Neuro Anaesthesia & Critical Care Society of Great Britain and Ireland

NACCSGBI ASM Abstracts 2017

Section 1: Audit

Awake vs asleep craniotomy: a case series

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Introduction: Awake craniotomy is a technique gaining popularity for resection of space occupying lesions such as tumours or arteriovenous malformations near eloquent areas of the brain, due to its shorter length of stay and reduced minor complications.[1,2] We undertook a survey to discover if this was true and significant in our department.

Methods: We collected retrospective data on all fully or partly awake craniotomies carried out in Northern Ireland's regional neurosurgical centre between January 2014 and September 2016 and compared this data to an equal number of craniotomies that were performed fully asleep. We specifically compared length of stay and rate of complications, dividing these into major or minor complications.

Results: We performed 73 awake surgeries in the dates specified and compared these to 72 using a fully asleep technique. The mean length of stay was 6.93 in asleep vs 5.08 for awake techniques with p = 0.012. There was no significant difference in major or minor complications between the two groups (p=0.15 and p=0.34 respectively). Major complications were defined as extradural or subdural bleeding requiring a return to theatre, permanent hemiparesis or intensive care stay. Minor complications were temporary hemiparesis, minor nerve palsy, seizures, change of anaesthetic technique, adverse drug reaction excluding anaphylaxis and electrolyte abnormalities

Conclusions: Awake craniotomies are associated with shorter length of stay with similar complication rates to traditional asleep techniques.

References:

1. July J, Manninen P, Lai J, Yao Z, Bernstein M. The history of awake craniotomy for brain tumor and its spread into Asia. Surg Neurol 2009; 71:621-5
2. Khan SA, Nathani KR, Ujjan BU et al. Awake craniotomy for brain tumours in Pakistan: an initial case series from a developing country. J Pak Med Assoc 2016; 66: S68-71

Experience of 302 Cases of Intra-arterial Thrombectomy at the University Hospitals of North Midlands (UHNM) Trust

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Introduction: Stroke is the third leading cause of death and the leading cause of disability.[1] Intra-arterial thrombectomy (IAT) is increasingly being used to treat an acute ischaemic stroke. We present our experience of treating 302 patients with IAT at UHNM which is a tertiary level teaching hospital providing a consultant led service 24 hours a day, seven days a week. Evidence for thrombectomy done under general anaesthesia compared to local anaesthesia is small but increasingly growing.

Methods: The UHNM stroke team selected the patients for IAT. Data was collected prospectively and was entered into Microsoft Excel by the stroke team. This was compared against the Royal College of Anaesthetists Audit Recipe Book,[2] which is based on the Consensus Guideline.[3]

Results: From December 2009 to July 2016 302 patients underwent IAT. The patient demographics (age, sex, ASA) and times from admission to CT scan, needle puncture, anaesthetic time and recanalisation data were analysed. Also, the type of anaesthetic, NIHSS score, BP management and Modified Rankin Scale were studied. The data showed the median time from arrival to CT scan took 35 minutes and from arrival to groin puncture took a median of 130 minutes. The median time from groin puncture to recanalisation took 55 minutes. Our average anaesthetic time has improved from 43 minutes to 17 minutes in the last 100 patients. The majority of patients received a general anaesthetic (224), sedation (52), local anaesthetic (16) and 10 missing notes. In the first 200 cases 84% had systolic BP maintained within 15% of baseline, this improved to 88% for the last 100 cases.

Conclusion: Learning from our experience we have developed a standard operating procedure and anaesthetic protocol that has helped junior anaesthetists manage these time critical patients. The trust's experience has helped improve patient care and saved £ 0.8 million in length of stay costs and £1.6 million in social care costs.

References:

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3. Talke PO, Sharma D, Heyer EJ, et al. Society for Neuroscience in Anesthesiology and Critical Care Expert Consensus Statement: Anesthetic Management of Endovascular Treatment for Acute Ischemic Stroke. J Neurosurg Anesthesiol. 2014; 26:95–108

Noise Levels on the Neurointensive Care Unit (NICU)

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Introduction: Noise is a big issue on intensive care units (ICU). There are no specific ICU guidelines, but there are WHO guidelines on hospital noise levels.[1] Some areas in our hospital have noise meters, which monitor noise levels continuously and give a visual warning. They can be set at different levels as appropriate to the unit, and have a data logging system. The aim of this project was to look into noise levels on our neurointensive care unit (NICU).

Methods: A prospective audit was carried out over a number of days and nights. All data collection was done by one person using an iPhone app (SPLnFFT). This was used to take 5 min samples from both sides of NICU at different times of day. A survey of NICU patients on their thoughts of noise levels was also carried out.

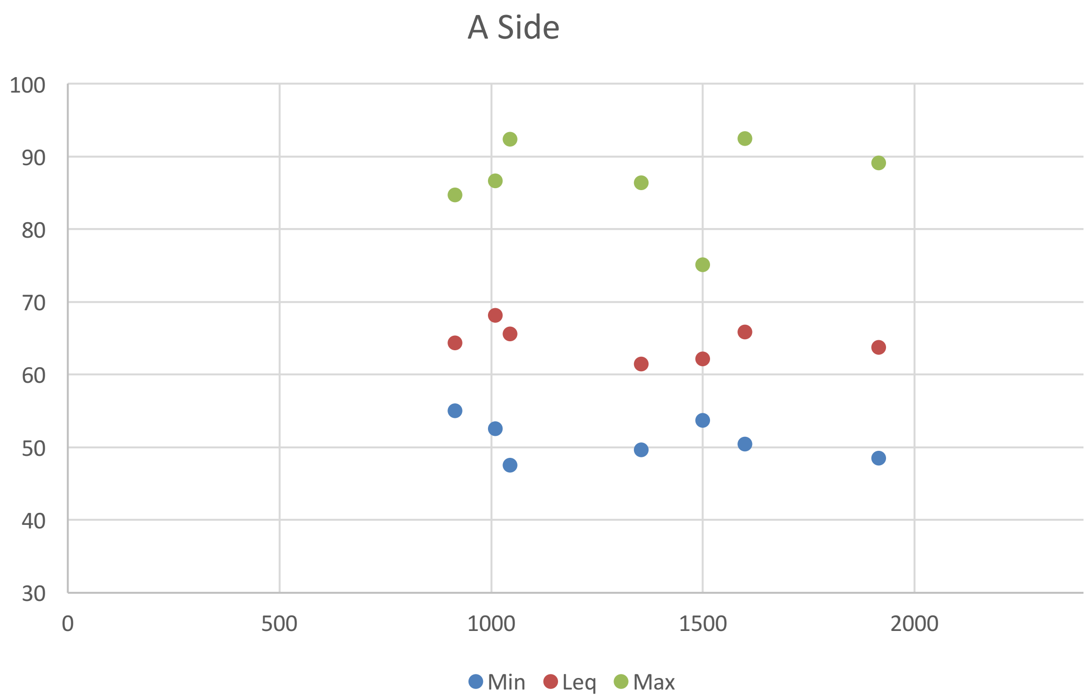
Results: The audit showed that the noise levels on NICU exceeded the recommended noise level at all times during the day and night (Fig. 1). During the day, the noise levels were actually often within acceptable limits, but this was often punctuated by alarms, use of equipment and raised voices. This was also reflected in the patient survey. 14 patients replied over a period of 10 weeks. Most cited causes of noise were talking, alarms and loud radios.

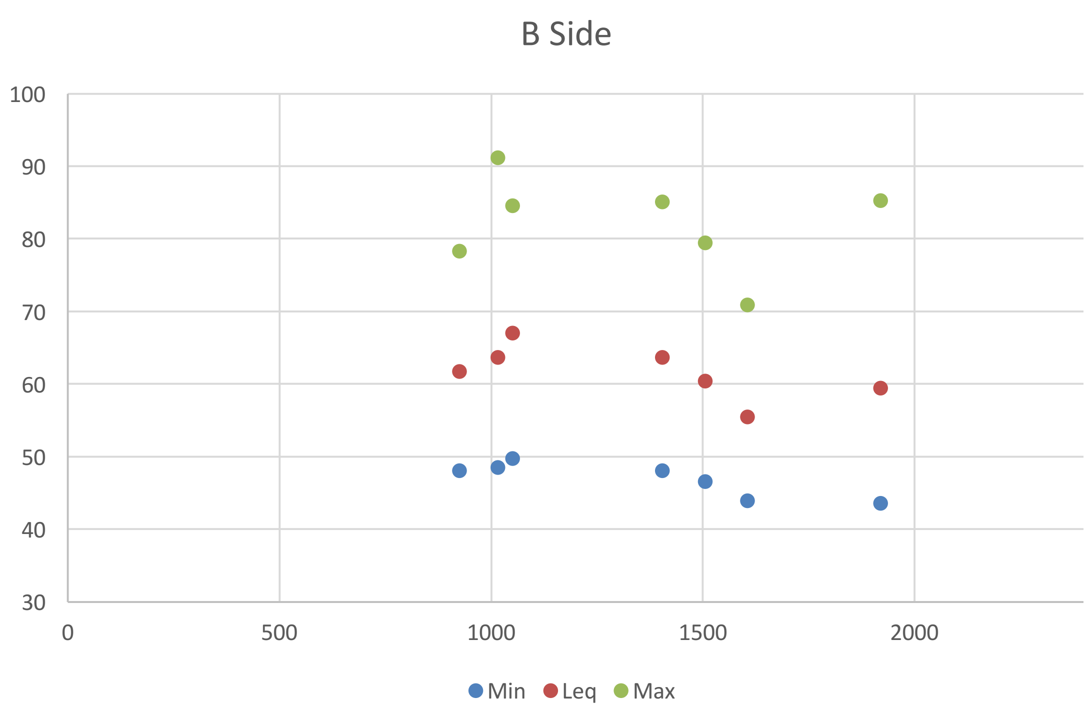
Conclusions: The results were discussed within the NICU multidisciplinary team. Staff education for increased awareness was implemented and guidelines for nursing care were developed. Noise meters will be introduced on both sides of NICU, similar to ones already in use in other areas of the hospital. We plan to carry out a snap audit after the introduction of these meters to decide on the appropriate setting for our unit, and then re-audit in 3 months' time.

References:

1. Darbyshire J. Excessive Noise in Intensive Care Units. BMJ 2016; 353:i1956

Figure 1. Noise levels on A side and B side of NICU. (x axis – time; y axis – decibels, dB). Minimum, maximum, and Leq (weighted average) dBA levels. WHO guidelines suggest hospital noise levels should average 35 dBA during the day and 30 dBA at night.





Management of Anaemia on Neurointensive Care Unit (NICU)

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Introduction: Anaemia affects 60-80% of intensive care patients, and is associated with increased morbidity and mortality. Most patients have normochromic, normocytic anaemia associated with chronic illness.[1] The guidelines on our neurointensive care unit (NICU) previously included routine iron supplementation if haemoglobin (Hb) was less than 10g/dl. They were recently updated, in line with recent national guidelines and after local discussion.[2] The aims of this audit was to assess whether the current NICU guidelines for management of anaemia were being followed.

Methods: Data was collected prospectively over a period of 8 weeks. All in-patients were reviewed daily. Data collected included patient demographics, blood results and pateint management. Patients less than 18 years old, pregnant patients, and patients expected to die within 48 hours of admission were excluded from the audit. Anaemia was defined as a Hb level less than 10g/dl; and less than 7 g/dL if considering transfusion.

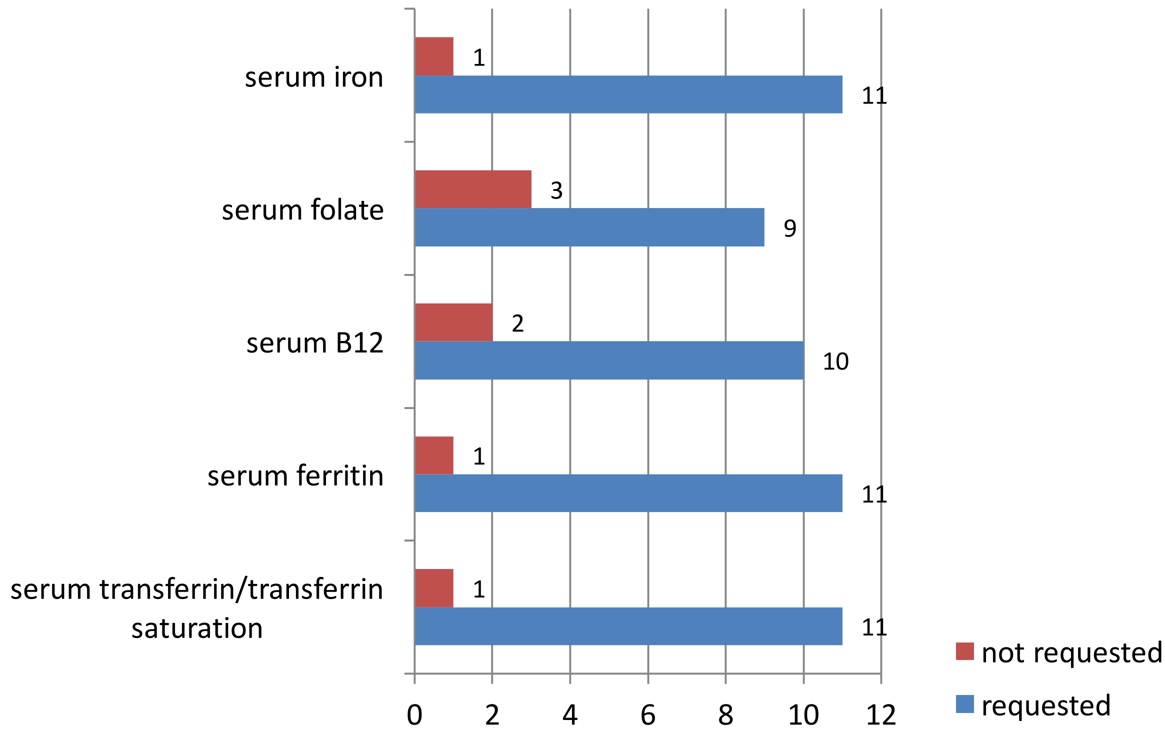
Results: A total of 32 patients were followed up in the eight-week period. Of these, 12 (37.5%) developed anaemia (Hb < 10 g/dL) at some point during the eight-week period. Very few patients had any investigations done as part of their work up (Fig. 1). Only 2 out of 12 patients had iron suplementation started; one had had iron investigations done prior; the other had only had serum folate and B12 levels done. Only two patients were transfused.

Conclusions: The audit indicates that education to improve awareness of the current guidelines is needed. This will be done using a multidisciplinary approach. We plan to re-audit in 12 months' time.

References

1. Retter A, Wyncoll D, Pearse R, et al. Guidelines on the management of anaemia and red cell transfusion in adult critically ill patients. British Journal of Haematology 2013; 160:445-64.
2. Guidelines for the Provision of Intensive Care Services (GPICS). https://www.ficm.ac.uk/standards-and-guidelines/gpics (accessed 20 September 2016).

Figure 1. Number of patients who had anaemia investigations done as per guidelines (x axis represents number of patients)



Intra-arterial thrombectomy for acute ischaemic stroke at the Wessex Neurological Centre, University Hospital Southampton

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Introduction: Intra-arterial thrombectomy (IAT) for acute ischaemic stroke can improve outcomes in terms of functional independence when compared to conventional medical therapy.[1] This audit aimed to identify potential areas of improvement for our current service using best-practice standards.[2,3]

Methods: Retrospective analysis of all patients undergoing IAT at UHS from 2014-2017. Defined standards were as follows:

- target door to groin time < 90 min
- puncture to start of revascularisation <45 min in ≥65%
- puncture to end of revascularisation median ≤ 60 min
- all patients with GA or ASA ≥3 should have access to level 2/3 care
- all to have appropriate monitoring (ECG, BP and capnography)
- intraoperative systolic BP to be >140 mmHg but <220 mmHg

Results: Demographic and baseline data are given in table 1. For anterior circulation stroke (n=24), door-to-groin time <90 min was achieved in 50% (median 90 [33, 229] min). Mean door to groin time for patients transferred to UHS was 35±12.7 min versus 127±61 min for patients either presenting directly or existing inpatients (p=0.0004). Puncture to start of revascularisation <45 min was achieved in 94%. Puncture to end of revascularisation was ≤60 min in 47% (median 66 [20, 165] min). 84.8% had appropriate monitoring. 94% had systolic BP <220 mmHg but only 9% had systolic BP of >140 mmHg at all times. SpO2 was ≥94% in all patients. Following IAT, 88% were admitted to NICU (median stay 2 days, range 1-12). 95% with ASA ≥3 (20 of 21) were admitted to level 2/3 care. 35% had a modified Rankin scale of 0-2. Overall mortality was 32%.

Conclusions: Our developing service is performing well in relation to national standards but there are areas where improvement could be made both in terms of timing and patient care. We have also identified important resource implications that were not initially apparent. A full simulation programme has been designed to help streamline this time-critical pathway in conjunction with Trust-wide education.

References:

1. Saver JL, Goyal M, van der Lugt A, et al. Time to treatment with endovascular thrombectomy and outcomes from ischemic stroke: a meta-analysis. JAMA 2016; 316:1279-88.

2. Dinsmore J, Campbell R. Intra-arterial thrombectomy. Chapter 14.7 in Raising the Standard: a compendium of audit recipes. 3rd Edition (2012). Royal College of Anaesthetists. Eds: Colvin JR, Peden CJ.
3. White PM, Bhalla A, Dinsmore J, et al. Standards for providing safe acute ischaemic stroke thrombectomy services (September 2015). Clin Radiol 2017; 72:175.

Table 1. Demographics and baseline data for all patients undergoing intra-arterial thrombectomy (n=34).

Gender (M/F)	Age (years)	ASA grade	Initial GCS	Pre-morbid modified Rankin score (mRS)	NIHSS score
21 M (61.8%) 13 F (38.2%)	Median 55 Range 18-79	1=10.7% 2=17.9% 3=14.3% 4=57.1%	Median 12 Range 3-15	mRS 0: n=32 mRS 1: n=2 mRS >1: n=0	Median 18 Range 3-39

Management of aneurysmal sub-arachnoid haemorrhage, pre and post NCEPOD in North Bristol NHS Trust

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Introduction: In 2010 we audited the management of aneurysmal subarachnoid haemorrhage (aSAH) patients at North Bristol NHS Trust (NBT) against current recommendations.[1] Several changes have since happened locally and nationally. NCEPOD SAH Managing the Flow recommendations were published in 2013.[2] NBT has merged into a new site, with reduced bed capacity. Simultaneously, NBT has had a significant increase in aSAH coiling referrals from SW Wales.

Methods: We retrospectively reviewed the notes of 74 out of 80 patients, re-auditing aSAH coiling over 6 months from 01/05/2015 at NBT, and compared the results with the data from 2010.

Results: In 2015, 93% of patients (69/74) had aSAH coiling within 48 hrs from admission to NBT, vs 91% in 2010. 92% of patients (68/74) had coiling within 48 hrs of CTA, but only 40/74 (54%) within 48 hrs of ictus. Over 6 months in 2015, 30 patients were transferred from Wales, vs. 2 in 2010. Based on the Rankin score at discharge, a greater proportion of patients in 2015 were discharged with a score >4, potentially due to the increase (9%) in patients presenting with higher grade SAH (3-5). 62/74 patients had a volatile anaesthetic, as opposed to TIVA (13/74). 40% of patients had a pre-coiling hydrocephalus and required an EVD insertion. 19% of patients had vasospasm (14/74). The length of stay in 2015 was shorter: range 1- 67 days, average 13 days (one outlier 345 days) vs 2010, range 3-85 days, average 21 days. Our results are presented in Table 1.

Conclusion: Following the NCEPOD report, despite nearly doubling the number of patients referred for coiling in 2015 vs 2010, 93% patients had coiling within 48 hours of admission to NBT, a slight improvement from 2010. The changes in transfer rate have contributed to the workload at NBT and may further increase due to pressures on the neuroradiology service for the management of thromboembolic stroke. Future work could include looking at intra-op BP in relation to incidence of vasospasm.

References:

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2. Gough MJ, Goodwin APL, Shotton H, et al. National Confidential Enquiry into Patient Outcome and Death. Subarachnoid Haemorrhage. Managing the Flow. 2013 Available at: http://www.ncepod.org.uk/2013report2/downloads/ManagingTheFlow_FullReport.pdf. Accessed 02/03/2017

Plasma sodium abnormalities in intensive care patients following aneurysmal sub-arachnoid haemorrhage – epidemiology, investigation and outcome

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Introduction: Hypo- and hypernatraemia are common problems encountered in intensive care following aneurysmal subarachnoid haemorrhage (SAH). This audit aimed to establish the epidemiology of sodium disturbance in this population, determine whether appropriate further investigations were carried out, and identify patient or disease characteristics that might predict those at risk.

Methods: All neuro-intensive care admissions from 17/09/2014 to 10/04/2016 were retrospectively screened. This identified 99 patients with spontaneous SAH from a radiologically confirmed aneurysm. Details of diagnosis, investigations, observations and treatment were retrieved from electronic records. Chi-squared tests with a significant p-value <0.05 were used for statistical analysis in SPSS.v.20.

Results: 64% of patients were female, with a mean age of 56 years (SD 12.3). Modal Fisher grade was 4. Thirteen patients died within 21 days of their SAH. Hyponatraemia was present during 58 (59%) admissions and hypernatraemia in 32 (32%). Hyponatraemia was not associated with Fisher grade or World Federation of Neurological Surgeons (WFNS) grade. Hypernatraemia was associated with WFNS grade (p<0.001) but not Fisher grade. No relationship between severity of hypo- or hypernatraemia and measurement of blood or urine osmolality or urine sodium was seen. WFNS grade and hypernatraemia (p=0.006), WFNS grade and daily negative fluid balance of > 1 litre (p=0.006) and hypernatraemia and mortality (p=0.001) were all positively correlated. There was no significant correlation between WFNS grade and mortality or hyponatraemia and mortality.

Conclusions: Incidence of hypo- and hypernatraemia were comparable with previously published data.[1,2] Hyponatraemia was not associated with increased mortality, whereas hypernatraemia had a positive association. There is scope for improving diagnosis of sodium abnormalities using protocolised management and, via more effective control, potentially reducing mortality.

References:

1. Mapa B, Taylor BE, Appelboom G et al. Impact of hyponatraemia on morbidity, mortality, and complications after aneurysmal subarachnoid hemorrhage: a systematic review. World Neurosurg. 2016; 85:305-314
2. Marupudi NI, Mittal S. Diagnosis and management of hyponatraemia in patients with aneurysmal subarachnoid hemorrhage. J Clin Med. 2015; 4:756-767

Fever burden, septic screening and cooling therapies in brain injury patients on a regional neurosciences intensive care unit

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Introduction: Fever is common in brain injury patients, and is likely to be both centrally mediated and due to infections. It is associated with poor outcome.[1] Current guidelines recommend frequent temperature monitoring, exclusion and treatment of infectious causes and active cooling,[2] although the best cooling method is subject of debate.[3] In our neurosciences intensive care unit (NICU), we audited the temperature burden and adherence to our guidelines.

Methods: We examined the electronic patient records for 40 patients admitted to NICU between 3 April and 30 June 2016 with subarachnoid haemorrhage or traumatic brain injury. We collected the temperature burden within the first seven days on NICU (defined as number of hours with a core body temperature of 38.0ºC or above) and maximum temperature. In febrile patients adherence to our fever management protocol was recorded (septic screen, antimicrobial treatment, cooling method: paracetamol, ice packs, cool wash, fan, cold air humidification, 4ºC crystalloid infusion, use of a forced air blanket).

Results: Two patients were excluded from analysis; in one case this was due to lack of data for an ICU stay of only a few hours, the second patient proceeded to organ donation. The majority of patients (n=29) in our sample had a diagnosis of aneurysmal subarachnoid haemorrhage. Our results are summarised in Table 1.

Conclusions: While the overall incidence of fever was low (median 3 hours), the temperature burden in the subgroup of febrile patients was significant (median 12 hours). We are planning to improve the adherence to our current guidelines (especially the exclusion of sepsis and other causes of pyrexia and the application and documentation of cooling methods) by introducing an interactive pro-forma to be included in our electronic record system; this will also simplify re-audit. We are currently investigating the feasibility of a trial of surface cooling.

References:

1. Badjatia N. Fever control in the neuro-ICU: why, who, and when? Curr Opin Crit Care 2009; 15:79–82.
2. Bohman LE, Levine JM. Fever and therapeutic normothermia in severe brain injury: an update. Curr Opin Crit Care 2014; 20:182–8.

3. Hoedemaekers CW, Ezzahti M, Gerritsen A, et al. Comparison of cooling methods to induce and maintain normo- and hypothermia in intensive care unit patients: a prospective intervention study. Crit Care 2007; 11:R9.

Table 1. Results summary showing data for all patients as well as for the febrile patients (>38.0 ºC) only. Data are numbers of patient unless specified otherwise. BC, blood cultures; BAL, broncho-alveolar lavage; MSU, midstream specimen of urine.

		All patients (n=38)	Febrile patients (n=23)
Median age (range) in years		61 (24-83)	59 (24-83)
Median hours with temperature ≥ 38.0 ºC (interquartile range)		3 (0-14)	12 (6-22)
Median maximum temperature in ºC (interquartile range)		38.3 (37.7-38.7)	38.6 (38.4-38.9)
Septic screen	Full screen sent (BC/BAL/MSU) (%)		9 (39)
	≥ 1 culture sent (%)		19 (83)
Antibiotics given (%)			14 (61)
Cooling methods used	Paracetamol only (%)		9 (39)
	≥ 2 cooling methods (%)		9 (39)

Audit of peri-operative serum magnesium levels in elective craniotomy patients.

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Introduction: Magnesium is the second most common intracellular cation and is critical for many cellular functions. Studies suggest that the modern Western diet and lifestyle may lead to magnesium deficiency.[1] Hypomagnesemia decreases seizure thresholds in animal models of epilepsy.[1] Magnesium supplementation in the peri-operative period during craniotomies has been shown to be associated with a reduction in biomarkers of brain injury.[2] We performed a retrospective audit of serum magnesium levels of all elective craniotomy patients at our hospital to determine the peri-operative incidence of hypomagnesemia.

Methods: The electronic records of all elective craniotomy patients done in 2015 were analysed for the peri-operative serum magnesium levels.

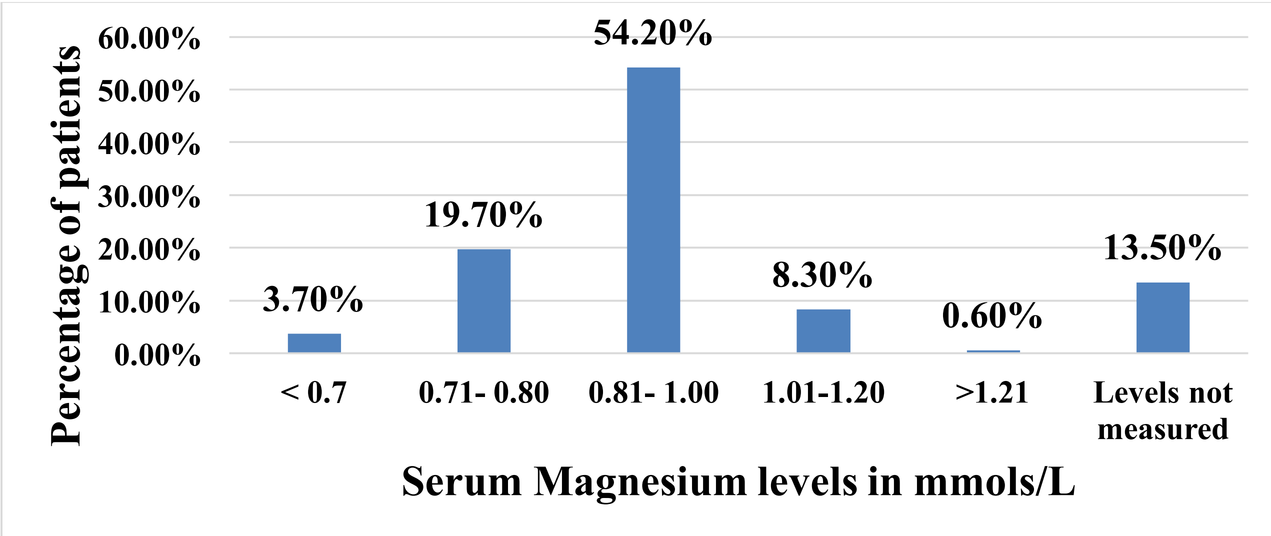
Results: Only 5.2% (17) of the total 325 elective craniotomy patients had serum magnesium levels checked pre-operatively. Whereas 86.5% (281) patients had them checked postoperatively. The results of the postoperative serum magnesium levels are shown in Figure 1. 23.4 % (76) patients had serum magnesium levels < 0.8 mmol/L, 54.2 % (176) patients had levels 0.81-1.0 mmol/L, 8.3 % (27) patients had levels 1.01-1.20 mmol/L and 0.6% (2) patients had levels greater than 1.21mmol/L.

Conclusions: We found that pre-operative serum magnesium levels was not routinely checked in elective craniotomy patients. The incidence of hypomagnesaemia was high with 23.4% of patients having serum magnesium levels less than 0.8 mmol/L. Whereas 3.7% patients had serum magnesium levels less than 0.7 mmol/L. While hypomagnesaemia has been known to reduce seizure threshold, the optimal serum magnesium levels for this subset of patients is currently unknown. We propose that serum magnesium levels should be routinely assessed pre-operatively for patients undergoing elective craniotomy and hypomagnesaemia should be treated. Further research is required regarding optimal serum magnesium levels required to reduce peri-operative biomarkers of brain injury.

References:

1. Yuen AW, Sander JW. Can magnesium supplementation reduce seizures in people with epilepsy? A hypothesis. Epilepsy Research 2012; 100:152-6
2. Mirrahimi B, Mortazavi A, Nouri M, et al. Effect of magnesium on functional outcome and paraclinical parameters of patients undergoing supratentorial craniotomy for brain tumors: a randomized controlled trial. Acta Neurochir 2015; 157:985-91

Figure 1. Distribution of postoperative serum magnesium levels



Management of patients with chronic subdural haematoma at North Bristol NHS Trust.

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Introduction: Chronic subdural haematomas (CSDH) occur most commonly in over 65s and are associated with falls and anticoagulants.[1] In our audit we reviewed the management of patients with CSDH in North Bristol NHS Trust.

Methods: We obtained a list of patients who had surgery for CSDH between July 2015 and July 2016 from theatre logbooks, identifying 137 patients. Notes were available for 69 patients. We recorded age, ASA grade, pre and post operation GCS, anti-coagulation status, time from decision to operation and time from arrival in our hospital to operation, length of surgery, re-operation rate, length of hospital stay and discharge destination.

Results: A summary of our results can be seen in Table 1. Nearly all the patients had a subdural drain placed, out of 4 patients who didn't one required re-do evacuation.[2] Overall 6 out of 69 (8.7%) patients required re-operation. 34 (49.3%) patients were taking anticoagulant or antiplatelet agents or had an impaired clotting. All patients on clopidogrel and half of patients on aspirin were delayed for 7 or more days, one patient on aspirin had a peri-operative platelet transfusion. Hospital stay ranged from 2-117 days (mean 13.2). 38 patients were transferred back to their local hospital, 27 discharged home, 2 long stay patients (79 and 117 days) required a place in nursing homes, and 2 out of 69 (2.9%) patients died.

Conclusions: Our findings are similar to a recently published surgical review of management of CSDH in UK.[3] The length of pre-operative delays, the average length of surgery and prolonged hospital stays have surprised us. A national review of current practice for patients presenting with CSDH would shed more light on this area and hopefully lead to improvement in care for patients, including shorter waits for surgery and procedure times in an elderly and co-morbid population. We think that introducing a care pathway similar to the Neck of Femur Fracture pathway would improve management of CSDH patients.

References:

1. Bonis P, Trevisi G, Waure C, et al. Antiplatelet/Anticoagulant Agents and Chronic Subdural Hematoma in the Elderly. PLoS One. 2013; 8:e68732
2. Santarius T, Kirkpatrick P, Ganesan D, et al. Use of drains versus no drains after burr-hole evacuation of chronic subdural haematoma: a randomised controlled trial. Lancet 2009; 374:1067–1073

3. Brennan PM, Kolias AG, Joannides AJ, et al. The management and outcome for patients with chronic subdural hematoma: a prospective, multicenter, observational cohort study in the United Kingdom. J Neurosurg 2016; 11:1-8

Table 1. Summary of Results

Age	Range 34-100 years		Mean 76 years	
ASA	ASA 1 = 0	ASA 2 = 18	ASA 3 = 44	ASA 4 = 7
Admission type	Direct = 8 (11.6%)		Transfer in = 61 (88.4%)	
Decision for surgery to surgery	Range 0.75 – 165 hours		Mean 25.4 hours	
Arrival at NBT to surgery	Range 0.25 - 240 hours		Mean 30.8 hours	
Surgery Type	Burr Hole = 64 (92.8%)		Mini-craniotomy = 5 (7.2%)	
Seniority of surgeon	Consultant = 7 (10.1%)		Registrar/Fellow = 62 (89.9%)	
Seniority of anaesthetist	Consultant = 27 (39.1%)		Registrar/Fellow = 42 (60.9%)	
Mode of anaesthesia	GA = 65 (94.2%)		LA = 4 (5.8%)	
Time in theatre	Range 60-250 minutes		Mean 121 minutes	
Pre-operative GCS	Range 5-15		Mode 15	
Postoperative GCS	Range 3-15		Mode 14	

An audit of measurement and management of serum glucose in traumatic and non-traumatic brain injury patients in a tertiary neuro-critical care unit.

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Introduction: Glucose variability is associated with poorer outcomes in patients with brain injury, and serum glucose excursions have been shown to adversely affect outcome.[1] Brain injured patients are prone to stress-induced hyperglycaemia, which is associated with higher mortality.[2] Departments adhere to locally devised protocols, and no national protocol exists for glucose homeostasis in these patients. Locally, we maintain blood glucose between 4-11 mmol/L.

Methods: Electronic patient records were retrieved by searching the Metavision® (iMDsoft, Düsseldorf, Germany) database for all admissions with a diagnosis of traumatic or non-traumatic brain injury who received Level 2 or Level 3 care in a single neuro-critical care unit. 61 patients were retrospectively identified covering a 24-month period. The records were analysed to identify whether any blood glucose measurement was documented on admission, at 6, 12, 24, 48, and 72 hours, and the glucose level in mmol/L. Records were analysed to identify patients who died, and highlight differences between Level Two or Level Three care, and traumatic versus non-traumatic brain injury.

Results: A total of 8 patients died during their admission, of which 3 suffered traumatic, and 5 non-traumatic brain injury. No significant difference in performance was found. Overall the management of glucose excursions was excellent, with very few measurements >11 mmol/L across all groups. Performance was extremely good on the measurement of blood glucose in Level 3 patient's, achieving in excess of 90% in this population. However, the level 2 patients' performance was poor with disappointingly low percentages of documented blood glucose at any time (Table 1).

Conclusion: There is significant room for improvement in measurement of glucose in level 2 patient's, this patient population can be falsely reassuring as they may have significant underlying stress-induced hyperglycaemia which can go unnoticed.

References:

1. Matsushima K, Peng M, Velaso M, et al. Glucose variability negatively impacts long-term functional outcome in patients with traumatic brain injury. J Crit Care 2012; 27:125-131
2. Borsage P, Shoultz T, Griffin R, et al. Stress-induced hyperglycemia is associated with higher mortality in severe traumatic brain injury. J Trauma Acute Care Surg 2015; 79:289-294

Table 1.

Point of inpatient stay	Percentage of patients in whom blood glucose was documented (n=61)			Number of patients with Blood Glucose >11mmol/L (n=61)			
	Level 2 (n=38)	Level 3 (n=23)	Level 2+3 (n=61)	Level 2 (n=38)	Level 3 (n=23)	Traumatic Brain Injury (n=28)	Non-traumatic Brain Injury (n=33)
On Admission	52.6 (20)	82.6 (19)	63.9 (39)	0	2	1	1
6 hours	13.2 (5)	95.7 (22)	44.3 (27)	1	2	1	2
12 hours	23.7 (9)	95.7 (22)	50.8 (31)	1	2	2	1
24 hours	28.9 (11)	95.7 (22)	54.1 (33)	0	3	1	2
48 hours	28.9 (11)	91.3 (21)	52.5 (32)	0	6	1	5
72 hours	18.4 (7)	91.3 (21)	45.9 (28)	0	0	1	0

Target temperature management in a specialist neurointensive care unit - an eighteen month review of practice

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Introduction: The use of target temperature management (TTM) is well established in general and neonatal intensive care. Guidelines recommend maintenance of normothermia in several brain injury types,[1] but despite this, there is little consensus on when TTM should be instituted, which patients might benefit from it and the optimal duration of TTM.[2,3]

Methods: Over an 18 month period from August 2015 to February 2017, we retrospectively reviewed the clinical notes of patients where TTM was instituted during their admission to our unit. Sixteen patients were identified, from which patient characteristics, admitting pathology, duration of fever, institution of TTM and discharge motor score were recorded as well as any complications from TTM treatment.

Results: Sixteen patients were identified, of which 13 were male. The age range was from 17 to 64 years old. Twelve of these patients had traumatic brain injury; one had a subarachnoid haemorrhage with severe vasospasm; one had intracranial hypertension from meningitis; one patient had a spinal cord injury and the remaining patient had a complication of an uncontrolled autonomic surge post baclofen pump change. All but one patient had TTM to normothermia defined as 36 to 37 degrees. The remaining patient was cooled to 35 degrees as the ICP was above 40 at 37 degrees. The period of time of TTM ranged from 20 hours to 432 hours. An endovascular cooling device was used 10 times and a surface cooling device was used 7 times. In 2 patients there was skin marking from the surface cooling device and there was one case of a potential catheter related blood stream infection from an endovascular device. Only one patient has died from the cohort within 30 days from unit discharge.

Conclusions: In our review of unit practice, we found that TTM was instituted in those 13 patients with intracranial hypertension as per unit guidelines. We had 3 cases where TTM was used to control of neurogenic fever with a good outcome.

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An audit and post-operative anti-emetic use in patients undergoing vestibular schwannoma resection, before and after a change in clinical practice

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Introduction: Postoperative nausea and vomiting (PONV) is a particular issue for patients undergoing vestibular schwannoma resection.[1] Previous work suggests that pre-operative injection of gentamicin into the middle ear may alleviate other symptoms postoperatively,[2] e.g. dizziness. This audit looked at postoperative anti-emetic use (as a proxy for PONV), in this population of patients, before and after the introduction of pre-operative intratympanic gentamicin injections.

Methods: This was a retrospective audit of post-operative anti-emetic use in patients undergoing vestibular schwannoma resection in a single neurosurgical unit, before and after a change in clinical practice. Usage by the first 21 patients post-introduction was compared to 45 patients who had surgery in 2014 (prior to the change).

Results: All patients received standard anaesthetic care, 78% of the 2014 group and 85% of the gentamicin patients received quadruple anti-emetic therapy peri-operatively (hyoscine patch, dexamethasone, ondansetron, and droperidol). All were prescribed at least three anti-emetics for PONV. The combined number of doses of three common anti-emetics (ondansetron, cyclizine, and buccastem) were compared on postoperative days 1 and 3. In the post-introduction group, the mean number of doses was 2.9 (range 0-6) and 0.9 (0-3) on days 1 and 3 respectively. In the 2014 group, the means were 3.7 (0-7) and 2.1 (0-6) respectively. Figure 1 shows the percentage of patients receiving each total number of doses on days 1 and 3. There appears to be a shift in the number of doses received by patients in the gentamicin group, towards the lower end of the range, suggesting that there may be a clinically significant reduction in PONV experienced by this sub-group of patients.

Conclusion: The use of pre-operative intratympanic gentamicin injection appears to have a positive impact on postoperative anti-emetic use (as a proxy for PONV) in patients undergoing resection of vestibular schwannoma.

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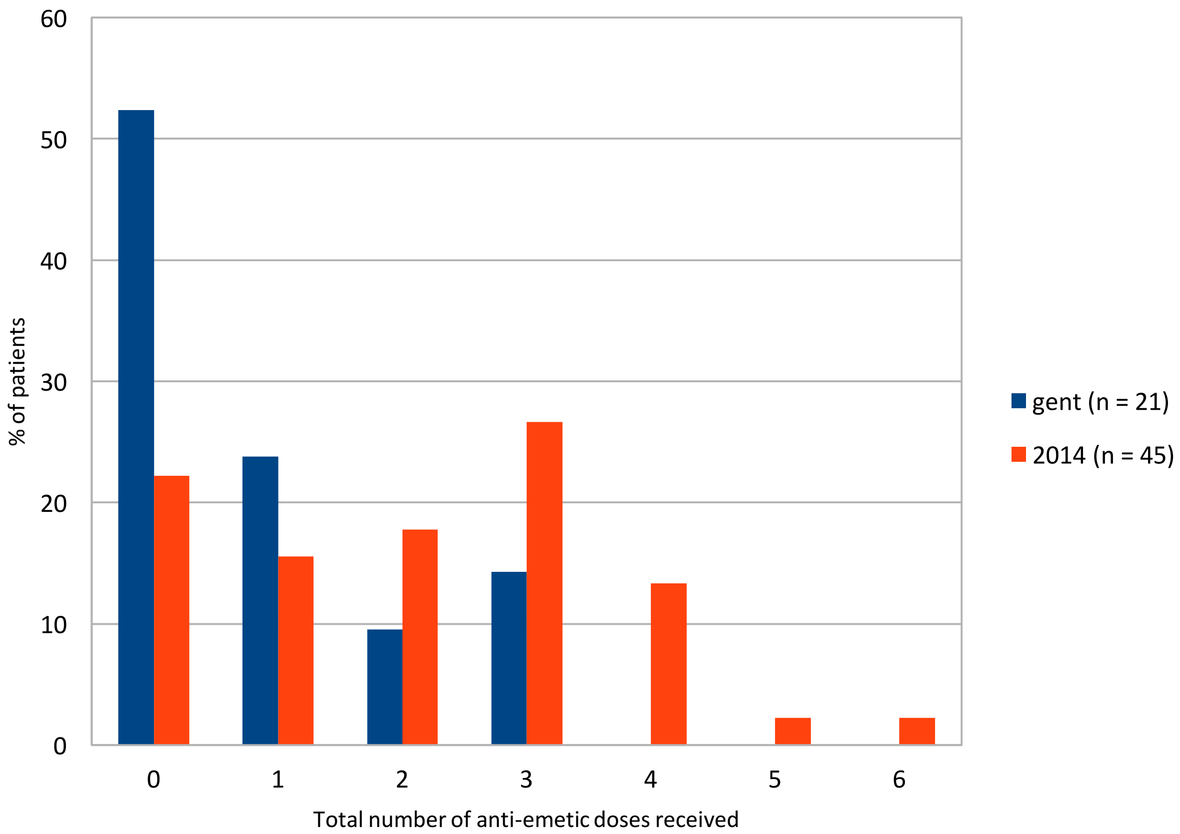
Figure 1. Comparison of anti-emetic use on postoperative day 3.



Early mobilisation in a specialist neurointensive care – a six-month review of safety

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Introduction: Early Mobilisation (EM) of patients in General Intensive Care is associated with improved patient outcomes and shortened length of stay (LoS) in hospital.[1] In some patient groups, it is possible to establish EM in Specialist Neurointensive Care (NICU).[2,3] In the United Kingdom, there are no reports outlining the safety profile in a NICU setting. In April 2016, we introduced an EM protocol in a regional NICU. Firstly, we wanted to evaluate the safety of EM for patients in NICU.

Methods: Prospective data was collected from April to September 2016 by the EM team. All patients admitted to NICU were considered eligible for EM. Exclusion criteria were then applied. Any patient entered into the EM project would recieve an additional two episodes of EM therapy per day above the standard physiotherapy input. Each day patients were considered for the maximal mobilisation therapy that could be achieved. This ranged from supine, passive use of MOTOmed letto2® to standing. Any clinically significant neurological, respiratory or cardiovascular complications were documented.

Results: Two hundred and eighty six patients were admitted to the NICU during this time period. 84 patients were identified as eligible for EM therapy. Only 52 were recruited to the EM project due to limited team resources. 1 case was excluded for review as no notes available. Further details are enclosed in table 1. There were no clinically significant complications reported in this patient group during the 6 month period. All 52 patients completed EM therapy during their stay on NICU.

Conclusions: The EM of patients in NICU appears safe and feasible. This is an important step in developing the service further. The impact on the length of stay and patient outcome has yet to be verified.

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2. Karic T, Roe C, Nordenmark TH, et al. Effect of early mobilization and rehabilitation on complications in aneurysmal subarachnoid haemorrhage. J Neurosurg 2017; 126:518-526.
3. Thelandersson A, Nellgard B, Ricksten S, et al. Effects of early bedside cycle exercise on intracranial pressure and systemic hemodynamics in critically ill patients in a neurointensive care unit. Neurocrit Care 2016; 25:434-439.

Table 1. Summary of data for early mobilisation on specialist neurointensive care

Patient Details	Male : Female	21 : 30
	Age (in years) – Median, (Range)	54, (17 -76)
Admission Diagnosis	Traumatic Brain Injury (TBI) Traumatic Spinal Injury (TSI) Intracerebral Haemorrhage Subarachnoid Haemorrhage (SAH) Other	16 1 6 25 3
Severity of Illness	WFNS grading for SAH – Median, (Range)	4, (1 - 5)
	Injury Severity Score for TBI & TSI: Median, (Range)	29, (17 – 50)
	APACHE II scores: Median, (Range)	12, (5 - 20)
#Total Number of Early Mobilisation sessions – Median, (Range)		4, (1 - 25)
Length of Stay (LoS) (in days)	Neurointensive care LoS – Median, (Range)	12, (2 - 64)
	Wessex Neuro Centre LoS – Median, (Range)	22, (4 - 81)
Discharge destination from Neurointensive Care	Referring/local Hospital Ward	18 33

Data collected on 44/51 patients.

Is there a solution to PONV after craniotomy?

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Introduction: Postoperative nausea and vomiting (PONV) occurs frequently after craniotomy; a recent UK audit found an incidence of 28% at 48hrs. We audited PONV to determine the rate and any specific risk factors in our centre.

Methods: We audited 54 patients over a 10-month period. A questionnaire was completed by the anaesthetist and patients were followed up by the authors up to 48hrs. We recorded patient demographics, operative approach, anaesthetic type, PONV risk factors, as well as timings of PONV ranging from recovery, 4-8hrs, 24hrs and 48hrs.

Results: Fifty-four patients were audited (25 males: 29 females) with a mean age of 56 years (26-85). 7 patients were lost to follow up after the recovery room. Follow up was complicated by many patients being discharged within 36 hrs. All patients were anaesthetised with TIVA. Peak PONV rates were found at 4-8hrs (nausea 14/47 (30%) and vomiting 6/47 (13%)). The incidence of PONV at 24hrs was well predicted by the Apfel score (average predicted PONV 40% and average incidence of PONV 43%). The PONV rate at 48hrs was much lower (nausea 8/47 (17%) and vomiting 2/47 (4%)). There was an increased incidence of PONV with posterior fossa and pterional approaches when compared with other craniotomy incisions (Fig. 1). There was delayed and sustained nausea following a pterional incision (rates at 24 and 48hrs were 40% and 33% respectively). This correlated with an increased use of IV morphine.

Patients who received magnesium intra-operatively used less opioid in the 24- 48hrs period.

Conclusions: This audit demonstrated a lower rate of PONV in our centre than previously described at both 24 and 48hrs.[1,2] Operative site and continued opioid use were identified as significant risk factors for PONV. We plan to introduce a PONV guideline, which includes the site of operation as a risk factor and recommends regular anti-emetics for the first 48 hrs after post fossa and pterional approaches. This will be re-audited thereafter.

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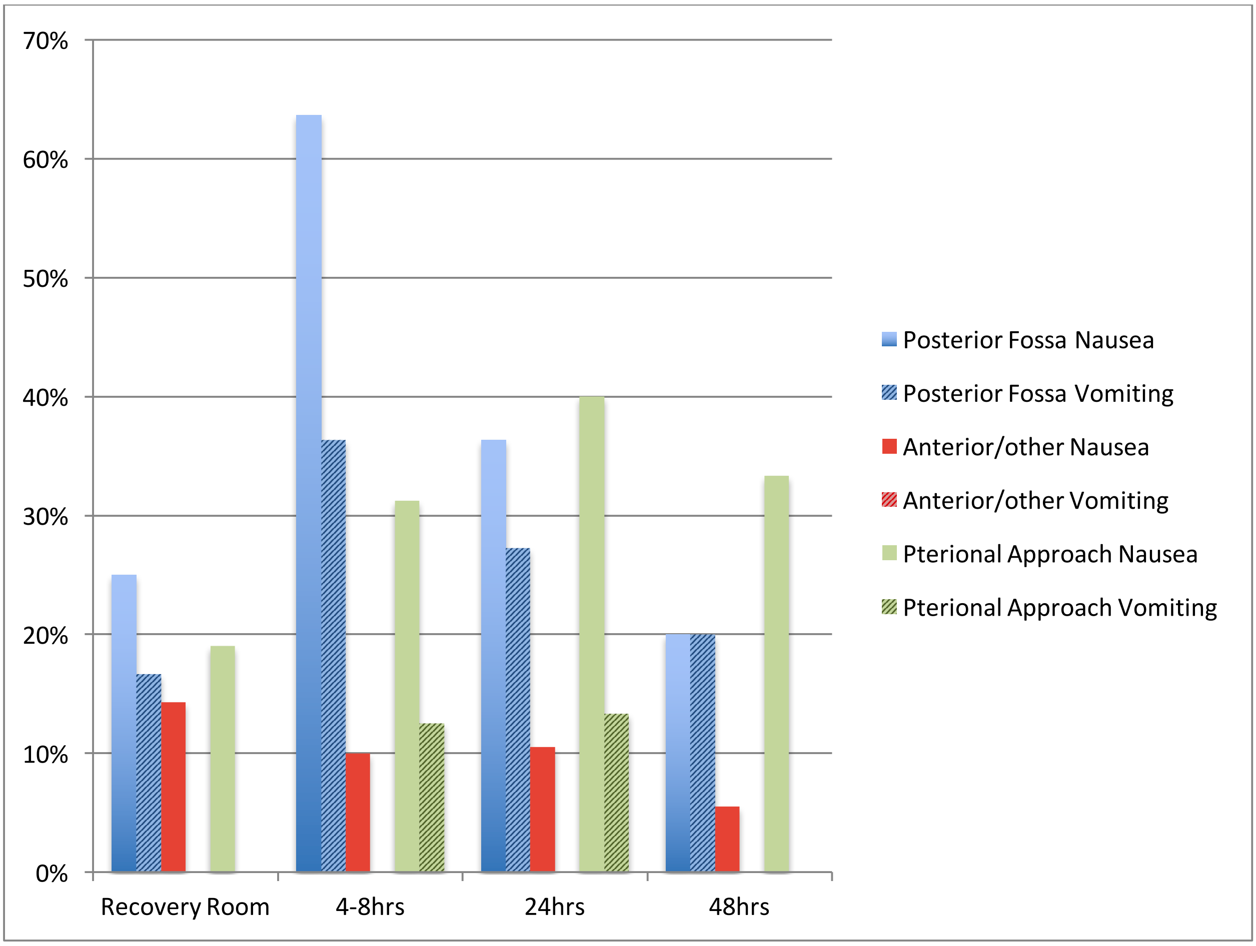
Figure 1. PONV rates according to surgical approach.



Recognition and management of steroid induced hyperglycaemia and steroid induced diabetes in adult patients undergoing elective craniotomy: experiences of one neurosurgical centre

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Introduction: Treatment with dexamethasone is frequently used peri-operatively in neurosurgical patients undergoing craniotomy. High dose glucocorticoids may result in significant hyperglycaemia and this has the potential to increase adverse neurosurgical outcomes. Recognition and control of hyperglycaemia aims to reduce the associated risks of acute metabolic complications and increased infection rate. Guidelines constructed by the Joint British Diabetes Societies (JBDS) provide a suggested framework for the diagnosis and subsequent management of steroid induced hyperglycaemia or diabetes.[1]

Methods: We performed a retrospective audit of all available adult patient records undergoing elective craniotomy in 2015. In those patients treated with steroids the presence of pre-existing diabetes, the results and frequency of blood glucose measurement and the management of any documented hyperglycaemia were recorded and compared to the recommended audit standards.

Results: Steroid therapy was given to 74 patients, of these 6 had pre-existing diabetes and 68 were non-diabetic. Overall the proportion of patients appropriately screened for hyperglycaemia for the duration of their steroid therapy was 5.4%. In the diabetic group this was 16.6%, and 4.4% in the non-diabetic group. Appropriate blood glucose control was achieved in 33% of the steroid induced hyperglycaemia and none of those patients with steroid induced diabetes. (Table 1)

Conclusions: Our findings demonstrate that blood glucose monitoring in neurosurgical patients treated with steroids, particularly in the non-diabetic population, were substantially below the JBDS recommended audit standards in our unit. This is likely to preclude the recognition and therefore management of steroid induced hyperglycaemia and diabetes. Appropriate levels of blood glucose control for both groups were also below audit standards; the subsequent introduction of a trust guideline and education program aims to improve this.

References:

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Table 1. Comparison of Joint British Diabetes Societies (JBDS) audit standards with achieved levels of screening for hyperglycaemia and appropriate control of steroid induced hyperglycaemia or diabetes.

	Diabetics (n=6)		Non-diabetics (n=68)	
	JBDS Audit Standard	Standard Achieved	JBDS Audit Standard	Standard Achieved
Patients appropriately screened for hyperglycaemia throughout steroid course	90%	1 (16.6%)	90%	3 (4.4%)
Patients with appropriately controlled steroid induced hyperglycaemia	75%	2 (33%)	N/A	N/A
Patients with appropriately controlled steroid induced diabetes	N/A	N/A	75%	0 (0%)

Overcoming roadblocks to King's - time-critical neurosurgical transfers

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Introduction: The target arbitrary maximum time from brain injury to neurosurgery is 4 hrs.[1] However, we have found substantial delays in patient transfers and a lack of communication regarding the patients involved. We feel that a speedier transfer time might be achieved with advice from the receiving neuroanaesthetist and that information given to that neuroanaesthetist prior to their arrival would enable better preparation.

Methods: Transfer times for cases of traumatic brain injury brought to King's over a period of approximately 12 months from 03/10/2015 was sourced from the Trauma, Audit & Research Network (TARN).[2] A 3-month audit of neurosurgical communication with the rest of the theatre team regarding patient information was carried out.

Results: TARN data showed that injury-to-King's arrival times were 1-4hrs 12.5%, 4-10hrs 37.5%, 10-24hrs 25%, >24hrs 17.9%. The internal audit showed inadequate information regarding patient details in 50% of cases with some adverse incidents whereby patients arrived with a transfer team but without adequate notice to open a second theatre.

Conclusions: Delays in transfer may possibly be due to unnecessary interventions. Inadequate prior notice is given for the anaesthetic team to open a second theatre. Inadequate anaesthetic assessment from the neurosurgical team for patient preparation. The referring anaesthetist could directly contact the neuroanaesthetist for advice regarding management for transfer and give their anaesthetic assessment. A Wi-fi phone has been purchased for this purpose and its number will be advertised on-line. The neuroanaesthetist could have access to the on-line neurosurgical referral system to view patient details. Verbal communication between the neurosurgeon, theatre coordinator and anaesthetist could be improved.

References:

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Implications of anaemia and blood transfusion in patients with spontaneous intracerebral haemorrhage

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Introduction: Anaemia is associated with poor outcome after spontaneous intracerebral haemorrhage (ICH).[1,2]

Methods: We explored the relationship between anaemia,[3] blood transfusion, and clinical outcomes in all patients with ICH admitted to our Surgical Intensive Care Unit (SITU) from January 2014 to December 2015.

Results: 175 spontaneous ICH patients were admitted. 159 patients (58% male, mean age 61.08 [15.44] years) had complete data and were included. Mean SITU and hospital stay were 10.44[10.6] days and 30.45 [42.73] days respectively. 56 patients (35%) were anaemic on SITU admission; 19 (12%) were transfused. 127 patients (80%) survived to hospital discharge. Outcomes for anaemic patients, and for those who received transfusions, are shown in Table 1. Neither anaemia nor blood transfusion was associated with a survival difference. Admission anaemia was associated with blood transfusion. Transfused patients had significantly longer SITU stay than non-transfused patients.

Conclusions: We found no significant association between anaemia, blood transfusion, and survival to discharge. This contradicts previous studies identifying anaemia and blood transfusion as poor prognostic factors in ICH. Larger cohort studies are required to elucidate the implications of anaemia and blood transfusion in this population.

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Table 1. Outcome after spontaneous ICH in anaemic and transfused patients

	Anaemia on SITU admission (n=51)	No anaemia on SITU admission (n=100)	P value
SITU length of stay (days) (mean, SD)	12.4 (11.1)	9.6 (10.5)	0.12
Hospital length of stay (days) (mean, SD)	28.8 (30.5)	33.2 (49.1)	0.56
Transfused during SITU stay (n, %)	11 (22%)	5 (5%)	0.002
Survival to hospital discharge (n, %)	36 (71%)	75 (75%)	0.48
	Transfused during SITU stay (n=16)	Not transfused during SITU stay (n=135)	P value
SITU length of stay (days) (mean, SD)	18.8 (11.6)	9.6 (10.2)	0.001
Hospital length of stay (days) (mean, SD)	44.0 (53.4)	30.1 (42.1)	0.23
Survival to hospital discharge (n, %)	11 (69%)	100 (74%)	0.65

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Section 2: Case Reports

Anaesthesia and peri-operative management of a patient with carnitinepalmitoyl transferase deficiency type 2 and malignant hyperthermia undergoing a posterior fossa craniotomy and resection of cerebellar tumour.

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Introduction: Carnitine Palmitoyltransferase II (CPTII) deficiency is an autosomal recessive disorder which results in the inability to derive energy from fatty acid oxidation.[1] Clinical manifestations include recurrent episodes of myalgia, rhabdomyolysis and paroxysmal myoglobinuria following times of stress, such as exercise, fasting or surgery.[1] Propofol is contra-indicated in patients with CPTII and other mitochondrial fatty acid oxidation disorders. Malignant hyperthermia (MH) is a rare, but potentially life-threatening, autosomal dominant disorder. Exposure to volatile anaesthetic agents and depolarising muscle relaxants in susceptible individuals leads to a metabolic disturbance of calcium homeostasis in skeletal muscle. Features of this "crisis" includes hypoxaemia, hypercapnia, cardiovascular instability, a mixed acidosis and a sustained hyperthermia.[2]

Case History: We describe the anaesthetic management of a 42-year old male having a posterior fossa craniotomy for resection of tumour, with CPTII deficiency and known MH: conditions that preclude the use of propofol and volatile agents, thus representing a unique anaesthetic challenge. The patient was induced using sodium thiopentone (STP) and rocuronium with an infusion of remifentanil. Anaesthesia was maintained using a combination of STP, remifentanil and midazolam infusions. The STP infusion was stopped once the patient had been transferred to the ICU, 8.5 hours after induction. The patient was extubated 19 hours later.

Discussion: This case presented a rare anaesthetic conundrum, posing the question of how best to maintain anaesthesia in a patient who cannot receive propofol or volatile anaesthetics. The combination of drugs we used provided optimal operating conditions combined with cardiovascular stability. Although the use of a STP led to delayed emergence from anaesthesia the patient suffered no complications. We would advocate this technique should you find yourself in a similar conundrum.

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Iodinated Contrast-Induced Encepalopathy following Neurovascular Intervention

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Introduction: Contrast-induced encephalopathy (CIE) is a known but rare complication of angiography and neurovascular intervention. It is characterised by transient reversible nonspecific neurological signs ranging from cortical blindness to seizures which can develop over a period of hours. The prognosis is usually good with supportive management alone.[1]

Case History: A 74-year old lady with a history of hypertension and ischaemic heart disease presented with headache, vomiting and diplopia. Radiological imaging revealed bilateral carotid cavernous aneurysms and she underwent stent-assisted coiling. The procedure was technically difficult involving repeated injections of Iohexol (Omnipaque). Four hours later the patient developed seizures and had a depressed level of consciousness. She required intubation and mechanical ventilation. An emergency CT brain showed an abnormality in the frontoparietal lobes reported as an acute ischaemic infarction. The scan was subsequently reviewed by a specialist neuroradiologist who felt the findings could represent CIE. The patient was admitted to the Intensive Care Unit for supportive therapy. A follow-up scan 24 hours later showed an improvement in the appearances in keeping with CIE. She was successfully extubated 48 hours later with no residual neurological deficits.

Discussion: The mechanism of CIE remains unclear but is thought to be related to osmotic disruption of the blood brain barrier due to the physical and chemical properties of the contrast media.[2] Clinically, due to the heterogeneity of the presenting symptoms, it can be difficult to distinguish CIE from other neurological conditions such as subarachnoid haemorrhage and cerebral infarction.[3] Recognition of CIE is crucial for appropriate patient management and prognostication. CIE should be considered in any patient developing neurological symptoms following procedures involving the use of iodinated contrast media.

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Cooling in quad fever: successful use of targeted temperature management for fever in acute traumatic cervical spinal cord injury

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Introduction: Half of patients with acute traumatic SCI suffer fever.[1] Autonomic dysfunction leading to aberrant thermoregulation is thought to underlie this susceptibility. The term neurogenic fever is used where no identifiable aetiology other than the SCI itself exists; it is a diagnosis of exclusion. Its incidence may be 4-5% in traumatic SCI.[1] It can be progressive and fatal, a case series of 5 patients with cervical SCI and neurogenic fever had 100% mortality within 8 days of injury.[2] We present a case of suspected neurogenic fever in which the patient survived with prolonged use of targeted temperature management (TTM).

Case History: A previously well 61-year old male sustained a complete C4 SCI after falling head first over the handle bars of his road bike. He was admitted to Neuro ICU in neurogenic shock. Non-invasive ventilation was commenced on admission but within 24 hours of injury he required tracheal intubation and ventilation. On day 1 his core temperature rose to 39°C, passive cooling measures were commenced. By day 3 it reached 41.8°C, intravascular TTM to 37.5°C was commenced. TTM continued for 12 days (Fig. 1), with three failed attempts at cessation and a change to a surface TTM method. He underwent a tracheostomy on day 40, and was repatriated to a local ICU day 54.

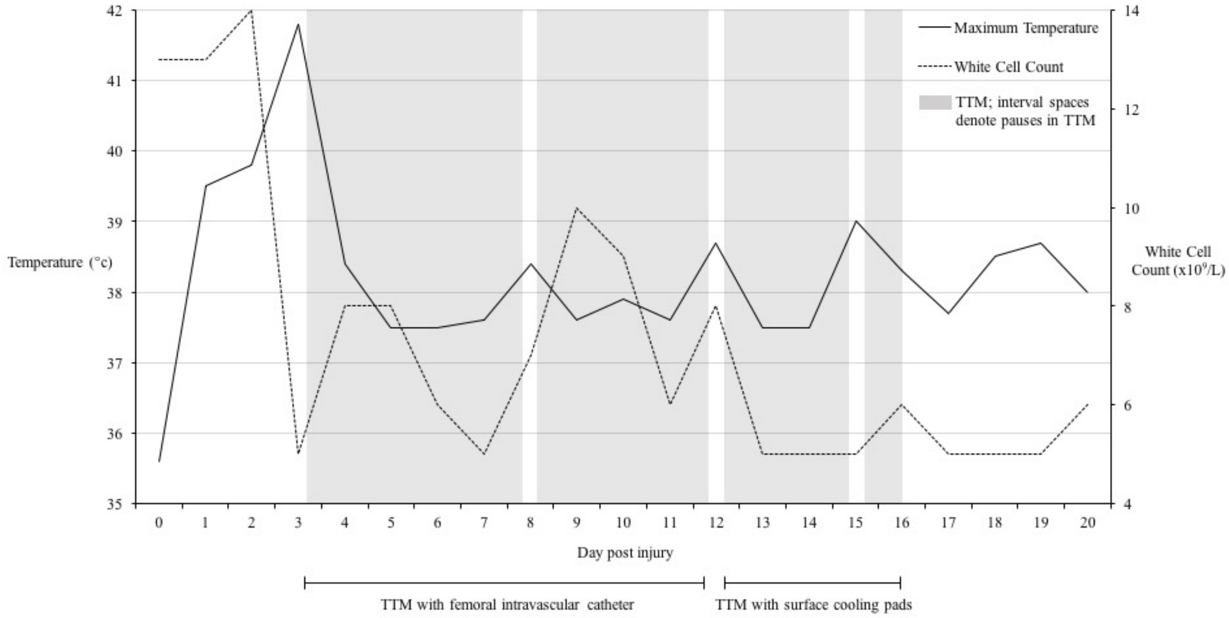
5 months post injury he is decanulated and soon to be discharged home.

Discussion: Whilst there is growing use of TTM in neurocritical care, this is predominantly for intracranial insults. Savage et al.'s recent systematic review highlights the lack of evidence available to clinicians managing neurogenic fever.[1] Indeed, challenges in this case included early recognition of life-threatening hyperthermia, distinguishing the cause of the fever and its clinical management. We found no literature to aid decision making on the threshold, duration or method of cooling. There are now invasive and non-invasive cooling methods; we have shown that both can be efficacious in this condition.

References:

1. Savage KE, Oleson CV, Schroeder GD, et al. Neurogenic Fever after Acute Traumatic Spinal Cord Injury: A Qualitative Systematic Review. Global Spine J. 2016; 6:607-14.
2. Ulger F, Dilek A, Karakaya D, et al. Fatal fever of unknown origin in acute cervical spinal cord injury: five cases. J Spinal Cord Med. 2009; 32:343-8

Figure 1. Daily maximum temperature and white cell count, with highlighted periods of targeted temperature management (TTM)



Is this a super-super refractory status epilepticus? A case report on a patient with super refractory status epilepticus (SRSE) lasting thirteen days despite numerous anti-epileptic drugs (AEDs) but awoke without neurological deficit.

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Introduction: Status Epilepticus (SE) is a medical emergency; if it persists 24 hours after onset or cessation of anaesthesia it is termed super-refractory.[1] The management of SRSE is not well established and some cases may require medications beyond the recommended guidelines.

Case History: A 58-year old man with previous history of encephalitis presented with grand mal seizure after one-week history of malaise. He was sedated and ventilated due to SE. We started antimicrobials and oseltamivir for positive influenza swab. His MRI showed thalamic changes with a differential of infective, metabolic or paraneoplastic disorders. Raised IgG suggested monoclonal gammopathy of undetermined significance. Despite adding valproate to phenytoin and levetiracetam, his EEG showed continuous epileptiform features with bispectral index (BIS) value less than 20. Midazolam, then thiopentone infusion to induce burst suppression were started after failure of regular AEDs; lacosamide and topiramate were added. After weaning thiopentone, seizures continued; phenobarbitone was added which ceased epileptiform features on EEG. He required further thiopentone and midazolam prior to extubation. Post-extubation EEG demonstrated no seizures.

Discussion: Following failure of multiple AEDs and newer agents, consideration should be given to earlier generation AEDs;[2] we were late to add phenobarbitone which may have prevented the need for thiopentone coma. It has been suggested that SE results from failure to synchronize seizure activity preventing seizure termination.[1] After 24 hours, cytotoxic damage is likely to have occurred and it is unknown to what extent further seizure control is important.[1] Thiopentone was used to re-synchronise electrical activity but seizure activity recurred on cessation. After 13 days of uninterrupted SE, the patient was extubated with evidence of delirium. "There is no clear duration of SE or number of failures to wean therapy that should be considered futile".[3]

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2017

Section 3: Research

Optic nerve sheath diameter (ONSD) response to end tidal carbon dioxide concentration in patients under general anaesthesia

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Introduction: Intracranial Pressure (ICP) monitoring is an essential component in management of traumatic brain injured (TBI) patients. While invasive techniques are associated with many complications, the non-invasive nature of ultrasonographic measurement of optic nerve sheath diameter (ONSD) is now becoming popular. Carbon dioxide alters the ICP by changing the size of cerebral vasculature. We aimed to assess the effect of (hypercarbia and hypocarbia) different levels of end tidal carbon dioxide ($ETCO_2$) on the ONSD.

Methods: ASA grade I adult patients between 18 to 65 years, undergoing surgery for brachial plexus injury repair under general anesthesia were enrolled. Following standard anaesthetic protocol, the ONSD was measured at $ETCO_2$ of 30 mmHg, 40 mmHg and 50 mmHg. The mean of three ONSD values was taken as final value. Statistical analysis summarized the data using mean (SD) or number (%) as appropriate. Following the approach recommended by Bland Altman, owning to possibility of within-individual correlation between successive measurements, standard deviation (SD) was estimated. Statistical significance was achieved when p value was less than 0.05.

Results: Thirty patients (all males) participated in the study with age 29.8 (8.8) years and weight 65.6 (8.8) kg. The mean ONSD was 0.34 mm at $ETCO_2$ of 40mmHg, 0.29 mm at $ETCO_2$ of 30mmHg and 0.40 mm at $ETCO_2$ of 50 mmHg.

Conclusion: ONSD does not change significantly in response to different $ETCO_2$ levels in healthy non neurosurgical patients under general anaesthesia with oxygen, air and propofol infusion.

Surgery and anesthesia after concussion

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Introduction: Concussion is a functional manifestation of mild traumatic brain injury. In patients who have recently experienced concussion and are in a vulnerable recovery phase, surgery and anesthesia[1] and the exposure to physiologic aberrations and pharmacologic interventions they produce[2] can potentially affect outcome for the vulnerable brain. We describe the epidemiology of surgical and anesthetic procedures in patients recently diagnosed with concussion.

Methods: Study patients were those who presented to a single institution for care following a concussion between July 1, 2005 and June 30, 2015 and who also underwent a surgical procedure and anesthesia support under the direct or indirect care of an anesthesiologist.

Results: During the study period, 1038 patients met all study inclusion criteria and subsequently received 1820 anesthetics. In this population of anesthetized patients, rates of diagnosed concussions due sport injuries, falls, and assaults, but not motor vehicle accidents, increased during 2010-2011 (Fig. 1). Ninety-three percent of concussions were diagnosed within 1 week of injury. However, 29 of 554 (5%) also had anesthesia and surgical procedures unrelated to their concussion-producing traumatic injury within 1 week following injury. The highest utilization of surgery occurred early following injury and most frequently required general anesthesia. Orthopedic and general surgical procedures accounted for 57% of procedures. Nine patients received 29 anesthetics prior to a concussion diagnosis. All 9 patients sustained motor vehicle accidents and received at least 1 anesthetic within 1 week of injury.

Conclusion: Surgical and anesthesia utilization are common in patients following concussion. Clinicians should have increased awareness for concussion in any patient who sustained a trauma and take measures to avoid any potentially injury-augmenting cerebral physiology in these patients.

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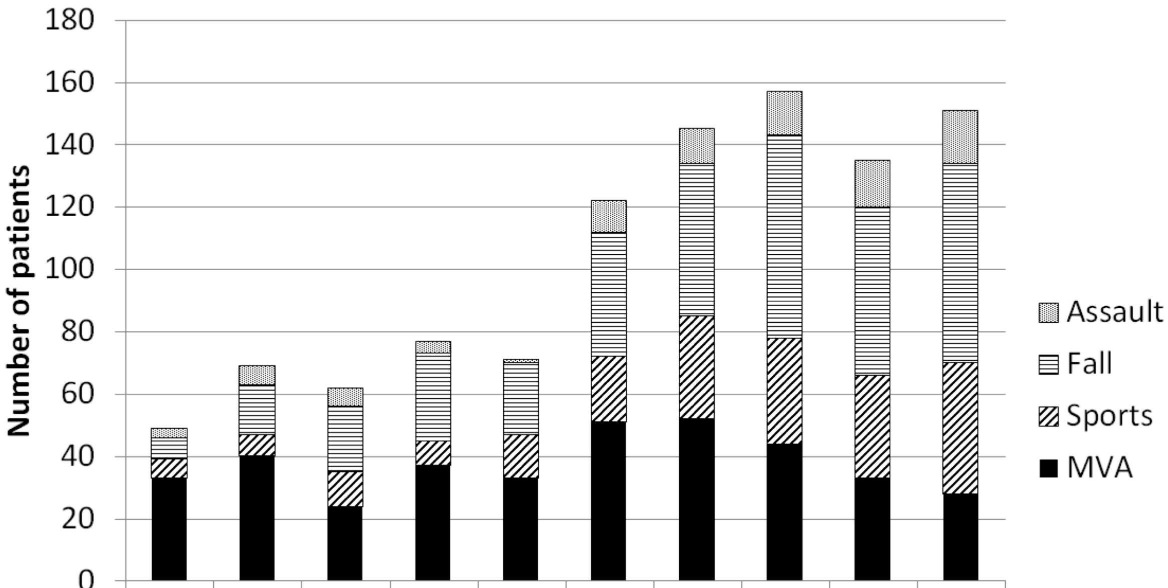
Figure 1.



Dates →	7/1/05-6/30/06	7/1/06-6/30/07	7/1/07-6/30/08	7/1/08-6/30/09	7/1/09-6/30/10	7/1/10-6/30/11	7/1/11-6/30/12	7/1/12-6/30/13	7/1/13-6/30/14	7/1/14-6/30/15
Assault	3	6	6	4	1	10	11	14	15	17
Fall	7	16	21	28	23	40	49	65	54	64
Sports	6	7	11	8	14	21	33	34	33	42
MVA	33	40	24	37	33	51	52	44	33	28

Effect of peak end expiratory pressure on optic nerve sheath diameter in paediatric patients with traumatic brain injury

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Introduction: The optic nerve sheath diameter (ONSD) increases much earlier as a manifestation of raised intracranial pressure (ICP). One of the established ventilation strategies to improve oxygenation index in lung injury is by recruiting collapsed alveoli through application of high positive end-expiratory pressure (PEEP). High PEEP therapy has been shown to increase ICP in adult head injured patients. The primary aim of our study was to compare the effect of different values of PEEP on ONSD and to note simultaneous change in the ICP, in paediatric traumatic brain injury (TBI) patients.

Methods: After approval from the Institutional Ethics Committee and written informed consent obtained from parents, paediatric patients suffering from TBI between 1 to 18 years of age, of either gender admitted in neuro-intensive care unit were enrolled over a period of 3 months. Only those patients in whom ICP was measured using intraparenchymal Codman catheter were enrolled. The ONSD was measured at PEEP values of 0, 3 and 5 cmH2O, respectively. The sequence of application of PEEP (0 cmH_2O or 3 cmH_2O or 5 cmH_2O) was randomized. Data recorded are expressed as median (range) or mean (SD) or number (%) as appropriate. The ONSD and ICP at various stages were compared using two-way repeated measures ANOVA with Bonferroni correction. A value of $P < 0.05$ was considered significant.

Results: Ten patients (7 males and 3 females) were enrolled. The age and weight of the patients were 5 (1-10) years and 15 (8- 35) kg, respectively. The change in ICP and ONSD in response to increase in PEEP values has been tabulated (Table 1).

Conclusion: We conclude that when required, PEEP up to 3 cmH_2O can be safely applied in paediatric patients following TBI. Further increment of PEEP might improve oxygenation but accentuate ICP, which may compromise the cerebral perfusion pressure.

Table 1. Optic nerve sheath diameter (ONSD) and intracranial pressure (ICP) with different levels of positive end-expiratory pressure (PEEP). Values are median (range)

PEEP (cmH_20)	ONSD (mm)	ICP (mmHg)
0	3.1 (2.3-3.9)	11.5 (3-14)
3	3.3 (2.4-4.3)	12 (3-15)
5	3.5 (3.0-5.5)	13 (3-18)
PEEP Increments		
0 to 3	P = 0.183	P = 0.417
3 to 5	P = 0.000	P = 0.001

Effects of crystalloid preloading (20 ml/kg) on hemodynamics during positioning in patients undergoing neurological operations in sitting position.

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Introduction: Hemodynamic disturbances like hypotension is very common in neurosurgical procedures in sitting position. The reported incidence of hypotension in literature varies from 5-32%. Several studies have shown a decrease in mean arterial pressure (MAP), stroke volume index (SVI), cardiac index (CI) in patients undergoing neurosurgical procedures in sitting position.[1,2] None of the studies, have prospectively studied the effects of crystalloid preloading on hemodynamic changes in patients during positioning from supine to sitting position.

Methods: A total of twenty patients with ASA physical status I/II, in the age group 18 to 60 years, undergoing elective sitting craniotomy were included. Patient with patent foramen ovale are excluded. Heart rate (HR), mean arterial pressure (MAP), central venous pressure (CVP), cardiac output (CO), stroke volume variation (SVV), cardiac index (CI), systemic vascular resistance (SVR), inferior vena cava diameter changes in inspiration (IVCD insp) and expiration (IVCD exp). These variables are measured in the supine position, at 30 degrees propped up position, 60 degrees head up position, at the final sitting position for the surgery, and 30 minutes after sitting position given. Inferior distensibility index calculated and correlated with cardiac index.

Results: The MAP showed a declining trend but the changes were not significant ($p > 0.05$). When compared to the supine position MAP decreased by 6% in 30°, 7% in 60°, 8.4% in final sitting position. None of the patients required vasopressor boluses during positioning. Thirty minutes after final positioning the MAP decreased by around 11%. A significant fall in central venous pressure were noted CVP in 30°, 60°, final sitting position as compared to the supine position. There was no significant difference in SV, SVV, SVI, CO, CI. Declining trend was noted with SVR and SVRI.

Conclusion: Crystalloid preloading helps in maintaining hemodynamics in sitting position craniotomy.

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Table 1. Hemodynamic parameters during positioning from supine to sitting. Values are mean ± SD with p values in brackets.

	Supine	30^{o}	60^{0}	Final sitting	30 min after sitting
HR	73.1±6.5	73.2±6.3 (0.9)	73.5±6.3 (0.7)	74.2±6.3 (0.34	72.1±6.5(0.3
MAP	81.6±5.8	76.6±5.6 (0.09)	76.0±2.6 (0.08)	74.3±3.4 (0.07)	72.6±2.4 (<0.001)
CVP	8.1±1.4	6.7±1.9 (0.03)	7.2±1.3 (0.05)	6.6±1.6 (0.001)	7.1±1.1 (0.05)
SV	67.3±4.3	66.4±5.6(0.4)	67.7±9.3 (0.8)	68.1±10.1 (0.7)	70.0±12.4 (0.4)
SVV	8.9±2.4	9.4±3.2 (0.6)	8.0±1.5 (0.1)	8.6±1.8 (0.5)	8.4±1.7 (0.3)
SVI	45.4±5.1	46.2±7.5 (0.6)	45.6±7.9 (0.9)	44.6±8.1(0.6)	46.2±7.9 (0.7)
CO	4.8±0.4	5.01±0.8 (0.3)	5.04±0.8 (0.3)	5.04±0.6 (0.2)	5.03±0.7 (0.4)
CI	3.34±0.41	3.40±0.5 (0.6)	3.33±0.5 (0.9)	3.24±0.5 (0.4)	3.28±0.4 (0.6)
SVR	1174.1±112.8	1121.6±127.3 (0.07)	1112.2±123.6 (0.06)	1084.8±110.5 (0.07)	1023.7±147.9 (0.003)
SVRI	1761.7±248.21	1689.8±245.2 (0.07)	1693.2±207.3(0.1)	1687.4±214.9 (0.09)	1606.6±209.2 (0.02)

HR, heart rate; MAP, mean arterial pressure; CVP, central venous pressure; SV, stroke volume; SVV, stroke volume variation SVI, stroke volume index; CO, cardiac output; CI cardiac index; SVR, systemic vascular resistance; SVRI, systemic vascular resistance index

Comparison of Full Outline of UnResponsiveness (FOUR) Score and the conventional scores in predicting outcome in aneurysmal subarachnoid hemorrhage patients

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Introduction: Full Outline of Un-Responsiveness (FOUR) score is proposed to overcome the drawbacks of Glasgow Coma Scale. In aneurysmal subarachnoid haemorrhage (aSAH) different scales such as Hunt and Hess (HH), World Federation of Neurosurgical Societies (WFNS) and Fisher scales are used for grading the severity of SAH and its prognostication. Our primary objective was to assess which score best predicts mortality in these patients.

Methods: This observational study prospectively evaluated the use of FOUR score to describe the mortality and outcome in 75 patients during the period from November 2015 to November 2016. For each patient of aSAH, admitted in our center, FOUR score, HH score and WFNS score were determined by any one of the examiners who had been randomized previously to do so. The management plan and any perioperative event were noted. All patients were followed till 28 days post discharge from hospital. Postoperative complications and mortality were noted. Data are presented as mean (SD) or number (%). We calculated the sensitivity (Sn) and specificity (Sp) for these scores. We also generated the Receiver Operating characteristic curve (ROC) and quantified the accuracy by the area under curve (AUC) and also calculated their 95% Confidence Interval [95% CI].

Results: The mean age was 52.2 (14.8) years. The male: female ratio was 32: 43. The SN and Sp for the various scores are tabulated (Table 1). The mortality was 24 with 23 in-hospital deaths. In terms of the predictive power for mortality, the area under the ROC (AUC-ROC) was 0.80 [95% CI: 0.68 – 0.91] for the FOUR score, 0.78[95% CI: 0.67 – 0.9] for the GCS score, 0.79 [95% CI: 0.67 – 0.9] for HH and 0.76 [95% CI: 0.64 – 0.88] for WFNS.

Conclusion: The FOUR score is a comparable predictor of mortality in aSAH patients, when compared to other scores. Due to the important advantages that it has, FOUR score can be an impeccable tool in the ICU setting in SAH patients.

Table 1. Correlation of various scales for mortality and Glasgow Outcome Score at 28 days.

Outcome	TP	FP	TN	FN	Sensitivity	Specificity	AUC (95% CI)
Mortality							
FOUR	18	7	44	6	90.20%	70.83%	0.80(0.68-0.91)
HH Grade	17	10	41	7	87.50%	43.14%	0.79(0.67-0.90)
WFNS	17	7	44	7	70.83%	86.27%	0.76(0.64-0.88)
GCS	18	14	37	6	82.35%	70.83%	0.78(0.67-0.90)
GOS							
FOUR	24	6	34	11	95.00%	65.71%	0.81(0.72-0.90)
HH Grade	24	3	37	11	68.57%	92.50%	0.82(0.71-0.91)
WFNS	21	3	37	14	60.00%	92.50%	0.78(0.68-0.88)
GCS	25	7	33	10	90.00%	62.86%	0.81(0.72-0.90)

FOUR, Full Outline of Unresponsiveness; HH Grade, Hunt and Hess Grade; WFNS, World Federation of Neurological Surgeons; GCS, Glasgow Coma Scales; GOS, Glasgow Outcome Score; TP, True Positives; FP, False Positives; TN, True Negatives; FN, False Negatives; AUC, Area Under Curve; CI, Confidence Interval.

Cost analysis of out-patient versus in-patient awake craniotomy

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Introduction: The advantages of outpatient or ambulatory surgery to patients and healthcare providers are well established.[1] Traditionally, neurosurgery is considered a resource-intense speciality, many patients needing admission before surgery, and long post-operative stay including intensive care unit (ICU) admissions. Outpatient craniotomy has been shown to be safe for some neurosurgical procedures.[2,3] The economic implications of outpatient neurosurgery have not been studied. Our study aimed to determine the cost implications of outpatient compared to in-patient craniotomy for brain tumour.

Methods: After ethical approval, we conducted this single centre-study on patients who underwent either outpatient or in-patient craniotomy for tumour over eighteen months. We included awake craniotomies performed by a single surgeon. All cases were less than 4 hours in duration without post-operative ICU admission. The hospital costs were gathered using data from the Ontario Case Cost Initiative (OCCI). Direct, indirect and total costs were compared between the groups. We used student's t-test, ANOVA and chi-squared tests for data analysis.

Results: Patient characteristics were similar. The results on costs of the two groups are shown in Table 1. Four patients were excluded as the length of stay (LOS) extended to 10 days or more. The costs were significantly lower for patients who underwent ambulatory surgery. Breakdown showed significant reduction in expenses incurred in pharmacy, general ward and investigations but not theatre or anaesthetic expenses. The total cost reductions became statistically significant when LOS extends to 2 days or more.

Conclusions: This was the first study examining the cost implications of outpatient versus in-patient craniotomy. Our results show that LOS of 2 days nearly doubles the cost of outpatient surgery. It is unclear whether this saving could be extrapolated to other surgical specialties or other neurosurgical procedures.

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Table 1. Main results on cost analysis. All values are means (± standard deviation) unless otherwise stated. * # denote statistical significance. CAD, Canadian Dollars; LOS, Length of Stay.

	Out-patient	In-patient	P value	
Costs				
Direct	3695 (± 666)	7636 (± 4054)	< 0.01	
Indirect	1547 (± 277)	3013 (± 1522)	<0.01	
Total	5242 (± 931)	10649 (± 5570)	<0.01	
Direct Costs ($ CAD)				
Theatre	2299 (± 430)	2312 (± 623)	0.94	
Anaesthetics	276 (± 51)	259 (± 54)	0.25	
Investigations	531 (± 406)	834 (± 517)	0.02	
Pharmacy	18 (± 20)	372 (± 638)	0.004	
Food	N/A	190 (± 172)	-	
Unit (ward costs)	570 (± 248)	3000 (± 2534)	< 0.01	
Costs according to LOS				
Mean (± 95% CI).	Out-Patient	1 Day	2 Days	> 2 Days
Direct	3695 (± 877) * #	5443 (± 1670)	7683 (± 1785) *	10506 (± 1928) #
Indirect	1547 (± 331) * #	2187 (± 629)	3031 (± 673) *	4094 (± 727) #
Total	5242 (± 1205) * #	7630 (± 2295)	10714 (± 2453) *	14600 (± 2650) #

Assessment of non-neurosurgical complications in traumatic neurosurgical patients admitted in ICU: a prospective observational study

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Introduction: Traumatic brain injury (TBI) and spinal injury are frequent occurrences in developing countries such as India and recent estimates suggest the number of injured to be almost 1.5 to 2 million persons where more than half succumb to death every year. We have undergone this study to estimate various non- neurological complications in neurotrauma patients during ICU stay and also to observe the effect of these complications on ICU stay, disability and mortality.

Methods: This was a prospective observational study of 200 neurotrauma patients conducted at neurosurgical ICU of level 1 trauma center. Patients with age >16 years with severe head injury patients (GCS<8) and with cervical spine injury requiring mechanical ventilation were included in this study.

Results: Hypotension at ICU admission was present in 33 (21.4%) and 10 (21.7%) patients in TBI and spine injured patients respectively. Hypoxia (PaO_2 < 60 mmHg) was present in 48 (31%) and 24 (52%) TBI and spine patients respectively. Raised ICP was found in 107(69.5%) TBI patients at ICU admission. We observed that the commonest non-neurological problem involved respiratory system and was present in almost 60.5% of patients. This was followed in order by dyselectrolytemia (40%), cardiovascular (33.5%), coagulopathy (32%), infection (24%), abdominal dysfunction (16.5%) and acute kidney injury (3.5%). The median ICU stay for head injured patients were 7 (1-45) days while spinal injury patients were kept in ICU for around 5 (1-38) days before shifting to ward.

Conclusions: The present study highlights the importance of non-neurological complications in the neurotrauma ICU patients. The presence of respiratory complications was independently associated with 3 times increased chances of worsening of clinical condition (disability) in our study. Although the literature suggests that moderate and severe respiratory failure are poor prognostic factors, ICU stay was quite significantly increased in these patients unlike the mortality.

Table 1. Effect of the systemic complications on ICU stay in patients with traumatic brain and spinal cord injuries. Values are median (range).

Nature of complications		ICU stay (days)			
		Traumatic brain injury	p-value	Traumatic spine injury	p-value
Respiratory	Y	8(1-45)	0.0002	5(2-38)	0.344
	N	4(1-14)		5(1-20)	
Cardiovascular	Y	9(2-45)	0.01	5.5(2-31)	0.045
	N	6(1-25)		4.5(1-38)	
Infection	Y	11(1-45)	0.00	16.5(4-31)	0.002
	N	5(1-26)		4.5(1-38)	
Acute kidney injury	Y	3(2-18)	0.84	26(26)	0.12
	N	7(1-45)		5(1-38)	
Abdominal	Y	12(2-45)	0.00	23(18-38)	0.00
	N	6(1-22)		4.5(1-13)	
Dyselectrolytemia	Y	9(1-45)	0.00	18(3-31)	0.001
	N	4(1-22)		4(1-38)	
Bleeding and coagulopathy	Y	10(1-45)	0.00	8(2-31)	0.002
	N	6(1-22)		4(1-38)	

Neuroprotective role of dexmedetomidine in epilepsy surgery: a preliminary study

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Introduction: Long-standing temporal lobe epilepsy (TLE) causes cerebral insult and may cause raised brain injury biomarkers, S100b and neuron specific enolase (NSE). Dexmedetomidine is postulated to have neuroprotective effects. This study aimed to see the cerebroprotective effect of intraoperative dexmedetomidine in patients undergoing TLE surgery, by using biomarkers S100b and NSE.

Methods: 19 adult patients of mesial temporal sclerosis undergoing anteromedial temporal lobectomy and 11 non-epileptic age matched controls planned for spine surgery were enrolled. Baseline serum S100b and NSE values were obtained. Patients posted for epilepsy surgery were randomised into 2 groups. Group D received dexmedetomidine (infusion at a rate of 0.5µg/kg/h), group C received saline as placebo at the same rate. Blood samples were drawn at the end of surgery, 24 hours and 48 hours postoperatively and analyzed for serum S100b and NSE.

Results: Nineteen adult epileptic patients were enrolled for TLE surgery, 10 in Group C and 9 in Group D. Demographic profile, duration of seizure and total number of antiepileptic drugs used were similar in both groups. Baseline values of S100b in group C and group D was 66.7 ± 26.5 pg/ml, 34.3±21.7 pg/ml ($p=0.013$) respectively. After adjustment for baseline, overall value of S100b was 71.0±39.8 pg/ml and 40.5±22.5 pg/ml ($p=0.002$) in control and study group respectively. S100b values (79.3±53.6 pg/ml) ($p=0.017$) were highest at 24 hours postoperative. S100b values were lower in Group D compared to Group C at all time points. Mean value of NSE in control and study group was 32.8±43.4 ng/ml (log 3.0±0.1) and 13.51±9.12 ng/ml (log 2.42±0.60) respectively. NSE values in both groups was comparable at different time points.

Conclusion: S100b levels were significantly raised in epileptics compared to non-epileptics. Lower perioperative S100b values were observed in patients receiving intraoperative dexmedetomidine, possibly due to cerebroprotection by dexmedetomidine.

Comparison of scalp block and local anesthetic skin infiltration for craniotomy on Analgesia Nociceptive Index guided fentanyl consumption: a randomized controlled trial

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Introduction: Scalp block for craniotomy blunts haemodynamic response to noxious stimuli, reduces opioid requirement and decreases postoperative pain.[1] Analgesia Nociceptive Index (ANI) monitor provides objective information about the magnitude of pain and adequacy of intraoperative analgesia.[2] This study compared ANI-guided intraoperative fentanyl consumption in patients who receive scalp block with those who receive incision-site local anaesthetic infiltration.

Methods: Forty adult patients scheduled for elective supratentorial tumour surgery were randomly allocated to receive scalp block (group A) or pin-site and incision-site local anaesthetic infiltration (group B) after induction of anaesthesia. Exclusion criteria were pregnancy, diabetes mellitus and beta-blocker use. All patients received fentanyl 0.5µg/kg/h throughout the surgery and ANI was continuously monitored. Additional 1µg/kg of fentanyl was supplemented when ANI decreased below 50. Data regarding ANI values, fentanyl consumption and haemodynamic parameters were analysed using unpaired t-test and repeated measures ANOVA.

Results: The fentanyl consumption (µg/kg/h) was less in the scalp block group compared to incision site infiltration (1.12 ± 0.28 vs. 1.34 ± 0.28 respectively; mean difference (0.23), $p = 0.01$). (Table 1)

Conclusion: ANI-guided analgesic administration demonstrated significantly lower fentanyl consumption in patients receiving scalp block as compared to incision site local anaesthetic infiltration.

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Table 1. Demographic and intraoperative parameters in local anaesthetic infiltration at incision and pin site and in scalp block group. Values are median (IQR).

Parameters	Skin infiltration	Scalp block	p value
Age (years)	41 (26 - 49)	41 (25 - 51.5)	0.972
Weight (kg)	59.5 (54.25 - 65)	60 (53.5 - 66.5)	0.898
Preoperative numerical rating scale	3 (0 - 3.75)	3 (0 - 4)	0.818
Duration of surgery (hours)	3.92 (3.1 - 4.75)	4 (3.45 - 4.62)	0.592
Total Fentanyl consumed (µg)	305 (292.5 - 340)	260 (235 - 280)	< 0.001
Fentanyl $\mu g\ kg^{-1}\ h^{-1}$	1.34 (1.18 - 1.59)	1.04 (0.92 - 1.34)	0.001
Number of fentanyl boluses	1(1- 2)	0 (0- 1)	<0.001
Length of the incision (cm)	16 (15 - 18)	16 (14.5 - 17.5)	0.297

Cerebral oxygenation changes after decompressive craniectomy in patients with malignant cerebral venous thrombosis

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Introduction: Decompressive craniectomy (DC) is performed for management of refractory intracranial hypertension in patients with cerebral venous thrombosis (CVT).[1] DC results in improvement in cerebral oxygenation (cSO_2) in patients with traumatic brain injury[2] but has not been evaluated in CVT. We hypothesized that DC will improve cSO_2 in patients with malignant CVT.

Methods: The cSO2 was monitored non-invasively using near infrared spectroscopy technique before and after DC. Data regarding factors likely to affect cSO2 such as systolic blood pressure (SBP), partial pressure of oxygen and carbon dioxide in blood (PaO_2 and $PaCO_2$), and haemoglobin were also simultaneously collected. The primary outcome measure was pre-post change in the cSO_2 on the ipsilateral cerebral hemisphere. The secondary outcome measure was length of hospital stay.

Results: Seventeen patients underwent DC during the six-month study period. The mean age was 39.2 ± 12.4 years. The cSO_2 on the ipsilateral side was 59.4±6.3%, 62.9±5.4%, 65.2±6.4% and 65.8±6.1% before DC, immediately after DC, and on the first and second postoperative days respectively. For similar time-points, the contralateral cSO_2 was 65.2±6.7%, 64.9±6.1%, 66.8±7.5% and 66.9±6.9% respectively (Fig. 1). The pre-post DC change in cSO2 on the ipsilateral side was significant (mean difference 3.6%, 95% confidence interval 1.5-5.7; p=0.002). There was no correlation between PaO2, $PaCO_2$, SBP and haemoglobin level with cSO_2 suggesting no confounding effect of these variables on the cSO_2 improvement after DC. Overall, postoperative hospital stay was 4 (3-5) days. There was no difference between the patients with preoperative ipsilateral ScO_2 <60% and >60% (4 (2.5 – 7) vs. 3.5 (3 – 4) days, p = 0.743).

Conclusions: Patients with malignant CVT have a lower cSO_2 on the ipsilateral side of lesion, which improves significantly after a DC. Preoperative cSO_2 was not associated with length of postoperative hospital stay.

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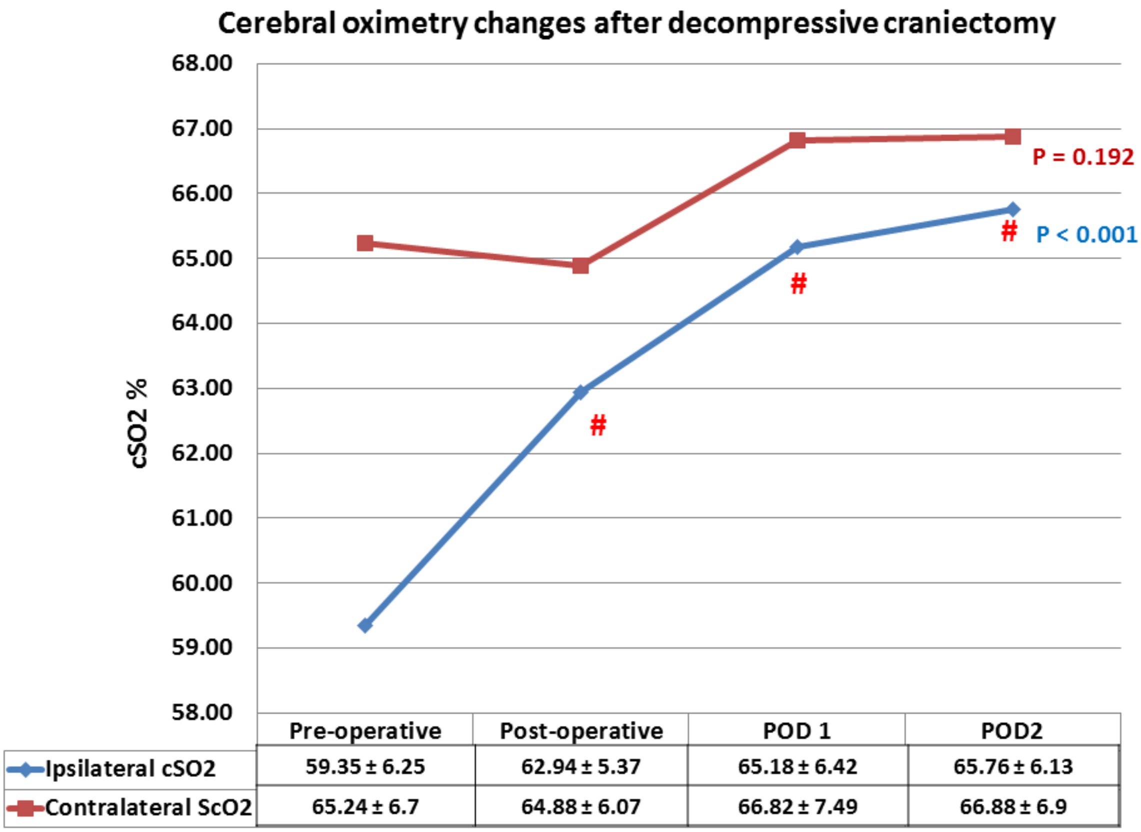
Cerebral oximetry changes after decompressive craniectomy
cSO2 %
68.00
67.00
66.00
65.00
64.00
63.00
62.00
61.00
60.00
59.00
58.00
P = 0.192
P < 0.001
#
#
#
Pre-operative
Post-operative
POD 1
POD2
Ipsilateral cSO2
59.35 ± 6.25
62.94 ± 5.37
65.18 ± 6.42
65.76 ± 6.13
Contralateral ScO2
65.24 ± 6.7
64.88 ± 6.07
66.82 ± 7.49
66.88 ± 6.9

Validity of surgical severity score-based investigations in patients undergoing elective neurosurgery

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Introduction: Rationalizing pre-op investigations based on patient characteristics and surgical severity prevents indiscriminate testing but need to be validated to prevent perioperative harm to patients.

Methods: After extensive consultation with neurosurgical and neuroanaesthetic colleagues, each neurosurgical procedure was assigned a surgical severity score. Based on NICE recommendations and co-morbidities a pre-op investigations framework was formulated and its validity was subsequently evaluated. Retrospective notes review for all elective and expedited patients undergoing neurosurgery, was undertaken for November 2015 & 2016. Missed investigations (which should have been done based on framework), additional investigations (requested by clinicians), cancellations and complications were recorded. The objective was to establish if pre-op investigations framework was followed.

Results: In 2015 November (n= 168) guidelines were followed in 111 patients, 48 patients had missed investigations, and only 9 patients had additional investigations performed. In 2016 November (n=123) guidelines were followed in 109 patients, 14 patients had missed investigations, 43 patients had additional investigations performed. After the review of data for 2015 repeated educational initiatives were undertaken with pre-assessment nurses, to aid implementation. Intraoperative complications were also reviewed over 2 years on the trust's information database (EPIC). There were no cancellations due to inadequate pre-assessment and neither groups had unanticipated intra-operative complications related to inadequate pre-op investigations.

Conclusion: Surgical severity and comorbidity based preoperative investigations framework in neurosurgical patients appears to be a valid model. Notes review confirmed that additional tests ordered by clinicians did not change intraoperative management.

Table 1. Abbreviated guidelines for pre-operative investigations based on surgical severity grading. Actual pre-operative testing framework incorporates NICE guidelines and patient related comorbidities G&S, Group & Screen; ECG, Electrocardiogram; FBC, Full Blood Count; U&E, Urea & Electrolytes.

Surgical severity score	Recommended investigations	
	Age 15-59	Age ≥ 60
Grade 1	Nil	ECG
Grade 2	G&S	ECG, G&S
Grade 3	G&S, FBC	ECG, G&S, FBC, U&E
Grade 4	G&S FBC, U&E, Clotting	ECG, G&S, FBC, U&E, Clotting

Adenosine assisted neurovascular surgery: an initial case series from a UK tertiary referral centre.

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Introduction: Cerebral aneurysms in complex anatomical locations and intraoperative rupture of aneurysms are a challenge for neurosurgeons and anaesthetists alike. Mechanical and non-mechanical methods to reduce blood flow into aneurysms are well recognised techniques to facilitate aneurysm exclusion from the circulation. Mechanical methods; temporary clipping of parent arteries[1] carotid artery ligation and endovascular balloon occlusion are commonly used in clinical practice. However, non-mechanical techniques like rapid ventricular pacing and adenosine induced cardiac standstill and hypotension are still emerging strategies.[2,3] The aim of this study is to report our unit's experience in the use of adenosine in aneurysm clipping and arteriovenous malformation (AVM) resection.

Methods: Following a literature search on EMBASE and PubMed, the records of all patients who had adenosine assisted clipping of intracranial aneurysms and AVM resections in our institute were reviewed. The following data were collected: patient demographics, comorbidities, size and location of the aneurysms/AVM, number of boluses and total dose of adenosine, duration of cardiac standstill and hypotension (systolic blood pressure < 60 mm Hg), intraoperative and postoperative complications and outcome scores at discharge.

Results: 10 cases were identified, of which 50% had emergency surgery. The results are cited in Table 1. We used adenosine safely with spontaneous return of rhythm in all cases. Temporary clips to the parent artery were applied for brief periods in 2 patients who had pre-adenosine intraoperative rupture. We did not observe any immediate or late adverse events related to administration of adenosine.

Conclusions: Transient adenosine-induced asystole is a safe and effective technique in facilitating surgical treatment of complex aneurysms and AVMs. In addition, adenosine use reduces the need, duration and associated complications of temporary clip applications to parent arteries.

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Table 1. Summary of results in patients who had adenosine for clipping of intracranial aneurysms and AVM resections. Values are median (IQR) or mean.

Age (years)	56.5 [45-59]
Total dose Adenosine (mg)	21 [12-33]
Number of doses	1.5 [1-2]
Duration of asystole (s)	9 [6.5-17.5]
Duration of SBP < 60 mm Hg (s)	60 [32.5-77.5]
Medical complications (%)	Nil
Surgical complications (%)	20% intra-operative rupture (pre-adenosine)
Incidence of temporary clip application to parent artery (%)	20%
Mean duration of temporary clip application (mins)	7
Glasgow Outcome Score ≥ 4 at discharge (%)	80%

Empowering patients with information leaflets – Just a recommendation or a necessity?

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Introduction: The Royal College of Anaesthetists (RCoA) have developed patient information leaflets to help patients prepare for their anaesthetic.[1] RCoA accreditation standards for neuroanaesthesia recommend improving patient experience by providing them with patient information leaflet.[2] Information leaflets allow patients to digest information at their own speed and are a point of reference.[3] We explored the process of delivering anaesthetic information to patients in the neurosurgery pre-assessment clinic in our unit.

Methods: After audit committee approval, we circulated a pre-designed questionnaire prospectively to patients attending neurosurgery pre-assessment clinic over a period of 2 weeks (January 2017). We explored patients' opinions on adequacy of information they received.

Results: We received 54 responses. 20 (37%) patients were seen by the pre-assessment nurse, 26 (48%) by an anaesthetist whilst 8 (14%) were pre-assessed by a nurse and an anaesthetist. More than 60% patients either partly agreed or disagreed that they had adequate understanding of their anaesthetic. The possible reasons could be limited time (44% believed, the time for discussion was inadequate), the limitations of the pre-assessment nurses to provide detailed anaesthetic information or information overload especially for oncology patients as they undergo a range of consultations on the day of pre-assessment. 91% of patients either strongly agreed (60%) or agreed (31%) that information leaflets explaining aspects of anaesthesia for neurosurgery would be very useful to understand what to expect on the day of their surgery.

Conclusion: These results confirmed that there are limitations to how much anaesthetic information can be adequately provided to the patients attending pre-assessment clinics. Taking into consideration patients' opinions, we have formulated and introduced patient information leaflet specific to neuroanaesthesia and aim to explore patient experience in recent future.

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Morphologic changes in intracranial pressure waveform demonstrate compliance changes Irrespective of intracranial hypertension

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Introduction: For 50 years, intracranial pressure (ICP) measurement has been employed for the management of severe neurologic disease. Continuous monitoring provides more information about brain tissue compliance; however, such dynamics are rarely utilized in patient care. Morphologic changes in ICP waveform may precede malignant intracranial hypertension, thus, providing an alternative threshold for treatment.

Methods: Four neurocritical care patients underwent continuous ICP and electrocardiogram monitoring between 2015-2016 at the University of Pennsylvania. After de-identification, we ran this data through the Morphological Clustering and Analysis of ICP Pulse algorithm.[1] ICP waveforms were grouped by pressures and their waveforms averaged based on 20-minute segments. Trained intensivists qualitatively analyzed the data to ensure the average waveforms represented the raw data, including assessment of component peaks, whether they were distinct, represented by an area of inflection, or if no differentiation of peaks existed. Finally, we compared the patient's clinical course (hyperosmolar therapy, surgery) to these average waveforms.

Results: While only four patients with different disease processes have been analyzed to date, all demonstrate similar results. All patients demonstrated early poor intracranial compliance as evidenced by either P2 to P1 ratio > 1, or loss of distinction between P2 and P1. Despite the poor compliance waveform, ICPs ranged between 10-20mmHg. For each patient, traditional management of intracranial hypertension with hyperosmolar therapy over the following 48-72 hours resulted in normalization of intracranial compliance, evidenced by P2 to P1 ratio < 1.

Conclusions: Early results show promise in the use of waveform as a marker of worsening intracranial compliance. If others in the cohort show similar phenomena, future research will determine if management based on morphologic changes portends better outcome than current ICP treatment.

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The development of a basic questionnaire to assess patient experience before, during, and after undergoing an awake craniotomy.

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Introduction: Previous work has shown that, whilst physically well-tolerated,[1] awake craniotomy may be less emotionally well-tolerated.[2, 3] However, the use of pre-existing measures developed for other (general) surgical procedures means there is a need for a tool specifically designed to evaluate experiences during awake craniotomy.

Methods: An iterative approach (incorporating patient and practitioner feedback) is being used. The tool is designed to be completed by the patient/advocate on the first/second day after surgery.

Results: The draft tool (completed by the patient's anaesthetic practitioner) was developed with 31 items (mostly scale-based but with some free-text comments; scales were 1-7 or 1-10). This draft was piloted with 16 patient/practitioner dyads and feedback obtained. The form was then streamlined and the content expanded, to give a more holistic overview. This second iteration contained 35 items – rated from 1 ("strongly disagree") to 5 ("strongly agree") – and a single "free-text comments" box. Feedback was obtained from stakeholders (three patients and five consultant anaesthetists), resulting in the third version of the draft tool. Containing 40 items (to be rated as above) – 10 pre-operative, 20 intra-, and 10 postoperative – and a single generic free-text box, it is designed to be completed by the patient. This third version will be piloted to see if it is fit for purpose.

Conclusion: Developing a novel tool to assess patient experience has proven difficult, given the small numbers who undergo the procedure each year. We have partially overcome this using the iterative and inclusive approach described here. Subsequent data collection and analysis will allow further refinement if needed. In time, consistent and reliable completion of the form will provide valuable insights into patients' experiences. However, one weakness will be that pre- and intra-operative experiences are recorded retrospectively and therefore susceptible to recall bias.

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Using arterial spin labelling to estimate cerebral blood flow after severe subarachnoid haemorrhage

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Introduction: Aneurysmal subarachnoid haemorrhage (SAH) results in disruption to cerebral blood flow (CBF) as a result of rupture of a berry aneurysm. Pathological changes in tissue blood flow after SAH may be the basis of delayed cerebral ischaemia. CBF may be quantified using arterial spin labelling (ASL) MRI, a non invasive method that does not need contrast. Measurement of regional CBF changes may be useful in identifying patients at risk of infarction, in particular in higher grade SAH patients who are likely to be ventilated and sedated.

Method: The study was approved by the South Central – Oxford C NHS Health Research Authority Ethics Committee 12/SC/0366. Six patients with SAH WFNS Grade 2-5 were recruited following securing of the aneurysm by endovascular coiling. All patients were intubated and ventilated. Patients were scanned with vessel encoded ASL MRI, which uses arterial blood water as a tracer to estimate regional tissue perfusion, on up to three occasions. Age and sex matched healthy controls were also scanned using an idential scanning protocol. A biophysical mathematical model was used to estimate grey matter cerebral blood flow from the MRI data.

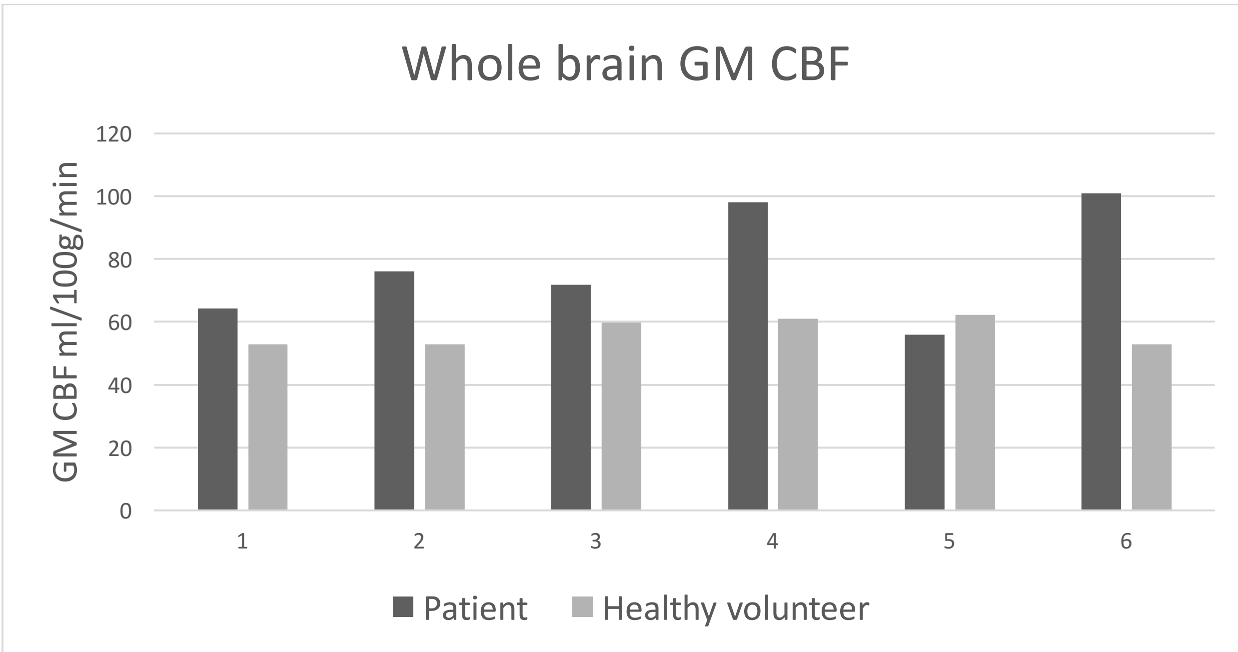
Results: The final analysis revealed that there was a trend towards elevated whole brain grey matter (GM) CBF in the acute phase of SAH in all patients except patient 5, as can be seen in Figure 1. This is in keeping with our data from a previous study performed in Grade 1 and 2 SAH patients,[1] demonstrating feasability of this method to produce estimations of regional cerebral blood flow in this group of patients.

Conclusion: We have demonstrated that this method can be used to estimate whole brain and regional GM CBF inpatients with severe SAH, and that it is possible to gain potentially useful clinical information. Use of a non invasive method to measure blood flow changes has the potential as a tool to identify patients at risk of cerebral infarction when clinical assessment is not possible.

References:

1. Kelly, M.E, Rowland, MJ, Okell, TW, et al. Pseudo-continuous arterial spin labelling MRI for non-invasive, whole-brain, serial quantification of cerebral blood flow following aneurysmal subarachnoid haemorrhage. Transl Stroke Res 2013; 4:710-8

Figure 1. Bar chart demonstrating higher overall grey matter cerebral blood flow (GM CBF) in patients that have experienced high grade subarachnoid haemorrhage (SAH) compared to age and sex matched healthy volunteers, with the exception of patient 5. This may be indicative of disruption to cerebral autoregulation and may contribute to later infarction.



Scoliosis fusion for neuromuscular scoliosis: respiratory outcome and complications

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Introduction: Neuromuscular scoliosis (NMS) is a spinal deformity resulting from an underlying neurologic disease and mainly affecting the respiratory system. Stabilization of the respiratory function can be achieved by scoliosis fusion, which unfortunately has a high postoperative morbidity mainly due to pulmonary complications.[1,2] This retrospective analysis investigates postoperative pulmonary complications (PPC)[3] for different underlying neurologic diseases after NMS-fusion and tries to identify intraoperative risk factors for PPC.

Methods: After IRB-approval, all patients with NMS undergoing elective scoliosis-fusion between August 1st 2011 and July 31st 2016 and postoperatively admitted to the Intensive Care Unit (ICU) were included. Excluded were patients with incomplete data.

Results: 60 patients were eligible and divided in 3 groups according to the underlying neurologic condition: neuromuscular disease (NMD, n=18), cerebral palsy (CP, n=25), and a group of various neurologic conditions (NOS, n=17). There was no significant difference in the incidence of PPC between the 3 groups: NMD: 29%, CP: 39% and NOS: 32% (p=0.706, Chi-Square-test), with an overall incidence of 63%. A significant difference was observed in the different groups regarding the duration of mechanical ventilation: NMD: median, (interquartile range, IQR): 6(2.8-19), CP: 7(0-14.5) and NOS: 1(0-4) hrs (p=0.031, Kruskal-Wallis-ANOVA). Patients with PPC had a longer duration of postoperative ventilation median, (IQR): 6(1.5-16) vs 2(0-6) hrs; p=0.034), longer ICU- (46 (22-91) vs 22(20-25) hrs; p=0.004) and hospital length of stay (12(9-13) vs 9(8-12) days, p=0.014) compared to the non-PPC group (Mann-Whitney U test). Besides, patients with PPC received significantly more frequently blood products (71 vs 29%, p=0.047, Chi-Square-test).

Conclusion: NMS-fusion is associated with a high incidence of PPC that significantly affects outcome but is not related to the underlying condition.

References:

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Effects of Trendelenburg and head rotation on blood volume and its asymmetry, assessed by Cerebrotech, in healthy volunteers.

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Introduction: The Cerebrotech monitor (Cerebrotech Medical Systems Inc, Pleasanton, CA) is a novel, non-invasive method of monitoring cerebral blood volume. It assesses change in cerebral blood volume (BDex) and compares right-to-left asymmetry. The device rests on the bridge of the nose with bilateral sensors near the occiput. Using Volumetric Integral Phase-shift Spectroscopy, it measures alterations in the electrical properties of tissues due to changes in fluid composition. The Trendelenburg position is employed in clinical practice with the head in neutral or rotated (e.g. central line insertion)[1] and we sought to assess the effect on BDex of head-down positioning with simultaneous head rotation.

Methods: Approval was obtained from the University of Sheffield ethics committee to study the effect of positioning on BDex and asymmetry in healthy male volunteers. Readings were taken in the following sequential positions: supine, 20° Trendelenburg, head-left, head-neutral, head-right, head neutral and supine. Heart rate and blood pressure (BP) were monitored throughout. Repeated measures ANOVA with Bonferroni correction was performed on the pooled data from each position.

Results: Ten male volunteers were studied (mean (SD) age 22 (2) years). No statistically significant changes in mean heart rate, blood pressure or BDex readings were seen in any position. Asymmetry showed a negative shift of 8.1% with head rotation from neutral to the left ($p = 0.046$) and a positive shift of 13.1% with head rotation from neutral to the right ($p = 0.009$) (Fig. 1).

Conclusions: No change was seen in BDex, most likely due to intact cerebral autoregulation in all volunteers. Marked asymmetry was seen during head rotation; this may be artefact from changing pressure on the occipital sensor or from jugular occlusion causing venous congestion. It is currently unknown how BDex and asymmetry might be affected by anaesthesia. Further work is needed to investigate these effects more fully.

References:

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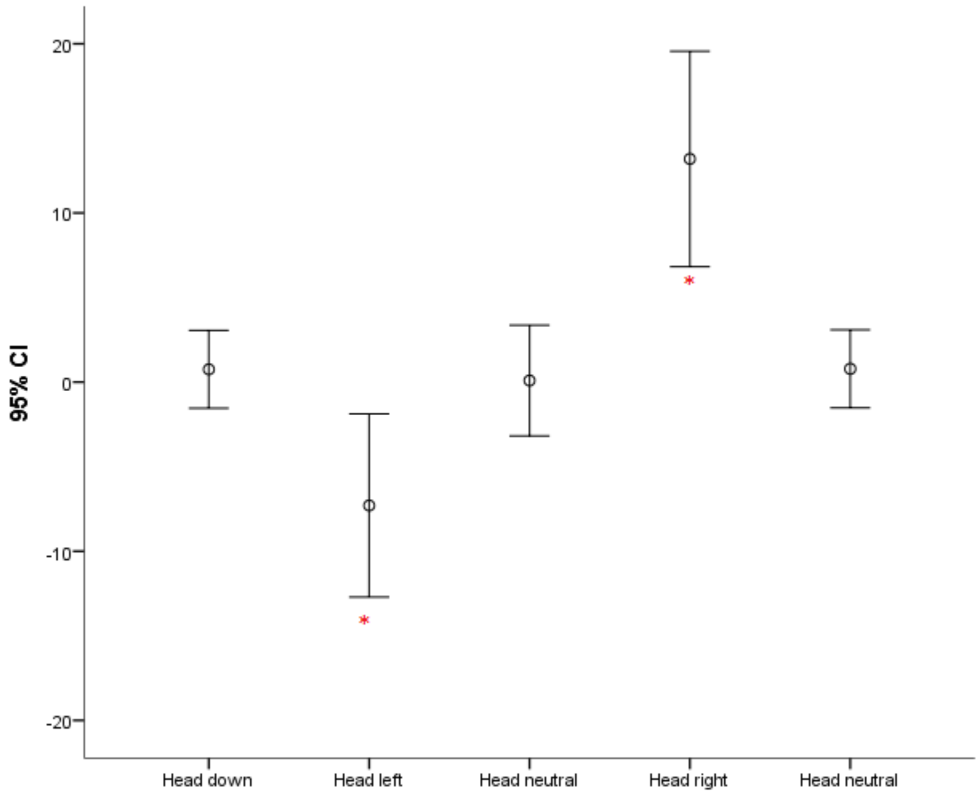

Figure 1: Error bars showing the % change in asymmetry as the head is rotated when in the Tredelenburg position. * = significance<0.05

Propofol alters functional connectivity in the endogenous sleep-wake system

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Introduction: Whilst molecular targets of anaesthetics are well defined, higher system-level descriptions remain elusive. Specifically, whether anaesthetics work by global suppression of neuronal activity or by manipulation of physiological wake-sleep pathways remains unclear. The brainstem and hypothalamic nuclei within the proposed physiological 'wake-sleep switch' have mutually inhibitory projections, creating a subcortical 'flip-flop' switch that enables rapid transitions between levels of consciousness.[1] Animal work has shown that propofol inhibits the locus coeruleus (LC),[2] an important wake promoting nucleus in the 'wake sleep switch'.[1] Using resting state functional magnetic resonance imaging (RS-fMRI), we examined the effects of propofol in humans on the LC.[3]

Methods: 22 volunteers were sedated with target controlled infusions of propofol to three plasma levels: no drug; 0.6µg/ml ('lower propofol'); 1.2µg/ml ('higher propofol'). RS-fMRI was collected at each propofol concentration. The data was analysed to determine connectivity changes between the LC[3] and the rest of the brain with increasing propofol concentration.

Results: LC functional connectivity was limited to immediately adjacent areas in the brainstem when subjects were awake. Changes associated with increasing propofol involved the 'wake-sleep switch' in the mesopontine junction (dorsal raphe and laterodorsal tegmental nuclei) and the hypothalamus (ventrolateral pre-optic and tuberomammillary nuclei). The switch components become increasingly interdependent as sedation approaches the transition to unconsciousness.

Conclusions: These findings demonstrate for the first time in humans that functional connectivity of LC to the rest of the 'wake-sleep switch' increases following propofol sedation. These changes may be either a cause or consequence of diminished cognition and conscious level, and may offer a systems level explanation of mechanism of action of anaesthetic agents.

References:

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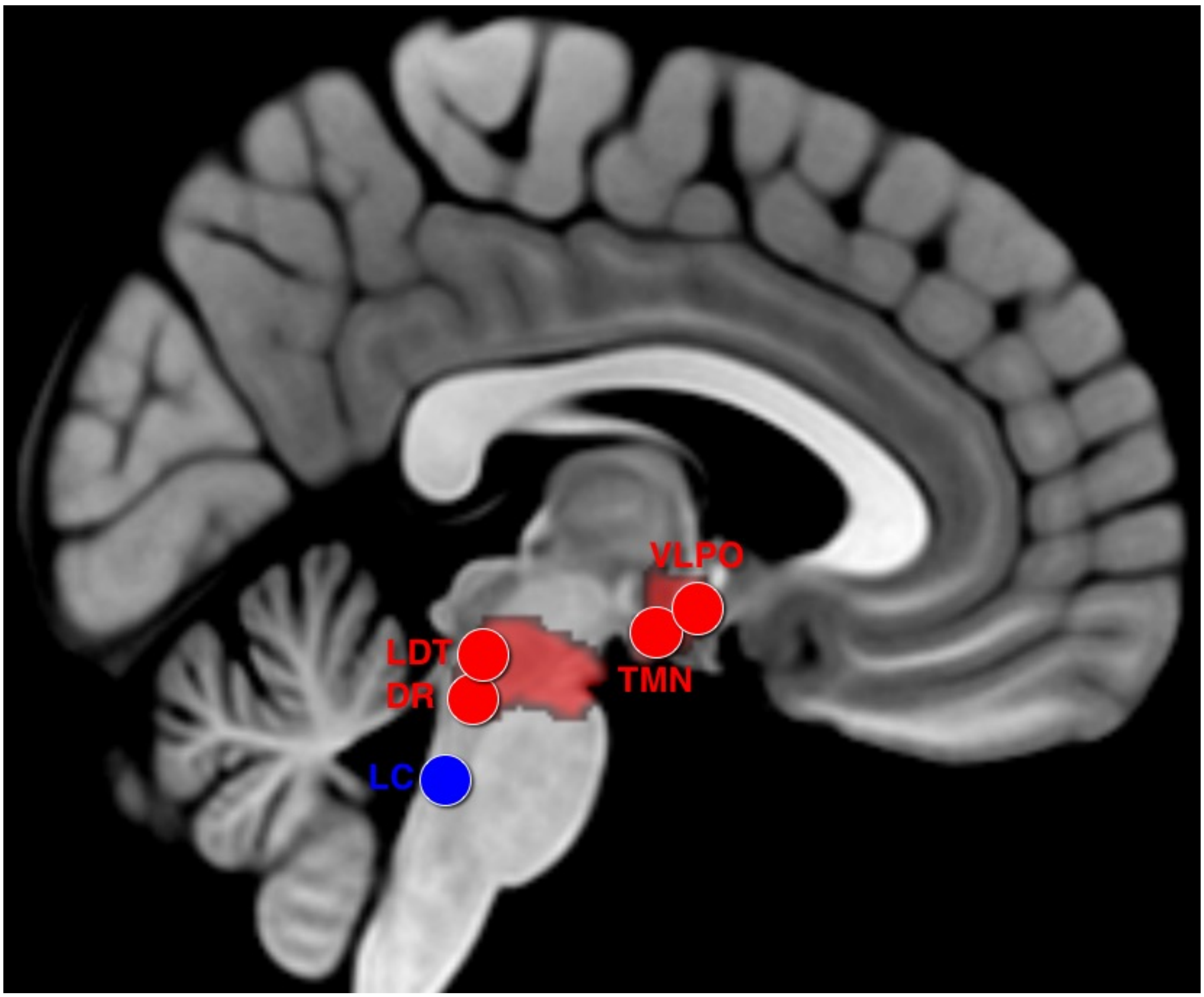
Figure 1. Sagittal section of the human brain with area of increased LC functional connectivity in response to increasing propofol highlighted in red. Schematic depiction of centres of 'wake-sleep' nuclei superimposed on our finding: 'wake promoting' LC (noradrenergic projections), DR (dorsal raphe; serotonergic projections), LDT (laterodorsal tegmental nucleus; cholinergic projections), and TMN (tuberomammillary nucleus; histaminergic projections); 'sleep promoting' VLPO (GABAergic projections).



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Section 4: Surveys

Cardiac arrest during neurosurgery in theatre. Can you handle it?

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Introduction: The Management of Cardiac Arrest during Neurosurgery in Adults guidelines[1] (Resuscitation Council, UK) were introduced in 2014. We aimed to establish our neurosurgical theatre team's knowledge of these guidelines and develop in-house high fidelity simulation teaching.

Methods: A simple survey was distributed to all members of the neurosurgical theatre team to establish awareness of the guidelines. We then set up in-house simulation based teaching for the multidisciplinary team. This process involved:

-development of 2 cardiac arrest scenarios: asystole in a Mayfield clamp and VT when prone;

-liaison with theatre management and clinical leads to allow multidisciplinary team participation and theatre space availability;

-coordination with on-site Clinical Skills department to get access to SimMan;

-Obtaining staff feedback after the session.

Results: A total of 51 completed the survey including 3 (6%) neurosurgeons, 18 (35%) anaesthetists and 30 (59%) nursing staff. Only 10 (20%) were aware of the guideline. 15 (29%) knew all 3 main causes of cardiac arrest in neurosurgical patients. 3 (6%) correctly stated the initial dose of adrenaline. 37 (73%) identified that release of the Mayfield clamp was required during CPR and 38 (75%) correctly stated that although CPR can be done in prone patients, this was ineffective on proning mattresses. At time of writing, three simulation half days have taken place in our department. Feedback has been strongly positive with 15/16 (94%) saying they found it 'very useful'.

Conclusion: Availability of theatre team and space is difficult to coordinate during normal working hours. We have organised a quarterly educational day. Elective theatre lists will be cancelled enabling the theatre team to participate in neurosurgical emergency simulation sessions. Following feedback, we will develop further neurosurgery emergency scenarios (major haemorrhage, sitting position air embolism and neuro-obstetric emergencies).

References:

1. Management of cardiac arrest during neurosurgery in adults (Resuscitation Council UK). August 104. Available at: https://www.resus.org.uk/publications/management-of-cardiac-arrest-during-neurosurgery-in-adults/. Accessed May 2016.

Practical issues in anaesthesia – a nationwide survey in India

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Introduction: Non-adherence to practice guidelines and checklists remains a practical problem in anaesthesia.[1] This survey tried to assess patterns of anaesthesia practice and adherence to defined checklists/protocols in India. Non-compliance to guidelines/protocols was considered as faulty practice.

Methods: The survey was conducted in 3 phases:1. A questionnaire related to safety protocols and human factors in anaesthesia practice was circulated to 8 anaesthesia consultants 2. Short survey was done on 60 anaesthesiologists at a local conference to develop a final questionnaire 3. A nationwide electronic survey was conducted. Results are presented as percentage and odds ratio (OR). p-value <0.05 was considered significant.

Results: 2,025 anaesthesiologists responded to the questionnaire during a period of 2 months (response rate:15%). 76% of them maintained manual records;16.8% had no/minimal records. 15.4% did not have standard anaesthesia proforma; 73.5% had anaesthesia assistants (AA) at workplace. 43.9% did not use WHO checklist for safe surgery; 45.9% did not use formal ASA checklist. 83.4% use closed circuit. 63.3% do not confirm presence of defibrillator; 25.1% do not check drug-expiry. 36.9% forget completing anaesthesia notes. 21.6% mentioned shifting of patients directly to ward after surgery. On univariate analysis, multiple reasons were associated with non-confirmation of anaesthesia machine check or presence of oxygen cylinder, and performing preanaesthesia check on day of surgery. On multivariate analysis, OR was 1.9 for not confirming presence of oxygen cylinder if AA was available, 7.22 for doing preanaesthesia check on day of surgery for freelancers (Table 1).

Conclusions: Anaesthesiologists in corporate hospitals, freelancers and those with experience >5 years are more prone to make errors. Equipment check and record keeping are the most common neglected areas. Adherence to a comprehensive anaesthesia safety checklist may reduce human errors.

References:

1. Gurses AP, Kim G, Martinez EA et al. Identifying and categorizing patient safety hazards in cardiovascular operating rooms using an interdisciplinary approach multisite study. BMJ Qual Saf 2012; 21:810-18.

Table1: Results of multivariate analysis

Outcome	Variable	Odds Ratio (95% CI)
Not ensuring presence of oxygen cylinder	Availability of anaesthesia assistant	1.90 (1.38-2.61)
	Corporate setup	1.99 (1.54-2.56)
	Private medical college	1.47 (1.10-1.97)
	Senior consultants	1.73 (1.13-2.64)
Preanaesthesia check on day of surgery alone	Freelancers	7.22 (4.45-11.71)
	Government setup	0.58 (0.35-0.95)
Reaching operating room just in time, and not earlier	Experience 5-10 years	1.71 (1.28-2.30)
	Experience >10 years	1.99 (1.53-2.59)
	Corporate setup	0.74 (0.59-0.92)

Mechanical thrombectomy for acute ischaemic stroke; are we ready to deliver a national 24/7 service? A survey of current practice.

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Introduction: Stroke is a leading cause of death; over 50% of survivors have long-term disability. It costs the NHS about £7bn per year. A disproportionately high share of the disability burden results from proximal large artery occlusive stroke where research has demonstrated unequivocal benefit of intra-arterial thrombectomy (IAT).[1] Provision of a dedicated IAT service has major resource implications for anaesthesia and critical care. Procedures are time critical, remote site and patients are high risk.

Methods: We collected information on current practice and organisation. A survey was sent via NACCSGBI to UK Linkmen in adult Neuroscience units via Survey Galaxy.

Results: Responses were received from 27 units (90% response rate). 25 centres currently provide interventional neuroradiology (INR); 56% with dedicated timetabled cover by neuroanaesthetists, others use a mix of general and neuroanaesthetists. There is wide variation in number of timetabled sessions [range 3-14, mean 8]; only 5 (20%) hospitals provide weekend timetabled cover. Only 6 (24%) hospitals provide a dedicated emergency INR service at nights and weekends. Out of hours anaesthetic cover is provided by consultants in 76%; 44% by neuroanaesthetists and a neuro/general mix in 32%. Cover is by on call trainees in 8%. Pre-hospital alert system for fast tracking stroke patients is available in 80% units but anaesthetic teams are pre-alerted in only 24 %. See table for type of anaesthesia.

Conclusions: NHS England is now developing a framework for delivery of IAT.[2] Currently there is enormous variability in availability and organisation of services. Introduction of this time critical service must be carefully planned to optimise quality and access. 92% of those surveyed felt that a 24/7 IAT service was not feasible with their current infrastructure. Units need to work towards implementation with educational support, review of staffing levels, protocols and care pathways.[3]

References:

1. Lambrinos A, Schaink AK, Dhalla I, et al. Mechanical thrombectomy in acute ischemic stroke: a systematic review. Canadian Journal of Neurological Sciences 2016; 43:455-460.
2. Mechanical clot retrieval for treating acute ischaemic stroke. NICE Interventional procedures guidance [IPG548] Febraury 2016. Available at: www.nice.org.uk/guidance/ipg548. Accessed December 28, 2016.
3. White PM, Bhalla A, Dinsmore J, et al. Standards for providing safe acute ischaemic stroke thrombectomy services. Clinical Radiology 2017; 72:175

Table 1. Preferred anaesthetic technique, the drive behind this preference, and post procedure destination expressed as a percentage of responding hospitals providing interventional neuroradiology services in the UK. LA, local anaesthesia; HASU, hyper -acute stroke unit; HDU, high dependency unit; NICU, neuro-intensive care unit.

Preferred anaesthetic technique	General Anaesthesia	16%
	Conscious sedation/LA	36%
	Variable	44%
	Anaesthetic protocol available	52%
What or whom drives this preference	Anaesthetist's choice	8%
	Radiologist's choice	12%
	Joint decision	68%
Post procedure destination	Recovery then HASU	40%
	Recovery then NICU / HDU	24%
	Straight to NICU /HDU	4%