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# Abstracts From the Neuro Anaesthesia and Critical Care Society, UK Annual Scientific Meeting: Nottingham May 11-12, 2023

## A systematic review of outcome measures used in research on tracheal intubation after cervical spine injury

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**Introduction:** In patients with traumatic cervical spine injury there have been concerns historically about the potential risk of secondary spinal cord injury with potentially devastating neurological effects. However, there are few studies that have directly assessed neurologically-important

endpoints in this population. We, therefore, performed a systematic bibliometric review of airway management techniques in patients with actual or suspected cervical spine injury in order to assess the reported outcome measures studied.

**Methods:** The study was registered with PROSPERO. We searched multiple on-line databases from inception until December 31st, 2019 using the search terms “cervical/c-spine”, “intubation/endotracheal intubation/tracheal intubation” and “trauma/injury/instability/unstable”. We did not include studies involving paediatrics (patient aged <18 y) or tracheostomy insertion.

**Results:** We retrieved 2882 studies, of which 189 underwent full-text review (Fig. 1). Mannikins were used in 46 (24%) studies and 58 (29%) studies used an outcome based on tracheal intubation metrics including intubation success rates, time to intubation or intubation difficulty score. Only 56 (30%) studies had a primary outcome measure that was related to vertebral column movement: 49 studies examined changes in cervical spine angulation (involving 1636 patient and 72 cadaveric intubations); and 7 directly measured the effect of tracheal intubation on the spinal cord (involving 8 patient and 52 cadaveric intubations).

**Conclusions:** There is a paucity of evidence to guide the optimal technique for tracheal intubation in patients with actual or suspected cervical spine injury; only one study has investigated directly the effect of tracheal intubation on the spinal cord in living subjects. These data will be of value to clinicians when choosing what technique to use for tracheal intubation and should inform strategy on the future directions of airway management research in this area.

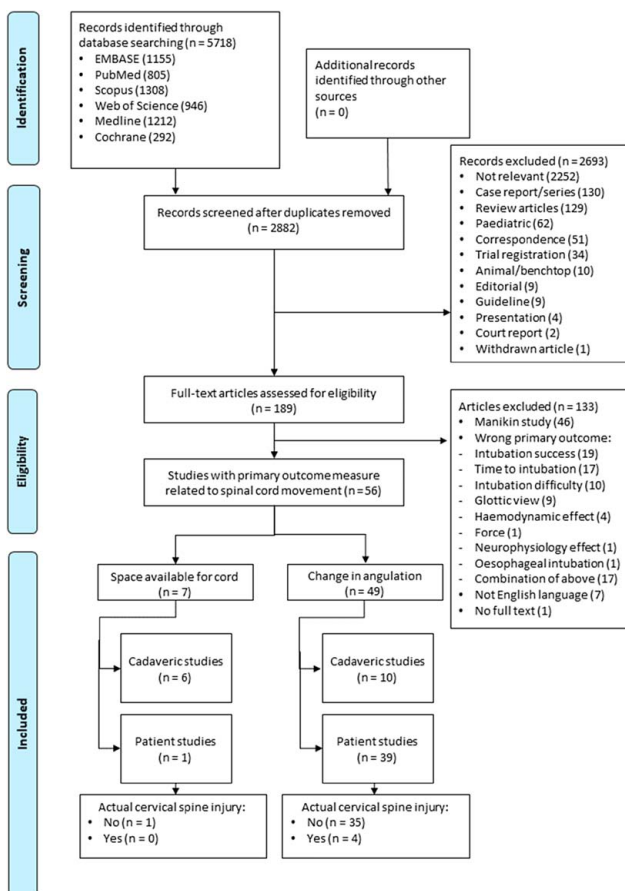


FIGURE 1. Studies flowchart.

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## Update on the development of a clinical practice guideline for patients with chronic subdural haematoma

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**Introduction:** Chronic subdural haematoma (CSDH) is a common neurosurgical condition in older patients. A significant proportion of these patients are frail, medically complex, take anti-thrombotic medications, and require significant perioperative input.<sup>1</sup> To date no specific guideline exists to define clinical best practice for caring for this patient cohort. We report on current efforts and next steps in the development of a multi-disciplinary guideline of relevance to professionals both in and outside of the neurosciences centre.

**Methods:** In October 2020 we convened a multidisciplinary research steering group to explore challenges and opportunities in the care of patients with CSDH.<sup>2</sup> Five major themes emerged; understanding of natural history, non-operative management, perioperative optimisation (including management of anticoagulation), surgical care, and rehabilitation and recovery. We formed cross-disciplinary working groups to explore each theme in more detail and write statements that encapsulate best practice.

**Results:** Through facilitated discussion our five working groups defined 44 key clinical questions. Feedback on these questions was obtained from patient and carer representatives. Following a systematic review of the literature (including the conduct of an umbrella review to critique

pre-existing systematic reviews) our steering committee has created 85 initial draft statements to populate a future clinical practice guideline for the care of patients with CSDH. As a research committee we are currently obtaining regulatory approvals to launch a national Delphi to obtain external feedback on the contents and phrasing of these draft statements from a diverse range of healthcare professionals.

**Conclusions:** We report on progress made in the production of the first multidisciplinary guideline for the care of patients with a CSDH. A national consensus building exercise to aid in the refinement of this document will begin in mid 2023.

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**Does using local anaesthetic with sedation for chronic subdural haematoma evacuation improve patient outcomes? A systematic review and meta-analysis**

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**Introduction:** Chronic subdural haematoma (SDH) is a collection of altered blood beneath the dura. The incidence is rising, with a predicted rise of 53% in operative case load by 2040,<sup>1</sup> and strategies to optimise care are vital. General (GA) and local anaesthetic with sedation (LAS) can be used for SDH evacuation<sup>2,3</sup> but the risks and benefits of each modality are uncertain. This systematic review and meta-analysis examines whether using LAS improves patient and system outcomes.

**Methods:** A systematic literature search in May 2022 of Medline and Embase identified 6,024 primary studies and 47 articles examining mode of anaesthesia selected for full text screening. LAS was considered the use of surgical field infiltration of local anaesthetic or a scalp nerve block with/without sedative agents. GA was defined as the use of general

anaesthesia requiring advanced airway management. The Newcastle Ottawa and Jadad Scale were used to assess study quality. Random effects meta-analyses were performed in R. The I2 statistic was calculated to assess heterogeneity of studies included. PRISMA guidelines were followed. The study is registered on PROSPERO (ID: CRD42022374873).

**Results:** The number of studies and analyses used in each meta-analysis is shown in Table 1. LAS is associated with fewer postoperative complications and a shorter duration of hospital stay and operative procedure. Moderate heterogeneity was observed in studies used to assess postoperative complication rates and duration of hospital stay.

**Conclusions:** LAS for SDH evacuation is associated with fewer perioperative complications, duration of operative procedure and total hospital stay. Work is required to confirm this association, investigate potential reasons, and examine the risks and benefits of modes of anaesthesia.

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**Morbidity and mortality in refractory status epilepticus following intensive care admission**

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**Introduction:** Refractory status epilepticus (RSE) has been defined as status epilepticus (SE) that does not respond to initial treatment with 2 antiepileptic drugs (AEDs),<sup>1</sup> by a minimum seizure duration or SE requiring induction of anaesthesia.<sup>2</sup> RSE requires refined clinical characterisation as mortality in patients admitted to the intensive care unit (ICU) is high, ranging from 12-77% in meta-analyses<sup>3</sup> with rates of poor functional outcome at discharge as high as 76.19%.<sup>3</sup>

**Methods:** A retrospective observational study was conducted on all patients with RSE treated between April 2019 and January 2022 on ICU at the National Hospital for Neurology and Neurosurgery (NHNN) after approval from our clinical audit department. 17 patients did not meet inclusion criteria for RSE. Primary outcome measures were mortality and

**TABLE 1. Results of meta-analyses**

Variable	Studies	Patients included (LAS)	Forest Plot (LAS vs GA)
Mortality (< 3 months of surgery)	4 <sup>k</sup>	1284 (790)	0.91 [0.30, 2.78] P = 0.87 I <sup>2</sup> = 24.7%
Recurrence (reoperation within 3 months)	10 <sup>l</sup>	2150 (1099)	1.24 [0.82, 1.88] P = 0.30 I <sup>2</sup> = 21.6%
Postoperative complications within same admission excluding recurrence <sup>l</sup>	8 <sup>k</sup>	1590 (905)	0.33 [0.20, 0.53] P < 0.0001 I <sup>2</sup> = 36.6%
Duration of hospital stay	3 <sup>k</sup>	141 (73)	-0.75 [-0.21, -1.28] P = 0.006 I <sup>2</sup> = 54.4%
Duration of operative procedure (inc. anaesthesia)	3 <sup>k</sup>	201 (102)	-1.70 [-0.95, -2.45] P < 0.0001 I <sup>2</sup> = 77.6%*

Forest plots with odds ratio/standardized mean difference with values below zero favouring LAS. 95% confidence intervals and P values are included.

<sup>k</sup>Includes one study that is a prospective randomized controlled trial. <sup>l</sup>Includes two studies that are prospective randomized controlled trials.

**TABLE 1. Patient characteristics**

Variable	Number (%)
Demographic characteristics	
Age [range]	46.6 [16-87]
Sex (male)	26 (49.1)
Aetiology of RSE	
Epilepsy ± subtherapeutic AEDs	22 (41.5)
Stroke	13 (24.5)
Central Nervous System Infection / Inflammation	13 (24.5)
Major Brain Lesion e.g. Tumour	17 (32.1)
Metabolic / electrolyte / drug induced encephalopathy	2 (3.8)
Post-neurosurgery	16 (30.2)
Other / Unknown	7 (13.2)

Data are from 53 patients with episodes of refractory status epilepticus (RSE). Anti-epileptic drugs (AED).

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functional outcome defined by Modified Rankin Score as good (0-3 or at baseline) or poor (4-6).

**Results:** 53 episodes of RSE were included (Table 1). Anaesthetic agents were used in 67.9% of patients, with 66% requiring invasive ventilation. The most commonly used first, second and third line AEDs were lorazepam (52.8%), levetiracetam (58.8%) and phenytoin (60%) respectively. Number of maintenance AEDs ranged from 1-10 (mean 2.96). Mortality was 3.77% (n=2), which rose to 5.77% in mechanically ventilated patients. Good/baseline functional outcome at 3 months, 6 months and 1 year post-discharge occurred in 56%, 57.1% and 61.3% of patients respectively. Predictors of good and bad outcome were pre-existing epilepsy ( $P=0.003$ ) and stroke ( $P<0.001$ ) respectively. Presence of a major brain lesion was associated with higher mortality ( $P=0.036$ ). **Conclusions:** Mortality (3.77%) in patients treated for RSE in NHNN ICU was substantially lower than that in published data although poor functional outcome was similar (38.7% at 1 y). These data have broader implications for salient predictive features of morbidity and mortality, in addition to effective treatment strategies for RSE.

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**Evaluation of cardiac function in patients with supratentorial brain tumours and raised intracranial pressure: HABIT-ICP; a prospective observational study**

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**Introduction:** Acute rise in intracranial pressure (ICP) has been shown to affect cardiac function due to brain ischemia and the associated increased sympathetic activity. However, in conditions where there is a slow and progressive increase in ICP, the effects of ICP on cardiac function have not been studied. We undertook HABIT-ICP (Heart and Brain Interaction in Tumours with raised ICP) study to assess and compare cardiac function, using transthoracic echocardiography, in patients with brain tumours presenting with and without raised ICP for neurosurgery.

**Methods:** In this prospective observational study, we included 70 patients: Group I (35 patients without features of raised ICP) and Group II (35 patients with features of raised ICP). Transthoracic echocardiography was performed on the day before surgery and on the

seventh postoperative day. Hemodynamic, electrocardiographic and echocardiographic parameters were recorded during pre and post-operative period. We performed intergroup and intragroup analyses of the recorded data before and after neurosurgery.

**Results:** Table 1 shows echocardiographic variables relevant in the assessment of chamber dimensions, systolic function and diastolic function, which were significantly different either in the intergroup and/or intragroup analyses. Four patients (11.4%) in Group II had mild systolic dysfunction whereas none in Group I had the same. Diastolic dysfunction was present in 33.3% in the group II during the preoperative period, whereas in the postoperative period, the dysfunction persisted in 30% of patients. None of the patients in the group I had diastolic dysfunction.

**Conclusions:** Our study suggests that in patients with supratentorial brain tumours, raised ICP might contribute to cardiac dysfunction, which does not entirely revert in the immediate postoperative period.

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**Changes in cerebral oxygenation during anterior cervical discectomy and fusion surgery: an observational study using near-infrared spectroscopy**

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**Introduction:** Injuries to the carotid artery and subsequent strokes due to extended retraction are uncommon complications in anterior cervical discectomy and fusion (ACDF) procedures. However, investigations have shown that retracting the carotid artery during cervical spine surgery can disrupt typical blood flow and can potentially increase the risk of stroke with increasing risk in patients with pre-existing atherosclerotic disease.<sup>1</sup> We conducted an observational study to determine the effect of retractors on cerebral oxygenation using NIRS monitoring intra-operatively.

**Methods:** We closely monitored cerebral oxygenation in 12 patients undergoing ACDF procedures. Data were collected before and after retractor placement at 5-minute intervals until extubation. Concurrently, vital signs and patient demographics, comorbidities, and postoperative recovery outcomes were recorded.

**TABLE 1.** Echocardiography findings

Chamber dimensions	Mean ± SD		P	Mean ± SD	
	Group I (preop)	Group II (preop)		Group II (postop)	P
LVIDs (cm)	2.89 ± 0.36	2.52 ± 0.81	<b>0.025</b>	2.47 ± 0.85	0.725
IWIDd (cm)	0.92 ± 0.20	1.09 ± 0.36	<b>0.025</b>	1.12 ± 0.45	0.715
IWIDs (cm)	1.06 ± 0.28	1.42 ± 0.34	<b>0.000</b>	1.41 ± 0.51	0.904
RWT	0.44 ± 0.14	0.63 ± 0.43	<b>0.028</b>	0.62 ± 0.35	0.893
<i>LVIDs (left ventricular internal diameter end-systole), IWIDd (inferior wall internal diameter end diastole), IWIDs (inferior wall internal diameter end-systole), RWT (relative wall thickness)</i>					
<b>SYSTOLIC FUNCTION</b>					
LVFS (%)	31.4 ± 5.7	37.7 ± 9.6	<b>0.004</b>	37.5 ± 13.2	0.9
LVEF (%)	70.0 ± 7.7	61.00 ± 12.25	<b>0.001</b>	68.48 ± 9.63	<b>0.001</b>
<i>LVFS (left ventricular fractional shortening), LVEF (left ventricular ejection fraction)</i>					
<b>DIASTOLIC FUNCTION</b>					
E' (m/sec)	0.12 ± 0.02	0.10 ± 0.03	<b>0.001</b>	0.11 ± 0.03	<b>0.007</b>
E/E'	6.87 ± 1.32	8.26 ± 3.25	<b>0.036</b>	7.94 ± 2.52	0.461
LA Vol index (ml/m <sup>2</sup> )	21.6 ± 2.3	24.26 ± 2.55	<b>0.000</b>	24.56 ± 2.38	0.512
Dec T (msec)	214.20 ± 36.86	196.81 ± 81.71	0.297	229.56 ± 65.80	<b>0.019</b>
<i>Dec T (deceleration time), LA Vol index (Left Atrial volume index)</i>					

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**Results:** The study encompassed a diverse patient group with a mean age of 47.3 years (SD=16.0), half of whom were male. On average, the surgery lasted 105 minutes (SD=51.1), with the retractor in place for 64 minutes (SD=29.9). Blood loss was minimal, averaging 42.0 mL (SD=7.2), and patients received an average of 1,513 mL (SD=428.1) of crystalloid. The total dose of vasopressors (phenylephrine infusion) was 11.58 mg (SD=3.7). Cerebral oxygenation levels did not exhibit a statistically significant reduction following retractor placement; however, due to the limited number of patients, the statistical relevance of these observations could not be definitively established.

**Conclusions:** NIRS has been used during carotid artery bypass surgery, carotid artery surgery<sup>2</sup> and bench position shoulder surgery.<sup>3</sup> Due to the potential risk of carotid artery compression, we applied NIRS monitoring to detect possible decrease in cerebral oxygenation. Our study did not detect any changes in NIRS CMRO<sub>2</sub> during ACDF surgery; we recommend further randomized study on this subject.

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**Survey of bite guard use in neuroanaesthesia**

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**Introduction:** Neurophysiological monitoring is used in neurosurgery to guide surgical resection. Application of cortical stimuli can cause jaw clenching, leading to damage to teeth, soft tissues and endotracheal tubes (ETT).<sup>1</sup> A bite guard can prevent complete dental occlusion under general anaesthesia, but may itself prove problematic, particularly in the prone position.<sup>2</sup>

**Methods:** To establish pragmatic data about frequency of use, types of bite guard used and any patient safety implications, we conducted a Neuroanaesthesia and Critical Care Society (NACCS), UK approved, national survey, sent electronically to 490 members.

**Results:** We received 92 responses (95% consultants); 65% use a bite guard at least monthly in their neuroanaesthesia practise. 23% have access to a proprietary bite guard (brands included BreatheSafe, Hudsons RCI, Anchorfast and BiteMe). The remainder used DIY bite guards - generally rolled up gauze and tape placed between the molars, often with part left protruding from the mouth. Of respondents, 52% state bite guard use is discussed at the team brief. Desirable features are shown in Table 1. Patient safety incidents: 15% of respondents witnessed displacement, 14% injury to the patient, and 2% airway obstruction. Serious incidents described included flattening of the bite guard and biting through ETT, severe tongue

**TABLE 1.** Desirable features

Feature	Percentage of respondents (%)
Easy insertion	77
Point of fixation	51
Bright colouration	46
Labelling on patient	29
Saliva absorbent	21
Bilateral	21
Biodegradable	15
Fixes to endotracheal tube	10
Non-absorbent	8

Additional suggestions to improve patient safety include radio-opacity.

ulceration, dental damage, retained swab during two-stage procedure and migration of bite guard into oesophagus requiring gastroscopy.

**Conclusions:** We note several significant patient safety incidents associated with bite guards; it is likely that these are underreported. Implementing the following may help mitigate the risks:

- Include bite guard in WHO checklist
- Document insertion and removal on anaesthetic chart
- Visual reminder on the patient e.g. sticker

Whilst clinical judgement is needed to choose the most appropriate bite guard depending on patient and surgical factors, there does appear to be a gap in the market for a device that is safe and easy to use.

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**Evolution of acute spinal cord injury management over 10 years in the United Kingdom: a neuroanaesthesia national survey**

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**Introduction:** The management of acute spinal cord injury patients in the United Kingdom has been shown to be widely variable.<sup>1</sup> A national survey was conducted to see how neuroanaesthetic practice in these patients has evolved over the past decade.

**Methods:** An online survey was conducted throughout the month of December 2022 among members of the Neuro Anaesthesia and Critical Care Society. Questions on anaesthetic and intensive care management of acute spinal cord injury patients were assessed including intraoperative monitoring modalities, anaesthetic techniques, physiological targets and drug treatments.

**TABLE 1.** Comparison of survey responses in 2012 and 2022

	2012 n (%)	2022 n (%)	P-value
Central venous pressure	n = 48	n = 56	< 0.001
Always	7 (15)	3 (5)	
Sometimes	36 (75)	27 (48)	
Never	5 (10)	26 (47)	
Bispectral monitoring	n = 48	n = 56	< 0.001
Always	1 (2)	21 (37)	
Sometimes	10 (21)	30 (54)	
Never	37 (77)	5 (9)	
Non-invasive cardiac output	n = 48	n = 56	0.027
Always	3 (6)	8 (14)	
Sometimes	17 (35)	27 (48)	
Never	28 (58)	21 (38)	
Somatosensory evoked potentials	n = 48	n = 56	< 0.001
Always	3 (6)	8 (14)	
Sometimes	10 (21)	33 (59)	
Never	35 (73)	15 (27)	
Motor evoked potentials	n = 47	n = 56	< 0.001
Always	0	7 (13)	
Sometimes	10 (21)	36 (64)	
Never	37 (79)	13 (23)	
Preferred anaesthetic technique	n = 49	n = 56	0.004
Sevoflurane	13 (26)	13 (23)	
Isoflurane	2 (4)	1 (2)	
Desflurane	17 (35)	2 (4)	
TCI propofol	1 (2)	1 (2)	
TCI propofol and remifentanyl	16 (33)	39 (69)	
Positive end expiratory pressure?	n = 49	n = 55	< 0.001
"Yes"	23 (47)	49 (89)	

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**Results:** Fifty-six neuroanaesthetists responded to the survey (Table 1). For intraoperative monitoring, compared to 2012 significantly higher numbers of neuroanaesthetists do not measure central venous pressure. On the other hand, more neuroanaesthetists reported using bispectral index and noninvasive cardiac output monitors, either sometimes or always. There was also a significant rise in the use of somatosensory and motor-evoked potentials monitoring. For preferred anaesthetic technique, there was a shift towards the use of total intravenous anaesthesia and positive end-expiratory pressure, with increases of 36% ( $P=0.004$ ) and 42% ( $P<0.001$ ), respectively. Of note, the use of desflurane declined by 31%. In comparison to anaesthetic management, the intensive care management of acute spinal cord injury patients remained largely unchanged. The only significant difference seen over the last 10 years was a change in the targeted arterial  $pO_2$ , with most neuroanaesthetists now preferring a target of 10–12 kPa (71% vs. 29%,  $P=0.001$ ).

**Conclusions:** Overall, there is still wide variability among neuroanaesthetists regarding the anaesthetic and intensive care management of acute spinal cord injury patients. Although practices had evolved in some aspects, the need for high-quality evidence to standardise care and improve outcomes is further highlighted in this survey.

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1. Werndle MC, Zoumprouli A, Sedgwick P, Papadopoulos MC. Variability in the treatment of acute spinal cord injury in the United Kingdom: results of a national survey. *J Neurotrauma*. 2012;29:880-8.

**Using communities of practice (cop) to improve mechanical thrombectomy (mt) delivery in england, a national quality improvement initiative**

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**Introduction:** 2% of strokes in England receive mechanical thrombectomy (MT). This is delivered by 24 Comprehensive Stroke Centres (CSCs) serving 83 Acute Stroke Centres. The long term objective is to achieve 10% by 2029. In April 2021 Thrombectomy Implementation Group (NHS England) commissioned Getting it Right First Time and stakeholders to produce an analysis of MT in England aiming to share learning through a communities of practice (CoP) model as a national quality improvement programme.

**Methods:** National process/outcome data were analysed (to Dec. 2021) including; hospital episode statistics, Sentinel Stroke National Audit Programme data, a NIHR Programme Grant research survey Promoting

**TABLE 1.** Summary of key data reviewed in community of practice virtual meetings

Median MT/year/CSC	83 (most active ~200)
Median DIDO Time	2 hours 35 minutes (IQR 138-178)
Median time symptom onset to groin puncture	5 hours 25 minutes (IQR 251-445)
Median length of thrombectomy	50 minutes (IQR 32-72)
Thrombolysis in cerebral infarction score 2b-3 (Successful Outcome)	79% (IQR 72-83%)
Discharge mRS 0-3	53% (IQR 37-63%)
Mortality at 30 d	16% (IQR 5-27%)
Complications following MT	20% patients (range 0-44%)
General anaesthesia for MT	84.6%
Anaesthetic provision for MT	42.3% Neuroanaesthetists

Comprehensive Stroke Centre (CSC), Door-in to Door-out (DIDO), interquartile range (IQR), modified Rankin scale (mRS), mechanical thrombectomy (MT).

Effective & Rapid Stroke Care, ambulance quality indicators and a survey of members of the Neuroanaesthesia and Critical Care Society of Great Britain and Ireland. Subsequently 7 MDT CoP QI meetings were held to share learning. Data were collected through engagement events using a survey, giving live data informing discussion on each day.

**Results:** A snapshot of anaesthetic practice was collected from 26/29 UK CSCs. At the time 5/24 CSCs in England offered a 24hr service. 6 preferred same day repatriation. The proportion of stroke patients referred for MT was 0.5-6% depending on CSC. Over 50% patients receiving MT are directly admitted to CSCs (on catchment population basis should be 26%). External patient transfer can take >80 minutes based on CSC configuration. Table 1 shows key data reviewed at CoP.

**Conclusions:** On average, results show MT provision has outcomes as expected for real-world populations. Substantial variation exists. Expanding ASC referral rates, reducing door-in to door-out (DIDO) times and increasing hours of operation is likely to improve access/outcomes. Whilst MT volumes remain low, anaesthetic cover is generally provided as extra responsibilities to existing rotas. As volumes grow this may not be sustainable and services may need to look at other models for anaesthetic cover.

**'Sip Til Send': Improving fluid fasting times with a liberal fluid fasting policy**

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**Introduction:** Current guidelines recommend a 2-hour fasting period for clear fluids. In practice, this is difficult to achieve due to the unpredictable nature of operating lists and evidence shows that actual fasting times can range from 6-18 hours.<sup>1</sup> Excessive fasting has a number of potential harmful effects and clinically significant pulmonary aspiration in surgical patients is rare. Many hospitals have now moved towards a more liberal fluid fasting policy. NHS Tayside have had great success with their Sip Til Send policy, allowing patients to drink clear fluids right up until they are 'sent for' by theatre. We sought to introduce a similar policy in our hospital.

**Methods:** Over 2 weeks, a baseline audit was carried out including fluid fasting time on arrival in theatre reception, staff survey, and patient satisfaction survey. The anaesthetic department agreed a new Sip Til Send policy, which was ratified through our local governance pathway. An education programme was undertaken prior to the policy launch. Repeat audit was carried out at 4 months. Adverse events were recorded via our incident reporting system.

**Results:** At baseline, the average fluid fasting time was 6 h (4 h for patients 1st on a list, 9 h for patients 2nd or later). Staff expressed frustration at excessive fasting times and lack of communication from theatre about list order. Following implementation of the new policy, 91% of patients drank water up until they were sent for by theatre. Staff agreed that Sip Til Send had a positive impact on patient care. No adverse incidents were reported.

**Conclusions:** Sip Til Send has been effective at reducing excessive fasting times in our hospital. However, the policy does rely on patient autonomy to drink. We have a significant cohort of patients who are unable to drink orally due to neurological conditions or altered airway anatomy. Avoiding excessive fasting in these patients requires additional input from staff, which can be challenging.

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**Proning in theatres - an evaluation of current practice and trainee experience**

M. Errico, FRCA; A.M.V. Luoma, FRCA; M. Leemans, FRCA. National Hospital for Neurology and Neurosurgery, London, UK.

**Introduction:** The prone position (PP) is frequently used in neurosurgery to facilitate surgical access. PP is associated with risks of life-changing injuries to patients due to physiological changes in combination with

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pressure & mechanical stressors to vulnerable areas.<sup>1</sup> We conducted a quality improvement project to enhance education and training in PP.

**Methods:** We implemented a local education program for PP including bitesize practical teaching sessions and a visual aid. All anaesthesia trainees were invited to complete an 11-question survey on PP prior to (baseline) and at the end (follow-up) of their rotation.

**Results:** Response rate: 59% for the baseline survey; 71% for the follow-up survey.

At baseline (n = 10): 60% of trainees had rarely or never used PP for surgery in the past year; 60% had received no formal teaching for PP in theatre; 70% consented all patients; 20% sometimes consented and 10% never consented specifically for PP; 70% felt competent to prone patients for surgery independently without Mayfield pins and 40% were confident with PP using Mayfield pins. Following our education program (n = 12) 83% felt they received satisfactory teaching for PP, 2 trainees were unable to attend the teaching sessions. All trainees felt they had performed an adequate number of PP cases. 92% were confident with independent use of PP without using Mayfield pins & 83% if using Mayfield pins.

**Conclusions:** Bitesize practical teaching sessions helped improve confidence in use of PP for neurosurgical procedures. Implementing these teaching sessions in the departmental induction program may ensure all trainees are able to attend. A quick reference visual aid was developed for trainees to encourage safe proning practice. Next steps would be to deliver training sessions with other members of the multidisciplinary team to ensure a standardised approach to PP. Good practice can also be transferrable to other surgical specialties where PP is used.

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1. Kwee M, Ho YH, Rozen W. The Prone Position During Surgery and its Complications: A Systematic Review and Evidence-Based Guidelines. *Int Surg.* 2015;100:292-303

**Improving the peri-operative journey for patients with chronic subdural haematoma at Oxford University Hospitals**

K. Jerram, FRCA; P. Garry, FRCA. Oxford University Hospitals NHS Foundation Trust.

**Introduction:** Patients with symptomatic chronic subdural haematoma (SDH) have heightened peri-operative risk on account of their advanced age and comorbidities.<sup>1</sup> Their journey from referring hospital to discharge can be tortuous and there is a drive to optimise this, similar to parallel conditions such as hip fracture. In our hospital a previous audit identified waiting times for chronic SDH drainage were sometimes prolonged due to theatre capacity issues. We thus introduced a thrice weekly 'in hours' emergency operating list. Here we demonstrate the benefits of this and consider other potential targets for improvement within the peri-operative journey.

**Methods:** Patients who underwent a primary drainage of chronic SDH from November 2022-January 2023 were selected using the electronic theatre management system and their medical notes reviewed.

**Results:** In comparison to the previous audit, patient demographics were similar. Mean age was 78.6 years (vs. 78.8) and median ASA 3 (unchanged). The mean wait for surgery was now 1.0 days (vs. 1.16 d) and the proportion of cases undertaken out of hours (outside 0800 - 1900) was 36.4% (vs. 44.4%). It took a mean of 2.0 days for the patient to be admitted from the original referral source and 8.8 days for discharge or repatriation.

**Conclusions:** The improvement of 'in hours' emergency operating capacity was associated with a reduction in both waiting time for chronic SDH drainage and the proportion of cases undertaken out of hours. We are currently investigating ways to improve emergency theatre efficiency and plan to further increase availability to 5 days a week. Our results also show initial transfer and post-operative rehabilitation account for large proportions of the total inpatient time. We therefore wish to engage with the multidisciplinary team to make improvements outside the immediate peri-operative period. We hope this will improve care of patients with chronic SDH and concurrently increase elective bed capacity.

**Reference:**

1. Stubbs, D.J., Davies, B.M. and Menon, D.K. Chronic subdural haematoma: the role of peri-operative medicine in a common form of reversible brain injury. *Anaesthesia.* 2022;77:21-33

**Adenosine-induced flow arrest in aneurysm clipping and AVM resection: review of cases and postoperative complications from a neurosurgical centre**

K. Rhodes, MBChB; A.K. Toma, MD; K. Hunt, FRCA; A.M.V. Luoma, FRCA. National Hospital for Neurology and Neurosurgery, University College London NHS Foundation Trust.

**Introduction:** Adenosine-induced transient flow arrest can be a useful tool to help achieve proximal aneurysm control during clip ligation of intracranial aneurysms. The clinical effect of a bolus of adenosine is apparent after 10-20 seconds; causing AV nodal blockade, bradycardia and cardiac arrest.<sup>1</sup> We present a case series of patients who received intraoperative adenosine whilst undergoing intracranial aneurysm clipping (IAC) or arteriovenous malformation (AVM) resection at a single specialty neuroscience centre.

**Methods:** This project is locally registered (45-202223-SE). A retrospective review of electronic records for all patients who received intraoperative adenosine bolus during IAC or AVM resection between April 2019 & August 2022 were conducted. Data included: patient demographics, comorbidities, complications, urgency of surgery, subarachnoid haemorrhage (SAH) grade, size & location of aneurysm and patient outcome. Adenosine total dose and dose per kg (mg/kg) were recorded. Postoperative cardiac complications included ECG changes, troponin rise and echocardiogram results.

**Results:** 28 patients were included (26 ICA, 2 AVM, Table 1). Indications for intraoperative adenosine included peri-clipping (n=21) & intraoperative rupture (n=5). The median (range) total adenosine dose was 18 mg (6-60 mg). No intraoperative complications were documented.

**TABLE 1.** Patient characteristics

Variable	Total
Age (y)	
Mean ± SD	53 ± 7
Range	36–72
Gender	
Male (%)	9 (32)
Female (%)	19 (78)
Body Mass Index (kg/m <sup>2</sup> )	
Mean ± SD	26.8 ± 7
Range	17–53
Urgency of surgery	
Emergency (%)	12 (43)
Elective (%)	16 (57)
Total Adenosine dose (mg/kg)	
Mean ± SD	0.3 ± 0.2
Range	0.1–1.1
Estimated intraoperative blood loss (ml)	
Median	300
Range	50–2200
Post-operative ICU stay (d)	
Median	1
Range	1–33
Total post-operative stay (d)	
Median	13
Range	1–96
Modified Rankin Scale at discharge	
Median	2
Range	1–6
Glasgow Outcome Score at discharge	
Median	4
Range	1–5

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Temporary clips were required for 7 patients. 4 patients (3 SAH) had postoperative ECG changes (new onset RBBB (n = 1); T wave inversion (n = 3)). All were associated with a troponin peak (median: 12 ng/mL, range: 7-133 ng/mL). 2 had postoperative echocardiograms, with normal biventricular function.

**Conclusions:** Our results as in keeping with previous local results & published literature.<sup>2</sup> Adenosine use in this cohort of patients appears safe. The titratability, quick onset and offset as well as predictable action, make adenosine a useful no-mechanical method for reducing blood flow in aneurysms and AVMs.<sup>3</sup>

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- Al-Mousa A, Bose G, Hunt K et al. Adenosine-assisted neurovascular surgery: initial case series and review of literature. *Neurosurg Rev.* 2019;42:15-22.
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**Working on wellbeing: evaluation of balint group participation on quality of work life in neurocritical care doctors**

A.J. Gilbert, MBChB; A. Paget, DCLinPsy. National Hospital for Neurology and Neurosurgery, London.

**Introduction:** Working in the intensive care unit (ICU) is emotional challenging with potentially profound psychological sequelae. Data has shown up to 47% prevalence of burnout in ICU professionals,<sup>1</sup> with high rates of emotional exhaustion in neurocritical care unit (NCCU) staff.<sup>2</sup> Evidence shows that regular Balint groups, forums using case discussions to reflect on poignant clinical events, may prevent burnout and improve wellbeing in ICU staff,<sup>3</sup> however there is a paucity of studies on their effect in NCCU.

**Methods:** A cross-sectional survey was devised to assess work-related stress, existing provision of wellbeing facilities and debrief opportunities in NCCU. This was anonymously completed by junior doctors working in NCCU at the National Hospital for Neurology & Neurosurgery in December 2022. Subsequently, a 2-weekly Balint group was started chaired by a trained neuropsychologist. Preliminary outcome data was collected 1-month post-intervention via further anonymous completion of a wellbeing survey.

**Results:** 12 NCCU doctors completed the baseline wellbeing survey. 100% felt stressed at work at least several times a month with 16.7% feeling stressed every day. 91.6% agreed that working in NCCU was emotionally challenging and 75% felt they did not have adequate opportunity to discuss distressing clinical encounters. Post-intervention, 100% of doctors agreed that Balint group was helpful to them, that regular groups would provide ample opportunity for debrief and that its continuation would provide sufficient wellbeing provision at work. 83.4% of those surveyed felt they were taught valuable coping strategies to respond to stressful work events.

**Conclusions:** Initial survey results show that working in NCCU has significant emotional impact on doctors and punctuate the need for interventions to augment wellbeing and reduce stress. Preliminary results show that Balint groups may be an effective strategy to promote resilience, reduce burnout and protect doctors' mental health.

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**TABLE 1. Patient data**

Presenting Hospital	Southmead	39 (25%)
	Other	119 (75%)
Thrombolysis	Yes	66 (42%)
	No	92 (58%)
Mean NIHSS score at presentation (range)		18.1 (5 to 37)
Mean NIHSS score change at 24 hours (range)		-4.5 (-24 to +16)
TICI Score	≤ 2a	18 (11%)
	≥ 2b	140 (89%)
Modified Rankin Score at follow-up	Favourable 0 to 2	8 (22%)
	Unfavourable 3 to 5	28 (88%)

National Institute for Health Stroke Scale (NIHSS), Thrombolysis in Cerebral Infarction (TICI)

**A service evaluation of anaesthetic strategy for stroke thrombectomy in a UK regional stroke thrombectomy referral centre**

J.A.G. Purdell-Lewis, FRCA; H. Niaz, MBChB; J.M. Harri, MBBS; A. Goswami, FRCA; A. Mortimer, PhD. North Bristol NHS Trust.

**Introduction:** Stroke is the second most common cause of death globally,<sup>1</sup> and endovascular thrombectomy (ET) for embolic stroke improves 90-day functional outcome.<sup>2</sup> General anaesthesia (GA) has been implicated in mixed ET outcomes, but the GASS study supported its role.<sup>3</sup> This service evaluation reviews anaesthetic strategies in a UK regional stroke centre.

**Methods:** The Sentinel Stroke National Audit Programme was used to identify patients presenting to North Bristol NHS Trust with stroke who underwent stroke thrombectomy under GA. Data points were collected retrospectively for cases between 1st January–December 31st 2021. These included: patient pathway, anaesthetic strategy, haemodynamics and outcome.

**Results:** In total 158 patients met the inclusion criteria with cases excluded due to lack of documentation (6) or use of sedation (3). Functional outcome data were completed for 36 patients (23%). Mode of anaesthesia was either volatile (94; 59%) or total intravenous anaesthesia (TIVA) (64; 41%). Fifty-five patients (35%) had depth of anaesthesia (DOA) monitoring (TIVA 29 patients: 47%, and vapour 25 patients: 26%). The average maximal reduction of mean arterial blood pressure (MAP) from baseline was 23mmHg (22%). No single anaesthetic approach was associated with improved early neurological outcomes. See Table 1.

**Conclusions:** In keeping with a growing body of evidence, GA was preferred in 98% of cases. Volatile and TIVA strategies were used, demonstrating an equal drop in MAP. DOA monitoring was used in 35% of cases and should be used in all cases to minimise the effects of burst suppression in already vulnerable brain parenchyma. Functional outcome was only completed in 36 patients, limiting evaluation of service efficacy.

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**Perioperative electrolyte imbalance and its effect on outcome in patients with aneurysmal subarachnoid haemorrhage**

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**Introduction:** Electrolyte disturbances encountered in patients with aneurysmal subarachnoid haemorrhage (aSAH) are attributable to multitude of reasons. These disturbances can worsen both immediate and long-term prognosis by causing secondary neurological insult and affecting other organ systems. Our study was aimed at investigating sodium and potassium imbalance in patients presenting with aSAH, factors contributing to it, and its effect on immediate and late outcomes.

**Methods:** After approval by ethics committee and obtaining consent from next of kin, 100 patients with aSAH were enrolled over a period of 15 months. All patients underwent microsurgical clipping and were provided standard neuro-critical care. Serum sodium and potassium levels were measured pre-operatively, intra-operatively and then daily, until 7th post-operative day. Pro-Brain Natriuretic Peptide (Pro-BNP) levels were measured on post-operative days 1 and 3. Outcomes were evaluated using Modified Rankin Scale (mRS) at discharge and Glasgow Outcome Scale-Extended (GOSE) at 3-month follow-up.

**Results:** Hyponatremia was observed in 69.8% patients while 4% developed hypernatremia. 86.7% patients were found to be hypokalemic while 8.2% patients were hyperkalemic. Electrolyte imbalances were not associated with poor outcome at discharge. Hyponatremia was found to be associated with a poorer GOSE at 3 months follow up ( $P$ -value = 0.027). Pro-BNP values on Day-1 and Day-3 were elevated in 77.5% and 95.9% patients, respectively. Pro-BNP levels were significantly elevated in patients who developed hyponatremia ( $P$ -value < 0.01). Patients with elevated Day-1 Pro-BNP levels had significantly poorer mRS at discharge ( $P$ -value = 0.047).

**Conclusions:** Hypokalemia was the most common electrolyte abnormality, followed by hyponatremia. Electrolyte abnormalities may result in secondary brain insults and worsen morbidity and long-term outcomes. Serial electrolyte monitoring is imperative for early detection and prompt treatment.

### Immediate post-operative oxycodone consumption in craniotomy following intraoperative remifentanyl

S. Lal, FCARCSI; W. Minhas, FCARCSI; M. Moore, FCARCSI. Beaumont Hospital, Dublin, Ireland.

**Introduction:** Munoz et al. revealed timely administration of morphine reduced post-operative morphine consumption in patients receiving remifentanyl-based general anaesthesia.<sup>1</sup> We performed a retrospective audit to evaluate the effect of the timing of intraoperative oxycodone administration and subsequent oxycodone consumption in post-anaesthesia care unit (PACU) in craniotomy patients who had received intraoperative remifentanyl.

**Methods:** We retrospectively audited the medical records of 50 patients undergoing supratentorial craniotomy. Group-1 patients received oxycodone more than 40 minutes before end of surgery and Group-2 patients received oxycodone less than 40 minutes.

Quantity and timing of oxycodone administration, surgery end time, PACU oxycodone dose, and PACU length of stay were collected.

**Results:** The mean quantity of intraoperative oxycodone administered was 4.3 mg (SD 1.3) in group-1 versus 4.1 mg (SD 2.1). The mean oxycodone consumption in PACU in group-1 was 2.8 mg (SD 1.3) and group-2 was 3.4 mg (SD 2.5).

**Conclusions:** Our audit showed that earlier administration of oxycodone in craniotomy patients receiving intraoperative remifentanyl showed a reduction in oxycodone consumption in PACU. Fewer patients needed oxycodone in the PACU when oxycodone was administered 40 minutes prior to the end of surgery. We plan to conduct a further study to determine if earlier administration of oxycodone may result in quicker discharge time from PACU, less post-operative nausea and vomiting, less nursing interventions and more patient satisfaction. From our audit we recommend craniotomy patient receiving intraoperative remifentanyl should receive oxycodone more than 40 minutes prior to end of surgery.

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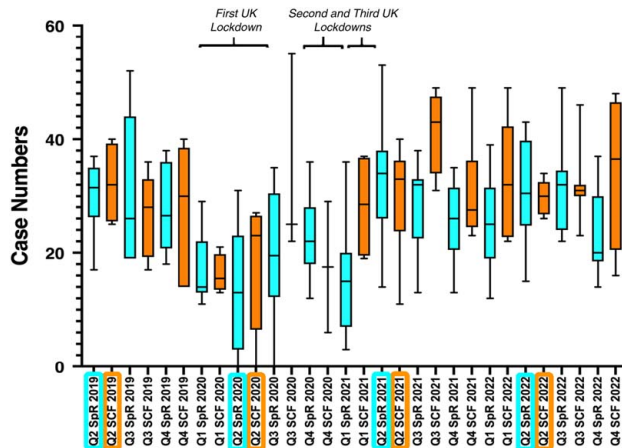


FIGURE 1. Trainee Case Numbers.

### The impact of the Covid-19 pandemic on case numbers achieved by neuroanaesthetic trainees and fellows at a specialist quaternary neurosciences centre: a service evaluation project

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**Introduction:** The Covid-19 pandemic led to a dramatic reduction in neurosurgical activity in the UK, with one standalone neurosciences centre completing 65% fewer cases.<sup>1</sup> At our institution, the neurocritical care unit was repurposed as a 'Covid-ICU',<sup>2</sup> hence reducing availability for neurosurgical operating. We aimed to determine how the number of neuroanaesthesia cases achieved by specialty registrars (SpRs) and senior clinical fellows (SCFs) changed during the pandemic.

**Methods:** Having registered this study locally, quarterly case numbers achieved by each rotational (three months) full-time SpR and SCF were obtained retrospectively from our electronic health record (Epic) between May 2019 and January 2023. Median quarterly case numbers for each cohort of SpRs and SCFs were calculated, with May-July 2019 (Q2(2019)), the earliest quarter, chosen to represent baseline neuroanaesthesia activity (Fig. 1). Kruskal-Wallis and Mann-Whitney U tests (GraphPad Prism 9) were used to compare baseline Q2(2019) to Q2(2020), Q2(2021), and Q2(2022).

**Results:** There were [median(IQR)] 9(9-10) SpRs and 6(4-6) SCFs per quarter. There was a significant difference in median SpR case numbers between the four Q2s overall ( $P=0.005$ ); Q2(2020) was the only year that differed significantly from baseline ( $P=0.003$ ). SCF case numbers were not significantly different overall ( $P=0.069$ ), and though Q2(2020) saw the lowest, baseline comparison did not reach statistical significance ( $P=0.079$ ).

**Conclusions:** There was a significant decline in SpR cases immediately following UK Covid restrictions in March 2020; low numbers of SCFs may explain the non-significant fall in SCF cases. Importantly, our findings rely on SpRs/SCFs recording their names on the Epic anaesthetic chart. Though strategies were implemented to maintain neuroanaesthetic education (weekly newsletter, neurosurgical/radiology teaching), it is clear that the pandemic severely disrupted neuroanaesthetic training at our institution.

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### Evaluating rates of external ventricular drain associated infection in critically ill patients across the COVID-19 pandemic: a retrospective service evaluation



**TABLE 1.** EVD-associated ventriculitis rates

	April-July 2019	April-July 2020	April-July 2021
<b>EVD-associated ventriculitis rate (%EVDs) [definite and probable infections]</b>	15.9% (7/44)	13.9% (5/36)	11.6% (5/43)
<b>EVD-associated ventriculitis rate (/1000 EVD days) [definite and probable infections]</b>	18.32	14.84	12.92
<b>Probable infections (%EVDs)</b>	13.2% (5/38)	5.6% (2/36)	0% (0/43)
<b>Definite infections (%EVDs)</b>	5.3% (2/38)	8.3% (3/36)	11.6% (5/43)
<b>Definite infections (/1000 EVD days)</b>	5.24	8.90	12.91
<b>Antibiotics without evidence of definite/probable infection (%EVDs)</b>	6.8% (3/44)	19.4% (7/36)	2.3% (1/43)

A. Skroban, BSc; E.M. Parkin; F.A. Wallace, FFICM. University of Manchester.

**Introduction:** Ventriculitis can be a devastating external ventricular drain [EVD]-associated complication resulting in long-term neurological sequelae<sup>1</sup> and increased patient mortality.<sup>2</sup> The ICU setting had been placed under exceptional pressure during the COVID-19 pandemic -the impacts on the quality of EVD care and infection rates are unclear. This service evaluation aimed to determine the EVD-associated ventriculitis rates in critically ill patients in a large critical care unit, identify implicated organisms, review antimicrobial prescribing, and assess whether care bundle interventions introduced in 2019 as a part of infection risk reduction measures, were being maintained.

**Methods:** Critically ill patients with an EVD in situ between April-July in 2019, 2020 and 2021 were retrospectively reviewed using electronic patient records. Follow-up was up to 30 days post-EVD removal or up to the point of further neurosurgical intervention. Care-bundle intervention adherence was assessed prospectively on the unit over 7-weeks.

**Results:** The infection rate was 18.32, 14.84 and 12.92 per 1000 EVD days in 2019, 2020 and 2021 respectively (Table 1). Gram-positive cocci were isolated in 2019, while in 2020 and 2021 Gram-negative organisms predominated. Meropenem and vancomycin accounted for the greatest antimicrobial burden across all periods. The 2019 care bundle was not being consistently maintained.

**Conclusions:** During the pandemic, increased cumulative antibiotic prescribing was observed for central nervous system (CNS) cover. It is unclear whether this was reflective of a general trend of increased empirical antimicrobial use in ICUs.<sup>3</sup> Comparisons with other infection rates are limited by the heterogeneity in surveillance definitions and follow-up. Few studies have examined nosocomial CNS infections across the pandemic. Work to review staff care bundle familiarity and implement a reporting system to establish current infection rates aims to improve patient safety.

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**Audit reviewing the Anaesthetic Management and Outcomes of Neurosurgical Patients aged over eighty in a Tertiary Neurosurgical Centre**

V. Kumar; R. Srinvasaiah, FRCA; S. Griffiths, FRCA. Walton Centre NHS Foundation Trust.

**Introduction:** Elderly neurosurgical patients have a higher risk of peri-operative morbidity and mortality due to age related physiological and pathological changes. People over 85 are the fastest growing age group within the population and will represent 2 to 3% of the world population in 2030.<sup>1</sup> This audit was performed to review the peri operative management and post operative outcomes of patients aged over eighty in our hospital.

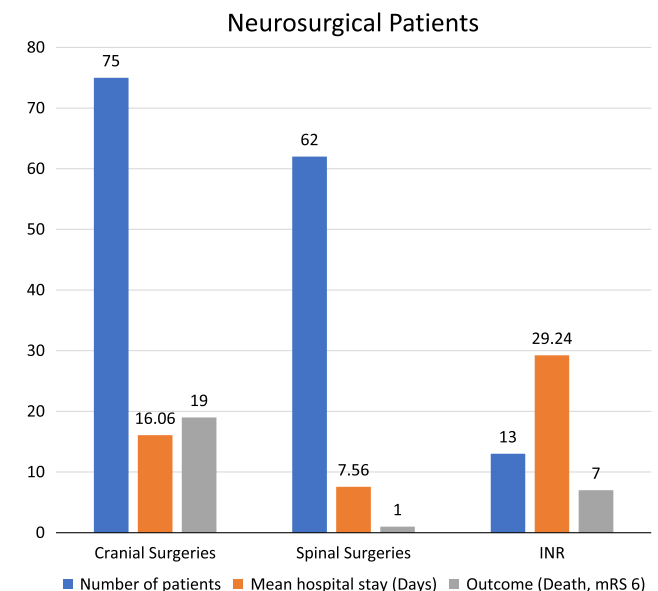
**Methods:** A retrospective audit of all patients aged over eighty who underwent neurosurgery in 2019. Data were collected from the electronic patient records and anaesthetic charts and included patient demographics, ASA Grade, NCEPOD classification, frailty, anaesthetic technique, postoperative complications, length of hospital stay and outcome at one year.

**Results:** A total of 150 patients were included (64 female). These underwent spinal surgery (62 patients), intracranial surgery (75 patients) and interventional neuroradiology (13 patients). 61% of patients were risk stratified as ASA 3 and above, and frailty scoring was done in 7%. 10% of the spine patients had a post-operative cardiac complication and 24% of the total patients had post operative cognitive dysfunction. See Fig. 1.

**Conclusions:** Increasing number of octogenarians are presenting for surgeries and have multiple co-morbidities. Patients who developed post op complications have increased length of hospital stay. Protocol driven multidisciplinary care including frailty risk assessment and optimising rehabilitation can minimise post operative complications and improve postoperative outcome. Post operative cognitive dysfunction is common and multimodal strategies should be used to reduce incidence.<sup>2</sup>

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**FIGURE 1.** Patient data.

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