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# Abstracts From the Neuro Anaesthesia and Critical Care Society, UK Annual Scientific Meeting: Birmingham May 9 to 10, 2022

# Introduction of a crisis resource management (CRM) tool for the management of a neurosurgical emergency using "The Blown Pupil Pathway" (BPP)

R Steele, S Kajal, A Al-Mohammad, PhD, MDM Yacaman, MPhil, I Adedugbe, MBA, P Grover, MSc. National Hospital for Neurology and Neurosurgery, University College London Hospitals NHS Foundation Trust, UK

Introduction: A blown pupil is a neurosurgical emergency and rapid surgical intervention is often required. The only neurosurgical emergency with a CRM tool is cardiac arrest during neurosurgery. Using this concept we created a CRM tool for the management of patients with a blown pupil, both to improve team communication and expedite surgical decompression. Methods: The neurosurgical multidisciplinary team collaborated to create the BPP. The protocol is accessible on the intranet and a trainee resource application. It went "live" in August 2021 and is activated through the hospital emergency bleep system; rapidly communicating simultaneously to all relevant stakeholders including porters, theater coordinators, and radiographers. We reviewed the impact of the CRM tool by comparing the mean time from BPP activation to "knife to skin". We have also conducted a subjective evaluation through a staff questionnaire.

**Results:** We demonstrate a reduction in the meantime from the blown pupil, or having been transferred from an external hospital, to "knife to skin" from 151 to 78 minutes. We sent the survey to 278 staff members and currently have a response rate of 10%. The majority of respondents felt it had improved team efficiency and communication. Common delays were obtaining patient identification wristbands and group and saving samples for external patients in addition to porter and emergency theater availability.

**Conclusions**: We demonstrate a reduction in the meantime to surgical decompression by the implementation of a CRM tool. The BPP provides a structured workflow for team members who may not have worked together previously, in time-critical cases, out-of-hours (OOH). This study provides baseline data to benchmark the ongoing efficiency of the BPP. Qualitative staff feedback will be used to drive improvements in patient care. We believe this concept is applicable for referring hospitals transferring neurosurgical emergencies.

# Evaluating the communication of antithrombotic management plans and follow-up advice in patients undergoing surgical evacuation of chronic subdural hematoma (cSDH)

DJ Lawson, BA, BM Davies, MRCS, RM Burnstein, PhD, A Joannides, PhD, DJ Stubbs. University of Cambridge, Cambridge, UK

**Introduction**: cSDH is a common neurosurgical condition, mainly affecting older patients,<sup>1</sup> a cohort who may suffer significant comorbidity and polypharmacy. Antithrombotic use is common in this cohort, which is of crucial importance as definitive management requires surgical evacuation in a specialist centre. Interhospital transfer poses challenges in communicating perioperative changes to these medications between

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FIGURE 1. Drug discharge plan.

teams.<sup>2</sup> We sought to evaluate the communication of changes to antithrombotic medications, as well as general follow-up advice, upon repatriation to referring hospitals.

**Methods:** Single-centre UK service evaluation (PRN8889). All cases of cSDH were referred from local district hospitals that underwent surgical evacuation from March 2019 to March 2020. Antiplatelet and anticoagulant medications were identified from admission clerking and postdischarge plans identified in discharge summaries. Plans coded as [drug] to be permanently stopped; already restarted; restart after neurosurgical input; restart after a set time; defer the risk-benefit decision to GP/referring hospital. General follow-up guidance (eg, red flag symptoms) was also recorded.

**Results**: One hundred sixty-three patients were identified, 31 (19%) patients were taking anticoagulants and 47 (29%) antiplatelets. Plans considered "unclear" (either deferred responsibility or none given) applied in 13 (42%) cases of anticoagulants and 20 (43%) of antiplatelets. Time dependent restarting of these drugs (n = 28) used periods between 4 days and 3 months, with a modal time of 2 weeks (n = 13, 46%). See Figure 1. Only 7 of the discharge summaries communicated concerning symptoms that should prompt seeking medical advice.

**Conclusions:** Communication of plans for anticoagulant/antiplatelet medication was inconsistent in both incidence and content, with patients on antiplatelets more often discharged without a clear plan. Our findings have implications both for patient safety and health service workload. **References:** 

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#### Understanding care outside of the neurosurgical centre in patients with cSDH: a multicentre study from the East of England

S Khanna, BM Davies, MRCS, RM. Burnstein, PhD, A Joannides, PhD, DJ Stubbs, and on behalf of the SENIOR-C collaborators. Addenbrooke's Hospital, University of Cambridge, UK

Introduction: cSDH is a common condition definitively treated with surgical evacuation in a neurosurgical unit (NSU). Patients diagnosed at regional hospitals (RH) require transfer for surgery and frequently return to their RH to continue recovery.<sup>1</sup> Inpatient outcomes upon repatriation are not clearly documented. We aimed to evaluate the outcomes of patients who underwent cSDH surgery at our centre upon their repatriation. Methods: Clinicians from the clinical team in each RH within our region were identified. The project was approved in each site as a multisite service evaluation (PRN8889) with data-sharing requirements approved by each institution's Caldicott guardian. Cases from each RH between November 2014 and March 2020 were identified from our NSU referrals database. RH data were collected by local team members and securely shared with the NSU. We examined pre and posttransfer lengths of stay (LOS), inpatient complications, discharge destinations, and readmissions. Results: Data were obtained on 381 patients from 6 RH (42% of total referrals over the study period). Median LOS pretransfer to NSU was 22 Hours (interquartile range:8 to 59). 146 (38%) of patients were repatriated to their RH. In these patients, the median NSU LOS was 10 days (7 to 13), with a median postrepatriation LOS of 12 days (2 to 24). 138 (36%) patients were readmitted in the 6-months postdischarge. Of patients admitted from their own homes (n = 338, 89%), 66 (20%) required increased care on discharge. 70 (51%) of repatriated patients were treated for a complication (most frequently new infection n = 59).

**Conclusions:** Our results demonstrate that upon repatriation, patients post-cSDH surgery continue to require significant inpatient management for medical complications and discharge planning. Readmission is common postdischarge. Understanding these outcomes and how they arise is vital in improving patient experience and outcomes in this cohort. **References:** 

1. Stubbs DJ, Davies BM, Bashford TH, et al. Identification of factors associated with morbidity and postoperative length of stay in surgically managed chronic subdural hematoma using electronic health records: a retrospective cohort study". *BMJ Open* 2020;10(6): e037385.

### Prolonged volatile anesthesia drives deleterious changes to astrocyte gene-expression

Z Jiwaji, PhD, J McQueen, PhD, P Baxter, PhD, S Chandran, PhD, GE Hardingham, PhD. University of Edinburgh

**Introduction**: Astrocytes are the most abundant cell type in the central nervous system (CNS). They have key roles in CNS homeostasis and detoxification,<sup>1</sup> yet are understudied. Prolonged anesthesia is a proposed risk factor for perioperative cognitive vulnerability, especially in elderly patients with preexisting dementia.<sup>2</sup> However, the molecular consequences of anesthesia on astrocytes were unknown.

**Methods**: We set out to address the above gap by measuring gene-expression changes in astrocytes in mouse models of prolonged volatile (isoflurane) anesthesia and Alzheimer disease (MAPT-P301S tauopathy). We used a specialized molecular technique—translating ribosome affinity purification (TRAP)<sup>3</sup> to overcome a key challenge: distinguishing gene-expression changes in astrocytes from those in other brain cells. TRAP utilizes transgenic mice expressing GFP-tagged ribosomes only in

astrocytes, allowing us to separate astrocyte ribosomes along with attached astrocyte-specific translating mRNA for sequencing (Fig. 1).

**Results**: We found that anesthesia alters the expression of thousands of astrocyte genes, enhancing reactive and inflammation-associated signatures, and suppressing pathways associated with metabolic homeostasis. Furthermore, anesthesia suppresses whole CNS activity-mediated prosurvival pathways and boosts activity-suppressed apoptotic pathways. Induced changes overlapped significantly with those induced by aging and Alzheimer's pathology.

**Conclusions**: We describe here the molecular consequences of prolonged volatile anesthesia on astrocytes. Anesthesia drives widespread transcriptomic changes, disrupting metabolic pathways and inducing inflammatory signatures. These changes could contribute towards brain vulnerability in high-risk patients and our ongoing work seeks to target astrocyte pathways to enhance CNS resilience in the perioperative period. **References:** 

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### Environmental noise in neuro intensive Care Units (ICUs)

M Mohamed, MSc, M Armoogum, D Papel, V Ventura, A Zoumprouli. St. George's University Hospitals NHS Foundation Trust, UK

**Introduction**: Noise levels in ICUs in the UK are consistently above WHO-recommended limits.<sup>1</sup> Patients were disturbed by activities around them and frequently report disrupted sleep, leading to slower recovery and long-term health problems.<sup>2</sup> The WHO guidelines state that the average sound level should not exceed 30 decibels (dB) in general hospital areas and 35 dB in rooms where patients are treated or observed; the maximum sound level indoors should not exceed 40 dB during the night.<sup>3</sup> This audit aims to measure and analyze acoustic noise levels in neuro ICU and compare them to the recommended WHO limits.

**Methods**: We collected data over 3 months (total, 324 h) using a mobile phone and the Decibel X App. Noise levels were recorded every hour, for 2 min/h from 3 different points. The lowest average and peak steady noise dB levels were recorded.

**Results**: Data were analyzed using Microsoft Excel. The mean  $\pm$  SD dB of all noise recorded was low at 60.8  $\pm$  3.3, an average of 64.2  $\pm$  3.8 and a peak sound of 74.9  $\pm$  5.1. The mean average of the recorded peak noises in the neuro ICU was 88% higher than the recommended peak noise level of 40 dB. The most frequent cause of peak noise during both day and night shifts was staff conversation; overall it was recorded 89 times with a peak of 98.7 dB, and 55 times at night with a peak of 95.2 dB. The second most frequent cause was trash bins; overall it was recorded 45 times with a peak of 86.3 dB, and 30 times at night with a peak of 96.1 dB.

**Conclusions**: The overall noise levels in Neuro ICU were well above the WHO-recommended levels. Our Quality Improvement team discussed the findings and implemented changes to alleviate the problem: installation of noise monitors, change of equipment that produces excessive noise levels, staff education, and awareness posters, as well as offering earplugs and white noise in the bed space. The plan is to evaluate their impact in 6 months. **References:** 

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FIGURE 1. Schematic of TRAP to investigate astrocyte gene expression.

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Improving management of external ventricular drains (EVDs) for intrahospital transfers: Multimodal education including a novel digital information tool. A quality improvement project at University Hospitals Plymouth NHS Trust

E Blunnie, BMBS, R Stabler, BM BCh, R Peagam, MBChB, W Alhalabi, T Burnett University Hospitals Plymouth NHS Trust, UK

**Introduction**: EVDs are placed in patients with hydrocephalus and raised intracranial pressure. These patients frequently require transfer to computed tomography scan, interventional radiology, or the operating theater.<sup>1</sup> Guidelines for EVD management vary between hospitals, but specific advice for transfers is limited.<sup>1,2,3</sup> This project aimed to provide guidance and increase clinician confidence for the intrahospital transfer of patients with an EVD.

Methods: An online survey assessed the current confidence of clinicians involved in the care of EVDs. Literature search of guidelines on EVD management during intrahospital transfer was performed and reviewed with neurology intensive care unit and neurosurgical colleagues to create a guideline. Interventions included education sessions, an educational poster, a reminder to close EVDs included on the neurology intensive care unit transfer checklist, and a label for EVDs with a mnemonic and a quick response code (QR) code providing a link to full guidance (Fig. 1). Results: Sixty-eight individuals involved in EVD management responded to the survey, including anesthetists, ODPs, and nurses. 24% had limited experience with EVD management, and 47% had some experience but wanted more training. 42% stated they felt unconfident or very unconfident in EVD management. 99% stated they would find further education useful. Only 33% stated that they would close an EVD for intrahospital transfer as per the novel guideline. Fifty-eight individuals viewed the EVD guideline through a QR code within the first 42 days. Conclusions: There is both a desire and need for education on EVD management during intrahospital transfer. Multimodal education has been delivered. EVDs now carry a clear visual message-"CLAMP: Close Line And then Move Patient". Continued usage of the QR code indicates it is enabling clinicians to find information at the time they need it. Further audits should assess changes in clinician knowledge, confidence, and patient safety. **References:** 

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FIGURE 1. External ventricular drain label.

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Depth of colour proportional to number of responses of that type

FIGURE 1. Patient perspectives on challenges of care.

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# Patient perspectives on the delivery of care for a cSDH in the East of England

ME Vivian, S Khanna, B Davies, MRCS, R Burnstein, PhD, A Joannides, PhD, DJ Stubbs. University Division of Anesthesia, University of Cambridge, UK

**Introduction**: Patients with cSDH are frequently transferred from RH, making it challenging to evaluate patient outcomes. We wanted to understand patient satisfaction in this context in the East of England, as part of an ongoing quality improvement initiative.

**Methods**: In collaboration with our Patient Satisfaction and Quality and Safety teams (PRN8510). We designed a survey to evaluate the care and satisfaction of patients who underwent cSDH surgery between November 2014 and March 2020. Surveys were posted to patients surviving up to July 2021. The survey encouraged assistance from relevant family members or carers to complete. Alongside multiple choice (Likert scale) questions, 4 offered free-text responses. Responses to these questions were thematically coded using an inductive framework analysis by 2 reviewers and arbitrated by a third. These themes were then amalgamated into 6 overarching themes and mapped against stages of perioperative care to draw an overall picture of satisfaction and highlight points in the care pathway that may require improvement. Percentages relate to responses per question.

**Results**: n = 209 (49%) partial or complete responses. Overall satisfaction with care was high (85% giving a score of 8 or higher). Transfer distances to the NSU were a key concern (patient factors: transfer box in Fig. 1), making relative visits difficult. Patients also reported cancellations and prolonged fasting (service capacity responses at preoperative optimization/intraoperative boundary in Fig. 1). 22% of patients reported they would have wanted more information at the point of discharge, suggesting that printed information leaflets would be helpful. **Conclusions**: Distance to NSU and delays in surgery seem to be major patient concerns. Patients ranked clinical care highly. Improved communication and provision of written information may be of benefit to patients and families.

# OOH provision of mechanical thrombectomy (MT) in the UK

Y Bramma\*, R Campbell<sup>†</sup>, RH Rehill<sup>†</sup>. \*Institute of Neurological Sciences, Queen Elizabeth University Hospital, Glasgow. †St George's University Hospitals NHS Foundation Trust, London, UK

**Introduction**: MT is considered the gold standard treatment for acute ischemic stroke. In 2017, NHS England stated every neuroscience centre should aim to provide 24-hour service. We conducted a survey to establish the current provision of MT services in the UK and its impact on existing services.

**Methods**: An online survey was sent to the Neuroanaesthesia and Critical Care Society (NACCS) linkmen, aiming for 1 response per UK neuroscience centre. The OOH period was defined as 1800 h to 0800 h.

**Results**: Sixteen centres responded (response rate 53%). OOH MT is provided in 63% (24h in 31%). In 24 h centres ~50% to 60% of cases occur OOH. Care is provided by neuroanaesthetists (53%), or a mix of general/ neuroanaesthetists (47%). 44% use senior trainees/fellows in addition to consultants. 67% centres have a dedicated MT team OOH; in 33% the cases are done by the theater emergency team. 75% of units have a staffed recovery OOH. General anesthesia (GA) is the most common anesthetic technique (88% of centres); driven by an agreement between anesthetist/radiologist (69%) or radiologist preference (38%). 81% have a protocol/guideline for anesthesia. Guidance includes: blood pressure (BP)

**TABLE 1.** Impact of Running an Out-of-hours Mechanical Thrombectomy (MT) Service on Existing Work

Delay in other emergency theater cases	75%
Delay in MT case if theater case already underway	75%
Cancellation/delay of elective theater and radiology cases the following day	67%
Stretching of staff, for example covering multiple areas and working beyond capabilities	17%

parameters/intervention triggers (69%); monitoring (63%); postprocedure destination (63%); and anesthetic technique (50%). In addition to MT, centres cover the following services OOH: neurosurgical theaters (100%), other theaters (81%), neurocritical care (31%), and other critical care (25%). The majority reported an impact on these other services due to OOH MT provision (Table 1). To accommodate extra OOH workload: 58% have absorbed this into their existing on-call rota; 25% have created a new on-call tier.

**Conclusions**: The provision of MT in the UK has expanded rapidly since its commissioning. GA is the predominant anesthetic technique, although practice varies internationally.<sup>1</sup> Many units lack dedicated MT staff and the majority report a detrimental impact on competing emergency and elective services.

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# Impact of contralateral carotid disease (CCD) on the choice of postoperative destination and functional outcome

UP Nanayakkara, MBBS, D Harshan, D Baker, PhD, I Adedugbe. National Hospital for Neurology and Neurosurgery, University College London Hospitals, NHS Foundation Trust, UK

**Introduction**: Carotid endarterectomy (CEA) is recommended within 14 days of symptoms to reduce the risk of disabling stroke.<sup>1</sup> CCD is a risk factor for perioperative stroke in CEA patients.<sup>2</sup> The current practice at our hospital is to admit all post-CEA patients to HDU. The aim of this service evaluation was to risk stratify CEA patients' post-operative destination based on the presence of contralateral disease to reduce the time interval to surgery caused by HDU availability.

**Methods**: Retrospective review of electronic records of all post-CEA patients from April 2020 to September 2021 to identify patients with CCD (>50% stenosis on imaging) who required postop BP intervention (intravenous vasoactive drugs). See Table 1. A modified Rankin score (mRS) was calculated and Pearson  $\chi^2$  test was used to assess correlation and outcome. The primary outcome was to determine if CCD is an independent risk factor for postoperative BP intervention and therefore need for a postoperative HDU bed. The secondary outcome was to determine the association between CCD and mRS at HDU discharge.

**Results**: In the 71 patients, a similar number of patients required BP intervention in the early postoperative period, that is. CCD (n = 28), no CCD (n = 31); missing data (n = 12). Pearson  $\chi^2$  test showed no significant correlation (X2 [1, N = 59]=0.84, P=0.36) in the primary outcome. For secondary outcome analysis, 61 patients had complete data and mRS > 2 were considered a poor outcome. 81.2% of patients with CCD (n = 16) had an mRS of 0 to 2 upon discharge from HDU versus 86.6% of patients with the ipsilateral disease (n = 45).  $\chi^2$  analysis showed no significant correlation between CCD and mRS, X2 (1, N = 61)=0.27, P=0.60.

**Conclusions:** CCD is not an independent predictor of post-CEA BP intervention, neurological outcome, or HDU bed requirement. Small sample sizes and confounding factors (cardiorespiratory comorbidities) in this high-risk patient group may have affected the results of this study.

TABLE 1.	Need f	or Blood	Pressure	Management in	ו Carotid
Disease					

	Presence of Contralateral Disease			
	Yes (n = 28), n (%)	No (n = 31), n (%)	Unknown (n = 12), n (%)	
No BP intervention postop $(n = 37)$	12 (42.86)	17 (54.83)	8 (66.66)	
Required BP intervention postop $(n = 34)$	16 (57.14)	14 (45.17)	4 (33.34)	

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# Development of a transcranial magnetic resonance-guided focused ultrasound thalamotomy service for treating essential tremor

A Eros, J Macfarlane, PhD, T Gilbertson, PhD, S Khan, MD, B Ulvatt, A Taylor. NHS Tayside, UK

Introduction: Transcranial magnetic resonance-guided focused ultrasound (MRgFUS) thalamotomy is a recommended noninvasive therapy for medication-refractory essential tremor.<sup>1</sup> We developed a new service with anesthetic support offering the first MRgFUS in Scotland.

Methods: Multiple bursts of MRgFUS (11-45s) target the motor nucleus in the thalamus. The procedure requires a stereotactic frame to be applied to the patient's head. The patient must be alert between sonications to allow examination and target adjustment. Skull density ratio (SDR) was measured. All patients received paracetamol and ibuprofen and had intravenous (IV) access with monitoring applied for those receiving IV medication. Effect was measured by specialist assessment including pre/ postprocedure spiral drawings. Requirement for analgesia/sedation was recorded

Results: All 9 patients experienced an immediate marked benefit from unilateral MRgFUS (Fig. 1). One patient returned for further treatment of a proximal tremor. Our 3-month follow-up data (n = 7) demonstrates sustained tremor resolution (7/7). One patient demonstrated side effects (dysgeusia and balance disturbance). Anesthetic support was essential for 3 patients. Titration of analgesia/sedation was required in 2 patients (acute headache during sonication). Both had low SDR: 0.42 (median 0.47, range 0.41 to 0.59). Morphine/midazolam was given to the first patient, which resulted in some masking of tremors, and alfentanil was given to the second with good effect. A third patient with poor glucose control required blood glucose monitoring.

Conclusions: Headaches requiring opioids were experienced by 2 patients with low SDR. A low SDR is associated with higher energy requirements,<sup>2</sup> increasing the risk of pain. Anesthetic support can be targeted to these patients. Alfentanil was successful in providing pain relief timed to coincide with the intensity of MRgFUS discomfort and minimizing risks of respiratory depression. This is key as the frame would impede mask ventilation.



# Pre-treatment

FIGURE 1. Spiral drawing.

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### Understanding anesthetic practice and decision making in the care of patients with cSDH: a survey of anesthetists and neurosurgeons

G Gathercole, MB BChir, BM Davies, MRCS, M Smith, E Edlmann, PhD, A Kolias, PhD, A Joannides, PhD, DJ Stubbs. University of Cambridge, UK

Introduction: cSDH is a common neurosurgical pathology. Surgery can be performed successfully under either local (LA) or GA however, definitive evidence as to the optimal method is lacking.<sup>1</sup> We aimed to define current practice and understand anesthetic and surgical decision-making relating to the choice of anesthetic technique.

Methods: An online survey was distributed to anesthetists and neurosurgeons through the NACCS and the society for British neurological surgeons (SBNS). As well as asking for their current practice the survey asked respondents for their opinion on patient factors, which influenced decision-making and perceived benefits of anesthetic modality on patient and system outcomes.

**Results**: We received 215 responses (n = 125 for anesthesia, n = 89 for anesthesia)surgery). GA was the most common technique reported by 81% (n = 89) of surgeons and 74% (n = 125) of anesthetists. Both groups indicated that they believed LA could be superior in terms of length of stay and rates of medical complications and that comorbidities, frailty, and increasing age favoured the use of LA (Fig. 1). LA was standard practice for only 6% (n = 125) of anesthetic respondents. Sedation with propofol alone was the commonest adjunctive LA technique (25%, n = 109). 53% of respondents chose IV maintenance for GA (n=118). 61% (n=118) of respondents routinely used additional monitoring (26% arterial line, 47% processed electroencephalogram (n = 118)). 61% (n = 104) anesthetic and 59% (n = 78) surgical respondents agreed that this question could benefit from the further investigation with a randomized controlled trial. Conclusions: GA was the most frequently used anesthetic technique in this





FIGURE 1. Anaesthetic technique for a chronic subdural hematoma.

UK survey. Frailty, age, and comorbidities seemed to make respondents favour the use of LA. A majority of respondents indicated that a definitive randomized controlled trial was required to inform best-practice. **References:** 

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