PLIF and the data were analysed using non-parametric analyses.
Results: 58 patients (median age 57 yrs) over fourteen months were identified. One level procedures accounted for 89% of MIS vs. 67% of open surgeries. Mean LoS was 4.3 and 6.7 days in the MIS TLIF vs open PLIF. The average hospital charges for single-level MIS TLIF surgery was \$72,214, and \$78,931 for open PLIF ($P = 0.07$); for two-level surgery, \$113,224 for MIS TLIF vs. \$138,906 for open PLIF ($P = 0.25$).
Conclusions: While hospital setting, patient selection, and physician expectation play major roles in

determining hospital charges and length of stay, this pilot study at an academic teaching hospital shows trends for quicker discharge, reduced hospital charges, and lower transfer rates to inpatient rehab with MIS surgery. Moreover, these trends are more strongly associated with multi-level surgeries.

OH F3-06: MMP-10 expression in the annulus fibrosis of degenerate intervertebral discs and regulation by interleukin-1 and tumour necrosis factor-a

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Objectives: Matrix metalloproteinases (MMP) are proteolytic enzymes involved in normal intervertebral disc (IVD) turnover and repair. Increased MMP activity leads to degradation of the annulus fibrosis (AF) during IVD degeneration. This study investigated the expression of MMP-10 and its correlation with pro-inflammatory cytokines interleukin-1 and tumour necrosis factor-a in the AF during IVD degeneration.
Subjects: Surgical IVD samples were obtained from patients with symptomatic lumbar IVD degeneration, undergoing surgery for lumbo-sacral back pain. Asymptomatic PM donors with no history of spinal pathology were utilised. Post-mortem IVD tissue was obtained from the lumbar spine of cadavers within 18 hrs of death, within the 48 hr viability window of IVD cells for immunohistochemical and PCR analysis.
Methods: AF tissue was obtained at post mortem (PM) from patients with no history of lower back pain (LBP; $n = 33$) and at surgery from patients presenting with LBP ($n = 15$). MMP-10 expression in both groups was assessed at the gene and protein level using real-time polymerase chain reaction and immunohistochemistry. Gene expression for IL-1 and TNF-a was carried out and correlated to MMP-10 gene expression.
Results: MMP-10 mRNA and MMP-10 protein expression was increased in symptomatic surgical AF samples, compared to the non-symptomatic PM group ($p < 0.001$). IL-1 and TNF-a mRNA were also increased in the surgical group ($p < 0.001$ and $p < 0.05$). MMP-10 mRNA showed positive correlation with both IL-1 and TNF-a mRNA in both PM ($p < 0.01$ and $p < 0.0001$) and surgical groups ($p < 0.01$ and $p < 0.05$).
Conclusions: MMP-10 expression is increased in degenerate IVD requiring surgical intervention, where it may contribute to accelerated matrix degradation. This expression is correlated with that of pro-inflammatory cytokines IL-1 and TNF-a, and highlights potential targets for inhibition in the prevention/treatment of degenerative IVD disease.

Trauma (head):

OH F4-01: Cerebral Parenchymal Cytokine Expression following Traumatic Brain Injury

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Objectives: The central nervous system (CNS) has long been regarded as an immunologically privileged site. Pre-clinical studies have repeatedly demonstrated that resident CNS cells both produce and respond to soluble inflammatory mediators i.e. cytokines. We sought to characterise the cerebral inflammatory response to trauma in humans using cerebral microdialysis.
Methods: We have utilised cerebral microdialysis in 6 patients to assay a panel of 42 cytokines throughout 5 days of monitoring. This was combined with simultaneous sampling of both arterial and jugular bulb blood to allow comparison of systemic and central cytokine concentrations.
Results: All 42 cytokines were recovered from human brain following TBI. A subset of cytokines had parenchymal concentrations more than ten-fold those found in serum including IL-1alpha, IL-1ra, IL-6, IL-8, IP-10, MCP-1 and MCP-3. A temporal profile was built up for each of the cytokines demonstrating that certain cytokines peak on day 1 (e.g. IL-1beta), certain cytokines peak on day 2 (e.g. IL-1ra) and some cytokines peak on day 3 (e.g. IP-10) following injury.
Conclusions: Cerebral microdialysis is capable of recovering a range of cytokines from the human brain and characterising their temporal profile. The time profile of cytokine expression is related to the time of injury, not the commencement of monitoring, suggesting that it is a genuine reflection of the pathophysiological response to injury rather than a result of trauma from catheter insertion. This provides direct empirical evidence for the production of cytokines within the central nervous system.

OH F4-02: Risk factors for Cranioplasty failure: a ten-year comprehensive review

J. Reaper, J. Sacree & R. J. Edwards (Frenchay Hospital, Bristol, UK)

Objectives: To undertake a comprehensive review of cranioplasty procedures at our institution, looking particularly at infection rates and rate of re-operation.
Design: Retrospective audit.
Subjects: All patients undergoing cranioplasty procedures over a 10-year period.

Methods: 143 cranioplasty procedures were performed in 123 patients. 49 patients underwent autologous bone flap replacement. Following craniectomy, bone flaps were autoclaved and placed in sterile dry-storage. 61 cranioplasties were titanium, 32 were acrylic and one was hydroxyapatite.
Results: 18 early, non-infective complications occurred in 16 patients. Infection rates for autologous cranioplasty were significantly higher (27% vs. 5%; $p < 0.0001$). All clinically infected flaps required removal. Operation time and grade of surgeon did not influence risk of complications. Paediatric patients were more likely than adults to undergo aseptic bone flap resorption (9.3% vs. 1.0%; $p = 0.03$).
Conclusions: The use of dry-stored, autologous cranioplasties carries an unacceptably high risk of morbidity in both adults and children and should be abandoned. Conservative management of clinically infected flaps was never successful. There were no significant differences between titanium and acrylic cranioplasties.

OH F4-03: External ventricular drainage for control of raised intracranial pressure in traumatic brain injury

I. Timofeev & Mr P. Hutchinson (Addenbrooke's Hospital, Cambridge, UK)

Objectives: Drainage of cerebrospinal fluid has a role in controlling raised intracranial pressure (ICP) following traumatic brain injury (TBI). The aim of this study was to evaluate the effect of external ventricular drainage (EVD) on ICP and associated physiological parameters, (cerebrospinal compensation, cerebral oxygenation and metabolism).
Design: Prospective observational study.
Subjects: 23 patients with TBI requiring parenchymal ICP monitoring were included.
Methods: Decision to perform ventriculostomy was driven by the local ICP management protocol after failure of initial measures. Monitoring parameters were continuously digitally captured at the bedside for at least 24 hours before and after EVD and compared using ANOVA and Wilcoxon tests.
Results: EVD insertion was successful in all but one patient. It led to a rapid reduction in ICP. Median daily values of ICP remained <20mmHg for at least 72 hours after ventriculostomy and were significantly lower than before the procedure ($p < 0.001$, ANOVA, Bonferroni corrections). Ventriculostomy also led to an improvement in craniospinal compensation (the RAP index) and to reduction in mean arterial pressure, with adequate cerebral perfusion pressure. Further analysis of the initial 24 hour period following the insertion of ventricular drain demonstrated that in 11 out 23 patients initial ICP reduction was followed by an increase to values exceeding 20mmHg. In the other 12 patients ICP remained stable, allowing subsequent reduction in the intensity of treatment. The effect of EVD on cerebral metabolism and tissue oxygen was variable.
Conclusions: Ventricular drainage of CSF is a useful ICP-lowering manoeuvre, with sustained ICP reduction achieved in over 50% of patients.

OH F4-04: A review of brain and spinal trauma in a regional trauma centre

D. Baxter, M. Amarouche, J Woollard, S. M. Joshi, N. Tai & J. Yeh (Department of Neurosurgery, The Royal London Hospital, Whitechapel, London)

Objective: To study the trends of adult traumatic spinal injury in a regional trauma centre and to assess whether reclassification of traumatic brain injury (TBI) offers any new insights or treatment opportunities.
Method: Admission details, injury type and severity as well as mechanism of injury were obtained from the trauma registry for all patients admitted in the hospital between January 2004 and December 2008. A representative sample of the patients was obtained and their notes and radiology reviewed. The data was analysed using SPSS.
Results: A total of 1554 cases of TBI were recorded over a 6 year period and 606 spinal injuries over a 4 year period. The majority were male (79%) and the median age was 37 (median: 14–91) years. Contusions and intraparenchymal haemorrhage were the most common injury sustained (548) followed by traumatic subarachnoid haemorrhage (457) and subdural haematomas (347). Diffuse swelling and diffuse axonal injury were associated with the highest mortality (90–100%), and contusion/haemorrhage with the least (5.4%).
The three commonest mechanisms of spinal injury were RTAs 47%, falls 40% and assaults 4%. The majority of patients (67%) had a single vertebral level injury, and lumbar spine injuries were the most frequent (26%). Most patient admissions took place during the week and during the day. The overall mortality was 10%.
Conclusions: Acute subdural haematoma, diffuse axonal injury and diffuse swelling of brain cases are more likely to die if they are not operated upon. In line with the hospital's transformation into a regional trauma centre, this study reports a sustained increase across the four year period in the number of trauma victims. These increases occurred across all age ranges, both genders, and involved all severities and mechanisms.

References

1 American Spinal Injury Association. *International Standards for Neurological Classifications of Spinal Cord Injury. revised ed.* Chicago, Ill: American Spinal Injury Association; 2000:1–23.

2 Saatman KE, Duhaime AC, Bullock R, Maas AI, Valadka A, Manley GT *et al*. Classification of Traumatic Brain Injuries for Targeted Therapies. *Journal of Neurotrauma* 2008;25:719–738.

OH F4P-05: Quantitative MRI reveals abnormalities in normal appearing white matter following mild head injury

C. J. A. Cowie, B. S. Aribisala, J. He, J. Wood, A. D. Mendelow, P. Mitchell & A. M. Blamire (Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, UK and Department of Neurosurgery, Newcastle General Hospital, Newcastle upon Tyne, UK)

Objectives: Our aim was to investigate patients with mild traumatic brain injury (mTBI) using quantitative 3 Tesla magnetic resonance imaging (MRI). Hypothesis: Analysis of normal appearing white matter (NAWM) using quantitative T1, quantitative T2 and diffusion tensor imaging (DTI) will demonstrate significant differences in mTBI patients when compared to age matched controls.
Subjects: 24 patients with mTBI (GCS 14–15, mean age 38y, range 18–68y) were recruited from the accident and emergency and neurosurgery departments, along with 20 age matched controls (mean age 40y, range 19–67y).
Methods: Patients were scanned within 10 days of injury (mean 4.9, range 1–10). Control subjects were scanned using the same protocol. Patients with a history of previous head injury, neurological or psychiatric illness or alcohol/drug abuse were excluded. Scan data was analysed by performing whole group comparison, and then by analysing subgroups defined according to location of any visible lesion.
Results: Statistical analysis (t-test) of patients grouped according to visible lesion location revealed a significant increase ($p < 0.05$) in the mean diffusivity of NAWM in the frontal lobe on the side containing the lesion, when compared to controls. A significant increase was seen in the T1 value in the frontal lobes of those with a left sided lesion, but not in those with a right sided lesion.
Conclusions: In mTBI patients with a visible lesion, DTI has revealed changes in frontal lobe NAWM on the ipsilateral side. These changes were not detected using T1 and T2 quantitative MRI, and were not visible on anatomical MRI. The changes observed may represent damage to neuronal tissue.

POSTERS

P1: What is the infection rate associated with deep brain stimulation surgery, and how important is the type of antibiotic prophylaxis?
R. Bhatia, A. Dalton, M. Richards, C. Hopkins, T. Aziz & D. Nandi (Charing Cross Hospital, London, UK)

P2: Analysis of Thalamus and Pallidum Shape and Atrophy in Essential Tremor
P. M. Schweder, P. Hansen, G. Quaghebeur, A. Green & T. Aziz (John Radcliffe Hospital & Oxford University, Oxford, UK)

P3: A Neuroimaging Analysis of Grey Matter in Cervical Dystonia
P. M. Schweder, P. Hansen, G. Quaghebeur, A. Green & T. Aziz (John Radcliffe Hospital & Oxford University, Oxford, UK)

P4: An Statistical Analysis of White Matter Pathways in Cluster Headache
P. M. Schweder, P. Hansen, G. Quaghebeur, A. Green & T. Aziz (John Radcliffe Hospital & Oxford University, Oxford, UK)

P5: Epilepsy surgery in the iMRI - the first 6 months
R. Morris, A. Miserocchi, M. White, L. Mancini, C. Micallef, W. Harkness & A. McEvoy (The National Hospital for Neurology and Neurosurgery, London, UK)

P6: A proposed grading system for ulnar nerve compression at the elbow
P. S. J. Weston, A. Jameel, S. Akmal, K. O'Neill & D. Peterson (Charing Cross Hospital, Lonodon, UK)

P7: Discrepancies in clinical coding - is income being lost?
K. Ghosh, A. Ray & A. Golash (Royal Preston Hospital, Preston, England)

P8: Improving Clinical Care: The Safety of Anaesthesia and Operative Radiographs in Female Neurosurgical Patients of Child-Bearing Age.
V. A. Elwell, C. Moss, S. R. Wilson & J.P. Grieve (The National Hospital for Neurology and Neurosurgery, London, UK)

P9: Efficiency of three session theatre days over two session theatre days
A. S. Nadig & I. Kamaly (Greater Manchester Neurosurgical Centre, Salford, UK)

P10: What can a prospective 'culture-positive' database tell us about common infections in a neurosurgical unit?
D. Holliman[1], N. Mukerji[1], J. Collins[2] & P. S. Bhattathiri[1] ([1]Departments of Neurosurgery and [2]Microbiology, Newcastle General Hospital, Newcastle, UK)

P11: Patient Experience of the neurosurgical ward round: A prospective study and comparison with Care Quality Commission Standards
D. S. Jeyaretna, R. M. Browne, R. Ashida & N. D. Haden (Derriford Hospital, Plymouth, UK)

P12: Unexpected Hospital Stay: A prospective Cohort Study in small neurosurgical unit
M. J. Asha, R. F. Price & H. L. Brydon (North Staffordshire University Hospital, Stoke-on-Trent, UK)

P13: Neurosurgical nurse practitioners - the impact of a nurse-led multidisciplinary model on the neurosurgical workforce
V. Apok, A. Alamri, L. Birch & G. Hall (Royal Preston Hospital, UK)

P14: What do junior doctors know about sending CSF for investigation of subarachnoid haemorrhage?
K. J. Whitehouse, C. Patel & R. H. Hatfield (Cardiff Neurosciences Unit, Cardiff, UK)

P15: Comparison of pretemporal and subtemporal approaches for deep bypasses to the posterior circulation: novel anatomical and image based methods
Z. E. Zador, D. C. Lu, C. M. Arnold & M. T. Lawton (Department of Neurological Surgery, University of California at San Francisco, San Francisco, California)

P16: Cerebral hyperperfusion syndrome following STA-MCA bypass: a retrospective study
K. Rajwani, M. Choo & C. Tolias (King's College Hospital, London, UK)

P17: Health Econmonics: Clinicians Vs Coders - audit of diagnosis and procedure clinical coding
N. Carleton-Bland & D. Walsh (King's college Hospital, London)

P18: Cerebral revascularization for occlusive disease and difficult aneurysms
U. J. Patel (Royal Hallamshire Hospital, Sheffield, UK)

P19: Curiosities in haemodynamics: distribution of flow related aneurysms in the distal posterior circulation. A study of 38 consecutive cases.
Z. E. Zador, A. Rodriguez & M. T. Lawton (Department of Neurological Surgery, University of California at San Francisco, San Francisco, California, USA/Heart of England NHS Foundation Trust Birmingham, UK)

P20: Persitent high T1 signal in haemorrhagic pituitary lesions represents structural differences in the pituitary
J. G. Bull C. Skogen, J, Akinwunmi & K. Good (Hurstwood Park Neurological Centre, Haywards Heath, West Sussex)

P21: A retrospective study to determine the outcomes of a linear incision prior to craniotomy in supratentorial neurosurgical procedures
H. S. Gillespie, H. Kirk & P. Bhatt (Aberdeen Royal Infirmary, Aberdeen, Scotland UK)

P22: Neuro-Oncology Database
C. E. Uff, C. Pierre-Davis, L. W. Thorne & N. D. Kitchen (The National Hospital for Neurology and Neurosurgery, London, UK)

P23: Increasing spinal oncology workload over 10 years: Can we keep up?
B. Nurboja, M. Wilson, F. Gow, J. Mullane, A. Meir, Z. Sarsam, J. Allibone & D. Choi (The National Hospital for Neurology and Neurosurgery, Queen Square, London, UK)

P24: Therapeutic increase in LAT 1 expression is possible in glioma cells to augment the efficacy of boron neutron capture therapy (BNCT) from increased BPA uptake.
D. Ngoga & G. Cruickshank (Dept of Neurosurgery, Queen Elizabeth Hospital, Birmingham, UK)

P25: Can T2-weighted MRI of glioblastomas be used as markers of invasion?
S. A. Chapman, V. Shi, J. H. Gillard & S. J. Price (Addenbrooke's Hospital, Cambridge, UK)

P26: A Role for SSEP Monitoring during Excision of Spinal Dural AVF
A. R. Jesurasa, D. G. Rao & D. Bhattacharyya (Royal Hallamshire Hospital, Sheffield, UK)

P27: Incidence and risk factors associated with the development of post-operative spinal epidural haematoma (SEH)
A. R. Amiri, I. P. Fouyas & A. T. H. Casey (National Hospital For Neurology and Neurosurgery, London, UK and Wellington Hospital, London, UK)

P28: Validation of a Modified Roland Morris Disability Scale for the Assessment of Sciatica
M. Kim, M. R. Guilfoyle, H. M. Seeley & R. J. Laing (Addenbrooke's Hospital, Cambridge, UK)

P29: The Effect of Mental Health on Spine Surgery Outcome
E. C. Maratos, R. Trivedi, H. Richards, H. Seeley & R. J. C. Laing (Addenbrookes Hospital, Cambridge, UK)

P30: Minimally Invasive Treatment (XLIF) of Lumbar Degenerative Disease- early profile
J. Dhir, S. James, P. Davies & A. Jones (University Hospital of LLandough, Cardiff, UK)

P31: White matter injury patterns in Normal Pressure Hydrocephalus
N. C. Keong, S. J. Price, J. H. Gillard & J. D. Pickard (Division of Neurosurgery and Department of Academic Radiology, Cambridge University Hospitals NHS Foundation Trust)

P32: Improving system efficiency using value stream mapping for treatment of chronic subdural haematoma
S.-A. S. Price, A. P. Williams & J. D. Palmer (South West Neurosurgery Centre, Derriford Hospital, Plymouth, UK)

P33: Causes, Consequences and Historical Perspectives with regards to a Fixed, Dilated Pupil following Traumatic Brain Injury
A. Helmy[1], P. J. Kirkpatrick[1], H. M. Seeley[1], E. Corteen[1], D. K. Menon[2] & P. J. Hutchinson[1] ([1]Addenbrooke's Hospital, Cambridge, UK, [2]Cambridge Neuroscience, Dept. of Medicine, Cambridge University)

P34: Timing of Prothrombin Complex Concentrate therapy in anticoagulated patients with intracranial haemorrhage
R. Ashida, A. Bacon, E. Thomas, T. J. C. Nokes & P. C. Whitfield (Southwest Neuroscience Department, Plymouth, UK)

P35: A clinical impact of myelodysplasia (MD) and myeloproliferative disorders (MPD) in patients undergoing neurosurgical procedures
A. H. L. Wong, K. Saeed, M. K. Lee, T. Pigott & M. Javadpour (The Walton Centre for Neurology & Neurosurgery NHS Foundation Trust, Liverpool, United Kingdom)

P36: Lactate is an energy source for the human brain: a 13C-labelled microdialysis and NMR study in traumatic brain injury.
K. L. H. Carpenter[1,2], C. N. Gallagher[1,3], P. Grice[4], D. J. Howe[4], A. Mason[4], I. Timofeev[1], D. K. Menon[2,5], P. J. Kirkpatrick[1], J. D. Pickard[1,2], G. R. Sutherland[3], P. J. Hutchinson[1,2] ([1]Division of Neurosurgery and [2]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK, [3]Division of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, Calgary, Canada, [4]Department of Chemistry, University of Cambridge, University Chemical Laboratory, Cambridge, UK and [5]Division of Anaesthesia, Department of Medicine, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK)