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[SNACC-1] Attainment of Neuromonitoring Signals Using Long Subdermal Needle Electrodes in a Morbidly Obese Patient
Mirkin E, Koht A. Northwestern University Feinberg School of Medicine, Chicago, IL.

Introduction: Somato sensory evoked potential (SSEP) and motor evoked potential (MEP) monitoring are commonly used techniques in neurosurgery to detect central and peripheral nerve dysfunction. SSEPs directly monitor the dorsal column-medial meniscus pathway, and are usually elicited by stimulation of a peripheral nerve at a distal site. These sites typically involve the median or ulnar nerves at the wrist for upper extremities, and the posterior tibial or peroneal nerves in the lower extremities. Barb electrodes, EEG metal disc electrodes, adhesive surface electrodes, and subdermal needle electrodes can be used for SSEP monitoring. MEPs monitor the corticospinal tract and can be obtained via transcranial electrical stimulation to the scalp utilizing needle electrodes or by magnetic stimulation. Neuromonitoring is dependent on these electrodes being secured in place.

Case Presentation: A 63-year-old male with a history of metastatic prostate cancer of C2 causing subluxation of C1-C2 and occiput cervical instability, cervical spondylosis from C2-C6, moderate central stenosis from C3-C6, and right foraminal stenosis at C4-C5 presented for an occiput to T2 posterior spinal fusion, C2-C6 decompression, and right C4-C5 foraminotomy. The patient’s comorbidities included morbid obesity (BMI: 48, 179 kg), obstructive sleep apnea, knee arthritis, and urinary incontinence. The prostate cancer was initially treated with chemical castration, seeding, and maintained on a non-steroidal antiandrogen, enzulutamide. The patient’s airway was graded as a Mallampati IV. He had significantly limited neck movement and a TMD of 4 cm. He was intubated uneventfully via an awake nasal fiberoptic technique using a low dose IV remifentanil infusion. Lines were placed, and anesthesia was maintained via TIVA using remifentanil, propofol, and ketamine infusions. Standard 13 mm long subdermal electrodes (Rhythm link) for neuromonitoring were placed. SSEPs and MEPs were obtained in the upper extremities, and MEPs were present in the lower extremities. However, no SSEPs could be acquired in the lower extremities. The needles were repositioned multiple times and replaced with a new set of electrodes, but SSEPs remained undetectable in the lower extremities. When the subdermal needles were applied to the lower extremities, edematous fluid was noted after puncture sites in the ankles rather than blood. Longer subdermal needles of 5 cm length (Ambu Neuroline Monopolar) were then placed in the lower extremities, and SSEPs were finally elicited. The case proceeded with 2 surgeons due to the patient’s difficulty anatomy. No adverse intraoperative events occurred. The patient was extubated and transferred to the NSICU for postoperative monitoring.

Discussion: This case highlights how subdermal needle length was key in SSEP signal capture in a morbidly obese patient. Edema versus expected blood was observed at the puncture sites in the lower extremities when the shorter needles were applied. This alerted us that the absence of SSEPs could be due to distance from the nerve or electrical shunting.

References:


George A, Koht A, Bebawy J. Northwestern University, Chicago, IL.

A 67-year-old female patient was undergoing a staged procedure for correction of scoliosis with an anterior lumbar interbody fusion (ALIF) at the levels L5-S1, followed by a posterior spinal fusion (PSF) of T10 to ileum. The ALIF was uneventful and 2 days later the patient was under

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general anesthesia for the PSF surgery with an IV infusion of Propofol (40 µg/kg/min) and Sufentanil (0.3 µg/kg/h) and inhalational Sevoflurane to maintain half or less MAC of anesthesia. Neurormonitoring was done throughout the surgery measuring motor evoked potentials (MEP), somatosensory evoked potentials (SSEP) and EMG’s. Following rod placement and pulse lavage of the surgical site, a complete loss of the SSEP’s from the right posterior tibial nerve was noted. The SSEP’s from bilateral upper extremities, and the left lower extremity in addition to the MEP’s from all extremities remained at baseline. We systematically excluded technical error, limb compression, perfusion, anesthetic and surgical causes. Mean arterial pressure (MAP) was raised to 90 mm Hg and surgery was stopped for about 45 minutes to resolve the situation but without success, at which point a senior anesthesiologist was consulted. Taking into consideration the sequence of events and proximity in time from the pulse lavage to complete loss of signal (7 min) we presumed the probable cause of the SSEP loss would be local irritation leading to vasospasm from the pulse lavage. A warm saline irrigation was started and the MAP’s were further raised to around 105 mm Hg. Seven minutes after warm saline irrigation and increasing the MAP, signs of reproducible SSEP recovery was noted and it completely recovered to baseline within 30 minutes.

[SNACC-3] Transition to Loss of Consciousness during Anesthesia Induction With Remifentanil and Propofol: EEG Patterns

Leitao Ferreira A*, Nunes C†, Mendes J*, Amorim P1. *Universidade Do Porto; †Universidade Aberta; ‡Centro Hospitalar Do Porto, Porto, Portugal.

The importance of more personalized care is becoming increasingly recognized. Identifying the precise moment of loss of consciousness (LOC) during the induction phase of general anesthesia is important as it will determine the drugs amount required for each individual to maintain adequate levels of anesthesia. The dynamics of EEG signals of volunteers subjected to anesthesia with propofol showed that, at LOC, both alpha (8 to 12 Hz) and low-frequency (0.1 to 1 Hz) power increases significantly. But, no surgical stimulus or drug interactions were present. The aim of our study is to examine EEG patterns that are associated with LOC in patients submitted to general anesthesia with remifentanil and propofol. Data of 10 patients were analyzed. Standard anesthesia induction protocol was with a remifentanil effect-site concentration (Ce) target of 2 to 2.5 ng/mL, followed by a propofol infusion of 200 mL/h until LOC. At LOC the propofol’s Ce target was set to the value achieved at LOC, until intubation. Data were recorded from the beginning of the remifentanil administration until 10 minutes after LOC. LOC was identified as the lack of eye opening to name calling and a tap on the forehead.

Multitaper spectrograms 2 were computed to observe the dynamics of EEG oscillations in window lengths of 6 seconds with overlap of 0.1 second and a time-bandwidth of 3 to 5 tapers. To quantify the variation of each decomposed wave from EEG spectrogram, the difference between the area under the curve from 1 minute before LOC to LOC and the area under the curve from LOC to 1 minute after LOC, were calculated.

Table 1 presented the results regarding: demographics, remifentanil, and propofol concentrations at LOC, the time to LOC and the magnitude of the waves changes in the transition from conscious to unconscious. Figure 1 is a representative example of one set of data. At LOC, all EEG spectrograms showed a decrease in gamma-frequency (25 to 40 Hz) power and an increase in alpha (8 to 12 Hz) and delta-frequency (0.1 to 4 Hz) powers.

Our results have not been previously showed in patients undergoing surgery with remifentanil and propofol. Using the spectrograms to quantify the changes at LOC and combining that with behavioral and other physiological variables would be able to create a robust and principle estimate model for tracking the dynamic changes in patients’ wakefulness as they enter into the unconsciousness state during induction with general anesthesia.

References:

A 77-year-old woman with cervical spondylosis and previous ACDF at C3-C5 presents with severe right arm and hand weakness and bilateral leg weakness. GA was induced and intubation was easily achieved with #3 Glidecope, keeping the head in neutral position. The patient was maintained initially on desflurane and converted to TIVA. Mean arterial pressure was maintained at 80 mm Hg. SEPs, motor evoked potential (MEPs), TOF, and EMG were utilized.

SEPs were recorded following stimulation of either posterior tibial nerve and of the right ulnar nerve; and remained stabler during the operation. The patient was maintained initially on desflurane and converted to TIVA. Mean arterial pressure was maintained at 80 mm Hg. SEPs, motor evoked potential (MEPs), TOF, and EMG were utilized.

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MEPs were initially present in the left deltoid, biceps and EDC muscles and small MEPs were present in the right deltoid and EDC muscles. There were no monitorable MEPs in the right biceps muscle or in either APB muscle. Twenty minutes after induction, with the patient supine, end tidal desflurane at 0%, mean arterial pressure was 80 mm Hg, and TOF 4/4 twitches, the MEPs that had been present in arm muscles disappeared bilaterally and were reproducibly absent (Fig. 1). There was no identifiable technical cause of the change; no anesthetic boluses, inhalational agents, or additional paralytic drugs had been given.

The anesthesiologist gently lifted the patient’s occiput resulting in 1/2 inch of elevation. Immediate return of the MEPs (Fig. 1) with the recovery to amplitudes that was comparable to baseline.

A wake-up test was performed. TIVA was reinduced. MEPs were still present on the left and small MEPs were present in the right deltoid and EDC muscles, and did not change with prone positioning. The patient underwent decompression at C3-C6 and fusion at C2-T2. MEPs that were monitorable at baseline levels with no significant changes. At the end of procedure, the patient was extubated. Her arm and hand strength was markedly improved from her preoperative examination.

Discussion: In a patient with severe cord compression, small alterations in the positioning of the head and neck can cause compromise. MEP loss in our patient’s arms was most likely due to small alterations in her neck position. This is confirmed by reappearance of the MEPs following small readjustment of the head.

If MEPs are suddenly lost in a patient with spinal compression, gentle adjustment of the patient’s head may be performed to relieve increased cord compression. MEP monitoring should be initiated early and recorded frequently. This case illustrates that cooperative interaction
between neuromonitoring, anesthesiologists, and surgeons, with rapid intervention in the event of loss of neuromonitoring signals, can result in excellent neurological outcome.4

References:

[SNACC-5] Spontaneous Oscillation in Brain Electrocerephalography, Hemodynamics and Metabolism: An Opportunity to Evaluate Neurovascular Coupling?
Highton D*, Phan P†, Elwell C†, Smith M†. *Princess Alexandra Hospital, Brisbane, Qld, Australia; †University College London, London, UK.

Introduction: Neurovascular coupling (NC) matches cerebral oxygen delivery to demand in response to changes in neuronal activity. In health this is observed as task evoked functional hyperemia. Impaired NC is implicated in cerebral energy failure following acute brain injury (ABI), but its evaluation using functional activation experimental paradigms is not feasible in unconscious patients. Spontaneous oscillations which might reflect NC are observed in neuromonitoring modalities, including electroencephalography (EEG), and near infrared spectroscopy (NIRS) derived cerebral haemoglobin oxygenation and cytochrome c oxidase. Considerable interest surrounds the physiological origins of these oscillations because they might associate the hemodynamic and metabolic response of the brain to energy demand. We hypothesize that slow EEG
oscillations (representing neuronal activity) are associated with NIRS-derived hemodynamic signals (oxy/deoxy-hemoglobin) and mitochondrial oxidation (cytochrome c oxidase) following ABI.

Methods: We investigated 20 patients with ABI following ethics approval and representative consent. Frontal multimodal neuromonitoring included: EEG (BIS-X, Philips) and a broadband NIRS system optimized for the monitoring of oxy/deoxy-hemoglobin and cytochrome c oxidase in adults. The wavelet transform was used to extract a continuous time series for EEG beta wave power and this was compared with several NIRS-derived variables using wavelet coherence as previously described. These were cerebral tissue oxygenation index (oxyhemoglobin/total hemoglobin), Hbdiff (oxyhemoglobin-deoxyhemoglobin), a marker of oxygen delivery, and cytochrome c oxidase oxidation (oxCCO).

Results: Figure 1A demonstrates significant coherence between NIRS and EEG beta power within the slow wave band 0.1 to 0.01 Hz. Two individual patient examples demonstrate variation in this relationship: a normal haemodynamic response to increased EEG power (Fig. 1B), and inversion of the normal response characterized by a fall in cerebral oxygen delivery associated with increased EEG activity (Fig. 1C).

Conclusions: We have demonstrated an association between EEG and NIRS hemodynamic and metabolic oscillations which is consistent with NC; neuronal activity (EEG) is significantly correlated to a hemodynamic and metabolic response function (NIRS). Individual patient datasets reveal variation in this response function including a normal response (functional hyperemia) and inverted response consistent with known pathophysiology following ABI. Although further work is required to correlate these changes with cerebral energy failure, the combination of EEG and NIRS may have unique potential as a noninvasive bedside marker of NC following ABI.

References:

[SNACC-6] Variability in Cerebral Oxygen Extraction Fraction During Anesthesia: Luxury and Misery Perfusion Patterns

Mahanna-Gabrielli E*, Bergonzzi K*, Baker W†, Yodh A*, Kohle W*.

*University of Pennsylvania; †Children’s Hospital of Philadelphia, Philadelphia, PA.

Background: Anesthesia providers rely on indirect information from blood pressure and SaO2 to infer adequate oxygen delivery to the brain. Without direct measurement of changes in cerebral blood flow (rCBF) and cerebral metabolic rate of oxygen consumption (rCMR02), it is impossible to predict oxygen extraction fraction (rOEF). A continuous measurement of rOEF would allow assessment of intraoperative autoregulation. Lack of autoregulation has been associated with paradoxical uncoupling of CBF from CMRO2 leading to either luxury or misery perfusion with the risk of hyperemia or ischemia, respectively. A recently developed Noninvasive Neurometabolic Optical Monitoring (NNOM) (Arun Yodh et al, US Patent 8082015), provides continuous measurement of rCBF, rCMR02, and rOEF by a scalp near-infrared light optode patch and Diffuse Correlation Spectroscopy and Diffuse Optical Spectroscopy. We aimed to determine the feasibility of using NNOM in older patients under general and regional anesthesia to determine rOEF variability and the presence of misery or luxury perfusion.

Methods: Prospective study of NNOM in 4 elderly patients undergoing total hip arthroplasty (1 general, 3 spinal anesthetics). Data were collected at r = 0 (2 to 3 min awake before anesthesia) until emergence. Changes of rCBF, rOEF, and rCMR02 were continuously recorded from baseline with each patient serving as their own control. OEF was calculated as 1–ScO2 and CMR02 as CBF×OEF. Misery perfusion was defined as >10% increase in OEF (rOEF > 1.1). Luxury perfusion was defined as >10% decrease (rOEF < 0.9). Intact CBF autoregulation occurred when rOEF remained constant during perturbations in rCBF or rCMR02.

Results: Monitoring was feasible in all subjects. All monitored cases showed periods of loss of autoregulation leading to changes in rOEF. Figure 1 shows an example of the intraoperative NNOM. Misery perfusion occurred in 1 subject for 33 minutes. Luxury perfusion occurred in 3 subjects, ranging from 17 to 59 minutes. Periods of intact autoregulation during 10% or greater changes in rCBF or rCMR02 occurred in all subjects (Fig. 2).

Conclusions: Intraoperative noninvasive monitoring of rOEF and rCBF is feasible during both general and spinal anesthesia. Episodes of luxury and misery perfusion were recorded in all patients suggesting alteration of cerebral autoregulation. Future directions of intraoperative NNOM will be to correlate rOEF patterns with perioperative cognitive disturbances and continuously assess neuropharmacological effects of anesthetics and vasoactive drugs.

References:

[SNACC-7] Prevalence and Risk Factors for Electrographic Seizures in Patients With Primary Spontaneous Intracerebral Hemorrhage

Garg D, Ouyang B, Liu Y, Garg R. Rush University Medical Center, Chicago, IL.

Introduction: Electrographic seizures (ES) are a common complication in patients with spontaneous intracerebral hemorrhage (sICH). They have been described in sICH with prevalence between 18% and 28%.1,2

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In these studies, >90% of ES did not show clinical evidence of seizure activity. The purpose of this study was to determine the prevalence of ES after primary sICH and its associative risk factors. We further examined whether ES is associated with discharge disposition.

Methods: We retrospectively identified patients with primary sICH who were monitored on continuous EEG (cEEG) between November/2011 and June/2016 at Rush University Medical Center in Chicago, IL. Clinical data were abstracted including age, sex, location of hemorrhage, and admission ICH score variables, including sICH volume, admission Glasgow coma scale (GCS), presence of intraventricular hemorrhage, and infratentorial origin. Presence or absence of seizures on cEEG and discharge disposition was also recorded. χ², Fisher exact, or T test were used to compare variables between sICH groups with and without ES. Statistically significant variables (P < 0.05) from the univariate comparisons were further examined using logistical regression.

Results: Of the 170 patients with primary sICH who underwent cEEG, 21 (12.6%) had ES. Among these patients, 10 (47.6%) did not have clinical evidence of seizure activity. The mean age of study population was 66.8 years and the median sICH score was 2. In univariate analysis comparing the ES versus the non-ES groups, age (73.1 vs. 60.5 y, P < 0.001), sICH volume ≥ 30 mL (52% vs. 74%, P = 0.04), presence of intraventricular hemorrhage (43% vs. 65%, P = 0.04), and lobar hemorrhage (90% vs. 41%, P < 0.001) were statistically significant. In multivariate analysis, age (odds ratio, 1.05; confidence interval, 1.01-1.1) and lobar hemorrhage (odds ratio, 7.08; confidence interval, 1.46-34.33) were significantly associated with greater odds for ES. Although not statistically significant, patients with ES were less likely to be discharged home (4% vs. 21%), more likely to be transferred to a long-term ventilator facility (38% vs. 23%), and more likely to die (33% vs. 16%).

Conclusions: In our study, ES occurred in ~13% of sICH patients monitored on cEEG. Age and lobar location of hemorrhage were associated with increased odds for developing ES. Nearly half of ES did not have a clinical correlate. Furthermore, seizures were associated with a nonsignificant trend towards worse morbidity and mortality. cEEG monitoring may be a valuable tool for the detection of seizures in patients with sICH. Further research is needed to determine the clinical factors associated with ES and the impact of ES on long-term outcome in sICH patients.

References:

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Kato S*, Yoshitani K*, Ohnishi Y*, Ozaki T*, National Cerebral and Cardiovascular Center, Suita, Osaka, †Hamamatsu Photonics, Hamamatsu, Shizuoka, Japan.

([Figure 1] The difference in rCBF-P

([Figure 2] The difference in rCBF-N

Background: Positron emission tomography (PET) is the gold standard examination to measure cerebral blood flow (CBF), but requires for patient to go to the division of nuclear imaging and cost much. Calculated the blood flow index (BFI) as relative value of regional CBF (rCBF) by using near-infrared spectroscopy (NIRS) with indocyanine green (ICG) at bedside. On the basis of this technique, we developed the calculation algorithms of rCBF using ICG as a tracer. To validate the rCBF measured by NIRS (rCBF-N), we compared rCBF-N with rCBF measured by PET (rCBF-P).

Methods: After approval of the institutional ethical board, patients with Moyamoya disease who underwent PET examination were enrolled in this study. rCBF by NIRS was measured shortly after the PET. rCBF-N was calculated by using the maximum gradient model combining the change of arterial blood concentration and maximum arterial blood concentration of ICG in the brain tissue. The kinetics of an intravenous bolus of ICG (0.25 mg/kg) was monitored by NIRO 200NX (Hamamatsu Photonics, Hamamatsu, Japan). Arterial ICG concentration curve was distinguished from the total ICG concentration curve measured by NIRO200NX by frequency filter. The maximum blood concentration of ICG was obtained by DDG analyzer (Nihon Kohden, Tokyo, Japan). rCBF-N was calculated by these 2 results. rCBF-N and rCBF-P were compared between diseased and healthy side in Moyamoya disease.

Results: We studied 15 subjects in whom PET would show laterality of rCBF-P. There was a significant difference in rCBF-P between diseased and healthy side in the region corresponding to the area of NIRS measurement (frontal lobe) (29.1 ± 4.4 vs. 33.3 ± 4.6 mL/100 g/min, P < 0.01). rCBF-N also demonstrated the difference in rCBF between the 2 sides (39.3 ± 18.3 vs. 46.5 ± 21.7 mL/100 g/min, P < 0.05) (Figs. 1, 2). Conclusion: rCBF-N detected the difference in rCBF between the diseased side and healthy side corresponding to the difference in rCBF-P in patients with Moyamoya disease.

[SNACC-9] Improvement With Anesthesia Assisted Intra-Arterial Drug Delivery to Brain Tumors With Multiple Versus Single Flow Arrest
Cooke J, Joshi S. Columbia University, New York, NY.
Introduction: Intra-arterial (IA) drugs have met with little success in brain tumor treatment. In contrast IA chemotherapy is regularly used for the treatment of retinoblastomas. To enhance IA drug delivery, blood flow is momentarily stopped during the treatment of retinoblastomas. We were interested in determining whether injection of a given amount of drug during multiple arrests was superior to drug delivery during a single arrest. We first tested our approach in a computational model of IA drug delivery and in parallel we tested the results of our in vivo model of brain tumors.

Methods: Simulation studies: The details of our computational model of IA drug delivery are provided in Figure 1A. In these simulations we compared the results of IA drug delivery with 1 and 4 arrests over a 15 minutes time period. Animal studies: in parallel as part of an IACUC
approved protocol, drug delivery optimization studies were undertaken in 9L tumor bearing Fisher 344 rats. Surgical preparation under general anesthesia consisted of intravenous access, tracheostomy and ICA cannulation. IA injections were made as boluses using Parker III injector driven with Agilent signal generator over 4 cycles. One milligram of FITC-labeled TAT was used to test tumor drug delivery. Brain tissue was harvested after euthanasia at 15 minutes after the last injection. Tissue fluorescence was measured using a photon counting camera. Single arrest data was obtained from a past set of animals under similar experimental conditions, however, using 1 mg TAT delivery during a single arrest.2

Results: Simulations studies: simulation studies failed should that single arrest drug delivery achieved much higher peak concentrations (Fig. 1B). At 15 minutes post injection the concentration of the drug was higher with single arrest than with multiple arrests at the corresponding time point.

Animal studies: One of the 6 animals had sustained hypotension and showed massive uptake of TAT-FITC. In the other animals, blood flow and hemodynamic parameters recovered promptly. This animal was excluded from analysis. In the remaining 2 animals, we observed a 2-fold increase in tumor TAT-FITC concentrations with multiple arrest compared with single arrest; however, nonspecific tissue uptake was also similarly increased (Fig. 1D).

Discussion and Conclusions: The in vivo experiments support the use of multiple versus single arrest in improving drug delivery. Although the increase in tumor drug delivery is not selective and there is an increase in nontarget site uptake. In a clinical setting, multiple arrests drug delivery can be locally achieved by balloon tipped micro catheters. The IA-pharmacokinetic model showed different results that may in part be due to single configuration of brain compartments and even with the tumor.

References:

**[SNACC-10]** Adult-born Hippocampal Neurons Drive Recurrent Excitatory Circuits During Epileptogenesis in Mice

Hendricks W*, Westbrook G*, Schnell E†. *Ohio, Portland, OR; †Tu Portland, Portland, OR.

Introduction: Hippocampal granule cell neurons generated after brain injury may contribute to either cognitive recovery or ongoing brain dysfunction. After seizures or traumatic brain injury, these neurons undergo aberrant morphologic development, and extend aberrantly target axons and dendrites into the inner molecular layer of the hippocampal dentate gyrus. Here, we directly studied the functional outputs of these adult born cells, to determine their contribution to the formation of hyperexcitable circuits.

Methods: We used the pilocarpine model of temporal lobe epilepsy to drive postseizure hippocampal neurogenesis in mice. By combining separate lines of genetically modified mice, we were able to pulse label entire cohorts of either neonatally born or adult-born granule cells in adult rats. We then used fluorescent and optogenetic markers. Two months after seizures, we studied the morphology and functional outputs of labeled granule cells using optogenetics and single cell electrophysiology in live, acutely prepared hippocampal slices, and focused on microcircuit dynamics.

Results: In epileptic mouse brain slices, we found that adult-born neurons formed aberrant monosynaptic excitatory connections with other granule cells, establishing recurrent glutamatergic positive feedback loop. These synapses had a high probability of release and exhibited profound short-term depression. Despite their rapid synaptic fatigue, they could potently drive burst firing in hippocampal slices even with single action potentials.

Conclusions: Our data suggest that adult-born neurons may play a contributory role in epileptogenesis, through their formation of functional recurrent positive feedback circuits. Although postinjury neurogenesis is often interpreted as a salutary response contributing to recovery after injury, our work suggests that these neurons likely contribute to brain hyperexcitability after seizure insults. As similar morphologic changes occur to newborn granule cell neurons after other forms of brain injury, including traumatic brain injury and stroke, we postulate that this mechanism may contribute to functional neuropathology in a variety of postinjury settings. This may present new opportunities for therapeutic intervention, including via the modulation of postinjury neurogenesis with anesthetic drugs.
423 miRNAs were analyzed using nCounter miRNA expression panel (NanoString). Successful subregional dissection was validated using RT-qPCR detection of the DG-rich gene desmoplakin. In situ hybridization of mir-181a-5p in combination with cell markers NeuN (neurons) and GFAP (astrocytes) was carried out to investigate cell-type specific expression changes in mir-181a-5p.

Results: Pronounced differences between CA1 and DG in miRNA expression was observed for several brain-enriched miRNAs, greatest with mir-219-2-3p and mir-181a-5p, known regulators of ischemic injury. MiR-181a-5p expression was detected in situ in both neurons and astrocytes.

Conclusions: MiRNA expression profiles in response to transient forebrain ischemia were assessed and compared between hippocampal subregions for the first time. Observed differences in microRNA expression patterns between CA1 and DG may explain selective CA1 ischemic vulnerability. Targeted modulation of select miRNAs identified here may serve as a therapeutic intervention to improve cognition in survivors of cerebral ischemia. Supported by Finnish Cultural Foundation award 09072017 to Dr. Arvola and American Heart Association award FTF-1970029 to Dr. Stary.

[SNACC-12] Neonatal Anesthetic Exposure and the Risk of Seizure Disorder in Adulthood
Lin D, Liu J, Kass I, Cottrell J. Suny Downstate Medical Center, Brooklyn, NY.

Introduction: The early developing brain is especially vulnerable to insults from different anesthetics, which can result in long-lasting functional changes. Anesthetics such as, sevoflurane (sevo) targets the GABAA
receptor by enhancing inhibitory synaptic transmission in neurons. This is one of the main targets of sevo in the CNS to produce an anesthetic state. How is the GABAA receptor being modulated and what are the long-term functional changes after exposure to sevo during the neonatal period? To address these questions, we first investigated the changes in the electrophysiological properties of GABAA receptors in adults that had undergone P7 sevo treatment. We then examined the functional correlates of these changes by scoring drug-induced seizures.

Methods: Postnatal day 7 (P7) C57/BL6 male pups were exposed to 2% to 2.3% sevo in a 40% oxygen (O2) 60% nitrogen (N2) gas mixture for 2 hours. Blood oxygen levels were monitored with a pulse oximeter. Pups were reared and weaned under standard condition. Electrophysiology and behavior experiments were conducted when the mice were adults (7 to 9 wk old). Paired pulse stimulation of hippocampal slice CA1 neurons was used to measure inhibition of extracellular population spikes. For the drug-induced seizure experiments, mice were given an IP injection of 45 mg/kg of pentylenetetrazole and the Racine scale was used to score different seizure intensities.

Results: Paired-pulse stimulation in the CA1 region of the hippocampus showed that adult mice treated with sevo at P7 had significantly less inhibition compared with no sevo treated mice (Fig. 1). When the GABA receptor was blocked by the antagonist bicuculline, a significant increase in excitation was observed in the P7 sevo treated mice compared to the no sevo treated mice (Fig. 2). To induce seizures, PTZ was administered to adults, P7 sevo treated mice showed a trend toward increased seizure intensities compared with no sevo treated mice (Fig. 3). We are continuing these studies. *, **, and *** denote $P<0.05$, $P<0.01$ and $P<0.001$, respectively.

Conclusions: Neonatal sevo treatment impairs GABAA receptors, resulting in decreased inhibitory and increased excitatory synaptic transmission. This long-term functional change of the GABAA receptor is a plausible mechanism for neonatal sevo associated seizure risks in adulthood.

[SNACC-13] Isoflurane Modulates Microtubule Stability and Transport Via microRNA-9 Expression in Neurons and Astrocytes

Background: Despite the widespread use of general anesthetics their exact molecular and cellular mechanisms remain unknown. Microtubules (MTs) are polymers of tubulin subunits present in all cells and are essential for normal biological function. Alterations in MT stability disrupt the transport of mitochondria, vesicles containing neurotransmitters, membrane proteins, and other cargoes necessary for brain development and functioning. MT stability is regulated by MT-associated proteins (MAPs) and posttranslational modifications (PTMs) of tubulin. Alterations both in MAP expression and PTMs during development, aging, and following injury is well-documented, but remains uninvestigated after exposure to anesthesia. MicroRNAs are a class of non-coding RNAs capable of silencing protein translation of target genes. MicroRNA-9 (miR-9) significantly increases in the brain after exposure to anesthetics and has been identified as a mediator of several MAPs. In the present study, we tested the hypothesis that general anesthetics disrupt neuronal and glial MT stability and downstream effector function via modulations in miR-9.
Methods: Purified astrocyte and neuronal cultures were subjected to 2% isoflurane for 2, 4, and 6 hours, followed by assessment of miR-9, biochemical and immunofluorescent assessment of tubulin PMT and MT-mediated mitochondrial transport with MitotrackerGreenTM live-cell fluorescence imaging. Cultures were also subjected to transfection with miR-9 inhibitor or mimic, then assessed for MT dynamicity with fluorescent EB3 “comet” live-cell imaging.

Results: We observed a reduction in the ratio of acetylated (stable) to unstable tubulin following isoflurane exposure in neurons and astrocytes. This occurred coincident with increases in miR-9 expression. Isoflurane exposure resulted in a reduction in the number of total EB3 comets and MT growth rate while miR-9 inhibition augmented MT stability in primary neuronal cultures.

Conclusions: These findings suggest that isoflurane exposure induces MT instability by induction of miR-9 and suppression of downstream MAP targets. As MAP and miR-9 are individually critical regulators of development with age-related changes in expression, these findings may hold relevance for age-related differences in the effects of anesthetics, including differences in minimum alveolar concentration, and neurotoxicity versus neuroprotection.

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[SNACC-14] Neuron-Targeted Caveolin-1 Promotes Neuronal Plasticity in a Mouse Model of Alzheimer Disease (AD)


Alzheimer disease (AD) is the most common neurodegenerative disease in patients over 65 years of age. AD patients develop severe cognitive deficits, which are closely correlated with decreases in synapses and neuronal loss. Caveolin-1 (Cav-1), a scaffolding protein within membrane/lipid rafts microdomains, organizes signaling complexes that promote dendritic and axonal growth and synapse formation. Our previous work showed that neuron-targeted overexpression of Cav-1 (SynCav1) improves learning and memory in vitro, promotes...
neuroplasticity, and increases synaptic plasticity in vivo. It is therefore conceivable that SynCav1 may serve as a therapy to promote neuroplasticity and improve cognitive function in AD.

Wild type (WT) mice received hippocampal injections of SynRFP as Control group, and APYsw/PS1DE9 (AD) received either SynCav1 or SynRFP at 2.5 months of age. Learning and memory and general behavior were assessed using fear-conditioning and open field at 9 months of age, respectively. Immunofluorescence microscopy was used to measure dendrites (MAP2), immunoblot was used to measure axonal (SMI 31) and synaptic markers (PSD95 and TrkB), and electron microscopy was used to measure ultrastructural changes of myelinated axons (G-ratio) and synaptic plasticity (synapses, presynaptic vesicles).

There is no significant difference in anxiety between groups showed by open field test. AD-SynRFP mice exhibited decreased percent freezing (ie, reduced fear learning) on day 1 compared with other 2 groups, with no deficit in contextual or cued memory recall on day 2 or 3, respectively. In contrast, AD-SynCav1 mice exhibited greater percent freezing on day 1 compared with AD-SynRFP mice (no difference vs. WT-SynRFP), increased contextual (P < 0.04) and cued memory recall (P < 0.004) compared with both WT-SynRFP and AD-SynRFP mice on day 2 and 3, respectively. Immunofluorescence revealed decreased MAP2 and Cav-1 in cortex and hippocampus in AD-SynRFP mice; Cav-1 and MAP2 expression in AD-SynCav1 mice was greater than both WT-SynRFP and AD-SynRFP mice. Immunoblot analysis revealed decreased Cav-1, SMI 31, and Tbr2 in AD-SynRFP hippocampus, while AD-SynCav1 showed increased Cav-1, TrkB, PSD-95, and SMI 31. Electron microscopy of CA1 distal apical dendrites from AD-SynRFP mice showed a reduction in total glutamatergic asymmetric synapses (P = 0.001 vs. WT-SynRFP; P = 0.002 vs. AD-SynCav1) and decreased PSVs/bouton (P < 0.0001 vs. WT-SynRFP; P < 0.001 vs. AD-SynCav1). G-ratio, an inverse measure of myelination, was increased in Shaffer collateral axons in AD-SynRFP (P = 0.038 vs. WT-SynRFP; P = 0.0001 vs. AD-SynCav1; AD-SynCav1 mice exhibited a significant decreased G-ratio versus WT-SynRFP (P < 0.0005).

AD mice at 9 months of age show learning deficits and decreased hippocampal Cav-1, TrkB, MAP2, and SMI 31. In addition, AD-SynRFP showed ultrastructural alterations indicative of neurodegeneration (reduced synapses and PSVs and increased G-ratio). AD-SynCav1 exhibited preserved or restored learning and increased contextual and cued memory. Furthermore, SynCav1 preserved synaptic plasticity, synaptic ultrastructure and myelination in AD mice, and thus may serve as a potential target to promote neuroplasticity and restore brain function in AD.


Griffiths B*, Arvola O*, Sahbaie P†, Xu L*, Clarke D†, Stary C†.
*Stanford, †Veterans Affairs Palo Alto Health Care System, Palo Alto, CA.

Background: Mild traumatic brain injury (mTBI) results in permanent impairment in memory and learning and may be a precursor to other neurological sequelae. Clinical treatments to ameliorate the effects of mTBI are lacking. MicroRNAs (miRNAs) are short, noncoding transcripts that can bind to and inhibit the translation of mRNA genes. Inhibition of miR-181a has been shown to be beneficial in cerebral ischemia, but a protective role in mTBI has not been investigated.

Methods: In the present study miR-181a-5p antagonist or mismatch control sequence was stereotactically injected intracerebroventricularly 24 hours before closed-skull cortical impact in young adult male mice. The 6 to 8 weeks post-injury and 16 weeks post-181a antagonist was assessed with ppi withdrawal, open field, zero maze, Y maze, object and novel object recognition tests. Animals were sacrificed at 6, 24, and 28 days after TBI. Brains were processed for immunofluorescent histologic assessment for the neuronal marker NeuN, the perineuronal net marker wisteria floribunda lectin (WFA), the astrocyte marker glial fibrillary protein (GFAP), synaptophysin, postsynaptic density 95 (PSD95), cFos and the interneuron markers parvalbumin and reelin. Protein quantification was performed with Western blots for PSD95 and synaptophysin, and miRNA was localized in the hippocampus with fluorescent in situ hybridization of miR-181a.

Results: MiR-181a antagonist treatment reduced neuronal miR-181a expression, restored deficits in novel object recognition and increased hippocampal parvalbumin neuron expression in the dentate gyrus, despite loss of perineuronal nets. These changes were associated with decreased measures of dentate gyrus hyperactivity, including relative reductions in post PSD95 and cFOS+ neurons compared with controls.

Conclusions: These results suggest that anti-miR-181a pretreatment reduced excitotoxic interneuron death in the dentate gyrus from mTBI and preserved cognitive function. Future studies will extend these findings to testing post-injury anti-mir-181a treatment as a therapeutic clinical target following mTBI.

Supported by Rona Giffard NIH #5R01NS053898, Creed Stary AHA #14FTF19970029.
Cognitive Decline in Tg2576 Mice is Sex-dependently Correlated With Cerebral Amyloid-beta Load


Background: There is a sex-dependent decline of cognitive function in patients suffering from Alzheimer disease. This has also been shown in animal models. Aim of our investigation was to analyze potential pathological mechanisms like accumulation of amyloid-beta.

Methods: After governmental approval, we assessed cognitive function in male and female Tg2576 mice with an age of 6, 8, 10, 12, 14, and 16 months and compared them with their wild type littermates. We evaluated explicit memory using the modified hole board test (wrong choice total). From the prefrontal motor-cortex we performed an ELISA for human amyloid-beta 1-42. The brain area covered with insoluble amyloid deposits in cortex and hippocampus was detected by Methoxy-04 staining. We logarithmized the results and calculated linear regression analyses to the total number of wrong choice.

Results: Increased concentrations of total amyloid-beta were associated with an increase in wrong choice total ($P<0.001$) with more wrong choice total in female mice ($P<0.001$). Moreover, female sex modified the effect of total amyloid-beta on the amount of wrong choice total significantly (sex $\times$ amyloid-beta: $P<0.001$) (Fig. 1). Increased brain area with insoluble amyloid deposits was associated with an increase in wrong choice total ($P<0.001$) with more wrong choice total in female mice ($P<0.001$). Moreover, female sex modified the effect of insoluble amyloid deposits on the amount of wrong choice total significantly (sex $\times$ amyloid-beta: $P<0.001$) (Fig. 2).

Conclusions: Impairment of explicit memory in Tg2576 mice is associated with increased “amyloid load.” The fact that female mice perform worse
than males might reflect a higher sensitivity of females to the effects of soluble and insoluble amyloid-beta. This pathologic mechanism could be a target for further research regarding the sex-dependent alterations in cognitive function by anesthetics in mouse models for Alzheimer disease.1

References:

[SNACC-17] Incidence Of Post-operative Visual Dysfunction After Robot-assisted Laparoscopic Radical Prostatectomy
Kitaguchi M*, Egawa J†, Kinomoto A†, Kawanishi H†, Inoue S†, Kawaguchi M†, *Belland General Hospital, Osaka, †Nara Medical University, Nara, Japan.

Background: Robot-assisted laparoscopic radical prostatectomy (RALP) is a widely performed minimally invasive surgical technique used to treat prostate cancer. RALP has several advantages in comparison with conventional open prostatectomy, including reduced need for blood transfusion, less postoperative pain, and fewer surgical complications. During a RALP procedure, a steep Trendelenburg position and abdominal carbon dioxide gas insufflation are required. This procedure can induce a significant increase in intraocular pressure and optic nerve ischemia. A previous study reported that 28% of patients showed transient visual field defects after RALP.1 However, no evidence regarding visual outcomes after RALP is available. The National Eye Institute Visual Function Questionnaire (NEI-VFQ-25) is a self-completion questionnaire addressing visual function and assesses vision-related quality of life (QOL). The NEI-VFQ was translated into Japanese, and the reliability and validity of the Japanese version has been verified.2 The current study investigated the incidence of postoperative visual dysfunction after RALP using the Japanese version of the NEI-VFQ.

Methods: After obtaining approval of the ethics committee of our institution, written informed consent was obtained from all patients. Thirty-two patients undergoing RALP were included in the study. Visual function was assessed one day before surgery, 5 days after surgery, and 1 month after surgery using the Japanese version of the NEI-VFQ. A higher score in the NEI-VFQ indicates better vision-related QOL. Postoperative visual dysfunction (POVD) was defined as a 40-point decrease in the preoperative NEI-VFQ score in at least one of 8 subscales comprising general health (GH), general vision (GV), near vision (NV), distance vision (DV), social function (SF), mental health (MH), role limitation (RL), and dependency (DP). The total VFQ score was calculated as the average score of 7 subscales (GV, NV, DV, SF, MH, RL, and DP).2

Results: Of the 32 patients recruited in this study, 3 patients were excluded 5 days after surgery and 1 patient was excluded 1 month after surgery due to incomplete data. Of the remaining 28 patients, 4 patients (14.3%) showed POVD 5 days after surgery and no patient showed POVD 1 month after surgery. There was no significant difference between preoperative, 5-day postoperative, and 1-month postoperative total VFQ scores (83, 83, and 83, respectively; P = 0.20). The average age of the patients was 70 ± 6 years in the non-POVD group and 68 ± 5 years in the POVD group. The duration of intraoperative hypertension (sBP > 160 mm Hg) was 2 ± 5 minutes in the non-POVD group and 4 ± 6 minutes in the POVD group. The duration of postoperative hypercarbia (EtCO₂ > 43 mm Hg) was 30 ± 52 minutes in the non-POVD group, and 5 ± 7 minutes in the POVD group.

Conclusions: POVD was observed in 4 of 28 patients 5 days after RALP, all of whom recovered 1 month after the procedure. The total number of patients who showed POVD was low. Therefore, further studies are needed to identify the factors associated with POVD post-RALP.

References:
### Table 2. Intraoperative parameters

<table>
<thead>
<tr>
<th></th>
<th>Placebo (n=50)</th>
<th>Mannitol 0.7 (n=50)</th>
<th>Mannitol 1.0 (n=50)</th>
<th>Mannitol 1.4 (n=50)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intro-op Head position, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-neutral head position</td>
<td>23 (46)</td>
<td>20 (40)</td>
<td>28 (56)</td>
<td>29 (58)</td>
<td>0.229</td>
</tr>
<tr>
<td>Pre-Mannitol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>85 (76-93)</td>
<td>89 (89-99)</td>
<td>88 (89-98)</td>
<td>87 (89-98)</td>
<td>0.166</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>59 (52-66)</td>
<td>61 (54-66)</td>
<td>60 (54-68)</td>
<td>60 (53-68)</td>
<td>0.799</td>
</tr>
<tr>
<td>GLU (mmol L⁻¹)</td>
<td>5.2 (4.9-5.7)</td>
<td>5.3 (5.0-5.7)</td>
<td>5.0 (4.7-5.4)</td>
<td>5.2 (4.6-5.5)</td>
<td>0.098</td>
</tr>
<tr>
<td>Na (mmol L⁻¹)</td>
<td>143 (141-143)</td>
<td>142 (140-143)</td>
<td>142 (141-144)</td>
<td>142 (141-144)</td>
<td>0.584</td>
</tr>
<tr>
<td>K (mmol L⁻¹)</td>
<td>3.7 (3.5-4.0)</td>
<td>3.8 (3.6-4.0)</td>
<td>3.7 (3.8-3.9)</td>
<td>3.7 (3.4-3.9)</td>
<td>0.154</td>
</tr>
<tr>
<td>PaCO₂ (mmHg)</td>
<td>34 (32-36)</td>
<td>36 (33-37)</td>
<td>34 (32-37)</td>
<td>35 (33-38)</td>
<td>0.585</td>
</tr>
<tr>
<td>PaO₂ (mmHg)</td>
<td>212 (165-260)</td>
<td>212 (152-283)</td>
<td>213 (171-257)</td>
<td>223 (184-304)</td>
<td>0.002</td>
</tr>
<tr>
<td>SaO₂ (%)</td>
<td>360 (323-443)</td>
<td>362 (332-408)</td>
<td>359 (340-403)</td>
<td>359 (325-459)</td>
<td>0.673</td>
</tr>
</tbody>
</table>

**Post-Mannitol**

<table>
<thead>
<tr>
<th></th>
<th>Placebo (n=50)</th>
<th>Mannitol 0.7 (n=50)</th>
<th>Mannitol 1.0 (n=50)</th>
<th>Mannitol 1.4 (n=50)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP (mmHg)</td>
<td>77 (72-89)</td>
<td>83.3 (74.3-91.3)</td>
<td>82.5 (74.3-89.3)</td>
<td>81.5 (75.8-89.3)</td>
<td>0.824</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>57 (51-62)</td>
<td>57 (52-64)</td>
<td>58 (52-66)</td>
<td>62 (58-68)</td>
<td>0.321</td>
</tr>
<tr>
<td>GLU (mmol L⁻¹)</td>
<td>5.4 (4.9-5.8)</td>
<td>5.2 (4.7-5.5)</td>
<td>4.8 (4.4-5.5)</td>
<td>4.8 (4.4-5.5)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Na (mmol L⁻¹)</td>
<td>143 (142-144)</td>
<td>138 (137-140)</td>
<td>138 (135-139)</td>
<td>135 (134-136)</td>
<td>0.000</td>
</tr>
<tr>
<td>K (mmol L⁻¹)</td>
<td>3.7 (3.5-4.0)</td>
<td>4.0 (3.7-4.2)</td>
<td>3.9 (3.6-4.1)</td>
<td>4.0 (3.7-4.3)</td>
<td>0.004</td>
</tr>
<tr>
<td>PaCO₂ (mmHg)</td>
<td>34 (32-35)</td>
<td>34 (32-37)</td>
<td>34 (32-36)</td>
<td>34 (32-36.3)</td>
<td>0.441</td>
</tr>
<tr>
<td>PaO₂ (mmHg)</td>
<td>208 (170-243)</td>
<td>173 (129-219)</td>
<td>220 (153-295)</td>
<td>212 (160-257)</td>
<td>0.017</td>
</tr>
<tr>
<td>SaO₂ (%)</td>
<td>345 (321-440)</td>
<td>330 (318-462)</td>
<td>342 (319-450)</td>
<td>358 (325-454)</td>
<td>0.563</td>
</tr>
<tr>
<td>Total input (ml)</td>
<td>2600 (2100-3252)</td>
<td>2600 (2087-3400)</td>
<td>2750 (2138-3663)</td>
<td>3050 (2175-3487)</td>
<td>0.621</td>
</tr>
<tr>
<td>Total output (ml)</td>
<td>1500 (1105-2135)</td>
<td>2000 (1343-2803)</td>
<td>2275 (1575-2775)</td>
<td>2705 (1900-3400)</td>
<td>0.003</td>
</tr>
<tr>
<td>Urine volume (ml)</td>
<td>1150 (800-1725)</td>
<td>1500 (1100-2225)</td>
<td>1700 (1238-2325)</td>
<td>2100 (1500-2822)</td>
<td>0.000</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>355 (200-600)</td>
<td>300 (200-525)</td>
<td>300 (200-600)</td>
<td>310 (200-623)</td>
<td>0.867</td>
</tr>
</tbody>
</table>

MAP, mean arterial pressure; HR, heart rate; Glu, glucose; Na, Sodium; K, Potassium; PaCO₂, arterial partial pressure of carbon dioxide; PaO₂, arterial partial pressure of oxygen; SaO₂, arterial oxygen saturation.

Data were median (IQR) and n (%), unless otherwise stated. Shapiro-Wilk test, parametric or nonparametric tests were used accordingly. P<0.05 was used to denote statistic significant.

### Table 3. The primary outcome and the secondary outcome.

<table>
<thead>
<tr>
<th></th>
<th>Placebo (n=50)</th>
<th>Mannitol 0.7 (n=50)</th>
<th>Mannitol 1.0 (n=50)</th>
<th>Mannitol 1.4 (n=50)</th>
<th>Overall p value</th>
<th>Cochran Armitage test P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brain relaxation</td>
<td>22 (44)</td>
<td>22 (44)</td>
<td>43 (86)</td>
<td>44 (88)</td>
<td>0.0000</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Secondary outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relaxed dural tension</td>
<td>16 (32)</td>
<td>20 (40)</td>
<td>34 (68)</td>
<td>32 (64)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Surgical exposure</td>
<td>22 (44)</td>
<td>26 (52)</td>
<td>44 (88)</td>
<td>44 (88)</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Remedies*</td>
<td>41 (82)</td>
<td>36 (72)</td>
<td>32 (64)</td>
<td>25 (50)</td>
<td>0.007</td>
<td>0.0005</td>
</tr>
<tr>
<td>Complications†</td>
<td>24 (48)</td>
<td>14 (28)</td>
<td>16 (32)</td>
<td>28 (56)</td>
<td>0.013</td>
<td>0.368</td>
</tr>
<tr>
<td>Cerebral edema</td>
<td>19 (39)</td>
<td>10 (20)</td>
<td>15 (30)</td>
<td>26 (52)</td>
<td>0.007</td>
<td>0.0487</td>
</tr>
</tbody>
</table>

Incidence of primary outcome and secondary outcome were presented in n (%), between groups analysis were presented in RR (99% CI).

*Post-mannitol remedies included hyperventilation and extra mannitol infusion.

†Post-operation complications included hematoma, cerebral edema and death. No patients died within one week postoperatively.
Methods: In this randomized, controlled and double-blinded study, a total of 204 patients with midline shift who underwent elective supratentorial brain tumour surgery were equally allocated to receive placebo or 0.7, 1.0, or 1.4 g/kg mannitol infusion from January 2017 to July 2017. The primary outcome was the incidence of satisfactory BR. The secondary outcome included relaxed dural tension, adequate surgical exposure, additional treatments and postoperative 7-day complications.

Results: Demographics and baseline characteristics were well balanced among the groups. Trend analysis showed mannitol infusion increased satisfactory BR (P < 0.0001), relaxed dural tension (P < 0.0001), and adequate surgical exposure (P < 0.0001), and decreased the requirement for remedial treatments (P = 0.0011), all in a dose-dependent manner. The 1.0 g/kg (86%) and 1.4 g/kg (88%) mannitol groups had significantly higher proportion of satisfactory BR than in the 0.7 g/kg group (44%) and placebo group (44%) (P = 0.000). However, the incidence of cerebral edema was higher in the 1.4 g/kg (52%) group than 0.7 (20%) and 1.0 g/kg (30%) groups (P = 0.007).

Conclusions: Mannitol improved BR in a dose-dependent manner in patients with midline shift undergoing elective supratentorial brain tumour surgery. An optimal mannitol infusion dosage of 1.0 g/kg is recommended to achieve better BR with fewer side effects.

Key Words: mannitol, supratentorial brain tumour, brain relaxation

Clinical trial registration: www.chictr.org.cn-ChiCTRTRC13003984.

[SNACC-20] Conscious Sedation Versus General Anesthesia During Mechanical Thrombectomy: A Retrospective Study (Our Institutional Experience)
Jangra K, Bhagat H, Khurana D, Samagh N, Kapil S. Postgraduate Institute of Medical Education and Research, Chandigarh, Chandigarh, India.

Background: Endovascular treatment (EVT) in the form of mechanical thrombectomy combined with intravenous thrombolysis has been proven to be superior to the intravenous thrombolysis alone for the management of acute ischemic stroke. The literature is quite conflicting regarding the superiority of conscious sedation (CS) or general anesthesia (GA) for outcome in stroke patients during EVT. Previous retrospective studies showed that there is better neurological outcome after CS compared with GA while a recent prospective trial showed the outcome is comparable between the groups. Hence, we present our institutional experience regarding the outcome of mechanical thrombectomy in patients receiving CS and GA.

Methods: After approval from the institutional review board, this retrospective study was conducted at Postgraduate Institute of Medical Education and Research, Chandigarh, from year 2015 to 2017. The data of patients who underwent mechanical thrombectomy was collected retrospectively form the stroke data base. Differences in outcome between the GA and CS groups were compared by unpaired t test or Mann-Whitney U test for continuous variables and Fisher exact test for dichotomous data. The Modified Rankin Scale (mRS) scores 3 months after the stroke were compared using 2-tailed χ² test. Statistical significance was set to P < 0.05.

Results: In GA group 11 patients and in CS group 40 patients were analyzed. Baseline parameters including National Institutes of Health Stroke Scale (NIHSS) on arrival was comparable between the group (P = 0.030). Other stroke parameters such as degree of recanalization (P = 0.408), postprocedural NIHSS (P = 0.193), NIHSS at discharge (P = 0.922), complications during the procedure (P = 0.214), major postoperative complications (P = 0.845), duration of hospital stay (P = 0.821) and mRS at 3 months (P = 0.540) were comparable between the groups.

Conclusions: We observed that during mechanical thrombectomy for acute ischemic stroke, there was no difference found between general anesthesia and conscious sedation for major in-hospital complications and neurological outcome 3 months after stroke.

References:

[SNACC-21] Comparison of the Effects of Desflurane and Total Intravenous Anesthesia on the Optic Nerve Sheath Diameter in Robot-assisted Laparoscopic Radical Prostatectomy
Lee S*, Jeon Y*, Hwang J*, Park H†, *Seoul National University Bundang Hospital, Seongnam-Si, Gyeonggi-do, †Seoul National University Hospital, Seoul, Seoul, Republic of Korea.

Background: Optic nerve sheath diameter (ONSD) is well known as surrogate marker for intracranial pressure (ICP) in robot-assisted laparoscopic radical prostatectomy (RALP). We compared the effect of total IV anesthetics on the changes in ICP during RALP, which is known to increase ICP due to steep Trendelenburg position and carbon dioxide pneumoperitoneum.

Methods: Sixty patients were randomly assigned to the TIVA or desflurane (DES) group. Anesthesia was maintained with propofol and remifentanil in the TIVA group, and desflurane and remifentanil in the DES group. Ultrasonographic measurements of ONSD were performed at before induction of anesthesia (T0), 10 minutes after Trendelenburg position (T1), 1 hour after Trendelenburg position (T2), 2 hour after Trendelenburg position (T3), 10 minutes after resuming supine position (T4), arrival in the postanesthetic care unit (T5).

Results: The mean ONSD at time points (T1, T2, T3, T4, and T5) after anesthesia significantly increased compared with that before induction of anesthesia (T0). The changes of ONSD at T1, T2, T3, and T4 were significantly less in the TIVA group compared with the DES group (P = 0.024, 0.000, 0.000, and 0.035, respectively).

Conclusions: Trendelenburg position and carbon dioxide pneumoperitoneum in RALP increased the diameter of optic nerve sheath. The change of ONSD in TIVA group was significantly less than that in desflurane group during operation time in RALP. Through this results, TIVA could be a better choice for patients with the risk of cerebral hypoperfusion or with increased intracranial pressure.

[SNACC-22] Effects of Serum Sodium Level on Postoperative Outcome in Patients After Neurosurgical Procedures
Ikeda K, Toda Y, Nakatsuka H, Hazama K. Kawasaki Medical School, Kurashiki, Okayama, Japan.

Background: Sodium disorders are often seen in patients after neurosurgical procedures. We hypothesized that sodium disorders in neuro-surgical patients are associated with a poor outcome.

Methods: In this single-center retrospective observational study, patients aged 18 years or older who received craniotomy or intracranial revascularization during the period from January 2016 to December 2016 were enrolled. Data were obtained from electronic medical records, and the patients were divided into 2 groups by postoperative outcome: a poor group and a good group. Patients in the poor group included patients who died, patients with consciousness disturbance of 100 or higher in the Japan Coma Scale, and patients with hemiparesis at discharge. Data for serum sodium levels in the preoperative, intraoperative, and postoperative periods were compared in the 2 groups, and patient backgrounds, duration of anesthesia, intraoperative fluid volume, amount of bleeding, and use of hydroxyethyl starch (HES), albumin or transfusion were also compared in the 2 groups.

Results: There were 84 operations in the study period. Twenty-six patients (31.0%) were in the poor group (5 patients died, 8 patients had...
Conclusion: Serum sodium level is high in patients with a poor outcome.

Conclusions: A Retrospective Matched Cohort Study

Background: Concussion represents the fundamental manifestation of traumatic brain injury (TBI). It is estimated that millions of concussions occur each year in the United States alone with patients frequently requiring anesthesiology soon after injury. Concussion is associated with significant changes in cerebral hemodynamics that may persist for weeks despite the resolution of clinical symptoms. Altered physiology that may occur in the perioperative and anesthetic period may place the vulnerable brain following concussion at risk for secondary injury. We describe rates of postoperative complications in those with and without recent concussion.

Methods: Following IRB approval, patients who had a concussion and underwent an anesthetic within 90 days between January 2005 and June 2015 were meticulously identified from subjects included in a prior investigation. Patients with concussion were matched to control patients based on age, sex, date of procedure (within 1 y), surgical procedure, anesthetic type (general vs. monitored anesthetic care vs. primary regional), and ASA (American Society of Anesthesiologists) status. Matched control patients were excluded if they had a history of concussion, TBI, neurological disease, cognitive dysfunction or delay, chronic pain syndrome or previous neurosurgical intervention. Collected patient data included the following: demographics, aberrations in intraoperative vital signs (PaO2 < 80 mm Hg, systolic blood pressure < 100 or ≥ 160 mm Hg, temperature < 35 or ≥ 38°C), arterial hypoxemia or hyperoxia, duration of hospital length of stay, and postanesthesia care unit (PACU) outcomes including opioid consumption in oral morphine equivalents, postoperative nausea and vomiting (PONV), pain scores, and headache. PONV was defined as any documented nursing diagnosis of nausea and any antiemetic administration. Unpaired t test and χ2 tests were utilized for continuous and categorical variables, respectively.

Results: Seventy-seven postconcentration patients were matched to 176 control patients. In patients with recent concussion, there were significantly increased rates of PONV (10.4% vs. 4.0%, P = 0.047), rates of PACU pain score ≥ 7 (26.0% vs. 14.8%, P = 0.033), and headache within 90 days of anesthesia (18.2% vs. 5.7%, P = 0.002). There was no difference in hospital length of stay, intraoperative or PACU opioid consumption, and total intraoperative crystalloid. There was no difference in intraoperative or postoperative aberrant physiological variables, including hypoxic events, hypotensive or hypertensive episodes, and hypothermia or hyperthermia. There was no difference in these PACU outcomes: maximum pain score, Richmond Agitation-Sedation Scale score, or headache while in the PACU.

Conclusions: Compared with patients without concussion, patients with recent concussion were more likely to suffer PONV and high pain scores. Moreover, patients with recent concussion were more likely to receive a diagnosis of persistent headache following the anesthetic despite similar rates of headache while in the PACU.

References:

SNACC-24] Diabetes Mellitus and the Risk of Vasospasm After Aneurysmal Subarachnoid Hemorrhage


Background: Diabetes mellitus is one of the most common and known risk factor associated with increased incidence of cerebrovascular disorders. Delayed cerebral ischemia (DCI) occurs in ~30% of patients, develops 4 to 12 days after subarachnoid hemorrhage (SAH), and is characterized by large artery vasospasm, distal autoregulatory dysfunction and micro vessel thrombosis. Cerebral vasospasm is the important component of DCI representing as the major contributor to poor outcome after SAH. The aim of our study is to assess the incidence of vasospasm after aneurysmal subarachnoid hemorrhage in the patients with and without diabetes.

Methods: After IRB approval, data were collected retrospectively for all the patients admitted to our hospital for an aneurysmal subarachnoid hemorrhage between January 2009 and December 2014 and the patients with the history of diabetes were noted. The primary outcome is to assess the incidence of vasospasm (angiographic and symptomatic) in the diabetic versus nondiabetic patients. Univariate and logistic regression analysis were performed to identify the independent predictors of vasospasm. P < 0.05 is considered statistically significant.

Results: A total of 181 SAH patients were included. Factors significant in the univariate analysis are shown in the Table 1. Logistic regression analysis identified diabetes (odds ratio [OR], 2.21; confidence interval [CI], 0.76-6.44), Hunt and Hess grade (OR, 1.575; CI, 0.66-2.327) and the age (OR, 0.972; CI, 0.946-0.999) as the significant predictors of angiographic vasospasm outcomes.

Conclusions: The data in our study indicates that the angiographic vasospasm outcomes after aneurysmal SAH depends on (1) the presence of diabetes, (2) Hunt and Hess grade, and (3) age. Larger prospective trials are needed to establish the role of the diabetes in the outcomes after SAH.

References:


Buhl L, Boone M. Beth Israel Deaconess Medical Center, Boston, MA.

Introduction: Ideal patient positioning for intubation depends upon range of motion in the cervical spine, particularly at the occiput-C1 and C1-C2 levels. Many patients undergoing procedures on the cervical spine have limitations in this range of motion, often necessitating advanced airway techniques. While much has been written on initial airway management in these patients, comparatively less is known about extubation criteria. We performed a retrospective analysis of posterior high cervical and occipital fusions to identify factors related to delayed extubation, postoperative airway complications, and postoperative pulmonary complications.

Methods: The operating room schedule was searched from January 1, 2009 to April 30, 2018 for all posterior fusions involving the occiput, C1,
or C2. Cases that ultimately did not involve instrumented fusion of the occiput, C1, or C2 were excluded. Anesthesia records were reviewed to identify patient characteristics, airway management, and complications. Patients who were already intubated on arrival to the operating room were excluded. Procedure length was measured from anesthesia induction to procedure finish. In-patient records and discharge summaries were also reviewed to assess extubation time and postoperative complications, including pulmonary complications.

Results: We identified 135 cases that met the inclusion criteria. Of these, only 2 patients had airway complications in the immediate postoperative period (2/135, 1.5%). Both patients required reintubation while still in the operating room; however, this proved to be difficult in both cases, ultimately requiring emergent surgical airways. This low rate of postoperative airway complications did not allow for the identification of predictive factors. Of the variables analyzed, procedure duration, blood loss, intraoperative fluid administration, and highest cervical level fused were all

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Diabetes (n=27)</th>
<th>No Diabetes (n=154)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean±SD)</td>
<td>63±15</td>
<td>55±14</td>
<td>.009</td>
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<tr>
<td>Male Gender n(%)</td>
<td>7(26%)</td>
<td>44(28%)</td>
<td>.81</td>
</tr>
<tr>
<td>BMI (Median/IQR)</td>
<td>27/23-30</td>
<td>27/23-33</td>
<td>.01</td>
</tr>
<tr>
<td>Anterior circulation n(%)</td>
<td>22(82%)</td>
<td>124(81%)</td>
<td>.9</td>
</tr>
<tr>
<td>Clipping n(%)</td>
<td>8(30%)</td>
<td>64(42%)</td>
<td>.23</td>
</tr>
<tr>
<td>H and H grading (Median/IQR)</td>
<td>3/2-4</td>
<td>3/2-4</td>
<td>.56</td>
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<td>Modified Fisher (Median/IQR)</td>
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<td>3/3-4</td>
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<tr>
<td>Perforation n(%)</td>
<td>2(7%)</td>
<td>5(3%)</td>
<td>.28</td>
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<tr>
<td>Symptomatic vasospasm Y(%)</td>
<td>11(48%)</td>
<td>71(51%)</td>
<td>.75</td>
</tr>
<tr>
<td>Any vasospasm Y(%)</td>
<td>8(35%)</td>
<td>88(60%)</td>
<td>.004</td>
</tr>
</tbody>
</table>

BMI= body mass index. H and H = Hunt and Hess grading.

Table 2: Logistic regression analysis for the predictors of angiographic vasospasm after SAH. Values are represented as odds ratio and 95% confidence interval. P<0.05 is statistically significant.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds ratio</th>
<th>95% Confidence Interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>.221</td>
<td>.076-.644</td>
<td>.006</td>
</tr>
<tr>
<td>Hunt and Hess grade</td>
<td>1.575</td>
<td>1.066-2.327</td>
<td>.023</td>
</tr>
<tr>
<td>Age at SAH</td>
<td>.972</td>
<td>.946-.999</td>
<td>.044</td>
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</tbody>
</table>
significant predictors of delayed extubation. Patient age, ASA classification, BMI, underlying cervical spine pathology, initial airway management, number of airway attempts, and use of neurophysiological intraoperative monitoring were not significant predictors of delayed extubation. Among those patients in whom extubation was delayed, we did not see an increased risk of postoperative pulmonary complications. Accordingly, although the overall rate of airway complications in this population is low, the consequences can be severe, necessitating a higher degree of scrutiny when deciding to extubate postoperatively. In our institution, factors predictive of delayed extubation were procedure duration, blood loss, intraoperative fluid administration, and highest cervical level fused. While the choice to extubate postoperatively must always be considered on a case-by-case basis, careful consideration of these factors and a recognition that airway complications in this population often have more severe consequences than in the general population can aid in decision making.

Conclusions: Our retrospective analysis revealed a low rate (1.5%) of postoperative airway complications in patients undergoing posterior high cervical and occipital fusions; however, both patients who required immediate postoperative reintubation required emergent surgical airways. Accordingly, although the overall rate of airway complications in this population is low, the consequences can be severe, necessitating a higher degree of scrutiny when deciding to extubate postoperatively. In our institution, factors predictive of delayed extubation were procedure duration, blood loss, intraoperative fluid administration, and highest cervical level fused. While the choice to extubate postoperatively must always be considered on a case-by-case basis, careful consideration of these factors and a recognition that airway complications in this population often have more severe consequences than in the general population can aid in decision making.

**References:**

**[SNACC-26] Predictive Factors for Hypotension After the Supine-to-prone Positional Change in Patients Undergoing Spine Surgery**
Park H*, Hwang J†, Jeon Y†, *Seoul National University Hospital, Seoul; †Seoul National University Bundang Hospital, Seongnam, Gyeonggido, Korea.

**Background:** The supine-to-prone positional change can result in hypotension by decreasing venous return. In general, this hypotension related with positional change can be counteracted by autonomic nervous system such as baroreceptor reflex and increased sympathetic activation in unanesthetized subjects. However, in anesthetized patients, depression of cardiac contractility and blockade of the compensation mechanism by anesthetics may increase the incidence of hypotension after the supine-to-prone positional change. There has been no study concerning the incidence and risk factors of hypotension after the supine-to-prone positional change in anesthetized patients until now. In this study, predictive factors for hypotension after the supine-to-prone positional change were investigated retrospectively.

**Methods:** Demographics, current medication, hemodynamic data such as mean blood pressure (MBP) and heart rate measured before (supine position) and after (prone position) positional change, respiratory variables, and pulse pressure variation in the supine position were collected from 179 patients undergoing elective posterior spine surgery in the prone position between May in 2017 and March in 2018. Hypotension after the supine-to-prone positional change was defined as a reduction in MBP > 20% after the positional change.

**Results:** In multivariate logistic regression analysis, preoperative use of beta-blocker (odds ratio [95% confidence interval], 1.64 [1.21-4.83], P = 0.031), MBP measured in the supine position just before the supine-to-prone positional change (supine MBP<sub>Plast</sub>, 1.04 [1.00-1.07], P = 0.033) and effect-site concentrations of remifentanil (2.12 [1.51-2.96], P < 0.001) were independent risk factors for hypotension after the supine-to-prone positional change.

**Conclusions:** Preoperative use of beta-blocker, high concentrations of remifentanil, high supine MBP<sub>Plast</sub> were associated with development of hypotension after the supine-to-prone positional change in patients undergoing posterior spine surgery.

**[SNACC-27] Comparative Analysis of Effect of Pressure Controlled and Volume Controlled Ventilation on Respiratory Mechanics, Haemodynamics and Systemic Stress Response in Patients Undergoing Lumbar Spine Surgery in Prone Position**
Purohit S, Gupta D, Sawai Man Singh Medical College and Attached Group of Hospitals, Jaipur, Rajasthan, India.

**Background:** General anesthesia in prone position is related with increased airway pressure, decreased pulmonary and thoracic compliance.

**Aim:** Comparison of pressure controlled and volume controlled ventilation in patients undergoing lumbar spine surgery in prone position.

**Methods:** After ethics committee approval and written informed consent, a comparative randomized interventional study was conducted from March to June 2017. Patients were randomized in 2 groups of 30 each using sealed envelope method with 80% power and 97.5% confidence interval of the study. Patients of either sex, ASA grade 1 and 2, age 20 to 65 years were included while those with severe pulmonary disease and BMI > 30 kg/m<sup>2</sup> were excluded. Mean and SD were calculated for quantitative data while proportions for qualitative data. For significance of difference, χ<sup>2</sup> test was used for proportions and unpaired t test for mean. P-value of <0.05 has been taken as significant.

**Primary Objective:** Peak airway pressure (P-Peak).

**Secondary Objectives:** PaO<sub>2</sub> levels, PaCO<sub>2</sub> levels, mean airway pressure, dynamic compliance, serum cortisol levels, blood glucose levels, heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure.

**Results:** Demographic parameters and perioperative hemodynamic values were comparable with no significant statistical difference. P-Peak levels were significantly higher in Group VC as compared with Group PC (P < 0.05). Dynamic compliance levels during prone position were higher in Group PC when compared with Group VC. Postoperative PaO<sub>2</sub> level was significantly higher in Group PC compared with Group VC. The difference between postoperative and preoperative serum cortisol and blood glucose levels was significantly less in patients put on PCV mode.

**Conclusions:** According to our study, PCV mode is associated with lower P-Peak levels during prone position, better oxygenation postoperatively and lesser systemic stress response. We concluded that PCV mode might be more appropriate in prone position during anesthesia.

**References:**
1. Kryzanski J, Nall J, Liu P, Balonov K. *Tufts Medical Center, Boston, MA.*
2. Background: Traditionally surgery for degenerative lumbar disc disease is performed under general anesthesia; however, spinal anesthesia has been shown to be as effective with similar perioperative outcomes and higher patient satisfaction. Studies have evaluated use of spinal anesthesia with decompressive surgeries and deemed it safe; however, there are few large series evaluating use during fusion operations in addition to decompressive surgeries. This study aims to present a single institution’s experience with spinal anesthesia for lumbar decompressive and fusion surgeries.

**Methods:** This is a retrospective chart review of patients undergoing spinal anesthesia for lumbar surgeries from March 2017 to March 2018. All patients requiring lumbar surgery that was expected to take <3 hours, including those requiring multilevel and interbody fusions, were offered spinal anesthesia. The level of the spinal was either rostral or caudal of the operative level was considered based on lumbar anatomy. Data was analyzed to determine the safety and efficacy of spinal anesthesia.

**Results:** The average age was 65. Fifty percent of patients underwent lumbar interbody fusions, with 20% of these patients having undergone prior surgery at the operative level. Of the 74 cases, only one required conversion to general anesthesia before beginning the operation and 2 required a second dose of adequate anesthesia before the beginning of the operation. None required conversion to general or additional doses intraoperatively. The average time from end of procedure to leaving the OR room was 5.6 minutes. There were no major cardiac or pulmonary events with 5% of patients with an ASA of III or IV. There was one spinal headache that required a blood patch for treatment.
Conclusions: To our knowledge this is the largest series of interbody fusions performed under spinal anesthesia. The results suggest that spinal anesthesia is a safe alternative for patients undergoing lumbar decompressive and fusion surgeries that are expected to be completed in under 3 hours. It should be considered for all patients, especially those with high risk for perioperative general anesthesia complications.

References:

[SNACC-29] A Retrospective Study Comparing Discrepancy Between Estimated and Calculated Blood Loss and Infectious Complications in Multilevel Spinal Fusion Surgery
Ford K*, Uejima J*, Moreland N†, Zeeni C‡, Hemmer L*, Behawy J*, Koht A*, McCarthy R§, Carabini L*. *Feinberg School of Medicine, Northwestern University, Chicago, IL; †Ronald Reagan UCLA Medical Center, Los Angeles, CA; ‡American University of Beirut, Beirut, Riad el-so, Lebanon; §Rush University Medical Center, Chicago, IL.

Introduction: Estimates of blood loss (EBL) in multilevel spine fusion surgery ranges from 50 to over 15,000 mL with greater inaccuracies associated with higher blood loss. While previous studies demonstrate an increased rate of surgical site infections in patients with anemia, overestimating EBL can also result in unnecessary transfusion, and thus higher morbidity and mortality. Calculated blood loss (CBL) can be derived from the hemoglobin (Hgb) lost, the volume of blood transfused, and reinfused cell salvaged blood. We hypothesized that for spinal
fusions > 3 bony levels, EBL would underestimate CBL, and that greater differences would be associated with infectious complications.

Methods: This is a retrospective study describing the morbidity and mortality observed in a large single center cohort of patients who underwent spinal fusions of ≥3 bony levels between January 2003 and September of 2013. The equation used for CBL = EBV × (Hgb initial − Hgb final/Hgb average) + 500 mL × PRBC units + Cell saver (mL). The difference in CBL and EBL was assessed using the Bland Altman analysis, and then analyzed for association with postoperative infectious complications. A P < 0.05 was required to reject the null hypothesis.

Results: The final cohort included 978 cases of multilevel spinal fusions. There were 10 perioperative mortalities and 349 (35.6%) cases involving a complication. A total of 27 patients completed the study and were analyzed. Median age: 59 years old (range: 33 to 76 y). Inconsistencies between self-reports and the TST were high (24/27, 88%), thus most patients either took substances they did not report or reported taking a substance that did not show up on the TST. Discrepancies occurred for acetaminophen, narcotics, benzodiazepines, muscle relaxants, antidepressants, NSAIDs, antiepileptic, antihistamines, lidocaine or hypnotics. Marijuana and alcohol use had high accuracy between self-report and TST, 100% and 87.5%, respectively. A correlation between polypharmacy and intraoperative and postoperative care. Preoperative toxicology screening tests (TST) can provide valuable information about substances taken at the time of surgery. We hypothesize that TST can identify patients at increased risk for higher doses of anesthetic and analgesics needed perioperatively. Earlier identification of these patients allows for the development of comprehensive and multidisciplinary strategies to improve perioperative patient care and reduce costs.

Methods: After IRB approval, 30 patients with chronic back pain scheduled for spine surgery were enrolled in a single-center observational study. Two preoperative urine samples were collected and TST were performed to detect up to 136 substances using a liquid chromatography and mass spectrometry system. Results were compared with the patient’s report of their prescribed and nonprescribed medications. Correlations were established between polypharmacy observed on TST and perioperative variables.

Results: A total of 27 patients completed the study and were analyzed. Inconsistencies between self-reports and the TST were high (24/27, 88%), thus most patients either took substances they did not report or reported taking a substance that did not show up on the TST. Discrepancies occurred for acetaminophen, narcotics, benzodiazepines, muscle relaxants, antidepressants, NSAIDs, antiepileptic, antihistamines, lidocaine or hypnotics. Marijuana and alcohol use had high accuracy between self-report and TST, 100% and 87.5%, respectively. A correlation between polypharmacy and intraoperative and postoperative care. Preoperative toxicology screening tests (TST) can provide valuable information about substances taken at the time of surgery. We hypothesize that TST can identify patients at increased risk for higher doses of anesthetic and analgesics needed perioperatively. Earlier identification of these patients allows for the development of comprehensive and multidisciplinary strategies to improve perioperative patient care and reduce costs.

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Conclusions: Greater differences in calculated and EBL were observed in patients that had infectious complications. Our findings confirm the association of inaccurate EBL and a greater incidence of postoperative infections. These results are likely related to delayed resuscitation with large volume blood loss and transfusion requirements.

References:

[SNACC-30] Comprehensive Strategies for Preoperative Optimization and Management of Spine Surgery Patients: A Pilot Study


Hypothesis: Toxicology screening tests performed in patients scheduled for spine surgery will help identify patients who are under polypharmacy and/or using nonprescribed substances to understand its effect on perioperative course.

Primary Outcome: Toxicology screening testing is a feasible, reliable and accurate method that can identify prescribed, over-the-counter and potential drugs of abuse taken by patients presenting for spine surgery.

Secondary outcome: The influence of polypharmacy, alcohol and marijuana on anesthetic and pain scores.

Background: Patients suffering from chronic pain have increased incidence of substance misuse and abuse of both prescribed and illicit substances and can present significant challenges in their intraoperative and postoperative care. Preoperative toxicology screening tests (TST) can provide valuable information about substances taken at the time of surgery. We hypothesize that TST can identify patients at increased risk for higher doses of anesthetic and analgesics needed perioperatively. Earlier identification of these patients allows for the development of comprehensive and multidisciplinary strategies to improve perioperative patient care and reduce costs.

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Conclusions: Toxicology screening testing in chronic pain patients presenting for spine surgery can be useful to identify medications and other substances currently taken by the patients as self-report is often inaccurate. Subgroups of patients benefit from optimization before surgery and from a personalized analgesic and anesthetic plan.

[SNACC-31] O-C1-C2 Dynamics During Flexible Fiberoptic Bronchoscopy and Video Laryngoscopy in Patients With Atlantoaxial Dislocation: A Cinefluoroscopic Comparison
Agrawal S, Bhagat H, Panda N, Jangra K, Salunke P. PGIMER, Chandigarh, Chandigarh, India.

Background: The optimal intubation technique for patients with suspected or documented cervical spine instability as well as for all patients requiring endotracheal intubation remains unresolved. Anesthesiologists usually encounter patients with cervical spine disorders. Improper airway management in these patients is frequently criticized for the neurological deterioration. We undertook this study to know the interrelationship and dynamic change of bony landmarks associated with fiberoptic bronchoscopy (FOB) when compared with videolaryngoscopy (VL) as an indirect suggestion of possible worsening or improvement of the diameter of the cervical spinal canal.

Methods: After oral and written informed consent, prospective, randomized, double blinded, clinical trial was conducted in 62 patients of ASA grade I-II aged between 12 and 65 years with atlantoaxial dislocation (AAD). Patients were randomized for intubation with either VL or FOB and process was continuously recorded cinefluoroscopically. The data was analyzed to calculate following distances: Distance D1 = atlantodental interval (ADI). Distance D2 = horizontal (h), vertical (v), and diagonal (d) distance between inferioposterior point on posterior atlas arch and superiobterior point at C2 spinolaminar junction (marker of spinal canal diameter when anterior arch of atlas not visualized due to occipitalization).

Results: The use of video-laryngoscope and fiberoptic bronchoscope guided intubation was associated with movement at Atlas and Axis as measured by change in horizontal, vertical, diagonal distances and distance ADI. There was statistically significant decrease in ADI in VL group (74.1%) as compared with FOB group (35.7%). No statistically significant difference was found in mean horizontal, vertical, diagonal distances in neutral position and in position with maximum movement during intubation. Postoperative motor power was comparable between the 2 groups.

Conclusions: Both the technique of intubation appears to be equally effective in preventing cervical spinal canal compression in patients with AAD with in line skeletal traction. However, VL appears to be superior to FOB with respect to reduction in distance ADI.

Reddy M, Kamath S, Dutta K. National Institute of Mental Health & Neurosciences (Nimhans), Bengaluru, Karnataka, India.

Introduction: Cervical spine (c-spine) movement during intubation with direct laryngoscopy (DL) can cause new-onset neurological deficits in patients with unstable cervical spine (UCS). While fiberoptic intubation is preferred, this is not always possible. Intubation using videolaryngoscope causes lesser c-spine movement than DL and may be better option for intubation in these patients. The primary objective of this study was to...
compare c-spine movement during awake fibreoptic-guided intubation (FGI) and McGrath videolaryngoscope-guided intubation (VGI) in patients undergoing surgery for UCS.

**Methods:** Following ethics committee approval and informed consent, 46 patients with UCS scheduled for fixation surgery were recruited over 1-year. Patients were included if they were 18 to 65 years and had upper c-spine instability. On the basis of computer-generated table, patients were randomized to FGI or VGI. Awake intubation was facilitated with airway blocks and fentanyl. C-spine movement during intubation was assessed by lateral fluoroscopy at three time points (T1-baseline, T2-during glottis view, and T3-with tube in situ). Motor power was assessed before and after intubation.

**Results:** The most common diagnosis was atlanto-axial dislocation followed by C1 or odontoid fracture. The mean age was 34.48 (13.29) and 32.74 (9.91) years in VGI and FGI groups, respectively. The degree of motion at C1/2 was 5.50 ± 1.2 in FGI and 8.75 ± 2.1 in VGI (P = 0.001). The movement at C3 was 4.37 ± 0.91 in FGI and 3.06 ± 1.1 in VGI. No patient developed new-onset deficits.

**Conclusions:** The degree of cervical spine movement was more with McGrath VL. However, no patient developed intubation-related motor deficits.

**References:**

**[SNACC-33] A Retrospective Study of Complications in Awake Craniotomy During Past 10 Years**
Charoenkoop P, Sangdee N, Ramathibodi Hospital, Mahidol University, Rachitevi, Bangkok, Thailand.

**Background:** Awake craniotomy for eloquent area lesion resection and deep brain stimulation (DBS) have become trend toward increasingly.

**Table 1 Anesthesia technique classification in awake craniotomy**

<table>
<thead>
<tr>
<th>Scheduled for awake craniotomy</th>
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</tr>
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</table>

<table>
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<tr>
<th>AC method (n =30)</th>
<th>Asleep phase with assisted or controlled ventilation by LMA 29 cases, ETT 1 case</th>
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<tr>
<td>Anesthetic agent: propofol +/- rocuronium, inhalation 0.5-1.5 MAC</td>
<td></td>
</tr>
<tr>
<td>Awake phase</td>
<td></td>
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<tr>
<td>Asleep phase with spontaneous ventilation with nasal cannula or oxygen mask</td>
<td></td>
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<tr>
<td>Anesthetic agent: propofol +/- rocuronium</td>
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<table>
<thead>
<tr>
<th>SP method (n =33)</th>
<th>Asleep phase with spontaneous ventilation by nasopharyngeal airway</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 cases, nasal cannula 14 cases</td>
<td></td>
</tr>
<tr>
<td>Anesthetic agent: total anesthesia agent</td>
<td></td>
</tr>
<tr>
<td>Awake phase</td>
<td></td>
</tr>
<tr>
<td>Asleep phase same as first phase</td>
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<td>Including DBS (n =16)</td>
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<thead>
<tr>
<th>CPAP method (n =3)</th>
<th>Asleep phase spontaneous ventilation by nasopharyngeal airway with CPAP 3 cases</th>
</tr>
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<tbody>
<tr>
<td>Anesthetic agent: propofol, inhalation 0.5-1.5 MAC</td>
<td></td>
</tr>
<tr>
<td>Awake phase</td>
<td></td>
</tr>
<tr>
<td>Asleep phase spontaneous ventilation by nasopharyngeal airway with CPAP 3 cases</td>
<td></td>
</tr>
<tr>
<td>Anesthetic agent: propofol, inhalation 0.5-1.5 MAC</td>
<td></td>
</tr>
</tbody>
</table>

**AC =** assisted or controlled ventilation, **SP =** spontaneous ventilation method, **CPAP =** continuous positive airway pressure, **LMA =** laryngeal mask airway, **ETT =** endotracheal tube, **MAC =** minimum alveolar concentration,
Awake test is a challenging task to perform adequate anesthesia without causing a problem.

**Methods:** All awake craniotomy records from 2006 to 2016 in our institution were reviewed. The anesthetic techniques were all asleep-awake-asleep technique. Patients were divided into 3 methods according to the ventilation technique. First method was assisted or controlled ventilation method (AC) during first asleep phase. Patients in second methods were on spontaneous ventilation method (SP) throughout the surgery. Last method, using nasopharyngeal airway with connector to inhalation anesthetic agents, created a continuous positive airway pressure (CPAP) while spontaneous breathing. Our study reviewed complications including anesthesia-related, respiratory, cardiovascular and neurological events.

**Results:** The 66 patients were classified in AC, SP, CPAP method. A total of 25 cases from 30 cases (83.33%) in AC method found a complications, mostly in neurological problems. 19 cases from 33 cases (57.57%) in SP method had complications, mainly in respiratory events. The serious respiratory-related complications including upper airway obstruction, reintubation, venous air embolism were only found in DBS from SP method. Three cases in CPAP method were all had complications.

<table>
<thead>
<tr>
<th>Table 2 Demographic data in awake craniotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics (66)</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>ASA physical status</td>
</tr>
<tr>
<td>BMI (kg·m⁻²)</td>
</tr>
<tr>
<td>Expected difficult airway</td>
</tr>
<tr>
<td>Smoking</td>
</tr>
<tr>
<td>Alcohol Drinking</td>
</tr>
<tr>
<td>On anti-epileptic drug</td>
</tr>
<tr>
<td>Burr hole</td>
</tr>
<tr>
<td>Functional neurosurgeon</td>
</tr>
<tr>
<td>Neuroanesthesiologist</td>
</tr>
<tr>
<td>Duration of anesthesia (minutes)</td>
</tr>
<tr>
<td>Duration of operation (minutes)</td>
</tr>
<tr>
<td>Duration of awake time (minutes)</td>
</tr>
<tr>
<td>Head fixation</td>
</tr>
<tr>
<td>Regional block</td>
</tr>
<tr>
<td>Anesthetic drug</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
</tr>
<tr>
<td>ICU stay (days)</td>
</tr>
</tbody>
</table>

BMI = body mass index, ICU = intensive care unit, mcg = microgram, N₂O = nitrous oxide
significant associations with complications were using fentanyl 100 µg or more, AC method, CPAP method, tumor removal operation and smoking. There were inversely related with complications by using dexmedetomidine, SP method and DBS.

**Conclusion:** Complications in awake craniotomy was massive and some were lethally. Anesthesiologist must be aware throughout procedure.

[SNACC-34] Assessment of Airway in Patients With Acromegaly Undergoing Surgery: Predicting Successful Tracheal Intubation
Prabhakar H, Kapoor I, Mahajan C. All India Institute of Medical Sciences, New Delhi, Delhi, India.

**Background:** In the field of anesthesia, acromegaly is considered a cause of both, difficult airway management and tracheal intubation. There is high possibility of unanticipated difficult intubation in patients with acromegaly despite a lower percentage of patients being identified preoperatively as having a difficult airway. In this study, we carried out various airway assessment tests preoperatively and during induction of anesthesia to find out the predictors of easy tracheal intubation in patients with acromegaly.

**Method:** After Ethics approval, all patients of either sex, diagnosed as a case of acromegaly scheduled to undergo pituitary surgery were enrolled, over a period of 3 years. Demographic details were noted. Various airway assessment tests for difficult intubation were performed before surgery; modified Mallampati classification in sitting and supine position, mouth opening, upper lip bite test, thyromental, thyrohyoid, sternomental, and hyomental distance; the length of upper incisors, presence of reching mandible and neck movement were checked. Any history of obstructive sleep apnea was also taken. After induction of anesthesia, Cormac lehane grading and external laryngeal manipulation, if carried out was also noted. Data were presented as number percentage or mean ± SD as appropriate. χ² test was used to assess the relationship between airway assessment parameters and ease of intubation. Logistic regression was used find the odds associated with airway assessment parameters in relation to ease of intubation. The results were reported as odds ratio (95% confidence interval). The P-value <0.05 was considered statistically significant.

**Results:** A total of 42 patients were enrolled. The male to female ratio was 19:23 with mean age of 37.95 [11.5] and mean weight of 72.7 [10.3]. The calculated odds ratio of airway assessment tests is tabulated. There was significant relationship between upper lip bite test and difficult intubation with 25.5 times higher chances of difficult intubation in acromegaly patients. We also found that with higher CL grading there is 8 times higher chances of difficult intubation.

**Conclusions:** We conclude that upper lip bite test and Cormac lehane grading are reliable predictors of easy intubation in patients with Acromegaly undergoing surgery.

| Table 3 Incidence of complications during awake craniotomy in each anesthetic method |
|-------------------------------|------------------|------------------|------------------|
| Anesthetic problem           | AC method n=30 (%) | SP method n=33 (%) | CPAP method n=3 (%) |
| Excess sedation              | 4 (13.3%)         | 1 (3.03%)         |                  |
| Nausea and vomit             | 4 (13.3%)         | 3 (9.09%)         |                  |
| Pain                         | 1 (3.33%)         |                  |                  |
| Uncooperative                | 1 (3.33%)         |                  |                  |
| Hypothermia                  | 1 (3.33%)         |                  |                  |
| Respiratory problem          |                   |                  |                  |
| Hypercarbia                  | 5 (16.67%)        | 8 (24.24%)        | 1 (33.33%)       |
| Upper airway obstruction     | 1 (3.03%)         |                  |                  |
| Reintubation                 | 1 (3.03%)         |                  |                  |
| Venous air embolism          | 1 (3.03%)         |                  |                  |
| Cardiovascular problem       |                   |                  |                  |
| Hypertension                 | 5 (16.67%)        | 2 (6.06%)         | 1 (33.33%)       |
| Hypotension                  | 5 (16.67%)        |                  |                  |
| Bradycardia                  | 2 (6.67%)         | 4 (12.12%)        |                  |
| Neurologic problem           |                   |                  |                  |
| Tight brain                  | 3 (10%)           | 1 (3.03%)         | 2 (66.67%)       |
| Weak                         | 9 (30%)           | 1 (3.03%)         |                  |
| Seizure                      | 2 (6.67%)         | 1 (3.03%)         |                  |
| Overall                      | 25 (83.33%)       | 19 (57.57%)       | 3 (100%)         |
| More than 1 problem          | 12 (40%)          | 5                 | 1 (33.33%)       |

AC = assisted or controlled ventilation, SP = spontaneous ventilation method, CPAP = continuous positive airway
Brainstem. Our patient lesions including locus coeruleus and nucleus tractus solitaries in the pathway, which is radiologically supported by studies showing correlation.ruled out. One mechanism is CNS lesions disrupting the autonomic risk procedure with little presenting as intraoperative profound refractory hypotension, despite low This case report demonstrated possible severe cardiovascular AD pre-

Conclusions: Formal testing for cardiovascular AD is a diagnostic challenge. Practical evaluation include obtaining preoperative orthostatic vital signs and history. One may also consider reviewing MRI lesions in regions associated with autonomic dysfunction which may help predict hemodynamic instability and need for invasive monitoring. Review of prior anesthesia records for response to specific vasopressors also can provide valuable information.

References:

| Table: Various airway assessment parameters in patients with Acromegaly |
|-----------------------------|----------------------|----------------------|
|                             | Odds ratio [95% Confidence Interval] | P-value |
| Mouth opening               | 2.4 [0.36 to 15.9]    | 0.36     |
| Mallampati grade (sitting)  | 6.25 [1.03 to 37.6]   | 0.05     |
| Mallampati grade (supine)   | 8.99 [0.97-83.0]      | 0.05     |
| Upper lip bite test         | 25.5 [2.12 to 307.2]  | 0.01     |
| Hyomental distance          | 13.6 [1.03 to 179.0]  | 0.05     |
| Steromental distance        | 5.81 [0.93 to 35.9]   | 0.06     |
| External laryngeal manipulation | 3.33 [0.57 to 19.5]  | 0.18     |
| Cormack Lehane Grade        | 8 [1.36 to 47.0]      | 0.02     |

[SNACC-35] Cardiovascular Autonomic Dysfunction in Multiple Sclerosis Contributing to Severe Intraoperative Hypotension
Srisooskae G, Mohamed B. University of Florida, Gainesville, FL.

Case Report: A 53-year-old women with history of multiple sclerosis (MS) was scheduled for intrathecal baclofen pump placement for severe spasticity. She was diagnosed at age 27 with primary progressive MS manifested as bilateral leg weakness and gait difficulties. Her 2014 magnetic resonance imaging (MRI) showed multiple lesions in periventricular and brainstem regions, including the pons and medulla. Her MS-related symptoms included fatigue, diplopia, and memory deficits. She denied cardiovascular diseases or symptom, although her functional status was difficult to assess due to wheelchair bound state. Her active medications were tizanidine and vitamin D. Preoperative vital signs and labs were normal. Shortly after uneventful IV induction and intubation, her blood pressure drastically dropped to MAP of 30 seconds, from baseline MAP in the 90 seconds. There was minimal responses to fluid boluses and high dose vasopressors, including phenylephrine up to 1 mcg/kg/min and large boluses of ephedrine, vasopressin, and calcium. On emergence, her hemodynamics improved and she was wean off vasopressor medications. She was extubated and recovered in PACU without sequelae.

Discussion: MS is an immune-mediated disease of the CNS involving inflammation and demyelination of optic nerve, brain, and spinal cord. Anesthetic considerations for MS patients include cautious use of neuromuscular blockers, avoidance of hyperthermia, aspiration risk, and postoperative urinary retention from neurogenic bladder. Cardiovascular autonomic dysfunction (AD) in MS are commonly described in neurology literature but has not been well studied in perioperative setting.

This case report demonstrated possible severe cardiovascular AD presenting as intraoperative profound refractory hypotension, despite low risk procedure with little fluid shifts and common causes of hypotension ruled out. One mechanism is CNS lesions disrupting the autonomic pathway, which is radiologically supported by studies showing correlation between the severity of cardiovascular AD and location of MRI lesions including locus coeruleus and nucleus tractus solitaries in the brainstem. Our patient’s MRI showed evidence of T2 lesions in the pons and medulla, adjacent to the fourth ventricle likely in areas of major cardiovascular autonomic dysfunction. 

Conclusions: Formal testing for cardiovascular AD is a diagnostic challenge. Practical evaluation include obtaining preoperative orthostatic vital signs and history. One may also consider reviewing MRI lesions in regions associated with autonomic dysfunction which may help predict hemodynamic instability and need for invasive monitoring. Review of prior anesthesia records for response to specific vasopressors also can provide valuable information.

References:

[SNACC-36] Midazolam At Induction Of General Anesthesia Does Not Reduce The Incidence Of Postoperative Nausea And Vomiting After Craniotomy
Ard J‡, Kendale S‡, Zhang E‡. *New York University Langone Medical Center, ‡Weill Cornell Medicine, New York, NY.

Background: Intracranial surgery is high risk for postoperative nausea and vomiting. Despite routine prophylaxis with conventional antiemetics, about 50% of patients having this type of surgery will experience PONV. This is distressing and uncomfortable for patients, but it also runs the risk of precipitating intracranial bleeding. Recent retrospective reviews and randomized, placebo controlled trials have found that preoperative midazolam is associated with a decreased incidence of PONV. The mechanism for this effect is uncertain. If this intervention is effective it could become part of a multimodal approach for preventing PONV in patients having craniotomies.

Currently intravenous midazolam 2 mg is used with other medications for induction of general anesthesia. Some craniotomy patients receive it and others do not, based on anesthesia provider preference and patient anxiety level. Comparing patients who received midazolam with those that did not could offer insight into the effectiveness of this treatment.

Methods: Our group conducted a retrospective chart review of patients receiving craniotomies over a 1-year period. There were 463 craniotomies over the time range (June 1, 2016 to May 31, 2017). Indications for craniotomy included tumors, arteriovenous malformations, aneurysms and seizures. Patients were separated into 2 groups; those that received midazolam 2 mg at induction and those that did not receive midazolam.
Demographic data and other medications administered were extracted from the anesthesia record. Administration of rescue antiemetics for the first 24 hours, was used to indicate the presence of postoperative nausea and vomiting. A statistical analysis was performed.

**Results:** Administration of IV midazolam 2 mg was not associated with reduced PONV (odds ratio [OR] = 1.2, 95% confidence interval [CI], 0.1-2.7; \( P = 0.43 \)) within 24 hours. Variables accounted for included age, sex, BMI, smoking status, history of PONV, and other anesthetic drugs administered.

**Conclusions:** Administration of midazolam 2 mg intravenously at induction was not effective in reducing overall PONV in craniotomy patients. It is possible the midazolam dose was too small, or the operation was too long for midazolam at induction to make a statistical difference. Of note, the overall incidence of PONV was 31% which is considerably lower than expected after this surgery. This may be due to the high percentage of patients who received a propofol based anesthetic along with dexamethasone and ondansetron. The low overall incidence of PONV may have diminished the chance of detecting the antiemetic effect of midazolam.

<table>
<thead>
<tr>
<th></th>
<th>Received midazolam</th>
<th>Did not receive midazolam</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>51 (38-62)</td>
<td>54 (34-73)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Sex (male)</strong></td>
<td>170 (45)</td>
<td>42 (49)</td>
<td>0.61</td>
</tr>
<tr>
<td><strong>Body Mass Index (kg/m²)</strong></td>
<td>27 (23-31)</td>
<td>26 (23-30)</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Smoking</strong></td>
<td>31 (8.2)</td>
<td>2 (2.3)</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Dexamethasone</strong></td>
<td>312 (83)</td>
<td>66 (77)</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Ondansetron</strong></td>
<td>351 (93)</td>
<td>85 (97)</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Propofol &gt; 500 mg</strong></td>
<td>243 (64)</td>
<td>53 (62)</td>
<td>0.71</td>
</tr>
<tr>
<td><strong>Total fentanyl (mcg)</strong></td>
<td>250 (200-350)</td>
<td>250 (150-300)</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>History of PONV</strong></td>
<td>20 (5.3)</td>
<td>13 (15)</td>
<td>0.003</td>
</tr>
<tr>
<td><strong>Nitrous oxide</strong></td>
<td>21 (5.6)</td>
<td>6 (7.0)</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>Had PONV</strong></td>
<td>120 (32)</td>
<td>24 (28)</td>
<td>0.56</td>
</tr>
</tbody>
</table>

[SNACC-37] Intravenous Versus Inhalational Anaesthesia (IVIA) Trial for Outcome Following Intracranial Aneurysm Surgery


**Background:** Aneurysmal subarachnoid haemorrhage (aSAH) accounts for significant percentage of strokes with substantial economic burden. The major burden of patients subjected to neuroanesthesia care in our hospital are the ones who undergo microsurgical clipping following aSAH. Both the intravenous and inhalational anaesthetics cause dose dependent reduction of CMRO2 which could have benefits of neuroprotection. However the long-term outcome with use of anesthetic agents is yet to be known in patients undergoing surgery for aSAH. The neurological outcome at 3 months was the primary outcome while intraoperative brain conditions, duration of hospital stay and the estimation of perioperative markers of brain injury were the secondary outcomes of the study.

**Methods:** The prospective randomized study was conducted at PGIMER, Chandigarh, India in 106 patients who underwent neurosurgery following aSAH. The patients were randomized into 2 groups—the Propofol group and the Desflurane group. WFNS grade I-II patients of 18 to 65 years of age were included in the study. The patients were induced with fentanyl and propofol while vecuronium was used for facilitating tracheal intubation. Anesthesia was maintained with propofol infusion or desflurane titrated to BIS of 40 to 60. Fentanyl infusion was used for analgesia and vecuronium was administered as boluses for muscle relaxation. Ventilation of patients was maintained with oxygen and medical air (1:1). The anesthetics were stopped following completion of skin closure. The brain relaxation score was recorded at the time of reflection of bone flap. The intraoperative events related to hemodynamic changes, intraoperative aneurysm rupture, and temporary clipping times were noted. The IL-6 and S 100 B were measured preoperatively, intraoperatively, and postoperatively in serum samples using ELISA. The duration of hospital stay was recorded. The neurological outcome was assessed at 3 months following discharge using the Glasgow outcome scale (GOS).

**Results:** The preliminary analysis of our results shows that 13 patients were excluded and the data was analyzed for 45 patients in propofol group and 48 patients in desflurane group. The preoperative data in terms of demography, WFNS grade, Fisher grade, and location of aneurysm were comparable among the 3 groups (\( P > 0.05 \)). The intraoperative characteristics including the duration of anesthesia, brain swelling, hemodynamic changes, temporary clipping time and the incidence of intraoperative rupture of aneurysm were similar among the 3 groups (\( P > 0.05 \)). The perioperative serum IL6 and S100B were comparable among the 3 groups (\( P > 0.05 \)). The duration of hospital stay was 8 (7.97 to 10.03) days in the propofol group and 8 (7 to 8.8) days in the desflurane group (\( P = 0.26 \)). The GOS at 3 months were 5 (3.94 to 4.77) in propofol group and 5 (4.53 to 4.93) in the desflurane group.

**Conclusions:** The long-term neurological outcome of good grade aneurysmal SAH patients undergoing craniotomy and clipping remains similar with use of either propofol or desflurane.

[SNACC-38] Effect of Goal-directed Intraoperative Fluid Therapy on Hospital Stay in Patients Undergoing Excision of Supratentorial Tumors

Rath G, Mishra N, Chaturvedi A, Bithal P. All India Institute of Medical Sciences, New Delhi, India.

**Introduction:** Optimal fluid management in neurosurgery involves a tight balance between over-correction and under-correction. Evidences suggest that goal-directed fluid therapy (GDFT) can improve postoperative outcome in patients undergoing major non-neurosurgical surgeries. We hypothesized that the stroke volume variation (SVV) guided GDFT would improve the surgical outcome in terms of duration of hospital stay, and reduce the incidence of postoperative complications in patients undergoing craniotomy for supratentorial brain tumors.

**Methods:** Forty patients in between the age group of 18 to 65 years with large supratentorial tumors (tumor size > 4 cm in one dimension on the radiologic scan) undergoing craniotomy and excision were prospectively randomized into 2 groups. Patients belonging to the control group received fluid regimen based on routine hemodynamic monitoring whereas those belonging to GDFT group received fluid regimen based on SVV-guided GDFT (by keeping SVV <12%) using FloTrac/Vigileo system. A colloid bolus of 250 mL 6% hydroxyethyl starch (130/0.4) was given, if the SVV was > 12% in the GDFT group. Hemodynamic parameters such as blood pressure and heart rate were recorded at baseline, 5, 10, 15, and 30 minutes postinduction and then every hourly till the end of surgery. Dynamic parameters such as cardiac index, stroke volume index, and SVV were recorded 15 and 30 minutes after induction and then every hourly till the end of surgery.

**Results:** The total amount of fluid (crystalloid) required was significantly lower in GDFT (\( P = 0.003 \)) group as compared with the control group. The incidence of intraoperative complications was significantly lower in the GDFT group (\( P = 0.005 \)); tight brain incidence was significantly higher in the control group. The duration of hospital stay (5.05 d in the GDFT group vs 12% in the GDFT group).
GDFT vs. 8.05 d control, \( P = 0.07 \) and incidence of postoperative complications (10% in GDFT vs. 25% in control, \( P = 0.32 \)) were lower in GDFT group but did not reach statistical significance. Neurological outcome in terms of Glasgow outcome score at-discharge were similar in both the groups.

**Conclusions:** This study did not show any benefit of GDFT over conventional intraoperative fluid therapy in terms of incidence of postoperative complications, hospital and ICU stay, Glasgow outcome scores at-discharge in patients undergoing craniotomy for excision of large supratentorial tumors.

**[SNACC-39]** Same Day Deep Brain Stimulator Internalization is Associated With Increased Hemodynamic Interventions
Bennit J*, Cohn M†, Fasano A†, Prasad S*, Venkatraghavan L*, †Toronto Western Hospital; †Krembil Research Institute; †Krembil Research Institute, Toronto Western Hospital, Toronto, ON, Canada.

**Background:** Deep brain stimulation is a well-established treatment modality in Parkinson disease (PD) patients. Deep brain stimulator (DBS) insertion is performed as 2 stage procedure; insertion of electrodes followed by implantable pulse generator (IPG) placement. The procedures can be performed on the same day or different days. Conscious sedation is the most common anesthetic technique for the first stage and general anesthesia for the second stage. Patients with PD are susceptible to autonomic instability and perioperative hemodynamic instability is common. We compared the number of hemodynamic interventions needed in patients undergoing the second stage on the same day or different days.

**Methods:** After IRB approval, we performed a retrospective study of patients who had insertion of DBS for PD in our institution from April 2015 to March 2017. Patient demographics, details of PD, surgical and anesthetic data, and perioperative vasoactive drugs used was collected. One hemodynamic intervention is defined as the use of ephedrine 5 mg or phenylephrine 40 mcg. The mean and median number of interventions was compared between same day (SD) and different day (DD) groups. Groups were compared using the Mann-Whitney U and Fisher exact tests.

**Results:** A total of 121 patients were reviewed and 117 met inclusion criteria (55 SD and 62 DD). Demographic data were similar, except dexmedetomidine use (Table 1). SD IPG insertion was associated with more hemodynamic interventions, mean 6.7 versus 1.8 (95% confidence interval, 3.7-9.7 vs. 1.1-2.6; \( P = 0.0011 \)), median 2.0 versus 0.0 (IQ range, 0.0 to 9.5 vs. 0.0 to 2.0, \( P = 0.0011 \); Fig. 1).

**Discussion:** Our study shows a significant difference in vasopressor requirements in patients undergoing SD IPG internalization versus DD.

**Table 1: Patient Demographics and Intraoperative Medication Use**

<table>
<thead>
<tr>
<th></th>
<th>Same Day (SD)</th>
<th>Different Day (DD)</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60.9 ± 7.0</td>
<td>61.7 ± 7.5</td>
<td>0.53</td>
</tr>
<tr>
<td>Male (%)</td>
<td>40 (72.7)</td>
<td>40 (64.5)</td>
<td>0.42</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.5 ± 8.5</td>
<td>25.1 ± 5.0</td>
<td>0.072</td>
</tr>
<tr>
<td>ASA Class III (%)</td>
<td>53 (96.4)</td>
<td>59 (95.2)</td>
<td>1.00</td>
</tr>
<tr>
<td>Hypertension history or use of one antihypertensive agent (%)</td>
<td>15 (27.3)</td>
<td>19 (30.6)</td>
<td>0.84</td>
</tr>
<tr>
<td>Preop MAP (mmHg)</td>
<td>92.2 ± 11.8</td>
<td>91.2 ± 10.9</td>
<td>0.73</td>
</tr>
<tr>
<td>Disease duration (years)</td>
<td>10.8 ± 4.7</td>
<td>10.3 ± 4.3</td>
<td>0.92</td>
</tr>
<tr>
<td>LVEDD (mm)</td>
<td>1480.3 ± 562.6</td>
<td>1405.2 ± 608.4</td>
<td>0.55</td>
</tr>
<tr>
<td>Bilateral procedure (%)</td>
<td>52 (95.4)</td>
<td>60 (98.6)</td>
<td>0.67</td>
</tr>
<tr>
<td>Desmopressin use in 1st stage (%)</td>
<td>42 (76.4)</td>
<td>58 (93.5)</td>
<td>0.016</td>
</tr>
<tr>
<td>Intravenous antihypertensive use in 1st stage (%)</td>
<td>31 (56.4)</td>
<td>46 (74.2)</td>
<td>0.052</td>
</tr>
</tbody>
</table>

**A recent study found no difference between the amount of vasopressor required during SD and staged DBS surgery.** They did show a trend toward more vasopressor required for patients undergoing SD surgery. The cause of this difference is likely multifactorial, such as intravenous fluid restriction and intraoperative antihypertensive medication requirements.

**Conclusions:** In patients undergoing DBS insertion, SD IPG insertion is associated with more hemodynamic interventions than staged surgery. Future prospective studies are required to elucidate which factors influence hypotension during the second stage of DBS surgery, as well as whether this hypotension is clinically significant.

**Reference:**

**[SNACC-40]** This Tube Shall Pass: Airway Management in the Setting of Undiagnosed Tracheal Stenosis
Trousdale E, Welch T. Mayo Clinic, Rochester, MN.

**Introduction:** Despite the development of numerous methods used to identify patients who are in danger of difficult intubation, unexpected airway pathology and complications still occur. Undiagnosed tracheal stenosis, a form of central airway obstruction, comprises a portion of unexpected difficult airways. While rare, this case highlights the potential fatal complications that can result in the setting of difficult intubation or ventilation secondary to undiagnosed tracheal stenosis as well as the lifesaving nature of airway algorithms.

**Case Report:** A 29-year-old female with a medical history significant for asthma and drug resistant focal epilepsy presented for a Visualase laser ablation of a left amygdalohippocampal seizure focus. Following induction of anesthesia the patient was an easy mask airway. Initial attempt at intubation via direct laryngoscopy with a Miller 2 blade showed a grade 1 view of the vocal cords, but a 6.5 single-lumen endotracheal tube was unable to be passed. Despite ongoing grade 1 view of the vocal cords on subsequent laryngoscopy a 6.0, 5.5, 5.0, and 4.5 endotracheal tube were unable to be advanced. Ear nose and throat surgeons were contacted and subsequently evaluated the patient’s airway while she remained anesthetized. Flexible bronchoscopy revealed grade 3 subglottic stenosis. The Visualase procedure was cancelled and the patient was woken up and taken to the postanesthesia care unit for recovery. The patient subsequently went back to the operating room later in the day for
carbon dioxide (CO₂) laser division of the subglottic scar. Work-up several weeks later was significant for previously undiagnosed subglottic stenosis secondary to myeloperoxidase-positive vasculitis. Following repeat CO₂ laser division, the patient had significant improvement in her breathing, and ultimately underwent successful Visualase laser ablation of her seizure focus.

**Discussion:** Tracheal stenosis can result from a variety of causes including iatrogenic, congenital, and acquired.² Diagnosis of tracheal stenosis can be challenging as symptoms such as dyspnea, wheezing, or stridor may be mistaken for other pathologies such as cardiomyopathy or obstructive lung disease.⁴ Even with adherence to practice guidelines, unexpected challenges arise. In these cases, proficient use of difficult airway algorithms remains paramount and saves lives.

**References:**

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**[SNACC-41] The Unarousable Patient With Nonconvulsive Status Epilepticus**

Quast M, Pasternak J. Mayo Clinic, Rochester, MN.

Nonconvulsive status epilepticus (NCSE) is persistent seizure activity in the absence of motor manifestations. NCSE can be a potential cause of delayed emergence after anesthesia.

A 55-year-old male with a history of transient ischemic attacks, chronic alcohol abuse, and remote seizures underwent a right shoulder arthroplasty. He received a preoperative intarsialcane block with 15 mL of 0.25% bupivacaine and 30 mL of 0.5% bupivacaine with epinephrine followed by general anesthesia with isoflurane and nitrous oxide. Following surgery, he achieved extubation criteria, the tracheal tube was removed, and he was sent to the postanesthesia care unit for recovery. Upon arrival in the postanesthesia care unit, he was hemodynamically stable, breathing spontaneously, but unresponsive to both verbal and painful stimuli. His left pupil was dilated and was attributed to a Horner syndrome from his intarsialcane block. Routine laboratory studies were unremarkable. Bilateral arterial vertical and horizontal disconjugate ocular movements were noted along with bilateral eyelid and left hand fluttering. CT scan of the head was negative for acute pathology. NCSE was considered but electroencephalography (EEG) was not available. Lorazepam 4 mg IV was administered, after which the patient opened his eyes, began to respond to stimuli, and was able to appropriately answer questions. Emergent neurology consult recommended obtaining an EEG in the future; however, one was not performed while he was an inpatient. He was admitted to the intensive care unit for observation overnight, with no subsequent episodes of unresponsiveness or seizure activity throughout his 3-day hospital course.

The differential diagnosis for delayed emergence after anesthesia is extensive and includes pharmacologic causes, metabolic derangements, and primary neurological disorders such as stroke or NCSE. Patients with NCSE often present with altered mental status and possibly slight motor movements such as twitches or rhythmic myoclonus. NCSE is readily diagnosed with EEG. When EEG is not available, NCSE is assumed if clinical status improves following administration of antiepileptic drugs.

**References:**

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**[SNACC-42] Spinal Cord Ischemia and Infarct Presenting as Cauda Equina Syndrome From Disk Herniation**

Kramer D, Aguirre-Alarcon A, Kinon M, Kim J, Brook A. Montefiore Medical Center, Bronx, NY.

A 56-year-old male presented with lower back pain, foot drop and urinary retention. MRI revealed a HNP with protrusion at L4/L5. Lower extremity examination revealed 4+/5 strength on the left leg with 3/5 strength on the right leg. He underwent MIS discectomy at L4/L5 under GA. MAP was maintained between 69 and 111 mm Hg (mean MAP = 88.7 mm Hg). Positioning was without extreme lordosis. Pulse oximetry was 99% to 100% throughout. Dexamethasone was administered but antifibrinolytic agents were not given.

Postoperatively he had improvement of symptoms. Twelve hours postoperatively, he walked to bathroom. While on the toilet he had severe back pain. The patient was assisted back to bed and examination revealed bilateral loss of motor function and sensation to the level of T12. Open laminectomy and decompression with bilateral foraminotomies and repeat L4/L5 discectomy was performed. The patient’s examination did not improve. Neurology consult felt examination consistent with conus medullaris syndrome; high dose steroids were administered. MRI was obtained which revealed cord signal hyperintensity at the conus medullaris, with progressive hyperintensity remote from the area of the surgery (Fig. B).

On follow-up MRI a new signal abnormality at the level of the conus suggestive of hemorrhage was seen. The patient was discharged from the hospital on day 28 to an rehabilitation facility without improvement in examination.

**Discussion:** Spinal cord infarcts (SCI) are uncommon presentations of central nervous system (CNS) ischemia. They account for 0.3% to 2% of all CNS infarcts. Many patients with SCI have vascular risk factors including hypertension, DM, PVD, and dyslipidemia. Our patient had all these risk factors. In thoracic or thoracolumbar SCI, the etiology is often idiopathic. Symptoms often develop concomitantly with sudden movements of back (such as Valsalva maneuver in our patient). While there are many etiologies for SCI, the diagnosis of occult spinal AVM is intriguing. SCI has been associated with AMVs. MRI can miss the diagnosis of spinal AVM. Should there be a concern regarding this a spinal angiogram should be considered. The most common location of dural AVMs is at the level of the conus medullaris. The symptoms have been reported often to be initiated or worsened with Valsalva maneuver. All these features are noted in our patient.

During the presentation we will discuss the possibility of this patient have an occult spinal AVM as etiology of SCI.
In summary, the clinician should maintain a high index of suspicion in patients presenting with acute onset of back pain, when there is sensory dysfunction in addition to motor weakness, in patients with sphincter dysfunction. While the symptoms of conus medullaris syndrome may be difficult to distinguish from cauda equina, the clinician must be vigilant, for the consequences of a missed or delayed diagnosis can be devastating.

References:

[SNACC-43] Suspected Propofol Infusion Syndrome During Intraoperative Total Intravenous Anesthesia for Anterior and Posterior Cervical Discectomy and Fusion
Kumar M, Changyaleket B, Banchs R. University of Illinois at Chicago, Chicago, IL.
Propofol infusion syndrome (PRIS) is a rare complication of propofol infusion. PRIS has been associated with infusions of >67 mcg/kg/min for >48 hours in the ICU; however, has also been reported intraoperatively in high-dose short-term infusions. PRIS is a poorly understood phenomenon that presents with lactic acidosis, rhabdomyolysis, elevated creatine kinase, lipemic blood, elevated LFTs, and if progresses, bradycardia, Brugada syndrome, and myocardial failure. The incidence of PRIS estimated to be <1% with a mortality of 33% to 66%. Treatment includes discontinuing the infusion and supportive care. We report a case of possible PRIS with an 11 hours high dose infusion of propofol during an anterior cervical dissection and fusion (ACDF) and posterior cervical fusion (PCF) lasting 14 hours.
The patient is a 62 year-old male with a history of HTN, TIA, severe cervical stenosis, and myelopathy who presented with neck stiffness, back pain, and LE weakness with gait instability. Anesthesia was maintained with propofol (180 to 270 mcg/kg/min) and remifentanil infusions to allow for monitoring of somatosensory and motor evoked potentials. An infusion of phenylephrine (20 to 100 mcg/min) was also required to maintain hemodynamic stability. During placement of second ACDF site of contrast leak.

Dynamic computed tomography myelogram (dCT) is a radiologic study indicated to localize a cerebrospinal fluid (CSF) leak in a patient with spontaneous intracranial hypotension (SIH) after other radiologic studies have been inconclusive. During the study, radiologic contrast is intrathecally injected, and then CT imaging is performed to identify the site of contrast leak. The injection of intrathecal volume at lumbar level has the potential to increase intracranial pressure (ICP) and adversely affect cerebral perfusion pressure. Ideal conditions to quantify these observations would require direct
ICP monitoring or a responsive patient for neurological assessment. We describe a dCTM procedure performed with monitored anesthesia care in a 50-year-old female with a preexisting ventriculostomy. The patient came from the ICU with a suspected diagnosis of severely symptomatic SIH. Figure 1 summarizes positioning, medications, vital signs, and ICP changes. The patient is initially supine, and then positioned prone to allow for lumbar dural puncture and injection of contrast. ICP increased following placement into the prone position likely due to an increase in intrathoracic pressure and reduced venous return. This patient received a total of 32 mL of intrathecal volume and ICP increased from 18 to 85 mm Hg. We observed an increase in both mean arterial pressure and heart rate with contrast injection likely due to stimulation of the sympathetic nervous system as a result of decreased cerebral perfusion pressure, but pain associated with intracranial hypertension may have also contributed. Although reflex bradycardia often occurs in the setting of moderate intracranial hypertension, it is possible that tachycardia was observed for multiple reasons including inadequate transmission of the pressure to the cerebral compartment, or pain leading to sympathetic predominance. The association of high ICP paired with elevated heart rate is of particular interest because it contradicts one of the most overstated pathes: the Cushing reflex. This case serves as a reminder that the combination of hypertension and bradycardia is not the only hemodynamic consequence of increase ICP.

**[SNACC-45] Cardiac Manifestations in a Patient With Cervical Spine Mass**

MacKie-Mason P, Koht A. Northwestern University, Chicago, IL

A 77-year-old man with a history of metastatic atypical neuroendocrine tumor, with an intradural mass measuring 1.2×1.2×3.4 cm in C1-C3, presented for C1-C3 laminectomy and resection of mass. He did not have any significant cardiac history, had an exercise tolerance of >4 metabolic equivalents, and his electrocardiogram (EKG) was significant only for left bundle branch block. The patient was induced with propofol and succinylcholine, and fiberoptic intubation was performed. Maintenance was started with propofol and remifentanil infusions, and supplemented with 0.5 minimum alveolar concentration of sevoflurane. A radial arterial line was placed, baseline motor and sensory evoked potentials were measured, and the patient was flapped supine. After positioning, it was noted that the arterial line and pulse oximeter did not consistently display waveforms, and end-tidal CO₂ was present but fluctuating in value. EKG showed a wide complex bradycardic rhythm with ST depressions. All of this indicated an ischemic event. The patient was flipped back supine, after which he became asystolic for 20 seconds, but was successfully resuscitated with chest compressions. He was treated with atropine and epinephrine. At this point, the patient’s EKG showed complete heart block with slow escape rhythm. Transesophageal echocardiography was performed which did not show any wall motion abnormalities or valvular dysfunction. The patient was transtunaneously paced, and a Swan-Ganz catheter was placed to allow for transvenous pacing. By this time, the patient had recovered intrinsic cardiac rhythm and hemodynamic stability. After flipping the patient supine, it was noted that while prone, there was a decrease and, at times, loss of motor and sensory evoked potential signals. However, upon flipping him into the supine position, both motor and sensory evoked potential signals returned to baseline, further supporting that ischemia to the cervical spinal cord during positioning caused the decrease of signals.

The patient was transferred to the CCU, shortly after which he was extubated. He was able to follow commands, move all extremities, and continued to remain in normal sinus rhythm. Five days later, he had a dual-chamber permanent pacemaker inserted. This was placed in anticipation of his eventual tumor resection, to prevent any recurrent episodes of complete heart block leading to hemodynamic instability that could occur during positioning. The patient went on to have the mass resected 3 weeks later, without any complications during the surgery. Of note, he intrinsically remained in sinus rhythm throughout the surgery. This case illustrates how extreme caution is necessary when positioning a patient with a cervical spinal cord mass. Most likely, flexion of the patient’s neck led to stretching of the small vessels supplying the brainstem and spinal cord, leading to ischemia and causing hypotension, bradyarrhythmias, and loss of motor and sensory evoked potentials. Prompt recognition and repositioning the patient was critical in preventing permanent neurological deficits.

**[SNACC-46] Critical, Subfatal Venous Air Embolism During Ventriculoperitoneal Shunt Placement**

Gurrieri C, Munis J, Abejo A. Mayo Clinic, Rochester, MN.

**Introduction:** Venous air embolism (VAE) is a rare but potentially life-threatening complication. Clinical manifestations vary from clinically nonsignificant to hemodynamic catastrophe with “gas lock” effect right ventricular outflow obstruction, paradoxical embolism, pulmonary hypertension, cardiovascular collapse or death. We present a nonseated neurosurgical case complicated by VAE-associated hemodynamic collapse.

**Case report:** We report a challenging case wherein an otherwise healthy 47-year-old male presented for laparoscopic ventricular-peritoneal shunt placement for communicating hydrocephalus. Six months prior, the patient underwent a right decompressive hemicraniectomy for traumatic epidural hematoma and subsequently a right cranioplasty for persistent craniofacial deformity. He had a long hospital course complicated by severe traumatic and diffuse axonal brain injury with neurological impairment.
A 3-month follow-up head computed tomography scan was performed and it revealed persistent significant ventriculomegaly necessitating ventricular-peritoneal shunt placement. After uneventful induction of general anesthesia, insufflation of the pneumoperitoneum coincided with immediate bradycardia into the 30 seconds refractory to atropine treatment. Concomitantly, he became severely hypotensive before suffering pulseless electrical activity cardiac arrest. Advanced cardiac life support was initiated. Pneumoperitoneum was immediately deflated. Intraoperative transesophageal (TEE) echocardiogram revealed massive venous air burden. Diffuse air bubbles were visible in all 4 cardiac chambers as well as the ascending aorta and hepatic veins (Figs. 1, 2). No patent foramen ovale was identified. Estimated left ventricle systolic function was ~50%. Right ventricle was within the normal size but with reduced systolic function. Return of spontaneous circulation was achieved after 10 minutes of cardiopulmonary resuscitation. The procedure was aborted and drainage of empyema suddenly decompressing the brain leading to a drop in intracranial pressure and subsequent hyperperfusion state. Although our case differs from previous reports in time-course and specific surgical intervention, we believe that the underlying pathophysiological mechanisms are related.

**References:**


**[SNACC-47] Case Report: Malignant Cerebral Edema Following Removal of Infected Autologous Cranioplasty Flap**


**Introduction:** Cranioplasty is a common procedure conducted to restore defects following decompressive craniectomy. Growing evidence has identified an acute and catastrophic complication following cranioplasty: Post-Cranioplasty Malignant Cerebral Edema (PCMCE). We present a case of PCMCE following removal of an infected cranioplasty flap and include neuropathologic correlative evidence.

**Case History:** A 54-year-old man had a decompressive craniectomy and cranioplasty following a severe head injury. He was subsequently weaned off mechanical ventilation and no longer required vasopressors support. The patient was transitioned to comfort care and withdrawal of life-sustaining measures per family request. He expired the postoperative day 1.

Postmortem examination showed extensive fragmentation of the right cerebral and cerebellar hemispheres, as well as focal fragmentation within the brainstem. Histologic examination demonstrated widespread reperfusion petechiae and frank hypoxic necrosis. Correlated clinically this suggested PCMCE.

**Discussion:** To our knowledge, this is the first report of PCMCE after removal of a cranioplasty flap (ie, reversal of the previous reported procedure). Previous reports of PCMCE suggest the pathophysiology might be related to acute negative intracranial pressure from cranioplasty flap application and results in cerebral hyperperfusion and acute cerebral edema in patients with impaired cerebral autoregulation. In contrast to previous reports, the mechanism in our case might be related to the acute removal of the cranioplasty flap and drainage of empyema suddenly decompressing the brain leading to a drop in intracranial pressure and subsequent hyperperfusion state. Although our case differs from previous reports in time-course and specific surgical intervention, we believe that the underlying pathophysiological mechanisms are related.

**References:**


Introduction: Patients often perceive their risks inaccurately, and patients at increased risk of stroke may underestimate their risk. Our objectives were to assess the (1) accuracy of risk prediction and level of worry about perioperative stroke; and (2) proportion of patients who have discussed perioperative stroke with a physician. We created a stepwise multivariate logistic regression model to identify variables associated with underestimation of stroke risk.

Methods: With approval from our institutional research ethics boards and after pilot testing, surveys were distributed to 2 large Canadian pre-anesthetic clinics to patients before noncardiac and non-neurological surgery. The survey questioned patient demographics, surgery timing and type, and known risk factors for perioperative stroke. Patients were asked to estimate their absolute and relative risk and level of worry about perioperative stroke using a visual analog scale (VAS), and if they had discussed perioperative stroke with a physician. We created a stepwise multivariate logistic regression model to identify variables associated with underestimation of stroke risk.

Results: A total of 600 patients completed the survey of 773 eligible patients (response rate 78%). A total of 479 and 119 patients were classified as low risk and high risk, respectively. In all, 57% of patients (n=332) estimated their absolute perioperative stroke risk to be very low (0.01%) and 82% (n=332) incorrectly believed the risk of dying after surgery was less than 1%. Moderate/high risk patients were more likely to have discussed perioperative stroke with a physician before their anesthetic consultation (25% vs. 12%, P<0.0001), although the overall rate was low (15%).

Conclusions: Patients undergoing noncardiac non-neurologic surgery underestimate their risk of perioperative stroke, including moderate/high risk patients. Despite these misconceptions, the majority of patients had not discussed their risk of stroke with a physician before their anesthetic consultation. Our study identifies opportunities for improvement.

References:
Protocolized Perioperative Care for Complex Spine Surgeries and the Resulting Reduction in ICU/Hospital Length of Stay


Background: In April 2015, we implemented a new perioperative protocol for patients undergoing complicated spinal procedures. The implementation of our protocol involved the combined efforts of providers in the Anesthesiology/Neurosurgery/Orthopedic spine/ICU departments. Biweekly preoperative meetings amongst providers were established to discuss high risk cases and plan of care; the preoperative and intraoperative management of the protocol then ensued. Immediately proceeding the procedures, patients were transferred to the ICU and intensivists continued to implement a protocolized postoperative management strategy. As the implementation of our new perioperative protocol we have observed the reduction in both ICU and hospital length of stay (LOS), in addition to a decrease in postoperative complications.

Methods: Patients that were selected for the study included those who were scheduled for complicated spine surgeries, which we defined as including any one of the following criteria: surgery involving >6 levels, surgical timeline >6 hours, predicted blood loss >2 L, combined anterior and posterior approach, staged procedure, classified as high risk by the spine surgeon, patients with significant comorbidities and are of advanced age. Preoperative strategies involved outpatient clinic assessments from both anesthesiologists and surgeons, as well as any necessary consultants, to establish thorough optimization. Providers convened preoperatively at conference to discuss upcoming cases and strategies/goals of care. Intraoperative management aimed at emphasizing frequent communication between anesthetic and surgical providers, in conjunction with strict monitoring, hemodynamic and resuscitation strategies. Standardized handoff between anesthetic/surgical staff and ICU providers was enforced postoperatively. Neuro ICU providers abided by structured resuscitation and weaning strategies.

Results: A total of 201 cases were reviewed. A total of 94 cases were treated under the new complex spine surgery protocol, while 107 cases were treated under the old protocol. The mean ICU LOS for patients cared for under the old and new protocol decreased from 6.3 to 4.2 days, respectively (P=0.011). The mean hospital LOS for patients treated under the old and new protocol decreased from 14.8 to 10.0 days, respectively (P<0.0001). Postoperative complications decreased with patients treated under the new protocol as well, from 0.7 to 0.4 (P=0.187). This analysis was completed under the exclusion of one of the patients after protocol implementation, who developed an unusual complication of pseudomonas aspiration pneumonia and was held in ICU for 56 days and in the hospital for 85 days, the mean length of ICU stay after implementing the protocol decreased from 7.58 to 5.03 with an 85% confidence level.

Conclusions: Protocolized perioperative care pathways, with emphasis on multidisciplinary care and efficacious communication strategies, safely and effectively enhance patient recovery in complex spine surgeries. The implementation of our protocol led to significant reductions in ICU LOS and hospital LOS, along with decreased postoperative complications.

Designing an App-based Curriculum For Residents in Neuro Anesthesiology

Rao S, Kurup V, Hines R. Yale School of Medicine, New Haven, CT.

Objective: To design an app-based curriculum intended to improve orientation and preparation of incoming residents into Neuro Anesthesiology. To emphasize board examination relevant teaching topics. To seek feedback at the end of the rotation.

Background: Most of our neurosurgeries are performed in 2 operating rooms, with state of the art equipment as well as facilities for intraoperative MRI scanning and angiogram if required. Residents are required to rotate for 4 weeks each at a Junior level (basic learner/CA-1/CA-2) as well as at a Senior level (Advanced learner/CA-3 level).

Descriptive Analysis of Quality Improvement Reporting Patterns in Neuroanesthesia

Slade I*, Brown M†, Yang J*, Boggia S*, Sharma D* *. Harborview Medical Center; †University of Washington, Seattle, WA.

Background: This project describes quality improvement (QI) reporting patterns in neuroanesthesia cases at a single academic institution with 2 major hospital-based practice sites. Categorizing reported event types by major domains provides hospital-specific data to prioritize future QI initiatives tied to these domains.

Methods: This is a retrospective, descriptive analysis of QI reports from the institutional anesthesiology QI databases for neuroanesthesia cases conducted from 2013 to 2017. Neuroanesthesia cases included craniotomies, awake craniotomies, microvascular procedures, cranial nerve surgery, and neurosurgeon-performed spine surgery. Cases were identified in each hospital’s QI database based on keywords and manual review. This subset of cases had further manual review to categorize event reports into domains, defined by the QI team, based on primary event characteristics. Each domain was summarized proportionally to the total reported neuroanesthesia QI events and the total neuroanesthesia cases at the respective hospitals.

Results: For the 2013 to 2017 review period, at hospital A, there were 3870 neuroanesthesia cases and 152 QI events reported (3.9% of all neuroanesthesia cases). At hospital B, there were 10,876 neuroanesthesia cases and 280 QI events reported (2.6% of cases). The top 5 event domains reported at hospital A were drug error (27 events, 17.8% of all QI reports), communication/documentation (18 events, 11.8%), vascular catheter dislodgement (15 events, 9.9%), skin injury (15 events, 9.9%), and equipment/device failure (12 events, 7.9%). The top 5 event domains reported at hospital B were communication/documentation (93 events, 33% of all QI reports), equipment/device failure (39 events, 13.9%), vascular catheter dislodgement (28 events, 10%), drug error (17 events, 6.1%), and skin injury (17 events, 6.1%). Each hospital’s primary QI event domain was further subcategorized. At hospital A, the primary domain of drug errors included drug not given/not infusing (12 events, 7.9% of QI reports), wrong dose (6 events, 3.7%), incorrect infusion duration (3 events, 1.9%), unintentional administration (3 events, 1.9%), wrong route (2 events, 1.2%), and drug stocking error (1 event, 0.6%). At hospital B, the primary domain of communication/documentation issues included preoperative or postoperative handoffs (34 events, 12.1%), transfusion-related (24 events, 8.6%), documentation (17 events, 6.1%), intraoperative communication (6 events, 2.1%), and patient placement/bed availability (6 events, 2.1%).

Discussion: This is the first neuroanesthesia-specific QI event analysis in this academic institution. There are no known similar analyses reported in the neuroanesthesia literature. Although the QI event databases are subject to reporting bias, the events reported are likely reflective of issues that providers thought were of sufficient significance to voluntarily submit in the interest of system improvement and patient safety. Therefore, despite this inherent bias, the information learned can reflect hospital-specific needs to help inform and prioritize quality domains for future QI interventions at the respective hospitals. Postintervention analysis of subsequent QI data may provide a mechanism for ongoing monitoring of effectiveness of such initiatives over time.
The set up of these rooms as well as the anesthetic management of patients can be intimidating to the new incoming resident (photographs: OR1 and OR2).

**Method:** Hence, we prepared a rotation specific curriculum under “Canvas” portal, which can be easily accessed via any smartphone/I-pad/computer. the curriculum incorporates a multi-modal teaching approach designed specifically for incoming residents (Table).

**Results:** We have implemented this teaching curriculum for about 4 months now, and we have noticed improvement in resident confidence and knowledge during the rotation. A total of 21 residents have completed this rotation until date. A brief survey was sent to all the residents who have completed the rotation to assess response and feedback. In all, 70% of them responded that the material was easy to access online, 77% of the residents felt that the curriculum improved their confidence and orientation in the Neuro-surgical ORs (Figs. 1, 2).

**Conclusions:** Although long-term results are required, the initial positive responses received indicate that the residents have benefited from this app-based curriculum design and content. We would continue to constantly improvise on the content and seek feedback on suggestions for improvement.

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**[SNACC-54] Snapshot Audit: Consent for Anaesthesia: Positioning and Procedures**

Winter V, Pack E, Luoma V, Virmani S. *The National Hospital for Neurology and Neurosurgery, London, UK.*

In 2015, changes were made to UK law surrounding consent following the landmark judgment in the Montgomery vs Lanarkshire case. The judgment stated that to gain valid consent, a patient must be told what they want to know and not what a doctor thinks they should be told. The Association for Anaesthetists of Great Britain & Ireland (AAGBI) updated guidelines on consent for general anesthesia (GA) and the Royal College of Anaesthetists acknowledged the importance of discussing rare complications by publishing patient information leaflets.

Guidance states that patients should be consented for components of anaesthetic technique, specifics related to procedure and common/significant side effects/risks. UK Government guidelines state “valid consent for blood transfusion should be obtained.” Our department has audited consent documentation since 2012.

**Aim:** Audit of consent for GA at our institution.

**Methods:** A prospective snap-shot audit for documentation of consent for GA and surgical positioning conducted in April 2018. Data collected: evidence of discussion of common and significant side effects of GA, prone positioning, procedure specific consent (arterial line, urethral catheter, blood transfusion) and evidence that patient questions were addressed.

**Audit standard:** AAGBI and national blood transfusion guidelines. Data compared with previously collected local data.

**Results:** A total of 30 patients included: 9 spinal and 21 intracranial surgery, 11 in prone position. There was no documentation of discussion of complications of prone positioning by surgeons. Consent was documented for 65% of arterial lines and 39% of urinary catheters. Six patients were consented for blood transfusion—3 by the surgeon, 2 by the anesthetist, and 1 by both. Three patients received a blood transfusion, 1 of whom had no documented consent. Documentation of patient questions was only present in 1 case.

**Conclusions:** Thorough communication is essential to ensure patients are informed of the risks of GA. This should be documented, including
patient questions. Despite improved documentation of consent for proning since 2012, consent documentation continues to be inadequate. Although these findings do not necessarily indicate deficiencies in the verbal consenting process, changes in the UK law and this demonstrated deviation from national standards suggests a need for more protocolised documentation and ongoing education regarding consent for GA.

Patient Consent for Blood Transfusion, SaBTO.

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**Methods:** After induction of general anesthesia and endotracheal intubation, the EWD was lubricated and inserted into the esophagus (Fig. 1). The EWD is composed of a nonpermeable, silicone triple lumen system consisting of a fluid intake lumen, fluid return/output lumen, and separate central orogastric tube (for suction of gastric secretions). The device transfers heat to the body from the esophagus to closely apposed vascular structures such as the vena cava, aorta, and left atrium. The device is connected to a Norm-O-Temp fluid warmer (Cincinnati Sub-Zero, Cincinnati, OH) and run at 42°C throughout the case. Core temperature is monitored with a bladder probe (embedded in a urinary catheter). A lower body forced air warmer and IV fluid warmer were also used to avoid hypothermia.

**Results:** Case 1: patient is a 71-year-old female who presented to neurosurgical attention secondary to a severe lumbar scoliotic deformity with associated progressive low back and leg pain. T6-S1 fusion and L2-L3 laminectomies were performed with no significant intraoperative or postoperative complications. Intraoperative temperature was maintained between 35.5 and 35.8°C. Case 2: patient is a 77-year-old female who presented to neurosurgical attention for correction of a flat back deformity with associated low back pain and postural difficulties. Fusion from T10-pelvis, with pedicle screw fixation, and L3 pedicle subtraction osteotomy was performed without complication. Intraoperative temperature range was maintained between 36.7 and 36.9°C. Case 3: patient is a 77-year-old female who presented to neurosurgical attention for correction of a lumbar scoliotic deformity with associated severe L2-L4 stenosis and progressive low back and leg pain. Fusion from T10-pelvis with pedicle screw fixation, L3-L4 laminectomies, and L5-S1 transforaminal interbody fusion were performed without complication. Intraoperative temperature range was maintained between 35.4-36.2°C.

**Conclusions:** Patient warming with an EWD is feasible in major spine deformity surgery. Internal warming is a novel approach that will need to be formally tested against other methods of intraoperative temperature control.

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**Mazal A, Davenport O, Davies M, Bagley C, McDonagh D. UT Southwestern Medical Center, Dallas, TX.**

**Introduction:** Maintenance of intraoperative normothermia is of paramount importance during major spine deformity cases. Intraoperative hypothermia can lead to coagulopathy and may contribute to perioperative morbidity and mortality by increasing the risk of postoperative shivering, cardiac events, and surgical site infections. Heat loss occurs during major spine cases due to large body surface exposure to ambient temperatures. During these cases only the upper and lower extremities and head can be covered with an external warming device and actively warmed.

We explored the feasibility of using a novel esophageal warming device (EWD) in 3 patients undergoing major spinal deformity surgery.
[SNACC-56] Posttraumatic Midazolam Induces Cell Death and Impairs Neurofunctional Recovery
Sebastiani A, Bender S, Schaefer M, Thal S. Johannes Gutenberg University, Mainz, RLP, Germany.

Background: The benzodiazepine midazolam is a GABA-A receptor agonist, which is frequently used for sedation or stress control in patients suffering from traumatic brain injury (TBI). However, experimental work on benzodiazepines provided divergent results raising concerns about its widespread use in patients. While some studies show that benzodiazepine dependent potentiation of GABAergic neurotransmission is detrimental in brain-injured animals, other experimental investigations demonstrate neuroprotective effects especially in pretreatment paradigms. The objective of the present study was to investigate whether post-TBI single bolus midazolam application influences secondary brain damage.

Methods: Two different dosages of midazolam (0.5 and 5 mg/kg), combination of midazolam and its competitive antagonist flumazenil, or vehicle solution (NaCl 0.9%) were injected intravenously 24 hours following experimental TBI by controlled cortical impact. Mice were assessed for neurological and motor deficits using a 15-point neuroscore and the rotarod test. Histopathologic brain damage including detection of cell death by TUNEL and mRNA expression of inflammatory marker genes using quantitative PCR were analyzed 3 days after insult.

Results: Application of midazolam 24 hours after TBI increased peri-lesional cell death, and IL-1β mRNA expression, and aggravated motor deficits. Cytotoxic effects of midazolam were prevented by the benzodiazepine antagonist flumazenil.

Conclusions: Our results demonstrate a dose-dependent cytotoxic effect of the GABA-A receptor agonist midazolam in experimental TBI. Together with recent findings showing deleterious effects of the GABA-A agonist propofol after cerebral injury, the present study provides further evidence that GABA-A agonists may aggravate sequelae of rodent acute cerebral injury.

[SNACC-57] Prevalence, Evolution and Extent of Impaired Cerebral Autoregulation in Children Hospitalized With Mild Traumatic Brain Injury
Lele A*, Lakireddy V*, Clark-Bell H*, Moore A*, Zimmerman J†; Penn State Milton S. Hershey Medical Center, Hershey, PA; ‡University of Pennsylvania, Philadelphia, PA.

Background: Impaired cerebral autoregulation is associated with poor outcomes after traumatic brain injury (TBI). Children with mild TBI are often hospitalized, but there is a paucity of information about cerebral autoregulation in these patients.

Methods: A prospective observational cohort study was conducted on hospitalized children with complex mild TBI (history of trauma, admission GCS score 13 to 15 with either abnormal head CT or history of loss of consciousness). The primary outcome was the prevalence of impaired cerebral autoregulation (autoregulation index < 0.4), determined using transcranial doppler ultrasonography and tilt testing. Secondary outcomes include factors associated with impaired cerebral autoregulation, the evolution of cerebral autoregulation over time, and extent of cerebral autoregulation.

Results: Cerebral autoregulation testing was conducted in 31 children 10+5.2 years, mostly male (59%) with isolated TBI (91%), median admission GCS 15 (range, 13 to 15), injury severity score 14.2+7.7, TBI due to fall (50%), preadmission loss of consciousness (48%), abnormal head CT scan (97%). Thirty-one children underwent 56 autoregulation tests on admission day 1 (range, 0 to 2 d, 31 tests), day 2 (range, 1 to 5 d, 15 tests), day 5 (range, 4 to 11 d, 6 tests), and day 6 (range, 5 to 12 d, 4 tests). Impaired cerebral autoregulation occurred in 15 (48.4%) children who underwent 19 tests; 68% and 32% of these tests demonstrated unilateral and bilateral impairment, respectively. Impaired autoregulation occurred on the contralateral side of TBI (53.3%), bilaterally (33.3%), and ipsilaterally (13.3%). Compared with children tested between 6 and 12 days after TBI, the risk of impaired autoregulation was highest in the first 5 days after TBI (day 1, relative risk [RR], 3.7; 95% confidence interval [CI], 1.9-7.3 vs. day 2 RR, 2.7; 95% CI, 1.1-6.5 vs. day 5 RR, 1.33; 95% CI, 0.7-2.3). Compared with children with intact cerebral autoregulation, children with impaired autoregulation (N = 15; 48%) were older (12.3 +1.3 y vs. 8.7 +1.1 y; P = 0.04) and tended to have more subdural hematoma (64% vs. 44%), epidural hematoma (29% vs. 17%), and subarachnoid hemorrhage (36% vs. 28%). Eight of 15 children with impaired autoregulation (53%) were discharged home with impaired cerebral autoregulation.

Conclusions: Impaired cerebral autoregulation is common in children with mild complex TBI, despite reassuring admission GCS 13 to 15. The diagnosis of complex mild TBI suggests abnormal cerebrovascular hemodynamics, mostly during the first 5 days after injury. Impairment commonly extends beyond the location of CT lesion and discharge of children with impaired cerebral autoregulation is common.
Ultra-low Tidal Volume Ventilation (ULTVV) Reduces Neuroinflammation After Experimental Cardiopulmonary Resuscitation


Abstract: Lung-protective ventilation strategies are a well-developed, highly researched topic in critical care medicine. However, the optimal ventilation method for patients receiving cardiopulmonary resuscitation (CPR) still remains elusive and highly controversial. In this study, we tried to apply a new protective ventilation scheme during mechanical CPR in swine, which is derived from “lung-rest” ventilation known during ECMO therapy on intensive care units.

Methods: A total of 30 male German landrace pigs were anesthetized and instrumented with intravascular catheters. After a stabilisation phase (Vt, 8 mL/kg; FiO2, 0.4; PEEP, 5 mbar), base line measurements were taken and ventricular fibrillation was then induced via an intravenous stimulation probe. The animals were left untreated and without ventilation for 4 minutes. The pigs were randomized into 3 groups, group 1 receiving standard IPPV (Vt, 8 to 9 mL/kg; FiO2, 1.0; RR, 10/min; PEEP, 5 mbar), group 2 receiving modified chest-compression only resuscitation with 10l per minute passive oxygen insufflation (CCO) whereas group 3 was treated with ultra-low tidal volume ventilation (ULTVV) (2 to 3 mL/kg; FiO2, 1.0; RR, 50/min; PEEP, 5 mbar). During interventional ventilation, mechanical cardiopulmonary resuscitation was performed using a LUCAS-2 device. After 5 minutes, blood gas analyses were taken and advanced life support was commenced including up to 4 full cycles of CPR, rhythm analyses and defibrillations as well as administration of advanced life support.

Table 1:
Characteristics of Hospitalized Children (n = 31 with Mild Complex Traumatic Brain Injury by Cerebral Autoregulation Status. Data as mean ± SD or n (%))

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All patients N=31</th>
<th>Intact Cerebral Autoregulation N=16</th>
<th>Impaired Cerebral Autoregulation* N=15</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)(mean ± SD)</td>
<td>10.6 ± 4.9</td>
<td>8.9 ± 1.1</td>
<td>12.5 ± 1.3</td>
<td>0.04</td>
</tr>
<tr>
<td>Age groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4 years</td>
<td>5(16%)</td>
<td>4(25%)</td>
<td>1(7%)</td>
<td></td>
</tr>
<tr>
<td>5-9 years</td>
<td>6(19%)</td>
<td>4(25%)</td>
<td>2(13%)</td>
<td></td>
</tr>
<tr>
<td>10-14 years</td>
<td>14(45%)</td>
<td>7(44%)</td>
<td>7(47%)</td>
<td></td>
</tr>
<tr>
<td>15-18 years</td>
<td>6(19%)</td>
<td>1(6%)</td>
<td>5(33%)</td>
<td></td>
</tr>
<tr>
<td>Sex (Male)</td>
<td>19(61%)</td>
<td>11(61%)</td>
<td>8(57%)</td>
<td></td>
</tr>
<tr>
<td>Injury severity score (ISS) (mean ± SD)</td>
<td>15.5 ± 9.4</td>
<td>15 ± 2.5</td>
<td>16 ± 2.5</td>
<td>NS</td>
</tr>
<tr>
<td>Mechanism of Injury</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Fall</td>
<td>15(48%)</td>
<td>7(44%)</td>
<td>8(53%)</td>
<td></td>
</tr>
<tr>
<td>Motor vehicle collision</td>
<td>4(13%)</td>
<td>2(11%)</td>
<td>2(13%)</td>
<td></td>
</tr>
<tr>
<td>Struck by or against</td>
<td>8(26%)</td>
<td>4(22%)</td>
<td>4(27%)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4(13%)</td>
<td>3(17%)</td>
<td>1(7%)</td>
<td></td>
</tr>
<tr>
<td>Admit GCS</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>13</td>
<td>1(3%)</td>
<td>1(6%)</td>
<td>0(0%)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>6(19%)</td>
<td>3(19%)</td>
<td>3(20%)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>24(77%)</td>
<td>12(76%)</td>
<td>11(80%)</td>
<td></td>
</tr>
<tr>
<td>Loss of consciousness</td>
<td>15(48%)</td>
<td>8(47%)</td>
<td>7(50%)</td>
<td>NS</td>
</tr>
<tr>
<td>Intracranial pathology on CT head</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Skull fracture</td>
<td>2(68%)</td>
<td>1(61%)</td>
<td>8(53%)</td>
<td></td>
</tr>
<tr>
<td>Subdural hematoma</td>
<td>16(52%)</td>
<td>7(44%)</td>
<td>9(60%)</td>
<td></td>
</tr>
<tr>
<td>Subgaleal hematoma</td>
<td>14(45%)</td>
<td>8(50%)</td>
<td>6(40%)</td>
<td></td>
</tr>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>10(32%)</td>
<td>4(25%)</td>
<td>6(40%)</td>
<td></td>
</tr>
<tr>
<td>Pneumocephalus</td>
<td>7(22%)</td>
<td>4(25%)</td>
<td>3(20%)</td>
<td></td>
</tr>
<tr>
<td>Epidural hematoma</td>
<td>7(22%)</td>
<td>3(19%)</td>
<td>4(27%)</td>
<td></td>
</tr>
<tr>
<td>Intraparenchymal hemorrhage</td>
<td>4(13%)</td>
<td>2(13%)</td>
<td>2(13%)</td>
<td></td>
</tr>
<tr>
<td>Cerebral edema</td>
<td>1(3%)</td>
<td>0</td>
<td>1(7%)</td>
<td></td>
</tr>
<tr>
<td>No pathalogy detected</td>
<td>1(3%)</td>
<td>1(6%)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Definitions:
Intact autoregulation: Autoregulatory index > 0.4; Impaired autoregulation: Autoregulation with index < 0.4. SD: standard deviation; GCS: Glasgow Coma Scale Score; CT: computerized tomography, NS: Not statistically significant

* Impaired cerebral autoregulation days 1 to 5 after mild traumatic brain injury
adrenaline and vasopressin. In case of ROSC, blood gas, and mass spectrometry analyses were performed and the animals were then monitored for 6 hours before being euthanized according to German animal care law. Brain tissue samples were collected and analyzed for IL-6 and TNF-alpha expression via PCR. Results are displayed in mean difference/95% CI of difference. Statistical analysis was performed via 2-way ANOVA inter-group analysis with GraphPad Prism 5 software. P-values <0.05 were considered significant.

**Results:** IL-6 and TNF-alpha concentrations in hippocampus samples were significantly lower in ULTVV and CCO animals (IL-6: ULTVV [-7.91/-1,68 to -14,14, P<0.03]; CCO [-8,94/-2,71 to -15,17, P<0.01] [all *10^-7 relative to PPIA]; TNFA: ULTVV [-2.8/-0.6 to -5.0, P<0.05] CCO [-4.12/-1.99 to -6.38, P<0.001]) [all *10^-7 relative to PPIA]). Cortex samples showed no significant differences. Decarboxylation was more efficient in ULTVV than in CCO animals during CPR.

**Discussion:** Our data suggest benefits of lung-protective ventilation during CPR. Lower ventilation pressures combined with sufficient ventilation with ULTVV could provide better circulation and thus lead to increased cerebral perfusion and less cerebral tissue damage in the most oxygen-dependent regions. In addition, ULTVV provides better decarboxylation and might be sustained longer without substantial acidosis which usually limits CCO use.

**Conclusions:** ULTVV offers a novel treatment option under cardiac arrest receiving CPR. Lower driving pressures might increase venous return, thus providing better circulation and less neuroinflammation, possibly ameliorating outcomes.


**Background:** Cerebrospinal fluid drainage (CSFD) is recommended as a spinal cord protective strategy (ACC/AHA Class I, Level B) in open and endovascular thoracic aortic repair. However, the small studies support the evidence of CSFD, large scale study is needed. We previously conducted a retrospective large-scale study to investigated whether motor evoked potentials was effective to reduce the incidence of motor deficits in open and endovascular thoracic aortic repair. We use the same database to determine whether the CSFD reduce the motor deficits after open and endovascular thoracic aortic repair.

**Methods:** Patients included in the study underwent descending or thoracoabdominal aortic repair at 12 hospitals belonging to the Japanese Association of Spinal Cord Protection in Aortic Surgery between 2000 and 2013. Using multivariable mixed-effects logistic regression analysis, we conducted an audit of clinical utility of CSFD in open and endovascular thoracic aortic repair for decrease the incidence of postoperative motor deficits. We also used propensity score matching CSFD versus not-CSFD to adjust potential confounders.

**Results:** We reviewed data from 1214 patients (open surgery, 601 [49.5%]; endovascular repair, 613 [50.5%]), CSFD was performed in 417 patients, and not performed in the remaining 797 patients. Postoperative motor deficits were observed in 75 (6.2%) patients at discharge. Multivariable logistic regression analysis revealed that postoperative motor deficits at discharge had a significant association with CSFD (adjusted odds ratio [OR]=2.14, 95% confidence interval [CI], 1.32-3.47; P=0.002) (Table 1), and with other factors: history of neural deficit (adjusted OR=6.08; 95% CI, 3.10-11.91; P<0.001) (Table 1), and endovascular procedure (adjusted OR=0.45; 95% CI, 0.27-0.76; P=0.003) (Table). After propensity score matching (n=819), CSFD had a significant association with postoperative motor deficits at discharge (OR=4.62; 95% CI, 2.37-9.04; P<0.001).

**Conclusions:** CSFD in thoracic and thoracoabdominal aortic repair was a risk factor of postoperative motor deficits. CSFD may be used in high risk patients and less useful.

<table>
<thead>
<tr>
<th>Table: Result of mixed-effects logistic regression model of the association of MEP with motor deficits at discharge (n=1214)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N (%)</strong></td>
</tr>
<tr>
<td>MEP</td>
</tr>
<tr>
<td>Age&gt;70</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>HT</td>
</tr>
<tr>
<td>Smoking</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
</tr>
<tr>
<td>Neural deficit</td>
</tr>
<tr>
<td>Spinal drainage</td>
</tr>
<tr>
<td>TAA class (3 classes)</td>
</tr>
<tr>
<td>Endovascular</td>
</tr>
</tbody>
</table>

MEP: motor-evoked potential; TAA: Thoracic aortic aneurysm. Mixed-effects logistic regression model with each institution as a random intercept, with both univariate and stepwise multivariable analysis, were constructed using the confounders in this table. Stepwise selection for multivariable logistic regression with P-value of 0.05 for backward elimination was used to select the best-predictive model.
Reference:

[SNACC-60] Peritumoral Microcirculation and Oxygenation During Vasopressor Therapy in Anesthetized Patients With Brain Tumors
Koch K*, Mikkelsen I*, Espelund U*, Tietze A†, Nikolajsen L*, Rasmussen M*.*Aarhus University Hospital, Aarhus C, Jutland, Denmark; †Universitätsmedizin, Berlin, Berlin, Germany.

Background: Inotropes and vasopressors are widely used to maintain cerebral perfusion pressure (CPP) during craniotomy. Despite an increase in mean arterial blood pressure (MABP) near-infrared spectroscopy cerebral perfusion pressure (CPP) during craniotomy. Despite an increase in mean arterial blood pressure (MABP) near-infrared spectroscopy cerebral oxygenation (SctO2) decreases after phenylephrine, but remains unchanged after administration of ephedrine.1,2 The difference in SctO2 may arise from different influence of the 2 vasopressor agents on cerebral microcirculation and oxygenation.3,4 Effects of ephedrine and phenylephrine on cerebral microcirculation and brain oxygenation are unknown in patients with cerebral tumors.2

Aim and Hypothesis: The objective of this study was to compare the effects of ephedrine and phenylephrine on cerebral microcirculation as measured with capillary transit-time heterogeneity (CTH), and brain oxygenation in the peritumoral area and contralateral hemisphere. We hypothesized that phenylephrine was associated with a reduction in brain oxygenation and cerebral microcirculation by altering CTH and decreasing the oxygen extraction fraction (OEF) compared with ephedrine.

Methods: The study was an investigator-initiated, single-center, double-blinded randomized clinical trial consisting of 2 study arms defined by imaging mode: MRI or PET. Each study-arm included 24 patients scheduled to supratentorial brain tumor resection. The findings from the MRI-arm of the study are reported here.

Intervention: Patients were randomized to infusion of either phenylephrine or ephedrine during general anesthesia. Imaging was performed on the anesthetized patient before surgery with MRI scans completed before and during infusion of either ephedrine or phenylephrine. Surgery was initiated after MRI and subdural intracranial pressure was measured. Cerebral microcirculation was studied with cerebral blood flow (CBF) and CTH, while brain oxygenation was studied with OEF and cerebral metabolism rate of oxygen (CMRO2). Regions of interest was contralateral hemisphere and peritumoral area.

Results: Drug effects in the contralateral hemisphere were presented at the 2017 SNACC meeting. Briefly, when compared with ephedrine phenylephrine was associated with a significant SctO2 decrease in the contralateral hemisphere. In contrast, CBF, CTH, OEF, and CMRO2 was similar between ephedrine and phenylephrine treated patients.

Conclusions: Data concerning the effects of ephedrine and phenylephrine on CBF, CTH OEF, and CMRO2 in the peritumoral area will be presented and compared to the results from the contralateral hemisphere.

References:

[SNACC-61] Phenylephrine Modulates CSF IL-6 Concentration in a Sex Dependent Manner to Protect Cerebral Autoregulation and Reduce Hippocampal Necrosis After Traumatic Brain Injury in Newborn Pigs
*University of Pennsylvania, Philadelphia, PA; †University of Washington, Seattle, WA.

Introduction: Hypotension and low cerebral perfusion pressure are associated with low cerebral blood flow, cerebral ischemia, and poor outcomes after traumatic brain injury (TBI). TBI is the leading cause of death in children, and boys and younger children have particularly poor outcomes compared to girls and older children. Cerebral autoregulation is impaired after TBI, contributing to poor outcome. Cerebral perfusion pressure is often normalized by use of vasoactive agents to increase mean arterial pressure and optimize cerebral blood flow. Clinically, current vasoactive agent use is variable, empiric, and may be related to variability in mortality. As ethical considerations constrain mechanistic studies in children, we use an established porcine model of fluid percussion brain injury (FPI) to understand this pathology. In prior studies of newborn pigs, Phenylephrine (Phe) prevents impairment of cerebral autoregulation and histopathology in female but potentiated such injury in males via modulation of ERK mitogen-activated protein kinase. Prior unrelated studies indicated an association between upregulation of ERK mitogen-activated protein kinase with increased cerebrospinal fluid (CSF) IL-6 after FPI. However, the role of IL-6 in CNS pathology is not well understood. We presently investigated whether Phe protects autoregulation and limits histopathology after FPI in pigs due to a sex dependent modulation of brain injury associated upregulation of IL-6.

Methods: Lateral FPI was produced in anesthetized pigs. Pial artery reactivity was measured via a closed cranial window. IL-6 was quantified.
by ELISA. Data (n = 5) were analyzed by repeated measures ANOVA, with significance determined at P < 0.05.

**Results:** Results show that CSF IL-6 was increased by FPI, release potentiated by Phe in the male but blocked in the female. The IL-6 antagonist LMT-28 prevented impairment of cerebral autoregulation and hippocampal CA1 and CA3 neuronal necrosis after FPI in untreated and Phe-treated male and female pigs. Papaverine induced dilation was unchanged by FPI and LMT-28, indicating that impairment of vascular reactivity was not an epiphenomenon.

**Discussion:** These data indicate that Phe modulates CSF IL-6 concentration in a sex dependent manner to protect cerebral autoregulation and reduce hippocampal necrosis after traumatic brain injury in newborn pigs.

**[SNACC-62] Protective Effects of Heparinase in a Multiple Sclerosis Mouse Model of Experimental Autoimmune Encephalitis (EAE)**

Changyalekit B, Feinstein D. University of Illinois at Chicago, Chicago, IL.

**Background/Objective:** Multiple sclerosis (MS) is a debilitating disease with no effective cure that affects millions of people worldwide. An important part of MS pathology is the presence of neural inflammation. MS is traditionally thought to be a T-cell dependent pathology. The role of other cell types in MS such as astrocytes have not been explored. Heparanase is a heparin sulfate degrading enzyme expressed in many cells including astrocytes. The goal of this study was to elucidate the potential roles of heparanase and astrogliosis in MS using a well-established mouse model of experimental autoimmune encephalitis (EAE).

**Methods:** Female C57BL/6J mice were divided into 3 groups: wild type, EAE+vehicle, and EAE+heparanase inhibitor. EAE was induced in groups 2 and 3 using the established model employing synthetic MOG peptide and pertussis toxin. Three days after injection of MOG peptide, groups 2 and 3 were treated with heparanase and astrogliosis was determined. Western blot and immunohistochemistry were performed to determine the effect of inhibiting heparanase function in astrocytes.

**Results:** On the basis of Western blot analysis, there was a significant increase in expression of heparanase in EAE mice compared with wild type mice (P < 0.05) (Fig. 1). OGT2115-treated EAE mice had worse neurologic score compared with EAE mice that were vehicle-treated (P < 0.001) (Fig. 2). Immunohistochemistry showed that there was less astrogliosis in the heparanase inhibited EAE mice compared with the vehicle-treated EAE group.

**Conclusions:** Heparanase activity appears to be beneficial in EAE neurological outcome. Such neuroprotection may be mediated through astrogliosis.


Chui J, Fuji S, Freytag A, Murkin J. University of Western Ontario, London, ON, Canada.

**Background:** Mixed nerve somatosensory evoked potential (SSEP) monitoring is commonly used to monitor spinal cord function but inaccurate in detecting nerve root injury. Dermatomal SSEP has been used for nerve root monitoring in lumbar sacral spine surgery. However, recording dermatomal SSEP is technically challenging because of the smaller amplitude than mixed nerve SSEP. As the recent introduced automated SSEP device (EPAD) incorporates a proprietary artificial rejection and signal optimization system, we hypothesized that the EPAD automated SSEP device might provide an enhanced dermatomal SSEP signal. This study aimed to assess the feasibility of using this automated SSEP device to record dermatomal SSEP during noncardiac and non-neurological surgery.

**Method:** After Ethics Board approval and written consent, study participants were monitored using the EPAD automated SSEP device intraoperatively. The stimulating surface electrodes were applied to palmar side of thumb (C6 dermatome) and middle finger (C7 dermatome) bilaterally. Subcortical dermatomal SSEP were monitored. The recording surface electrodes were placed to the posterior neck at the fifth cervical spine level (C5) and referenced to the forehead electrode (Fz).

**Results:** Nine patients were consented and included. No technical issue was encountered. All patients were successfully monitored with satisfactory dermatomal SSEP signals (Fig. 1). The mean impedance was 230 ± 0.018 (Fig. 2). The amplitude and latency of C6 SSEP were 0.6 ± 0.3 mA and 16.0 ± 4.7 ms. The amplitude and latency of C7 SSEP were 0.63 ± 0.4 mA and 19.3 ± 4.4 ms, respectively. The smallest amplitude of recordable dermatomal SSEP signal was 0.3 mA.

**Conclusions:** We found that small amplitude dermatomal SSEP signals (of C6 and C7 dermatomes) could be consistently obtained from an automated SSEP device. This finding might facilitate the development a nerve root specific monitoring strategy for spine surgery. Further studies are required to evaluate the diagnostic accuracy and the application in spine surgery. Figure 1. Dermatomal somatosensory evoked potential from 2 patients. A, B, The dermatomal SSEP signals obtained from stimulation of left C6 dermatome of a patient. The baseline amplitude and latency of C6 dermatomal SSEP were 0.5 mA and 19.8 ms. A very small dermatomal SSEP signal obtained from stimulation of right C7 dermatome of a patient. The baseline amplitude of C7 dermatomal SSEP was only 0.3 mA. The scales of are 1 and 5 mA/div.

**References:**
[SNACC-64] Predictive Factors of Unpredicted Movement in Motor Evoked Potentia during Intraoperative Neurophysiologic Monitoring in Adult Patients Undergoing Brain Surgery

Lee S*, Jeon Y*, Park H†, Hwang J*. *Seoul National University Bundang Hospital, Seongnam-Si, Gyeonggi-do; †Seoul National University Hospital, Seoul-Si, Seoul, Republic of Korea.

Background: During transcranial motor evoked potential monitoring, electrical stimuli activates peripheral muscles and can cause bite injuries, excessive surgical field movement, and movement induced injury. The aim of this study was to identify risk factors associated with unexpected movements by motor evoked potential stimulation.

Methods: In this retrospective observational study, 464 patients undergoing brain surgery were enrolled. Demographic data and intraoperative laboratory data including arterial blood gas analysis, hematocrit, sodium, potassium, glucose, ionized calcium, ionized magnesium, and lactate were collected. We retrospectively compared the data of patients with and without unexpected movement during surgery.

Table 1. Comparison of demographic data and unpredictable and unacceptable movement of hypocalcemia group and normocalcemia group

<table>
<thead>
<tr>
<th></th>
<th>Hypocalcemia group (n=284)</th>
<th>Normocalcemia group (n=179)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>56.31 ± 10.84</td>
<td>54.64 ± 12.45</td>
<td>0.047*</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>94/190</td>
<td>67/112</td>
<td>0.197</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>160.47 ± 8.28</td>
<td>161.73 ± 8.35</td>
<td>0.112</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>58.19 ± 7.57</td>
<td>59.05 ± 7.77</td>
<td>0.239</td>
</tr>
<tr>
<td>BMI</td>
<td>22.51 ± 1.61</td>
<td>22.50 ± 1.66</td>
<td>0.960</td>
</tr>
<tr>
<td>Operation time (min)</td>
<td>263.54 ± 98.08</td>
<td>271.90 ± 96.50</td>
<td>0.370</td>
</tr>
<tr>
<td>Anesthetic time (min)</td>
<td>334.01 ± 107.00</td>
<td>340.22 ± 105.18</td>
<td>0.541</td>
</tr>
<tr>
<td>Hypertension</td>
<td>113 (39.7%)</td>
<td>68 (38.0%)</td>
<td>0.387</td>
</tr>
<tr>
<td>diabetes</td>
<td>25 (8.8%)</td>
<td>21 (11.7%)</td>
<td>0.193</td>
</tr>
<tr>
<td>Respiratory disease</td>
<td>12 (4.2%)</td>
<td>4 (2.2%)</td>
<td>0.191</td>
</tr>
<tr>
<td>Neurologic disease</td>
<td>7 (2.5%)</td>
<td>3 (1.7%)</td>
<td>0.415</td>
</tr>
<tr>
<td>Preoperative anticonvulsant infusion</td>
<td>271 (95.4%)</td>
<td>165 (92.2%)</td>
<td>0.107</td>
</tr>
<tr>
<td>Unpredictable and unacceptable movement</td>
<td>88 (31.0%)</td>
<td>89 (49.7%)</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation or number (percent).

*, P-value was < 0.05.
Results: Among the 464 patients, unexpected movements were observed in 174 patients (38%). Age (odds ratio, 0.98; 95% confidence interval, 0.96-0.99; P = 0.022) and ionized calcium (odds ratio, 244.21; 95% confidence interval, 4.96-2105.33; P = 0.006) were independent risk factors for unexpected intraoperative movement.

Conclusions: Age and ionized calcium concentration may be associated with unexpected movement during motor evoked potential monitoring for the brain surgery.

[SNACC-65] Hypoglossal Nerve Injury Following Cervical Spine Surgery
Dibble J, Adams S, Kurnutala L. University of Mississippi Medical Center, Jackson, MS.

Abstract: A 61-year-old male presenting with neck pain and bilateral upper extremity numbness (L > R). Work-up revealed a herniated nucleus pulposus at C3-C4 and an ossified posterior longitudinal ligament from C5-T1 with severe spinal canal stenosis and associated cord changes. He underwent a C2-T2 posterior cervical decompression and stabilization. Induction of anesthesia, intubation and the surgery itself was uneventful. The patient recovered from surgery and was discharged on postoperative day 4. Patient presented to the emergency department ~1 month later for the complaint of dysphonia, dysphagia and right tongue deviation. He was diagnosed with isolated cranial nerve XII injury. Work up included CT and MRI which showed no etiology for this deficit. EMG was obtained that showed evidence of chronic injury with evidence of ongoing reinnervation. Patient was ultimately managed conservatively. At a follow-up appointment 3 months postoperation patient was found have to have ongoing speech deficits, however, was able to hold his tongue midline with most of his symptoms resolved. Incident rate and proposed mechanisms of hypoglossal nerve injury following surgery are discussed as well as possible strategies for prevention.

[SNACC-66] Effect of Fosaprepitant on EEG, SSEP, and TcMEP Neuromonitoring Under General Anesthesia
Burbridge M, Lopez J, Shah A, Jaffe R. Stanford University, Palo Alto, CA.

Fosaprepitant (Emend) is an intravenous neurokinin type-1 receptor antagonist which inhibits the binding of substance P and attenuates its central nervous system functions. Substance P and the neurokinin type-1 receptor are found in high concentrations in the medulla vomiting center. Fosaprepitant is superior to both ondansetron1 and droperidol 2 in preventing postoperative nausea and vomiting (PONV) after craniotomy in adult patients. Craniotherapy has been shown to be a risk factor for PONV, and can cause potentially catastrophic complications. In addition to the medulla, neurokinin type-1 receptors and substance P are found in numerous other sensory pathways. We therefore sought to determine if fosaprepitant administration intraoperatively would interfere with electroencephalographic (EEG), somatosensory evoked potential (SSEP), and transcranial motor evoked potential (TcMEP) monitoring in patients undergoing general anesthesia.

We enrolled 5 adult patients who presented for interventional neuroradiology procedures under general anesthesia. Patients with preexisting sensory or motor deficits, diabetes mellitus, peripheral neuropathy, and those on hormonal-based medications such as the oral contraceptive pill were excluded. Our anesthetic protocol included premedication with 2 mg midazolam, and patients were induced with 3 mcg/kg fentanyl, 1 to 2 mcg/kg propofol and 1 mg/kg succinylcholine. All patients were intubated with a 7.0 cuffed endotracheal tube. Patients were maintained on propofol (100 mcg/kg/min) and remifentanil (0.05–0.1 mcg/kg/min) infusions. Fosaprepitant (150 mg) was administered after induction of general anesthesia, but after sufficient and reproducible baseline EEG, SSEP, and TcMEP were obtained before the surgical procedure. EEG and evoked potential amplitudes, latencies, and morphologies were analyzed at baseline following anesthetic induction. These electrophysiologic responses were then continuously monitored throughout the duration of the case. SSEP’s were run at least every 5 minutes. The average duration of EEG, SSEP, and TcMEP monitoring was 165 minutes after fosaprepitant administration.

Results show that fosaprepitant does not have a significant effect on the amplitude, latency, or morphology of SSEP monitoring, or on EEG or TcMEP morphologies obtained using our anesthetic protocol. This preliminary data demonstrates that fosaprepitant can be administered during neurosurgical cases under general anesthesia without interfering with EEG, SSEP or TcMEP neuromonitoring.

References:

[SNACC-67] A Rare and Unexpected Cause of Acute Unilateral Loss of Transcranial Motor Evoked Potential Signal During Posterior Thoracic Spine Surgery
Simmons C, Clavijo C. University of Colorado, Aurora. CO.

Introduction: Intraoperative neurophysiological monitoring (IOM), including somatosensory evoked potentials (SSEPs), transcranial motor evoked potential (TcMEP), and electromyography (EMG) are commonly used in spinal fusion procedures and have been shown to decrease the incidence of neurologic injury, improve outcomes3 and subsequently lower cost.2 Intraoperative loss of signal requires immediate assessment and efforts to identify causality, as signal loss without return is a poor prognostic indicator.3 A systematic approach to identifying and correcting signal loss is imperative. Here, we present a case of TcMEP signal loss not previously reported at our institution and the related unique interventions utilized to resolve concerns.

Case Presentation: A 23-year-old previously healthy male, status post Motor Vehicle Crash and subsequent T5 burst fracture, presented for posterior spinal fusion at T2-T9. At surgery request, neuromonitoring was utilized and included: SSEP, TcMEP, spontaneous EMG. Patient arrived to the operating room (OR) intubated and under sedation. After induction of general anesthesia, placement of intravenous and arterial catheters, and before final positioning, baseline signals were obtained. Large-sized, polysynaptic responses at the expected latency were present in left and right upper extremities and bilateral adductor hallucis muscles. Signals were not obtained in the bilateral tibialis anterior. After prone positioning, responses were again obtained, and no significant changes were detected. Patient anesthesia was maintained with infusions of propofol, sufentanil, and ketamine. Signals were followed throughout the procedure with no significant changes noted. At completion of instrumentation and at start of wound closure, TcMEP responses were undetectable at the adductor hallucis. Attending surgeon was informed immediately and was concerned with overcorrection of deformity and considered reopening wound to assess. During this time technical aspects and anesthesia were ruled out as a possible cause. At this time, physical examination of the extremities was undertaken resulting in discovery of a left foot that was cool and pale. The left foot was the location of intra-articular catheterization and was thought to be contributing to physiologic derangements noted. Vascular surgery was consulted and after obtaining dorsalis pedis pulses via doppler, recommended to discontinue the arterial line and observe. At case completion patient was transported to the intensive care unit. Immediate neurological examination was not possible; however, follow-up examination indicated 4/5 strength testing at all major lower extremity muscle groups.

Discussion: A standardized approach to acute unilateral loss of intraoperative TcMEPs includes immediate communication with surgical and anesthesia teams, investigation of possible sources of vascular occlusion or nerve compression, evaluation of patient positioning, and technical considerations including electrode placement, circuit integrity, and machine calibration. In this case, a systematic approach was followed and led to timely discovery of a rare complication. As a result of adherence to protocols and prompt corrective measures, this patient sustained no permanent neurologic injury.
[SNACC-68] Inadvertent Burst Suppression in a Case Series of 130 Spine Patients Under Total Intravenous Anesthesia

Myers J, Sharma D, Hecker J. Harborview Medical Center, University of Washington, Seattle, WA.

Introduction: The electroencephalography (EEG) pattern called burst suppression is well characterized but poorly understood. Described as a generally pathologic state of low cortical activity, the signal is straightforward to identify and amenable to quantification. In patients undergoing surgery, it is a marker for a deeply anesthetized state and has been utilized as a neuroprotective intervention in cerebral vascular procedures. However, recent emerging evidence indicates it may be a potential factor in the development of postoperative delirium and the frequency of unintended suppression during major surgery is largely unexplored. Here we describe the incidence and degree of burst suppression among 130 spine patients undergoing surgery at Harborview Medical Center.

Methods: Patients were selected from department-maintained case lists for spine surgery patients from January to February of 2016. EEG was visually assessed in 1 minute epochs for the presence and degree of burst suppression over the course of the case by a qualified and experienced EEG technician. EEG monitoring was applied after induction, measures reported here are postinduction. Burst suppression was recorded in percentiles with the amount of time in burst suppression noted in minutes, as well as objective notes about the point in time of the surgery.

Results: We analyzed the EEG of 130 patients undergoing spine surgery at HMC between January and February of 2016. We report that 91 of 130 patients experienced some degree of inadvertent burst suppression. The degree of burst suppression could be very high: twenty-three of these cases showed 90% to 100% burst suppression for at least 10 minutes, 15 for over 60 minutes. In addition, the time spent in suppression spanned the entirety or near-entirety of the procedure for 34 of the 91 patients.

Conclusion: The impact of changes in EEG activity under anesthesia are beginning to be characterized, but the importance of particular changes are still poorly defined. In this study, we identify a surprisingly high incidence of inadvertent burst suppression at some point during a typical intravenous anesthetic at our institution. Not only was the degree of burst suppression quite high, 90% to 100% in one quarter of the patients who experienced suppression, but burst suppression was experienced across the near-entirety of the procedure in over one third of those 91 patients. Recent data has indicated a possible link between intraoperative burst suppression and postoperative delirium, thus the data presented here may indicate the potential for refinement in anesthetic management with regard to monitored EEG activity.


Myers J, Sharma D, Luk K. Harborview Medical Center, University of Washington, Seattle, WA.

Case Description: Anesthetic management of complex patients is often multifaceted, frequently requiring monitoring beyond ASA standards. In particular, carotid stenosis may necessitate attempts to assure brain perfusion, with many modalities studied but often with difficulty in interpretation or application. We present here a case report of a 64-year-old with a history of severe bilateral carotid occlusion and stroke who presented for resection of a progressively symptomatic thoracic intramedullary spinal cord mass. The patient’s right carotid was stented after a stroke in 2015, from which she had some residual weakness. In addition, the patient had peripheral vascular disease, hypertension and endometrial cancer status post hysterectomy. Preoperative transcranial Doppler (TCD) showed a completely occluded left carotid and left to right flow dependence. To monitor collateral flow during surgery, we used intraoperative TCD as well as somatosensory evoked potentials, motor evoked potentials, and EEG, in addition to standard ASA monitoring. After a typical induction and intubation, anesthesia was maintained with propofol and remifentanil, blood pressure was supported with a phe- nylephrine infusion and ephedrine boluses. Early in the case, once TCD monitors were in place and before incision, it was noted that the patient had reduced flows in her MCAs bilaterally, left worse than right. It was also noted that her EEG signals were depressed and there were signs of slowing and amplitude loss on her somatosensory evoked potentials and motor evoked potentials. Raising the patient’s MAP to 90 to 95 mm Hg (5% to 10% higher than her baseline of 85 mm Hg) proved to ultimately best support blood flow as measured by TCD in her bilateral MCAs and perfusion as measured by neuromonitoring methods. Subsequent periodic dips in her blood pressure resulted in similar changes, which were managed without additional agents or infusions. The surgery was completed without complication and the patient was extubated at the end of surgery. In the immediate postoperative period, she did not show any new neurological deficits. At 3 months the patient had returned to baseline functional status and was undergoing chemotherapy for a local, limited recurrence of her endometrial cancer.

Discussion: Delivery of an appropriate anesthetic can be a careful balancing act, given that many patients have significant comorbidities whose management is more difficult than their presenting complaint. In this case, multimodal intraoperative neuromonitoring assisted us in relieving the new-onset spinal cord compression she had and preventing further injury from her neurological frailty. The periodic dips in the patient’s blood pressure were most likely secondary to ongoing blood and fluid losses, phenylephrine tachyphylaxis, potential accumulation of anesthetic given propofol’s context sensitive half-time, and surgical manipulation. The striking feature was the patient’s sensitivity to small decreases in MAP, undermining the critical dependence of her left cortex on right cerebral blood flow. Although this degree of monitoring is not appropriate for many cases, in patients with severe comorbidities multiple efforts to reduce risk are worth the investment of time and attention.

[SNACC-70] Exercise Mediates Anesthetic Recovery in Diabetic and Control Rats

Sinon C*, Ottensmeyer A*, Slone A+, Pardue M+, Garcia P+. *Emory University, Atlanta, GA; †Vanderbilt University, Nashville, TN; ‡Georgia Institute of Technology, Atlanta, GA.

Background: Type 2 diabetes mellitus is the most prevalent metabolic disease worldwide. Diabetes is associated with decreases in cortical volume and an increased risk for experiencing cognitive impairments. It has been previously reported that diabetic patients experience impaired cognitive function following cardiac surgery, especially on speed-related tasks. In an animal model of type 1 diabetes, exposure to isoflurane anesthesia without surgery is sufficient to cause memory problems. Exercise is often prescribed for diabetic patients and regular physical activity is hypothesized to decrease the risk of postoperative cognitive impairments. This study presents the first results of our investigation into the effects of diabetes and of exercise on recovery from isoflurane anesthesia in a type 2 diabetes rat model.

Methods: Wistar (n = 32) and Goto-Kakizaki (GK) type 2 diabetes (n = 32) rats between 3 and 4 months old underwent forced treadmill exercise or remained idle on a stationary treadmill for 10 days. Rats then received either a 2-hour exposure to 1.5% to 2% isoflurane in oxygen at 1 L/min or oxygen. At 2 hours, rats were removed and placed into a recovery chamber. Time to appearance of postanesthetic milestones were recorded for 30 minutes, after which the rat was moved to a video-monitored rodent cage environment for 1 hour to record postanesthesia behavior. Preanesthesia and Postanesthesia Y-maze spatial alternation was recorded to determine cognitive performance on a spatial memory task.

Results: At baseline, diabetic rats show a decrease in spontaneous alternation behavior (P = 0.0291) and in maze exploration (P < 0.0001). Rats receiving 10 days of forced treadmill exercise displayed no difference from idle rats in their emergence times from isoflurane general anesthesia (return of righting reflex, P = 0.9259), but exercise hastened the appearance of our general recovery marker (Sticky Dot) post anesthesia for both Wistar and GK rats (P = 0.0079). Rats that underwent exercise and isoflurane treatment displayed a decrease in spatial memory compared with other experimental groups, as revealed by a significant main effect for anesthetic treatment and activity on a postanesthesia Y-maze test.

Discussion: At baseline, we found the diabetic rats were less active and showed decreased spatial working memory compared with Wistar rats in the Y-maze. Forced exercise training before general anesthesia resulted in hastened recovery from isoflurane regardless of the presence of metabolic syndrome. Despite the lack of an effect of diabetic status on postanesthesia behavioral outcomes, these results suggest a need for further study of the interaction between exercise and recovery from anesthesia.
[SNACC-71] Brief Sevoflurane Application Allows Subthreshold High-frequency Synaptic Stimulation To Induce Persistent Long-term Potentiation In Acute Rat Hippocampal Slices


Introduction: The ability to prevent memory loss in the postoperative state is one of the neuroprotective properties of anesthetics. Wang et al. showed that 4% sevoflurane preconditioning improved neuronal recovery from hypoxia and that this is prevented by ZIP, an inhibitor of protein kinase Mζ (PKMζ), a constitutively active atypical PKC isofrom critical for maintaining long-term potentiation (LTP) and long-term memory. They also found that 4% sevoflurane increases PKMζ levels in area CA1, suggesting that PKMζ offers neuroprotection without affecting preexisting synaptic pools of PKMζ—otherwise it would risk introducing noise detrimental for memory engrams.

To examine the mechanisms that control the compartmentalization of PKMζ pools and thus guarantee the integrity of preexisting engrams in the hippocampus, we conducted synaptic capture experiments in slices treated with sevoflurane. We hypothesized that new PKMζ synthesized by a brief sevoflurane application would not enter the synapse and saturate LTP, but instead can be captured and utilized at synapses “tagged” by local synaptic activity induced by a subsequent weak, subthreshold high-frequency stimulation (wHFS) before sevo application by 15 minutes. Remarkably, 4% sevoflurane increases PKMζ levels in area CA1, suggesting that PKMζ offers neuroprotection without affecting preexisting synaptic pools of PKMζ—otherwise it would risk introducing noise detrimental for memory engrams.

When 4% sevo is delivered either before or after wHFS, a persistent LTP is obtained lasting >180 minutes (Mean fEPSP: 159 +/- 9% and 184 +/- 6%, vs. 97 +/- 6% in control). The repeated measures ANOVA showed that the main effect of both group and HFS are significant (F1,7 = 27.925, P < 0.001, F2,7 = 61.564, P < 0.001, respectively). The interaction between group and HFS is also significant (F2,7 = 15.931, P < 0.005). Tukey post hoc tests further confirmed that both “wHFS before sevo” and “wHFS after sevo” at 180 minutes posttetanization are significantly larger than wHFS alone (P < 0.001).

Conclusions: A weak, subthreshold HFS capable only of inducing transient LTP in the CA1 region of rat hippocampal slices can elicit persistent LTP if preceded or followed by a 20-minute application of 4% sevoflurane. Future experiments will determine whether the underlying mechanism involves capture by the weakly tetanized synapses of new PKMζ synthesized in the dendrite in response to sevoflurane. The results of these experiments will help elucidate the neuroprotective role of PKMζ during sevoflurane preconditioning.

References:

[SNACC-72] Modeling Intraarterial Liposomal Delivery to Human Brain Tumors

Cooke J, Joshi S. Columbia University, New York, NY.

Introduction: The key to pharmacokinetic (PK) modeling of intra-arterial (IA) drug delivery is to faithfully describe the effect of 2 opposing forces: forces of attachment of the drug to the endothelium and forces of displacement from...
the endothelium. Once attached to the endothelium, the internalization rates and uptake properties follow the classical PK models. The creation of a human IA drug delivery model is necessary for hypothesis development as well as for scaling animal studies to human cerebral circulation.

**Methods:** To develop a human brain tumor PK model we used the classical model of human cerebral circulation developed by Young et al.2 The model provides details of shear forces in cerebral arteries based on angiographic measurements of arterial sizes. The model has a built-in auto-regulatory function. We replaced the AVM compartment with a tumor component. We stratified tumor vascular characteristics into 5 types (Fig. 1 and Table). Further we incorporated liposomal uptake characteristics described by Shaole et al.2 to investigate how: (a) liposomal delivery varies with different grades of brain tumors; (b) effect of reduction of blood flow on the delivery of liposomes.

**Results:** This model reflects the complexity of drug delivery to brain tumors, given the morphologic and flow characteristics of the tumor compartment. This model shows that drug delivery to brain tumors is profoundly affected by the underlying nature of the tumors (Fig. 1B). Additional simulations revealed the advantage of IA transient cerebral hypoperfusion (TCH) drug delivery and how blood flow characteristics affected tumor liposomal uptake.

**Discussion and Conclusions:** Young and colleagues had developed a successful model to predict AVM behavior based on shear forces in human cerebral circulation. We adapted the model by replacing the AVM compartment with a tumor and assigned it with properties likely to be seen with 4 grades of glioma. The model showed that the uptake of liposomes was a function of tumor grade. It also revealed the advantages of IA-TCH drug delivery assisted by and the increasing deposition of liposomes with particle sizes as have been observed with experimental animal data.2,4 Human GBMs are physiologically and structurally complex lesion, achieving adequate and consistent drug delivery is essential to survival of the patients.

**References:**
Results: In cytologic studied the EC50 concentration of melphalan was 1.29 mM with high dose sustained exposure and 18.5 μM with low dose transient exposure assessed on day 7 (Figs. 1A, B). These results were subsequently confirmed with BrdU assay. Animal survival studies revealed a tendency for excessive surgical hemorrhage with melphalan treatment. Even in the 0.25 group development of a neck hematoma led to premature euthanasia. Survival tended to improve, with the 0.25 mg melphalan treatment (P = 0.07).

Discussion and Conclusions: Although we observed a strong trend toward improved survival compared the control group, however, hemorrhagic complications were encountered. Melphalan is known to inhibit platelet functions. While it may be possible to treat gliomas with the IA-TCH delivery of melphalan, the procedure carries the risk of hemorrhagic complications.

References:

Background: In patients with subarachnoid hemorrhage (SAH), cause of decreased psychosocial function and poor life quality cannot be fully explained by long-term neuropsychological problems as anxiety and depression, and executive cognitive impairment may be the primary factor. Preclinical study of complex decision-making test like reversal learning test and various neurobehavioral tests in mice will offer an opportunity to find neuropsychological sequelae, mechanism and further treatment.

Methods: C57BL/6J mice were categorized into control and SAH group (n = 9 and 10 respectively). In SAH group, mice were subjected to endovascular perforation technique to induce SAH. At 3 to 4 weeks post-procedure, both groups were tested on various tests (to measure different neurobehavioral outcomes), including open field (anxiety), Y maze (spatial memory), novel object recognition (object learning-memory), forced swim (depression), 80/20 probabilistic feedback reversal learning tests (RLT; cognitive flexibility), marble burying (repetitiveness) and nestlet shredding (repetitiveness).

Result: SAH mice displayed an increase in stereotyped repetitive behaviors compared to control mice as shown by increased marble burying and nestlet shredding (Fig. 1A). SAH mice also demonstrated an increase in overall object touching in novel object recognition test with favor in novel one (Fig. 2A), indicating repetitive and fixation on object. In the open field test, SAH mice showed shorter and more fragmented grooming compared with that of controls (Fig. 2B). SAH mice showed impairment on perseveration in RLT compared with that of control mice (Figs. 1B, C). There was no difference in motor deficits, Y maze test nor forced swim test between both groups. From histology study (Fig. 3), at injury-side of SAH mice, cortical neuronal density was decreased compared with control, but not at the rest area of the brain.

Conclusions: In long-term neuropsychological study, SAH directly caused repetitive compulsive behaviors, fixation, and restriction of behavior repertoire in mice without impairment in motor function, spatial cognition, object learning-memory, anxiety, and depression. These findings
suggested that cognitive inflexibility and potential impairment of executive control might be the cause of poor psychosocial function and of the subsequent anxiety and depression in SAH patients.

[SNACC-76] Isoflurane Anesthesia, Sex Independently, does not Influence Neurocognitive Function and Behavior in a Mouse Model of Alzheimer Disease

Preis L, Schmid S, Poetzl C, Blobner M, Schneider G, Rammes G, Jungwirth B. Technical University Munich, Klinikum Rechts Der Isar, Munich, Bavaria, Germany

Background: The number of patients with Alzheimer disease (AD) undergoing surgery and anesthesia increases. Furthermore, these patients show a sex-dependent decline of cognitive function. The aim of our study was to investigate the sex-dependent impact of general anesthesia on cognition, behavior, and fine motor function in a mouse model of AD.

Methods: After governmental approval 10-month-old male and female Tg2576 mice and their wild type littermates were randomly assigned to one of 2 groups: mice in the "Iso" group underwent general anesthesia with 1 MAC isoflurane for 2 hours, whereas control animals were not exposed to isoflurane (sham). Beginning on the first day after general anesthesia we evaluated working memory (repeated choices), fine motor function (time food intake), and anxiety (time on board) for 8 consecutive days using the modified hole board test (10 mice per group, total of 80 mice). Data were analyzed using general linear modelling.

Results: Tg2576 mice make significantly ($P<0.001$) more repeated choices compared with wild type littermates irrespective of sex or exposure to isoflurane (Fig. 1). Tg2576 need significantly ($P<0.001$) more time for food intake compared with wild type littermates (Fig. 2) with no significant effect of sex or anesthesia. Tg2576 spend significantly ($P=0.024$) more time per trial on the board than wild type littermates with no significant effect of sex or anesthesia (Fig. 3).

Conclusions: A 10-month old Tg2576 mice show typical characteristics of the early stage of AD: decline in working memory, impaired fine motor function and a reduced level of anxiety. However, sex did not affect neurobehavioral outcome in this age. Interestingly, in contrast to previous hypothesis, isoflurane anesthesia did not aggravate progression of AD. Whether sex or isoflurane anesthesia might affect outcome at a later stage of AD warrants further investigations.

Reference:
Background: Patients with traumatic brain injury (TBI) often develop hemodynamic instability, which leads to poor outcomes. Novel methods to detect subclinical systolic dysfunction have been described following TBI, however, the effect on cardiovascular and cerebral hemodynamics is not known. Our study aimed to describe early cardiovascular and cerebral hemodynamic responses after moderate-severe TBI and examine their association with subclinical systolic dysfunction.

Methods: This is a secondary analysis of a prospective cohort study examining subclinical systolic dysfunction with echocardiographic speckle tracking analysis in patients with isolated moderate-severe TBI. Transcranial Doppler ultrasound (TCD) was performed on day 1 and between day 5 and 7 after injury. Cardiovascular hemodynamic parameters (stroke volume [SV], stroke volume index [SVI], cardiac output [CO], cardiac index [CI], systemic vascular resistance [SVR], and systemic vascular resistance index [SVRI]) were calculated from TTE data. Systolic dysfunction was defined based on clinical criteria (ejection fraction < 50%) or subclinical criteria (global longitudinal strain [GLS] > −16%). Transcranial Doppler ultrasound (TCD) was also performed on the first day. We determined the association between systolic dysfunction and hemodynamic parameters using linear regression.

Results: A total of 29 TTE and 15 TCD examinations were performed in 15 patients. During examination, 9 (60%) patients had propofol infusion and 3 (20%) were on vasopressor. Overall, SV (median: 58.3 mL,
IQR: 44.9 to 75.7), SVI (median: 29.0 mL/m², IQR: 20.5 to 31.0), CO (median: 5.34 L/min, IQR: 4.09 to 5.75), and CI (median: 2.83 L/min/m², IQR: 2.05 to 3.10) were within low to normal ranges, while SVR (median: 1295 dyne⋅sec/cm−5; IQR: 1233 to 1993) and SVRI (median: 2704 dyne⋅sec/cm−5/m², IQR: 2210 to 4084) were normal to high. Five (33%) patients had subclinical systolic dysfunction with impaired GLS (>−16%), among which 2 patients also had low ejection fraction (<50%). All TCD variables were normal. Linear regression analysis demonstrated an association between GLS and SVI ($r^2=0.274$, $P=0.034$). However, there was no significant association between GLS and SV, CO, CI, SVR, or SVRI. Strain abnormality and hemodynamic parameters remained the same in the first week after TBI.

**Conclusions:** This preliminary study suggests that patients with isolated moderate-severe TBI commonly develop high SVR/SVRI suggesting a catecholamine-excess state. However, the SV/SVI are in lower ranges resulting in heterogeneity in the CO/CI. Advanced hemodynamic monitoring and cardiac function evaluation may be considered for personalized hemodynamic management in TBI.

**[SNACC-78] Serum Angiopoietin-2 in Children with Traumatic Brain Injury**

Lele A*, Lakireddy V*, Clark-Bell H*, Moore A*, Zimmerman J†, Chesnut R*, Vavilala M*. *University of Washington, Mercer Island; †Seattle Children's Hospital, Seattle, WA.

**Introduction:** Traumatic brain injury (TBI) is a major public health burden in children. Angiopoietin-2 is thought to mediate blood-brain barrier breakdown and angiogenesis in animal models of brain injury. The expression of angiopoietin-2 in children with TBI is unknown.

**Methods:** A prospective observational study was conducted to examine the association of clinical and radiographic characteristics on the expression of serum angiopoietin-2 in children with mild, moderate and severe TBI.

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Figure 1a
Serum Angiopoietin-2 Levels in Children with Traumatic Brain Injury (n = 28) by Admission Day and TBI Severity

Figure 1b
Serum Angiopoietin-2 Levels in Children with Traumatic Brain Injury (n = 28) by Patient, Admission Day and TBI Severity

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Results: We examined a cohort of children with mild (n = 14), moderate (n = 3), and severe (n = 11) TBI, aged 11 (1 to 17) years, mostly male (64.3%), with isolated head injury (75%) with injury severity score 25 (10 to 59). Expression of serum angiopoietin-2 (median) was associated with increasing age (P = 0.002), male sex (P = 0.04, 95% CI, 92.5-3089.2), and injury severity score (P = 0.004), and polytrauma (P = 0.02). Higher levels of serum angiopoietin-2 occurred in patients with intraventricular hemorrhage (P = 0.02), and trends were observed with subdural hematoma (3714.66+517.89 vs. 2682.63+517.89), subarachnoid hemorrhage (3771.04+561.03 vs. 2769.35+485.87), cerebral edema (4641.63 +957.6 vs. 2958.15+390.94), and subgaleal hematoma (3691.68+541.71 vs. 2771.35+504.30).

Conclusions: Higher serum angiopoietin-2 in children with TBI is associated with higher age, sex, injury severity, and intraventricular hemorrhage. Angiopoietin-2 may be a valid biomarker of BBB breakdown in children with TBI.
Table 2: Outcome Characteristics of 200 Patients with Severe Traumatic Brain Injury (TBI) Admitted to Jay Prakash Narayan Apex Trauma Center (JPNATC) by Intracranial Pressure (ICP) Monitor Placement.

<table>
<thead>
<tr>
<th>Outcome Characteristics</th>
<th>Total N=200</th>
<th>ICP/ICP Monitor Placement N=158 (78.5%)</th>
<th>No ICP/ICP Monitor Placement N=42 (21.5%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU length of stay (LOS) hours mean (SD)</td>
<td>6.1 [2.1]</td>
<td>6.1 [1.8]</td>
<td>5.9 [2.5]</td>
<td>0.57</td>
</tr>
<tr>
<td>Discharge Glasgow Outcome Scale (GOS) score</td>
<td>0.009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-9</td>
<td>49 (24.5)</td>
<td>26 (16.5)</td>
<td>23 (44.1)</td>
<td></td>
</tr>
<tr>
<td>9-12</td>
<td>107 (53.5)</td>
<td>57 (36.0)</td>
<td>50 (92.0)</td>
<td></td>
</tr>
<tr>
<td>13-15</td>
<td>44 (22.0)</td>
<td>28 (17.5)</td>
<td>16 (34.7)</td>
<td></td>
</tr>
<tr>
<td>Glasgow Outcome Scale (GOS) score</td>
<td>0.043</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>58 (29.0)</td>
<td>28 (22.2)</td>
<td>30 (46.2)</td>
<td></td>
</tr>
<tr>
<td>Glasgow Outcome Scale (GOS) score</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>67 (33.5)</td>
<td>56 (36.3)</td>
<td>11 (47.6)</td>
<td></td>
</tr>
<tr>
<td>Glasgow Outcome Scale (GOS) score</td>
<td>0.19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>71 (35.5)</td>
<td>68 (43.8)</td>
<td>3 (14.3)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3a: Association of Intracranial Pressure Monitor Placement and Mortality (inhospital and 3, 6 and 12 months) in Adults with Severe Traumatic Brain Injury.

<table>
<thead>
<tr>
<th>Mortality</th>
<th>Discharge N=200 RR (95% CI)</th>
<th>3 months N=198 RR (95% CI)</th>
<th>6 months N=198 RR (95% CI)</th>
<th>12 months N=198 RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ICP monitor placement</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>ICP monitor placement</td>
<td>0.50 (0.29, 0.87)</td>
<td>0.65 (0.40, 0.95)</td>
<td>0.70 (0.45, 1.11)</td>
<td>0.78 (0.51, 1.18)</td>
</tr>
</tbody>
</table>

RR = relative risk

**Model adjusted for age, EDR, SBH, IVH, cerebral edema, DAL, midline shift
***Model adjusted for age, SBH, IVH, cerebral edema, DAL, midline shift

Table 3b: Association of Intracranial Pressure Monitor Placement and Glasgow Outcome Coma Scale (GOS) at Discharge, 3, 6 and 12 months in Adults with Severe Traumatic Brain Injury.

<table>
<thead>
<tr>
<th>GOS (alive)</th>
<th>Discharge N=132 RR (95% CI)</th>
<th>3 months N=140 RR (95% CI)</th>
<th>6 months N=131 RR (95% CI)</th>
<th>12 months N=127 RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ICP monitor placement</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>ICP monitor placement</td>
<td>1.20 (0.51, 2.49)</td>
<td>0.87 (0.50, 1.51)</td>
<td>0.99 (0.64, 2.25)</td>
<td>-</td>
</tr>
</tbody>
</table>

RR = relative risk

**Crude RR as there are no confounders or precision variables for this model
**CRADE RR as there are no confounders or precision variables for this model
***Model adjusted age and adult GCS (motor)

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**Background:** India has a high brain injury (TBI) burden and intracranial pressure monitoring (ICP) remains controversial but some patients may benefit.

**Objective:** To examine the association between ICP monitor placement and outcomes, and identify Indian patients with severe TBI who benefit from ICP monitoring.

**Methods:** We conducted a secondary analysis of a prospective cohort study at a level 1 Indian trauma center. Patients over 18 years with severe TBI (admission Glasgow coma scale score <8) who received tracheal intubation for at least 48 hours were examined. Propensity-based analysis using inverse probability weighting approach was used to examine ICP monitor placement within 72 hours of admission and outcomes. Outcomes were in-hospital mortality and Glasgow Outcome Scale (GOS) score at discharge, 3, 6, and 12 months. Death, vegetative, or major impairment defined the unfavorable outcome.

**Results:** The 200 patients averaged 36 (18 to 85) years of age and average injury severity score of 31.4 (2 to 73). ICP monitors were placed in 126 (63%) patients. With ICP monitor placement experienced lower in-hospital mortality (adjusted relative risk [aRR], 0.50 [0.29-0.87]) than patients without ICP monitoring. However, there was no benefit at 3, 6, and 12 months. With ICP monitor placement, the absence of cerebral edema (aRR, 0.54; 95% CI, 0.35-0.84), and absence of intraventricular hemorrhage (aRR, 0.52; 95% CI, 0.33-0.82) were associated with reduced unfavorable outcomes.

**Conclusions:** ICP monitor placement without cerebrospinal fluid drainage after severe TBI burden and intracranial pressure monitoring (ICP) remains controversial but some patients may benefit.

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Bindu B, Singh G, Sati H. All India Institute of Medical Sciences, Gurgaon, Haryana, India.

**Background and Aims:** Fiberoptic bronchoscopy (FOB) guidance provides several advantages and is considered the best technique for percutaneous tracheostomy (PCT). Ultrasonography (USG) is easily available and USG screening of the neck has been shown to reduce complications associated with PCT. We aimed to compare the level of needle insertion, deviation from midline, intraprocedural complications and procedure time in critically ill neurosurgical patients undergoing PCT using 3 different techniques.

**Methodology:** Fifty patients were enrolled; 49 were analyzed. Randomization into 3 groups was done using computer generated randomization. Group 1 (Landmark) patients were tracheostomized using anatomic landmarks. Group 2 (FOB) patients were tracheostomized under visual guidance of FOB. In group 3 (USG) patients, a preprocedure scan of neck was done to identify vascular structures and tracheal rings. Needle was inserted under real time USG guidance. FOB was used in all 3 groups to make study observations. Demographic data, level and site of needle insertion, intraprocedural complications and total procedure time were noted.

**Results:** Baseline demographics were comparable between the 3 groups. Significant difference was found in the incidence of injury to posterior tracheal wall (P=0.021) and deviation of needle insertion site from midline (P=0.027) between the 3 groups (Table 1). Overall complication rate and incidence of other complications was comparable between the 3 groups.

**Conclusion:** Both FOB and USG-guided techniques of PCT are superior to landmark technique. USG guided technique may be used as an alternative to FOB for PCT.

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**[SNACC-81] Effectiveness of the Multilevel Pediatric Guideline Adherence and Outcomes (PEGASUS) Program on Traumatic Brain Injury Care and Outcomes**

Yang J*, Vavilala M*, King M†, Erickson S*, Mills B*, Grant R*, Blayney C*, Qian Qiu*, Chesnut R‡, Johnston B‡, *University of Washington, Bellevue; †Seattle Children’s Hospital; ‡Harborview Medical Center, Seattle, WA.

**Background:** In severe TBI, adherence to acute care key performance indicators (KPIs) during the first 72 hours is associated with favorable discharge outcomes. KPIs are avoidance of unwanted hypocarbia in the absence of brain herniation, maintenance of all cerebral perfusion pressure (CPP) >40 mm Hg, and early nutrition start within 72 hours. The Pediatric Guideline Adherence and Outcomes (PEGASUS) program is a multilevel, implementation science guided, comprehensive program that includes a clinical pathway and organizational efforts, as well as processes of care and provider perspectives. We report on the effect of the PEGASUS program on KPI adherence and clinical outcomes.

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Table 1: Comparison of complications and procedure time between three techniques of PCT

<table>
<thead>
<tr>
<th>Variable</th>
<th>Landmark technique (n=16)</th>
<th>FOB guided (n=17)</th>
<th>Real time USG guided (n=16)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure time (min)*</td>
<td>6 (3-14)</td>
<td>8 (4-17)</td>
<td>9.5 (4-18)</td>
<td>0.200</td>
</tr>
<tr>
<td>Improper level of needle insertion**</td>
<td>10 (62.5)</td>
<td>7 (41.2)</td>
<td>7 (43.8)</td>
<td>0.458</td>
</tr>
<tr>
<td>Deviation from midline**</td>
<td>14 (87.5)</td>
<td>9 (52.9)</td>
<td>7 (43.8)</td>
<td>0.027</td>
</tr>
<tr>
<td>Posterior tracheal wall injury**</td>
<td>6 (37.5)</td>
<td>5 (29.4)</td>
<td>0 (0)</td>
<td>0.021</td>
</tr>
<tr>
<td>&gt;1 attempt at tracheal puncture**</td>
<td>3 (18.8)</td>
<td>2 (11.8)</td>
<td>3 (18.8)</td>
<td>0.810</td>
</tr>
<tr>
<td>Tracheal cuff pierced**</td>
<td>3 (18.8)</td>
<td>0 (0)</td>
<td>1 (6.3)</td>
<td>0.113</td>
</tr>
<tr>
<td>Tracheal ring fracture**</td>
<td>2 (12.5)</td>
<td>3 (17.7)</td>
<td>4 (25.0)</td>
<td>0.741</td>
</tr>
<tr>
<td>Desaturation**</td>
<td>1 (6.3)</td>
<td>2 (11.8)</td>
<td>0 (0)</td>
<td>0.764</td>
</tr>
<tr>
<td>Vascular injury**</td>
<td>2 (12.5)</td>
<td>3 (17.7)</td>
<td>0 (0)</td>
<td>0.347</td>
</tr>
<tr>
<td>Occurrence of any complication**</td>
<td>15 (93.8)</td>
<td>13 (76.5)</td>
<td>13 (81.3)</td>
<td>0.495</td>
</tr>
</tbody>
</table>

*Median (range)  **n (%)
Methods: After IRB approval, we conducted a quasi-experimental interventional study at a level 1 pediatric trauma center. Program inclusion criteria were age older than 18 years, TBI diagnosis, and Glasgow Coma Scale <9. Patients admitted with less than severe TBI but who deteriorate were included. Preprogram phase patients (January 2007 to April 2011) were compared with a subgroup of patients in the Program phase (May 2011 to July 2017) meeting similar inclusion criteria. KPI adherence and discharge disposition were examined by program phase. To examine generalizability of the association between KPIs and clinical outcomes associated with the PEGASUS program, multivariate modified Poisson regression models were used to estimate clinical impact at discharge (survival and favorable discharge disposition [home or minor impairment]).

Results: A total of 199/201 (99%) eligible patients (9.9 ± 6.4 y old) participated in the PEGASUS program with 93% clinical pathway start within 24 hours of severe TBI diagnosis and 95% completed the clinical pathway. Compared with the 56 preprogram phase patients, the 71 program phase patients who met similar inclusion criteria had an 11% increase in avoidance of unwanted hypocarbia, and 4% increase in early nutrition start. Maintenance of CPP decreased from 64% to 61% but nursing notes documented efforts to increase CPP. Crude discharge survival remained at 91.6% but favorable discharge disposition increased from 55.4% to 68.4%. For the total cohort of 199 program participants, maintenance of CPP (ARR survival, 1.15; 95% confidence interval [CI], 1.01-1.32; ARR discharge outcome, 1.28; 95% CI, 1.03-1.59) and early nutrition start (ARR survival, 4.46; 95% CI, 2.29-8.67; ARR discharge outcome, 4.15; 95% CI, 2.01-8.55) were associated with better survival and favorable discharge disposition. Adherence to each additional KPI was associated with better discharge survival (ARR, 1.22; 95% CI, 1.07-1.38) and favorable discharge outcomes (ARR, 1.33; 95% CI, 1.13-1.57).

Discussion: In this study conducted at a level 1 pediatric trauma center where children with severe TBI receive care, implementation of the PEGASUS program was feasible, sustained, had high fidelity and was associated with higher KPI adherence and better discharge outcomes. Higher adherence to KPIs was associated with better clinical outcomes.

Conclusion: Higher adherence to KPIs was associated with better clinical outcomes. Multidisciplinary programs like the PEGASUS program can help in decreasing mortality and morbidity.
Methods and Material: A total of 100 patients with moderate to severe isolated head injury were included. Samples for coagulation tests (PT, PTI, INR, aPTT, and platelet count) were collected at 5 points of time. TIC was diagnosed if any 3 readings were abnormal. Patients were also followed up after hospital discharge using Glasgow Outcome Score (GOS) at 1 and 3 months.

Statistical Analysis: Data was analyzed using SPSS version 21. Logistic regression analysis was employed to determine individual coagulation test as best predictors for mortality. P-value of <0.05 was considered significant.

Results: The incidence of TIC was found to be 62%; it was 63.75% in severe head injury and 55% in moderate head injury patients. It was 70.83% in patients who had undergone decompressive craniotomy. De-reanged INR at the time of hospital admission (odds ratio = 4.38) and PTI at 24 hours (odds ratio = 3.913) are predictive of mortality. The incidence of mortality was 43.54% in patients who had TIC while it was 26.31% in patients who did not have TIC with risk ratio of 1.72 and 95% confidence interval of 0.94-3.12. There was no significant difference in GOS score at 1 and 3 months.

Conclusions: Incidence of TIC was 62% among patients with isolated head injury. Coagulopathy is more prevalent in severe head injury. De-reanged INR at hospital admission and PTI at 24 hours of hospital admission are highly predictive of mortality during hospital course. Patients having TIC had increased incidence of death in 1 and 3 months compared with those who did not have coagulopathy, though the neurological outcome at 1 and 3 months after discharge was not different in-between the groups.

Key Words: Trauma-induced coagulopathy, Isolated head injury, GOS

[SNACC-85] Self-administered Gerocognitive Examination (SAGE) to Assess Preoperative Cognitive Status of Elderly Patients Undergoing Major Surgery

Stoicaea N, Mavarez-Martinez A, Roeth C, Borrell-Vega J, Abdel-Rasoul M, Humeidan M, Scharre D, Bergese S. The Ohio State University Wexner Medical Center, Columbus, OH.

Background: Advanced age is considered a significant risk factor for postoperative cognitive decline. Several cognitive screening assessments are underutilized due to significant limitations imposed by the time-intensive nature and the special personnel and equipment required for administration and scoring. Scharre et al developed and validated the Self-administered Gerocognitive Examination (SAGE) to identify mild cognitive impairment (MCI) and early dementia in elderly patients. SAGE is a brief (12 questions), self-administered cognitive test that can be easily used by any health care provider without requiring patient interaction or special equipment. The maximum SAGE scores is 22. Scores of 15 and 16 are suggestive of MCI and scores <14 are suggestive of dementia. We aimed to assess preoperative cognitive status of elderly patients undergoing elective surgeries at our institution based on SAGE scores.

Methods: Elderly patients (60 y and older) undergoing elective major surgeries (noncardiac, non-neuro) under general anesthesia comprised our study patient population. SAGE was performed during the preoperative visit based on general guidelines of test administration. The following demographics were collected from the medical records and compared with the information provided by the patient at the beginning of the test: age (younger than 70 and 70 y and older), sex, race (whites and nonwhites), and level of education (≤ high school, some college/college degree, > college degree). Demographic variables were summarized as means (SD) for continuous variables and frequencies (percentages) for categorical variables. ANOVA was used to test univariate differences in SAGE scores among categories of demographic variables. A general linear model was fit to assess the multivariable relationship between the demographic variables and the overall SAGE score.

Results: Of the 174 patients who completed the SAGE preoperatively, 114 (65.52%) were below 70 years old and 60 (34.48%) were 70 years old and above; 115 (66.09%) were males and 59 (33.91%) females; 149 (85.63%) were whites and 25 (14.37%) nonwhites. Regarding the level of education, 59 (33.91%) completed high school or less, 83 (47.70%) some college or had a college degree, and 32 (18.39%) had more than a college degree. The overall mean SAGE score was 18.41 ± 3.03.

When assessing the relationship between SAGE scores and demographic variables, patients with level of education ≤ high school had significant lower scores (16.76 ± 3.27) compared with higher education categories (19.12 ± 2.62 and 19.59 ± 2.26) (P < 0.0001). Also, nonwhites patients had significant lower scores (16.64 ± 3.80) than white (18.70 ± 2.79) (P = 0.0145). For the interaction term race/age, the nonwhites with age younger than 70 years subgroup had significant higher SAGE scores (17.81; 95% confidence interval, 16.59-19.03) than the nonwhites with age 70 years and older subgroup (12.80; 95% confidence interval, 10.67-14.49) (P < 0.0001).

Conclusions: Cognitive function of elderly patients undergoing elective surgery can be easily assessed preoperatively with SAGE. Lower SAGE scores in patients older than 70 years old might be suggestive of low cognitive reserve.
Injectable Suspension (Exparel) for postoperative pain control. Recent literature suggests that transverse abdominis plane block (TAP block) may be an appropriate anesthetic technique addition for different procedures, while offering additional benefits such as reduced postoperative opioid consumption, reduced postanesthesia care unit (PACU) stays with reduced opioid related side effects. To the best of our knowledge, TAP block with Exparel has not been studied for ALIF procedures. Our retrospective study aims to analyze our institutional experience with Exparel applied by direct surgical infiltration or by TAP block for ALIF, and whether the analgesic technique used has any impact on PACU stay, opioid use and opioid related side effects.

Materials and Methods: We retrospectively reviewed cases of ALIF performed for the period of March 2015 through March 2018. We determined which patients received TAP block and which patients had direct surgical site infiltration. For both groups we used 20 mL vail of Exparel, with 266 mg free-base Bupivacaine, which is molar equivalent of 300 mg Bupivacaine HCL. We analyzed total time in PACU phase 1 (in minutes), total opioid administered in PACU phase 1 (in IV morphine equivalents) and the presence or absence of nausea and vomiting in the postoperative phase. Statistical analysis was performed utilizing the independent sample t test.

Results: A total of 88 ALIF patients were included in this study. A total of 28 patients received TAP block and 60 patients received surgical site infiltration. The mean times in the PACU were 66 minutes (SD = 32.18) for the TAP block group and 78 minutes (SD = 20.30) for the direct surgical site infiltration group. The mean opioid use in PACU was 6.78 mg Morphine equivalents (SD = 5.91 mg) in the TAP arm versus 8.44 g Morphine equivalents (SD = 7.07 mg) in the surgical site infiltration arm. With the independent sample t tests, the results did not show statistically significant difference. Ten patients in the TAP group and 21 in the direct infiltration group reported nausea and vomiting, which was not statistically significantly different.

Discussion: Our retrospective data showed that TAP block and surgical infiltration with Exparel for ALIF surgery did not have statistically significant differences in terms of PACU phase 1 stay times, immediate postoperative opioid use and opioid-related postoperative complications. This data suggests that the majority of patients that receive TAP block with Exarel for ALIF surgery tend to require minimal opioid immediately postoperatively with a trend toward shorter PACU stays, but those that do require opioids tend to require relatively large doses. Our data indicates that both TAP block and direct surgical site infiltration with Exparel are clinically effective measures to control postoperative pain in ALIF surgery. Further prospective study is necessary to fully delineate clinically significant outcomes.

Effect Of The Sitting Versus The Supine Position On Microbubble Clearance Times From The Right Atrium, Right Ventricle, and Pulmonary Artery


Background: Venous air embolism (VAE) occurs in neurosurgical procedures performed in the seated position. A treatment for VAE is central venous catheter (CVC) placement with the CVC tip at the cavoatrial junction. The rationale for CVC use is aspiration of entrained air from the right atrium with model studies suggesting the uppermost cardiac location is optimum for retrieval. This is based upon presumed bubble buoyancy, such that entrained air accumulates superiorly in the seated patient. This assumption has not been tested in human subjects. This study examines injected microbubble clearance times from the right atrium (RA), right ventricle (RV), and pulmonary artery (PA) in supine and seated positions of patients undergoing neurosurgical procedures in the seated position.

Methods: An IRB-approved prospective study of 20 patients undergoing seated neurosurgical procedures. Following induction and transesophageal echo (TEE) probe placement, a Cook Bunein-Albin Air Aversion CVC was positioned in the low SVC. Attainment of the TEE midesophageal right ventricular inflow outflow view, displayed RA, RV, and PA simultaneously. Microbubbles formed by agitating 10 mL saline with 1 mL air were injected into the CVC over 1 second. Real-time images were recorded from initial injection. Triplicate injections were obtained in supine and seated positions. TEE measured cardiac outputs were obtained. Clearance time was defined as the interval between the first appearance of microbubbles and the first bubble-free appearance at the specified location. ANOVA and t test analyses were performed.

Results: Microbubbles appeared in RA during agitated saline injection. There was no measurable delay in microbubble appearance in the RV and PA compared with the RA. Within subject repeated microbubble injections had no impact on clearance times. There were no significant differences in clearance times across subjects between supine and seated positions for RA (12.4 ± 1.9 vs. 10.2 ± 0.8 s), RV (13.5 ± 2.1 vs. 11.5 ± 0.9 s), and PA (13.7 ± 2.3 vs. 12.2 ± 1.2 s) or cardiac outputs (4.1 ± 0.8 vs. 4.8 ± 0.9 L/min). There were no significant differences in clearance times between RA, RV, and PA.

Discussion: The utility of a CVC in entrained air aspiration during VAE is contingent upon retention of a significant fraction of the air in a predictable and CVC accessible location. The suggestion that the optimum location for the CVC tip is the cavo-atrial junction implies air bubble buoyancy in the RA makes it a favorable location for retrieval. Our findings suggest microbubbles follow the bulk fluid in which they are suspended, blood, with fluid dynamic forces playing a greater role than buoyant forces. This may help explain a common observation that air retrieved from a CVC following precordial Doppler and TEE-demonstrated VAE is often <1 mL and of no demonstrable clinical benefit.

Conclusions: On the basis of microbubble clearance times, blood fluid dynamic forces are greater than microbubble buoyant forces, resulting in rapid passage of blood from the right heart into the pulmonary circulation. These results suggest that CVC use for neurosurgical procedures in the seated position as a standard of care deserves reconsideration and further study.

Preoperative Gabapentin Administration Improves Acute Postoperative Analgesia in Patients Undergoing Craniotherapy: A Randomized Controlled Trial

Zeng M*, Dong J†, Lin N†, Zhang W†, Zhang K†, Peng K†, Wang D*, Zhao Y*, Peng Y†, Han R†, †Beijing Tiantan Hospital, Capital Medical University; †Beijing Tiantan Hospital, Capital Medical University, Beijing, PR China, Beijing, China.

Background: Gabapentin is an adjuvant antiepileptic agent and help to reduce acute postoperative pain in several surgery setting. However, the effect of gabapentin on postoperative pain from suboccipital or subtemporal craniotherapy is not clear.

Methods: The study was a single-center, randomized, placebo-controlled, and double-blinded trial. A total of 122 patients undergoing elective craniotherapy via a suboccipital or subtemporal approach were randomly allocated into placebo group and gabapentin group. The patients received gabapentin (600 mg, orally) the night before surgery and 2 hours before anesthesia induction in gabapentin group, and vitamin B1 in the placebo group, respectively. The primary outcome was the postoperative pain score on movement at 24 hours. The secondary outcomes included pain score at other time points, incidence of nausea and vomiting, sedation and analgesic consumption.

Results: Gabapentin significantly decreased postoperative acute pain scores at rest (P < 0.001) and on movement (P < 0.000) within 24 hours, but did not have effect at 48 hours. Gabapentin decreased postoperative vomiting (P = 0.047) and rescue antiemetics (P = 0.033), but increased sedation score at postoperative 2 hours (P = 0.05). Besides, gabapentin decreased mean consumption of intraoperative propofol (0.7 mg/kg/h, P = 0.021) and remifentanil (1.3 µg/kg/min, P = 0.025), but did not influence postoperative opioid consumption.

Conclusions: Preoperative gabapentin significantly alleviates acute postoperative pain and decreased incidence of vomiting in patients undergoing suboccipital or subtemporal craniotherapy. However, more attention should also be paid to early postoperative sedation when multimodal analgesia with gabapentin is administered.
<table>
<thead>
<tr>
<th></th>
<th>Placebo Group (n = 50)</th>
<th>Gabapentin Group (n = 52)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years(^1)</td>
<td>43 (12)</td>
<td>44 (8)</td>
<td>0.670</td>
</tr>
<tr>
<td>Height in centimeter(^1)</td>
<td>166 (8)</td>
<td>165 (8)</td>
<td>0.551</td>
</tr>
<tr>
<td>Weight in kilogram(^1)</td>
<td>66 (11)</td>
<td>65 (11)</td>
<td>0.827</td>
</tr>
<tr>
<td>Female Sex(^3)</td>
<td>28 (56.0)</td>
<td>26 (50.0)</td>
<td>0.551</td>
</tr>
<tr>
<td>Education(^3)</td>
<td></td>
<td></td>
<td>0.522</td>
</tr>
<tr>
<td>Primary school and lower</td>
<td>13 (26.0)</td>
<td>9 (17.3)</td>
<td></td>
</tr>
<tr>
<td>Middle school</td>
<td>24 (48.0)</td>
<td>26 (50.0)</td>
<td></td>
</tr>
<tr>
<td>College and higher</td>
<td>13 (26.0)</td>
<td>17 (32.7)</td>
<td></td>
</tr>
<tr>
<td>Preoperative symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hearing loss(^3)</td>
<td>31 (62.0)</td>
<td>36 (69.2)</td>
<td>0.442</td>
</tr>
<tr>
<td>Facial numbness(^3)</td>
<td>10 (20.0)</td>
<td>18 (34.6)</td>
<td>0.098</td>
</tr>
<tr>
<td>Nausea or Vomiting(^3)</td>
<td>4 (8.0)</td>
<td>6 (11.5)</td>
<td>0.741</td>
</tr>
<tr>
<td>Dizziness(^3)</td>
<td>12 (24.0)</td>
<td>18 (34.6)</td>
<td>0.281</td>
</tr>
<tr>
<td>Headache</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence(^3)</td>
<td>11 (22.0)</td>
<td>15 (28.8)</td>
<td>0.499</td>
</tr>
<tr>
<td>VAS(^2)</td>
<td>0 (0.0-0.0)</td>
<td>0 (0.0-19.5)</td>
<td>0.314</td>
</tr>
<tr>
<td>Pathology type of tumor(^3)</td>
<td></td>
<td></td>
<td>0.923</td>
</tr>
<tr>
<td>Acoustic neuroma</td>
<td>35 (70)</td>
<td>38 (73.1)</td>
<td></td>
</tr>
<tr>
<td>Meningioma</td>
<td>8 (16.0)</td>
<td>8 (15.4)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>7 (14.0)</td>
<td>6 (11.5)</td>
<td></td>
</tr>
<tr>
<td>Operative approach(^3)</td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Suboccipital</td>
<td>43 (86.0)</td>
<td>44 (84.6)</td>
<td></td>
</tr>
<tr>
<td>Subtemporal</td>
<td>7 (14.0)</td>
<td>8 (15.4)</td>
<td></td>
</tr>
<tr>
<td>Tumor size (centimeter)(^1)</td>
<td>2.9 (0.9)</td>
<td>2.9 (0.9)</td>
<td>0.721</td>
</tr>
<tr>
<td>Duration of surgery (mins)(^1)</td>
<td>245 (74)</td>
<td>257 (72)</td>
<td>0.403</td>
</tr>
<tr>
<td>Duration of anesthesia (mins)(^1)</td>
<td>315 (81)</td>
<td>326 (80)</td>
<td>0.527</td>
</tr>
<tr>
<td>Time to tracheal extubation (mins)(^1)</td>
<td>16 (7)</td>
<td>19 (8)</td>
<td>0.065</td>
</tr>
</tbody>
</table>

\(^{1}\) data were presented as mean and standard deviation; \(^{2}\) data were presented as median and interquartile range; \(^{3}\) data were presented as number and percentage. VAS, visual analog scale.
### Table 2. Primary outcomes: postoperative VAS scores after surgery.

<table>
<thead>
<tr>
<th>Time points</th>
<th>Placebo Group (n = 50)</th>
<th>Gabapentin Group (n = 52)</th>
<th>Difference (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest</td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>1 hour</td>
<td>29.0 (20.0-40.0)</td>
<td>21.0 (20.0-27.5)</td>
<td>7.9 (2.9-12.9)</td>
<td>0.002*</td>
</tr>
<tr>
<td>2 hours</td>
<td>27.0 (18.0-30.0)</td>
<td>20.0 (16.3-28.0)</td>
<td>6.3 (2.2-10.3)</td>
<td>0.013*</td>
</tr>
<tr>
<td>24 hours</td>
<td>20.0 (18.0-28.5)</td>
<td>18.0 (10.0-20.0)</td>
<td>2.0 (2.4-10.4)</td>
<td>0.033*</td>
</tr>
<tr>
<td>48 hours</td>
<td>13.5 (10.0-20.0)</td>
<td>10.0 (10.0-17.8)</td>
<td>3.5 (0.0-6.5)</td>
<td>0.028</td>
</tr>
<tr>
<td>On movement</td>
<td></td>
<td></td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>1 hour</td>
<td>37.0 (29.8-48.3)</td>
<td>29.5 (22.3-39.5)</td>
<td>8.8 (2.8-14.7)</td>
<td>0.005*</td>
</tr>
<tr>
<td>2 hours</td>
<td>39.0 (28.0-45.5)</td>
<td>28.5 (18.5-41.0)</td>
<td>10.5 (3.3-13.2)</td>
<td>0.005*</td>
</tr>
<tr>
<td>24 hours</td>
<td>30.0 (28.0-41.0)</td>
<td>24.5 (18.0-29.0)</td>
<td>9.1 (4.6-13.5)</td>
<td>0.000*</td>
</tr>
<tr>
<td>48 hours</td>
<td>20.5 (19.8-29.0)</td>
<td>20.0 (10.0-22.8)</td>
<td>0.5 (0.14-8.4)</td>
<td>0.027</td>
</tr>
</tbody>
</table>

Values were expressed as median (IQR); *: indicated between-group difference with statistical significance after Bonferroni correction. CI, confidence interval.

### Table 3. Secondary outcomes

<table>
<thead>
<tr>
<th></th>
<th>Placebo Group (n = 50)</th>
<th>Gabapentin Group (n = 52)</th>
<th>Difference (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intraoperative period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remifentanil (µg/kg/hour)</td>
<td>11.3 (3.4)</td>
<td>10.0 (2.7)</td>
<td>1.3 (0.1-2.6)</td>
<td>0.025*</td>
</tr>
<tr>
<td>Propofol (mg/kg/hour)</td>
<td>6.3 (1.8)</td>
<td>5.5 (1.6)</td>
<td>0.7 (0.0-1.4)</td>
<td>0.021*</td>
</tr>
<tr>
<td>Vasodepressor requirements</td>
<td>15 (30.0)</td>
<td>8 (15.4)</td>
<td>14.6 (4.4-3.0)</td>
<td>0.077</td>
</tr>
<tr>
<td><strong>Postoperative period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative opioid dosage of PCA (µg)</td>
<td>1</td>
<td>18.3 (3.6)</td>
<td>17.6 (3.9)</td>
<td>-0.7 (-2.2-0.8)</td>
</tr>
<tr>
<td>1 hour</td>
<td>18.3 (3.6)</td>
<td>17.6 (3.9)</td>
<td>-0.7 (-2.2-0.8)</td>
<td>0.344</td>
</tr>
<tr>
<td>2 hours</td>
<td>36.3 (6.4)</td>
<td>34.8 (7.0)</td>
<td>-1.5 (-4.1-1.1)</td>
<td>0.268</td>
</tr>
<tr>
<td>24 hours</td>
<td>390.6 (64.0)</td>
<td>389.5 (67.4)</td>
<td>-1.1 (-27.0-24.7)</td>
<td>0.931</td>
</tr>
<tr>
<td>48 hours</td>
<td>772.9 (125.8)</td>
<td>774.8 (133.3)</td>
<td>1.9 (-49.0-52.8)</td>
<td>0.942</td>
</tr>
<tr>
<td>Tramadol requirements</td>
<td>12 (24.0)</td>
<td>6 (11.5)</td>
<td>12.5 (2.2-27.5)</td>
<td>0.123</td>
</tr>
<tr>
<td>48 hours</td>
<td>4 (8.0)</td>
<td>4 (7.7)</td>
<td>0.3 (0.1-1.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Ramsay sedation scores 2</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>0.3 (0.0-0.6)</td>
<td>0.038</td>
</tr>
<tr>
<td>1 hour</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>0.3 (0.0-0.6)</td>
<td>0.038</td>
</tr>
<tr>
<td>2 hours</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>0.3 (0.0-0.6)</td>
<td>0.038</td>
</tr>
<tr>
<td>24 hours</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>0.3 (0.0-0.6)</td>
<td>0.038</td>
</tr>
<tr>
<td>48 hours</td>
<td>2 (2-2)</td>
<td>2 (2-2)</td>
<td>0.3 (0.0-0.6)</td>
<td>0.038</td>
</tr>
<tr>
<td>Nausea 3</td>
<td>28 (56.0)</td>
<td>20 (38.5)</td>
<td>17.5 (1.5-36.6)</td>
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</tr>
<tr>
<td>Vomiting 3</td>
<td>14 (28.0)</td>
<td>6 (11.5)</td>
<td>16.5 (13.1-31.6)</td>
<td>0.047*</td>
</tr>
<tr>
<td>Rescue antiemetics 3</td>
<td>16 (32.0)</td>
<td>7 (13.5)</td>
<td>18.5 (2.6-34.5)</td>
<td>0.033*</td>
</tr>
<tr>
<td>Dizziness 3</td>
<td>33 (66.0)</td>
<td>37 (71.2)</td>
<td>14.5 (1.4-30.7)</td>
<td>0.671</td>
</tr>
</tbody>
</table>

1 data were presented as mean and standard deviation; 2 data were presented as median and interquartile range; 3 data were presented as number and percentage. PCA, patient controlled analgesia. CI, confidence interval. *comparing with placebo group, p<0.05. Difference for categorical variables was in proportion. * indicated between-group difference with statistical significance after Bonferroni correction.
**[SNACC-90] Role of Magnesium in Preventing Postoperative Sore Throat**

Singh N*, Makkar J†, Singh P†, Wourms V*. Max Rady College of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada; †Post Graduate Institute of Medical Education and Research, Chandigarh; ‡All India Institute of Medical Sciences, New Delhi, India.

**Background:** Postoperative sore throat (POST) after tracheal intubation not only has negative impact on patient satisfaction and recovery but also inflate health care cost. Magnesium, because of its role in nociception and inflammation has been found to be useful for POST prevention.

**Methodology:** We conducted a systematic review and meta-analysis to assess the efficacy of Magnesium in preventing postoperative sore throat in adult patients undergoing surgery under general anesthesia. The primary outcome was the incidence of POST at 24 hours after surgery. Secondary outcome were incidence of moderate to severe postoperative sore throat.

**Results:** Data for this comparison was available in 9 trials that included 386 patients in control and 386 patients in the comparator group. Incidence of sore throat was significantly lower in comparator group (41/386) as compared with control group (91/386); OR = 0.01, relative risk (RR) 95% confidence interval (CI), 0.32 (0.14-0.76).

On analysis of severity of POST in studies using inactive control, incidence of mild sore throat was significantly lower in magnesium group 28/185 and 10/185, (RR) 0.36 (0.17-0.77). Incidence of moderate sore throat was also significantly lower in magnesium group 1/185 as compared with control group 19/185 RR, 0.14 (0.04-0.48) P=0.00. None of the patients developed severe sore throat in any of the studies.

**Conclusion:** Compared with nonanalgesic as well as active controls, magnesium reduces the incidence and severity of POST.

**References:**

**[SNACC-91] Volatile Versus Total Intravenous Anesthesia for Endovascular Clot Retrievals in Acute Stroke: An Audit of Outcomes**

Crimmins D, Highton D, Frankel A. Princess Alexandra Hospital, Woolloongabba, Qld, Australia.

**Background:** Endovascular therapy for acute ischemic stroke is a time critical intervention with the potential to dramatically improve outcome. Anesthetic management may affect both time to intervention and neuroprotection, but choice of technique remains controversial (volatile anesthesia, propofol anesthesia or sedation). The aim of this study was to evaluate the effect of anesthetic technique on time to intervention and outcome in a single neurosciences center to guide service development.

**Methods:** Following ethics committee approval, we examined the electronic medical records of patients who underwent endovascular management of anterior circulation acute ischemic stroke at the Princess Alexandra Hospital, Brisbane, between February 2015 and January 2018. Patient characteristics and anesthetic details were gathered retrospectively, including stroke time, door arrival time, groin puncture time, reperfusion time, mode of anesthesia, Modified Rankin Scores (MRS) and mortality at 90 days. MRS were compared using Student t test and mortality using the x^2 test.

**Results:** A total of 131 patients were included, 62 female and 69 male, with a mean age of 64 years. A total of 125 of the 131 patients received general anesthesia: total intravenous (TIVA) (n = 59), volatile only after induction (n = 46), or a volatile/intravenous combined technique (n = 20). Stroke time to reperfusion time (299 min TIVA vs. 333 min volatile only, P=0.2) did not differ between the groups. MRS did not differ between the groups (2.37 TIVA vs. 2.70 volatile only, P=0.13), but mortality was greater in those exposed to volatile anesthesia (10.3% TIVA vs. 25.5% volatile only, P=0.04).

**Conclusions:** Our results illustrate that mode of anesthetic does not significantly influence door to reperfusion time in our center. However, these observational data are consistent with a potential protective effect of TIVA rather than volatile anesthesia thought to confer neuroprotection and improve outcome in acute stroke. Observational research findings. A randomized control trial is warranted to inform optimal anesthetic management (TIVA vs. volatile), as there is a lack of evidence to mandate one specific mode of anesthesia.

**Reference:**

**[SNACC-92] Modulation of Human Memory by Midazolam and Ketamine During Painful Stimulation**


**Introduction:** The interacting effects of anesthetics and acute pain on memory encoding have not been well-characterized. There is evidence that amygdala (fear) activity is not blocked by anesthetics while viewing aversive images. We investigated memory encoding of auditory items paired or not paired with acute painful stimuli under midazolam (Mdz) and ketamine (Ket) using functional magnetic resonance imaging (fMRI) in humans. We hypothesized that both agents would blunt learning and impair memory encoding of emotional items, but would be able to discriminate brain areas that mediate memory encoding for these distinct agents.

**Methods:** These preliminary data include 11 healthy adults (6 male), mean (SD) age = 24.7 (4.1) years. MRI scanning was at 3 T, 1 s temporal resolution. A list of 90 words was played 3 times (random order), and participants classified each (eg, alive or not) while response times (RTs) were recorded. Thirty of the words were consistently followed by a 1 s painful (rated 7/10) electrical stimulation. Either drug was then administered via target-controlled infusion to effect-site concentrations expected to be equi-anmestic. The same conditions were compared with saline. Pain did not significantly affect recognition memory (Fig. 2), so results were collapsed across pain condition. Both drugs impaired but did not eliminate, recognition memory encoding, and these responses were tabulated for each experimental condition. Preliminary group average fMRI maps were generated using SPM 12.

**Results:** Compared with saline, RTs were slowed by Mdz and further slowed by Ket (Fig. 1). There was a significant interaction between pain and anesthetic, with different pain versus nonpain RT time profiles seen under Ket and Mdz, compared with saline. Pain did not significantly affect recognition memory (Fig. 2), so results were collapsed across pain condition. Both drugs impaired but did not eliminate, recognition memory, which was more pronounced for Mdz compared with Ket. Preliminary fMRI analyses suggested that both drugs modulate activity in the hippocampus and amygdala.

**Discussion:** We have developed an experimental framework for assessing the influence of pain on learning and memory at baseline and under sedation. We describe preliminary behavioral and neuroimaging effects for 2 drugs. Additional data should allow more definitive conclusions for the interacting effects of acute pain and distinct anesthetics on human memory.

**References:**
1. Pryor KO, Root JC, Mehta M, et al. Effect of propofol on memory testing, accuracy and confidence in humans. We hypothesized that both agents would blunt learning and impair memory encoding. We also sought to determine brain areas that mediate memory encoding for these distinct agents.

**References:**
1. Pryor KO, Root JC, Mehta M, et al. Effect of propofol on memory testing, accuracy and confidence in humans. We hypothesized that both agents would blunt learning and impair memory encoding. We also sought to determine brain areas that mediate memory encoding for these distinct agents.


[SNACC-93] Impact of Intraoperative Ventilation With High Oxygen Content to Reduce the Incidence and Extent of Postoperative Pneumocephalus in Patients Undergoing Craniotomies

Sandhu G, Fiorda-Diaz J, Gonzalez-Zacarias A, Soghomonyan S, Targonski D, Prevedello L, Prevedello D, Abdel-Rasoul M, Uribe A, Stoica N, Bergese S. The Ohio State University Wexner Medical Center, Columbus, OH.

Background: Pneumocephalus has been defined as a collection of air in the cranial cavity. Recent scientific evidence supports supplemental oxygen therapy as a common practice to accelerate the resolution of pneumocephalus. Hypothesis: Intraoperative ventilation with FiO2 100% instead of the commonly used ratio air/oxygen 1:1 (FiO2 60%) will have a positive prophylactic effect on occurrence and extent of postoperative pneumocephalus in neurosurgical patients.

Objectives: To compare the rate of occurrence and volume of postoperative pneumocephalus in patients undergoing craniotomy receiving intraoperative ventilation with pure oxygen during the last stage of surgery versus a conventional air/oxygen 1:1 mixture.

Material and Methods: Prospective randomized single-blinded study to compare the rate of occurrence and volume of postoperative pneumocephalus in patients undergoing craniotomy receiving intraoperative ventilation with pure oxygen (group B) versus a conventional air/oxygen 1:1 mixture (group A) during the last stage of surgery.

Results: One hundred patients were randomized into group “A” and group “B.” Seventy patients were included in the final analysis with 39 patients allocated in group “A” and 31 patients in group “B.” Median and IQR were used for postoperative pneumocephalus volume. Group A: 9.65 (3.61-23.20); group B: 7.06 (2.70-20.1).

Discussion: Our study showed no prophylactic effect on postoperative pneumocephalus volume when using mechanical ventilation with higher oxygen concentrations than the standard FiO2 during the last stage of surgery in patients undergoing craniotomy (P=0.47). A blinded analysis of our data revealed the median pneumocephalus volumes in both groups were significantly lower than volumes described in previous reports, which no longer satisfied our hypothesis. Our data showed no statistical differences in SICU LOS between groups (median: 1380 [group A] vs. 1524 min [group B]; P=0.18).

Conclusions: The published literature describing the average volume of postoperative pneumocephalus is limited or highly variable among institutions. The great differences in postoperative pneumocephalus volume reported by our study when compared with actual published literature may be attributed to early diagnoses and intervention specific to our institution.

References:

[SNACC-94] Institutional Analysis of Best Practice Related to Usage of ASA Monitors and Hemodynamic Changes With Prone to Supine Emergence Transition in Neuoroanesthesia Practice: A Retrospective Analysis

LaGrone R, Chakraborty I. UAMS, Benton, AK.

Neurosurgical cases make up a large portion of surgeries performed in the United States and its increasing every year; according to the NIH from 2006 to 2013, not only is the number of neurosurgical cases increasing but the ratio of spine to craniotomy cases is increasing as well which means more and more prone positioning. Each year at UAMS, nearly 15% of all cases are neurosurgeries. Of those, 80% require prone position or 12% of all cases (up to 10 cases requiring this positioning per day). Understandably, each of these surgeries require 2 position changes and with these transitions come hemodynamic changes and a precarious time of very little monitoring. The purpose of this study was to determine our institutional use of ASA standard monitors at UAMS during the prone/supine position change in neurosurgical cases and to note any significant hemodynamic changes at this time.

Patients were selected from chart review of those cases that were performed by the neurosurgical department from 2010 to 2014 and required a position change to prone. The dataset contained 30,109 observations on 232 surgical cases from 223 patients. Note that 9 of the patients each had 2 surgeries. Cases where all monitoring devices had <7 measurements were removed from the analysis, leaving 225 surgical cases from 216 patients available for analysis.
Three primary results were measured: (1) the results of a UAMS Anesthesia Staff Survey on use of ASA monitors in neuroanesthesia; (2) patient data set results showing lack of ASA monitor usage during position change; and (3) patient data set results detailing hemodynamic alterations during position change. The primary results of the UAMS Anesthesia Staff Survey were that over 92% of providers do not keep on all ASA monitors during position change, and based on self-report most providers leave 2 ASA monitors on during position change, with pulse oximetry being the favorite monitor amongst all education and experience levels. The patient dataset shows that pulse oximetry, despite being the preferred monitor, was most likely to be left off the patient long enough to miss a cycle time during transition (80% to 84% of the time) and also recorded
the longest lag time before being replaced of 11 to 13 minutes. In regards to hemodynamic change, the largest significant change was seen in diastolic blood pressure with an increase of 6.87% or 3.88 points with a P-value of 0.024.

With the standardization of ASA monitors, “death due to anesthesia” has become rare over the last 25 years, falling from around 2 per 10,000 anesthetics administered to 1 per 200,000 to 300,000. However, there is still potential for problems, the most common times being at induction, emergence, major surgical events, or during intraoperative position changes. With this study, providers can be more aware of the changes that can occur during this position change and become increasingly vigilant on ASA monitor usage during this time.

**[SNACC-95] Pilot Retrospective Study Investigating ETCO2 in Stroke Patients for Emergency Thrombectomy Using JED (Jaw Elevation Device)**

**Background:** A total of 750,000 acute ischemic strokes occur annually in the United States; half of these patients have large vessel occlusion. Analyses have concluded that there is “strong evidence” that endovascular therapy in addition to IV thrombolysis improves outcome.1,2 There is greater preference for conscious sedation (CS), although it is still controversial if CS is superior to general anesthesia (GA).3,4 Arguments for CS include potentially better hemodynamics, lack of intracerebral steal, and prevention of cerebral perfusion derangements during GA.4 One of the challenges of managing these patients under CS is maintaining the airway during field avoidance while insuring adequate depth of anesthesia to prevent significant patient movement. Lack of adequate depth of anesthesia may result in vascular injury and intracranial hemorrhage. With these challenges in mind, our group have reviewed the outcome of patients undergoing thrombectomy for stroke with CS using the Jaw Elevation Device (JED) to maintain airway patency during thrombectomy for acute stroke.

**Materials and Methods:** After IRB approval, all patients undergoing acute thrombectomy for stroke from January 1, 2017 through April 30, 2018 were reviewed in the EPIC EMR at our institution. Patients were segregated into GA, CS, and CS with JED groups. Both CS and JED groups received CS at discretion of attending anesthesiologist. The hemodynamic, oxygenation, and ventilatory data were obtained by using a propriety algorithm written in PHP to parse and aggregate all SBP, DBP, HR, SpO2, and ETCO2 on all patients undergoing CS or JED. The results were analyzed using a student one-sided t-test with correction for unequal variance with the Microsoft Excel statistical package. On the basis of our interest in the fluctuation of the hemodynamic and ventilatory values of these parameters, we also analyzed the variances using the same student t test. P-value < 0.05 was considered statistically significant.

**Results:** There were 83 patients who underwent thrombectomy. A total of 22 underwent GA and were excluded. Fifty-three were in the CS group and 8 were in the JED group. Means of ETCO2 were significant for the JED group to P < 0.05. Means of variance for the ETCO2 were significant for the ETCO2 group P < 0.005. Mean SpO2 was not significant for the 2 groups, however, t test of variances for the 2 groups was significant (Table 1). Hemodynamic data including SBP, DBP, and HR did not differ between the 2 groups.

**Conclusions:** While this is a small retrospective review, it highlights that the use of the JED may provide more reliable ventilation with less fluctuation in ETCO2 and SpO2. The use of the JED may facilitate more reliable ventilation in these patients. Other factors to be explored in the future will include the ability to give a more generous sedation regimen without airway obstruction.

**References:**

**Table 1 ETCO2, SpO2 and Hemodynamic Data for CS and JED patients**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Variance</th>
<th>Value (CS</th>
<th>JED)</th>
<th>Statistical Significance (p)</th>
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<tr>
<td>ETCO2</td>
<td>Mean</td>
<td>20.54</td>
<td>27.22</td>
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<tr>
<td></td>
<td>Variance</td>
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<td>29.90</td>
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<tr>
<td>SpO2</td>
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<td>0.980</td>
<td>0.978</td>
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<tr>
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<td>Variance</td>
<td>0.0005</td>
<td>0.0002</td>
<td>0.015*</td>
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<tr>
<td>HR</td>
<td>Mean</td>
<td>78.68</td>
<td>76.67</td>
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<tr>
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<tr>
<td>SBP</td>
<td>Mean</td>
<td>138.49</td>
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</tr>
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<td>Variance</td>
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<tr>
<td>DBP</td>
<td>Mean</td>
<td>81.73</td>
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<tr>
<td></td>
<td>Variance</td>
<td>136.74</td>
<td>178.65</td>
<td>&gt;0.5</td>
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</table>

**[SNACC-96] Changes in Thromboelasticometry in Patients Undergoing Epilepsy Surgery**
Chavali S, Kapoor I, Mahajan C, Prabhakar H. All India Institute of Medical Sciences. New Delhi. Delhi, India.

**Background:** We hypothesized that patients undergoing resective epilepsy surgery are at increased risk of perioperative bleeding and blood transfusions due to coagulation derangements related to their exposure to multiple antiepileptic drugs, which may not be apparent on routine screening coagulation tests.

**Methods:** In this prospective study, 20 patients aged between 5 and 60, scheduled to undergo surgical resection of the epileptogenic focus under general anesthesia were enrolled. Demographics of the patients were noted. The following tests were performed for all patients immediately after induction of anesthesia: hemoglobin, hematocrit, prothrombin time, and platelet count, whole blood ROTEM, ionized calcium levels. The lowest intraoperative temperature, estimated blood loss, and blood product transfusions (intraoperatively and within 24 h after surgery) were recorded. Any complications related to altered coagulation were noted. Data will be presented as mean (SD) or number (percentage).

**Results:** Of the 20 patients enrolled in this study, 5 (25%) had a platelet count < or = 150×109/L. Bleeding times, serum calcium, and INR were normal in all the patients preoperatively. On thromboelasticometric (ROTEM) analysis, mean values for all parameters in EXTEM as well as INTEM were within normal limits. However, 8 patients (40%) had a slightly elevated CT on EXTEM, while one (5%) had a slightly elevated CFT and alpha angle. INTEM analysis revealed 7 patients (35%) to have
abnormal CT and CFT, and 10 patients (50%) to have an abnormal alpha angle. These abnormal values did not translate into any significant blood loss, and no patient required blood transfusions perioperatively.

Conclusions: Patients with normal preoperative routine coagulation screening had no significant changes in thromboelastometry parameters. The aberrant INTEM values suggest that aPTT may be considered as a routine screening test for coagulation in patients on multiple antiepileptic drugs, although this may not be indicative of significant bleeding risk.

Effects of Intraoperative Dexmedetomidine in Pain Relief and Prevention of Postoperative Nausea and Vomiting (PONV) in Patients Undergoing Acoustic Neuroma Surgery

Robles J, Somal J, Gupta M, Lemkuil B. UCSD, San Diego, CA.

Introduction: Craniootomy for acoustic neuroma resection carries a high risk of postoperative nausea and vomiting (PONV) and is associated with a headache and surgical site pain. Routine use of intraoperative remifentanil and reliance on narcotics for pain relief introduces the plethora of side effects like hyperalgesia and more PONV. Dexmedetomidine has been shown to exhibit an anesthetic-sparing effect and has been studied as an adjunctive postoperative analgesic in the setting of neurosurgery and spine surgery. It provides stable hemodynamic parameters in the face of noxious surgical stimuli, decrease in anesthetic requirements and facilitates early recovery. We aim to investigate the effects of low dose intraoperative infusion of dexmedetomidine in the prevention of PONV and its narcotic sparing effect in this subset of neurosurgical patients. We also looked at and recovery characteristics and the postoperative sedation scores in this group of patients.

Methods: From the retrospective registry, we studied 40 patients who had undergone acoustic neuroma resection from September 2017 to March 2018 (via trans labyrinthine, middle cranial fossa or retro-sigmoid approach). Twenty patients (DEX group) received low dose dexmedetomidine infusion (0.3 µg/kg/h) and the standard anesthetic with intraoperative propofol and remifentanil infusions titrated to provide adequate intraoperative conditions. Twenty patients (NDEX group) received standard total intravenous anesthetic as above with no dexmedetomidine. We compared the intraoperative hemodynamic parameters, total narcotic consumption, sedation scores, and anti-PONV drugs used during the first 4 hours of recovery. We matched the patients both groups and used a t test to compare these variables.

Results: The patients in dexmedetomidine group had comparable hemodynamics, but higher incidence of bradycardia mean HR in DEX versus ND = 40.35 (SD = 8.67) versus 55.75 (SD = 4.94), significantly less narcotic consumption (P = 0.05, CI = 95%) with mean consumption in DEX group 90.62 µg (SD = 84.6), N group = 146.87 µg (SD = 61.08). Only 4 (25%) patients in DEX group required > 2 antiemetics as compared with 12 (60%) patients in the control group. Early postoperative sedation scores (RASS) were higher in DEX group versus control and 10 patients in DEX had RASS < -1, compared with 4 in ND.

Discussion: Dexmedetomidine is an attractive alternative for narcotics and significantly reduces the narcotic consumption, provides superior analgesia and has a role in the prevention of PONV in acoustic neuroma surgery. These advantages can be extrapolated to obtain earlier recovery and improve patient satisfaction. Early high sedation scores and significantly higher incidence of intraoperative bradycardia might need consideration while planning perioperative care.

References:
[SNACC-98] Acetaminophen Does Not Reduce Postoperative Opiate Consumption in Patients Undergoing Craniotomy for Cerebral Revascularization

Stone S, Burbridge M, Jaffe R. Stanford University Medical Center, Stanford, CA.

Postoperative management in patients undergoing craniotomy is unique and challenging. Practitioners may minimize opioid use with the result that postcraniotomy pain is often undertreated. We utilized a unique population of patients who underwent bilateral extracranial-to-intracranial (EC-IC bypass) revascularization procedures for moyamoya disease and hypothesized that 1 gram IV acetaminophen given immediately after intubation and again 45 minutes before the end of craniotomy, may be more effective in minimizing opiate consumption and decreasing pain scores in the 24-hour postoperative period.

In a double-blind randomized placebo-controlled crossover study, 40 craniotomies in 20 patients were studied. A random number generator was used by the hospital pharmacy to assign patients to receive either 1 g of IV acetaminophen or an equal volume (100 mL) of normal saline immediately after intubation and again 45 minutes before the end of their first operation. For the second surgery, patients received the study drug (IV acetaminophen or normal saline) that they did not receive during their first surgery, both immediately after intubation and again 45 minutes before the end of the procedure.

In the IV acetaminophen group, the average 24-hour postoperative fentanyl equivalent consumption was decreased but the difference was not statistically significant: 228 µg compared with 312 µg in the placebo group (Fig. 1; P = 0.09). Pain scores did not significantly differ between the IV acetaminophen group and the placebo group in postoperative hours 0 to 12 (Fig. 2A; P = 0.44) or 24 (Fig. 2B; P = 0.77).

Our study demonstrates that in patients receiving bilateral craniotomies for moyamoya disease, IV acetaminophen when given immediately after intubation and again 45 minutes before closure, does not significantly decrease 12 or 24-hour postoperative opiate consumption.

[SNACC-99] Case Series: The Use of Dexmedetomidine for Sedation in Patients Undergoing Carotid Stent Placement

Faulkner A, Green A, Dorety J. University of Kentucky, Lexington, KY.

For symptomatic carotid stenosis, carotid artery stenting is a minimally invasive procedure performed under monitored anesthesia care with sedation. The aim of the sedation is to both facilitate a rapid neurological examinations as well as promote patient cooperation while on the operating table; the patient must remain very still for imaging, balloon angioplasty, and stenting. In what literature that exists and at our institution, standard sedation is usually achieved with a combination of midazolam and fentanyl, which may or may not be supplemented by propofol boluses. However, little literature exists on sedation regimens for patients with absolute or relative contraindications to these medications. Dexmedetomidine is a selective alpha-2 agonist that has found favor as an anxiolytic, analgesic, and anesthetic. Its rapid onset and rapid metabolism would seem to make it an ideal alternative for carotid artery stenting, but side effects including titration-dependent bradycardia and hypotension are known. Further, during balloon angioplasty and stenting of the carotid artery, bradycardia and hypotension can occur as a result of direct stimulation of the carotid sinus. We present a case series of at least 4 patients in which dexmedetomidine was utilized as an infusion to provide sedation under monitored anesthesia care for carotid artery stenting. Further, we demonstrate its safety for use as an alternative sedation regimen with minimal impact on hemodynamics throughout the procedure.
Neurosurgical Interventions For Neurotrauma In The Obstetric Population: A Systematic Review
Introduction: Trauma requiring neurosurgical intervention in the obstetric population is rare. Anesthetist management is challenged by conflicting goals related to simultaneous care of the mother and the fetus. There is scarce literature to guide anesthetic care and few resources summarizing these uncommon cases. The goal of this review was to provide a systematic search of the available literature on this topic.
Methods: We conducted a systematic literature search for English publications of neurosurgical interventions on obstetric patients following trauma. We used specific keywords to search trusted bibliographic databases (MEDLINE, EMBASE, and Google Scholar) from database inception through March 14, 2018. All abstracts were screened by 2 authors (A.C., K.A.). Data was extracted on patient, surgical and anesthetic variables. Maternal neurological outcome was reported as Glasgow Outcome Score; good maternal outcome was defined as Glasgow Outcome Score ≥ 4. Fetal outcomes were reported using Apgar scores at delivery.
Results: The literature search identified 10 cases from 14 publications (10 case reports, 3 case series, and 1 conference abstract). The majority of cases (83%) occurred in the setting of motor vehicle accidents and underwent evacuation of hematoma (61%), decompressive craniectomy (28%), and/or insertion of intracranial pressure monitor (39%). Median maternal Glasgow coma scale on presentation was 5 (range: 3 to 11); few articles provided a detailed description of maternal intracranial pressure management. All patients received general anesthesia for neurosurgical intervention and operative delivery (if applicable) but few details on anesthesia management were reported. Delivery was described before (6%), simultaneous to (17%), and following maternal neurosurgery (78%). Maternal and fetal outcomes were good in 40% and 69% of cases, respectively, but long-term outcomes were frequently unknown. Lower maternal Glasgow coma scale on presentation typically resulted in worse maternal and fetal outcome.
Conclusion: Our systematic review resulted in a small number of case reports and case series of obstetric patients undergoing neurosurgical intervention for neurotrauma with limited data on anesthetic management. Delivery most commonly occurred after the neurosurgical intervention. Maternal outcomes were generally poor and correlated with severity of neurological injury, although fetal outcomes were generally good. There is a potential selection bias toward reporting good outcomes in the literature.

Intraoperative Pulmonary Embolism During Craniotomy: A Case Report
Joseph K, Uejima J. Northwestern University Feinberg School of Medicine, Chicago, IL.
Background: Acute intraoperative pulmonary embolism (PE) is a serious, yet rare, life-threatening event that requires swift diagnosis and intervention. Rudolf Virchow first described his famous triad of risk factors for venous thromboembolism (VTE) >100 years ago and it remains relevant today: venous stasis, endothelial damage, and hypercoagulable state. Further, there is up to a 5-fold increase in the incidence of PE in the perioperative period. We present a case of intraoperative pulmonary embolism in a patient with known risk factors while undergoing craniotomy for tumor resection for recurrent malignant glioblastoma multiforme (GBM) status post prior resection, chemotherapy, and radiation, G Erd, HTN, and obesity presented for tumor resection. This patient had a history of recurrent glioblastoma multiforme (GBM) status post prior resection, chemotherapy, and radiation, and obesity presented for tumor resection. Per clinical trial, patient could not receive any medications that affected CVP/PA. Twenty minutes after induction, patient started to display hemodynamic instability and had hypoxic episodes that responded, initially, to recruitment breath maneuvers. At that time, baseline ABG was drawn that revealed a large PaCO2 end-tidal CO2 gradient, which raised suspicion for an acute pulmonary embolus. Shortly thereafter, hemodynamic instability ensued, and patient was up-titrated on vasopressors: phenylephrine, then norepinephrine and epinephrine. Surgery was stopped before entering the cranial vault, and interventional radiology (IR) was contacted. Patient was transported to IR for catherization of pulmonary arteries and was found to have massive bilateral pulmonary embolisms and subsequently systemically heparinized. Infiltration catheters were placed in bilateral arteries, and iPA boluses were started for clot lysis. After boluses, patient regained some hemodynamic stability, but remained on high-dose vasopressor infusions. Bilateral infusion catheters were left in place, patient was transported to neurosurgery ICU on norepinephrine and nitric oxide was started. Overnight, patient was weaned off norepinephrine, and oxygenation and ventilation improved. He remained on nitric oxide and catheter-directed thrombolysis. Despite cardiorespiratory improvement, patient’s family elected to withdraw care given his poor prognosis with or without tumor resection.
Discussion: An increase in alveolar dead space is associated with pulmonary thromboembolism with high sensitivity and specificity in surgical patients, in addition to cardiopulmonary compromise. Studies have shown a statistically significant reduction in mortality in patients with major PE who received directed thrombolysis compared with systemic heparin alone. Regardless of intervention, mortality in hemodynamically unstable patients with PE remains as high as 30%.

References:

Neuro-Obstetric Anesthesia Consultation for Chiari Malformation
Zhou D, Liu X, Gorgy N, Zhou J. Brigham and Women’s Hospital, Boston, MA.
Background: In the recent years, we found an increased number of patients with Chiari malformation (CM) coinciding pregnancy. Given the complexity of the condition, anesthetic approaches to these patients can be challenging. We performed a retrospective review of the anesthetic processes of parturients with CM at our institution.
Methods: Retrospective chart review of female patients who carried diagnoses of both pregnancy and CM at the Brigham and Women’s Hospital from 1996 to 2017 have been performed. Results: One hundred twenty-four patients with CM diagnoses were identified from 1996 to 2017, who made total 257 deliveries. We performed a partial review of the records. Complete review of the data will be done by the time of the SNACC meeting. In 63 patients, first labor and delivery preceded the diagnosis of CM. For this group of patients, 11 spinal, 34 epidurals, and 4 combined spinal epidurals were performed for 45 vaginal and 56 cesarean deliveries (CDs). Most common causes for CDs were failure to progress, non reassuring fetal tracing and breech presentations. There were total 226 deliveries after the diagnoses of CM were made, among which 1 natural child birth, 10 spinals, 26 epidurals, 6 combined spinal epidurals, and 6 general anesthesia were performed for 30 vaginal and 37 CDs. General anesthesia was applied to patients with neurological symptoms or signs of hydrocephalus/syringomyelia. Thirty patients who received decompression operations made 36 deliveries afterwards, during which 7 spinal, 10 epidurals were performed for 16 vaginal delivery and 15 CDs. At least 2 epidural blood patches for performed for this cohort of patients. No severe anesthesia-related complication was found.
Discussion: This retrospective study provides a large case series of parturient with CM. CM is a complex neurological condition that requires case-by-case review before any specific anesthetic plan is chosen. Recent development on neuroimaging has provided more insights of this condition. Our data and practice support that parturient with asymptomatic CM-I condition are general safe to receive neuraxial technique for labor analgesia and anesthesia. An algorithm for clinical management of parturient with CM is proposed. Prenatal anesthesia consultation is a very complex process of parturients with CM at our institution. Linking anesthesiologists with obstetricians and neurosurgeons/neurologists, from which a safe anesthetic and perinatal approach to individual patient can be developed.
Frailty in Patients Investigated and Treated for Normal Pressure Hydrocephalus


Normal pressure hydrocephalus (NPH) is a syndrome of gait dysfunction and enlarged cerebral ventricles in the absence of another cause. It is frequently accompanied by cognitive deficits and bladder detrusor overactivity. NPH is a disease of the elderly and timely diagnosis can lead to reversal of symptoms through ventricular shunting.† External lumbar drainage (ELD), for 72 hours, is used as a diagnostic tool to verify NPH. Once NPH is confirmed, treatment is by insertion of a ventriculoperitoneal shunt (VPS). Frailty is prevalent in older adults and may be a better predictor of postoperative morbidity than chronological age, where general anesthesia is associated with increased risk.

We therefore decided to examine the frailty of our population of patients who present with possible NPH. Our aim was to examine if the frailty of patients undergoing both ELD and VPS affected length of stay (LOS). We used the Modified Frailty Index (mFI) to define frailty, this has been shown to be a strong predictor for LOS.‡

We performed a retrospective analysis of all patients admitted for ELD, VPS or both for treatment of NPH between May 2017 and March 2018. The mFI score was calculated and perioperative data collected. Frailty was defined as a mFI ≥ 0.27.‡ Data collected included demographics, LOS and surgical morbidity. We used univariate analysis to examine the data. Our expected LOS for both procedures is 4 days.

Thirty-six patients (2 excluded due to incomplete medical records; 1 patient had both procedures during admission) had a VPS (25% frail) and 53 patients had ELD (17% frail) (Table 1). Frail patients showed a trend toward having a longer LOS following VPS (median: 5 [4 to 6.5] vs. 4 [3 to 6] d). Increased LOS was most commonly due to social factors and reduced mobility.

Two patients (3.8%) were readmitted after their ELD and 3 patients (8.3%) after their VPS. All of the readmissions were due to surgical factors. There were no deaths in either group.

Discussion: In keeping with published data, our patients are elderly with a significant proportion frail with multiple comorbidities. Although our numbers are small, mFI may be useful in identifying patients at risk of increased LOS following ELD or VPS. We suggest further work to confirm this.

The majority of patients with an extended period in hospital received extensive input from the therapy services. We have therefore initiated a multidisciplinary preoperative assessment for these patients where all appropriate patients are referred for therapy assessment before admission to improve quality of care and patient outcome.

References:

Anesthetic Management of Awake Craniotomy Under Intraoperative MRI Versus Traditional Operating Room Setup

Saasouh W*, Ahuja S†, Lee B, Avitsian R, Rajan S. *Detroit Medical Center, Detroit, MI; †Cleveland Clinic, Cleveland, OH.

Introduction: Intraoperative MRI (IMRI) has been gaining popularity for more precise tumor resection and decreased residual tumor. The anesthetic management of a patient in the IMRI suite presents a particular set of challenges that require appropriate preparation. Here we compare the use of IMRI to routine operating room procedures in terms of anesthetic management. This is an ongoing analysis and the data shall be available before abstract presentation.

Methods: After Institutional Review Board (IRB) approval data from the medical records of all Cleveland Clinic adult patients who underwent awake craniotomy under IMRI (December 2012 to December 2016) was reviewed. These patients were paired with non-IMRI awake craniotomy procedures in an observational cohort. The aim was to highlight the main differences in anesthetic management such as airway management, anesthetic medications, and intraoperative seizures.

Results: Most patients in the cohort received propofol with or without dexmedetomidine for maintenance of anesthesia. Airway management differed in that patients in the IMRI suite had an LMA in most of the cases. Intraoperative airway interventions were limited in the IMRI suite owing to the bulky head gear patients had to have. The management of intraoperative seizures was especially challenging in the IMRI suite due to limitations in allowed equipment. The cases were generally similar in terms of hemodynamics and postoperative recovery. Further numerical details to follow.

Conclusions: Intraoperative MRI adds a layer of complexity to an already demanding anesthetic management in awake craniotomy. We present our observational data comparing the anesthetic management of patients in the IMRI suite versus a traditional operating room setup. The data will be updated as it becomes available prior to the date of abstract presentation as this is an ongoing analysis.
Delivering Anesthesia for Emergent Neurosurgery in the Parturient

Saasouh W*, Mathews L†, Rajan S‡.* Detroit Medical Center, Detroit, MI; †Vanderbilt University Hospital, Nashville, TN; ‡Cleveland Clinic, Cleveland, OH.

Introduction: A parturient admitted for neurosurgery presents a unique set of challenges. Such scenarios are likely under-documented leading to a lack of practice guidelines for the proper anesthetic care. We present 3 such cases and the decision-making process involved in each.

Description of cases: Case 1: A 37-year-old primigravida at 26 WGA presented with a symptomatic AVM and scheduled for emergent delivery followed by embolization. The patient was premedicated with sodium citrate, metoclopramide, and metoprolol, and an arterial line and external subdural bolt were placed under mild sedation. Rapid-sequence induction of general anesthesia was performed (fentanyl, lidocaine, propofol, succinylcholine, esmolol) and anesthesia was maintained with propofol and sevoflurane (< 0.5 MAC). C-section was performed without complications and patient was extubated uneventfully. Angiography and embolization were carried the next day under general anesthesia (rapid-sequence induction) which was maintained with sevoflurane, remifentanil, and rocuronium without any untoward events.

Case 2: A 21-year-old G1P0 at 19 WGA presented with a symptomatic large CPA mass. Decision was to hold surgery until 24 WGA but she presented at 23 WGA with severe nausea and vomiting and was admitted to the NICU where an EVD was placed and high-risk obstetrics were consulted. Rapid sequence induction (propofol, rocuronium, fentanyl) was performed and FHR monitoring was performed throughout the case. Anesthesia was maintained with sevoflurane (0.5 MAC), propofol, and dexmedetomidine with phenylephrine for hemodynamic support. EVD was used for intermittent CSF drainage and mannitol and dexamethasone were administered after induction. Tumor resection was performed in the park bench position and lasted 14 hours after which patient was transferred to the NICU under sedation to be extubated the next morning. FHR remained normal throughout the procedure.

Case 3: A 37-year-old G4P3 with history of opioid dependence on suboxone presented at 32 WGA with basal ganglia hemorrhage and HELLP syndrome. She was admitted to NICU where FHR monitoring showed fetal bradycardia necessitating emergent C-section. Anesthesia was maintained with propofol and remifentanil and she received mannitol and hypertonic saline to treat intracranial hypertension. A nicardipine infusion was used to maintain blood pressure <140 mm Hg. Delivery was completed with minimal neonatal support. Her postoperative course was complicated with prolonged ventilation, HELLP, cerebral edema, and required tracheostomy and gastrostomy placement.

Discussion: Multiple dilemmas are presented in the parturient undergoing emergent neurosurgery. Care must be taken to manage the pregnancy, delivery (if any), as well as the complex neurological status. The choice of delivering a premature baby must be weighed against the risks of performing the neurological intervention without delivery. Safe administration of anesthesia is paramount to the health and wellness of parturient and neonate alike. A multidisciplinary approach is ideally performed at a health care facility capable of managing potential complications.

Effect of Anesthetic Choice on Hemodynamics and Vasopressor Use After Mechanical Thrombectomy for Acute Ischemic Stroke

Whalin M, Moran T, Levey N, Haussen D, Grossberg J, Nogueira R, Ratcliff J. Emory University School of Medicine, Atlanta, GA.

Introduction: New Guidelines extending the thrombectomy treatment window for acute stroke will lead to an increase in the volume of cases. As hospitals and providers prepare for this growth, they must consider how periprocedural management might impact post-thrombectomy care. Some patients require vasopressors after thrombectomy to meet blood pressure goals but the characteristics of this population have not been well-described. We hypothesized that the type of anesthesia used during...
thrombectomy would be associated with the use of vasopressors during the following 3 days.

**Methods:** We reviewed our institutional thrombectomy database from 2013 to 2017 and extracted hemodynamic data for the 3 days after thrombectomy. Continuous and categorical data were summarized using medians/interquartile ranges and percentages/95% confidence intervals, respectively. Predictors of vasopressor use were evaluated using logistic regressions.

**Results:** We obtained detail postprocedure hemodynamic data for 360 patients treated during the study period. Fourteen percent of patients received general anesthesia with sevoflurane and 86% of patients received MAC with dexmedetomidine. The overall rate of vasopressor use in this population was 15% during the 3 days following thrombectomy, with phenylephrine being the most common agent (Fig. 1). As shown in Table 1, patient demographics, comorbidities, and stroke features were not associated with vasopressor use. The maximum systolic blood pressure on the day of thrombectomy was higher on the day of thrombectomy in the patients who received general anesthesia (median difference 8.1 mm Hg, 95% confidence interval, 0.2-16.0 mm Hg) but no association was seen between anesthetic choice and postprocedure vasopressor use.

**Conclusions:** We failed to identify variables associated with postthrombectomy vasopressor use in this population. Future study is needed to determine if vasopressor use after thrombectomy is associated with long-term outcomes.

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**Table 1. Descriptive Statistics and Unadjusted Regressions Predicting Vasopressor and GA Use.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>% or Median</th>
<th>Any Vasopressor OR (95% CI)</th>
<th>Use of GA OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>64 (53 - 75)</td>
<td>1.005 (0.986; 1.024)</td>
<td>0.99 (0.98; 1.02)</td>
</tr>
<tr>
<td>Sex</td>
<td>-</td>
<td>1.332 (0.752; 2.392)</td>
<td>1.27 (0.67; 2.43)</td>
</tr>
<tr>
<td>Male</td>
<td>47.35 (42.13 - 52.57)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female</td>
<td>52.65 (47.43 - 57.87)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Infarct Volume</td>
<td>31.87 (7.79 - 79.69)</td>
<td>1.001 (0.998; 1.004)</td>
<td>0.999 (0.995; 1.003)</td>
</tr>
<tr>
<td>Initial NIHSS</td>
<td>18 (13 - 21)</td>
<td>1.03 (0.974; 1.089)</td>
<td>1.06 (0.99; 1.12)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>27.20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Race</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Black</td>
<td>41.70 (36.60 - 46.79)</td>
<td>0.594 (0.313; 1.129)</td>
<td>1.14 (0.556; 2.32)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5.93 (3.34 - 8.52)</td>
<td>0.393 (0.057; 2.687)</td>
<td>1.34 (0.16; 11.27)</td>
</tr>
<tr>
<td>Asian</td>
<td>2.00 (0.68 - 3.72)</td>
<td>2.788 (0.631; 12.315)</td>
<td>1.08 (0.12; 9.33)</td>
</tr>
<tr>
<td>Other</td>
<td>2.80 (1.10 - 4.50)</td>
<td>1.162 (0.235; 5.749)</td>
<td>3.88 (0.88; 17.10)</td>
</tr>
<tr>
<td>White</td>
<td>47.40 (42.16 - 52.64)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Diabetes</td>
<td>30.16 (25.38 - 34.93)</td>
<td>0.972 (0.516; 1.831)</td>
<td>0.82 (0.39; 1.73)</td>
</tr>
<tr>
<td>TCI</td>
<td>95.96 (93.76 - 97.96)</td>
<td>1.116 (0.242; 5.134)</td>
<td>0.91 (0.20; 4.23)</td>
</tr>
<tr>
<td>Basilar</td>
<td>5.30 (0.0 - 0.83)</td>
<td>0.656 (0.147; 2.93)</td>
<td>18.65 (6.53; 53.25)</td>
</tr>
<tr>
<td>Any Vasopressor Use of GA</td>
<td>15.00 (11.31 - 18.69)</td>
<td>0.53 (0.19; 1.51)</td>
<td></td>
</tr>
<tr>
<td>Use of GA</td>
<td>13.38 (9.21 - 17.55)</td>
<td>0.53 (0.19; 1.51)</td>
<td></td>
</tr>
</tbody>
</table>

[SNACC-107] Delayed Onset Macroglossia After Posterior Fossa Surgery Requiring Enteral Feeding Tube

**Case Presentation:**

A previously healthy 6-year-old male with cerebellar dysgenesis presented to the hospital for posterior fossa and craniofacial surgery. His medical history was significant for congenital heart disease, feeding difficulties, and delayed speech development. He had undergone multiple surgical procedures, including anterior fontanelle closure and cranial vault remodeling. He was scheduled for posterior fossa and craniofacial surgery. On arrival to the operating room, he was awake without any complications. On postoperative day (POD) 1 the patient underwent an uneventful postoperative MRI brain. Prior airway examination noted a Mallampati class 1 airway. The MRI noted anterior tongue edema and hyperemia extending to sublingual glands. Upon emergence, patient noted to have edematous tongue with protrusion out of oral cavity, with no visible abrasions or lacerations on tongue and no evidence of airway obstruction. ENT and Dental were consulted and recommended conservative management. The tongue edema intensified through POD 5 resulting in visible abrasions and ulcerations on ventral surface of tongue and preventing oral intake requiring nasogastric tube placement. By POD 10 the tongue was improving with cold saline gauze wrapping and by POD 13 the patient could retract tongue into oral cavity. The patient was discharged to inpatient rehab with nasogastric tube still in place.

**Discussion:** Macroglossia after neurosurgical procedures is a known but poorly understood phenomenon, more notably described in adult patients. The onset ranges from intraoperative to delayed up to 36 hours; while the duration can last > 2 weeks causing potentially devastating airway compromise requiring tracheostomy. There are 3 proposed mechanisms: mechanical trauma from neuromonitoring, obstruction of venous drainage due to positioning, and neurogenic vasodilation. This case presented well after any intraoperative mechanical trauma or venous obstruction was relieved. Given these factors we feel this case likely represents a neurogenic cause.

Our patient never developed respiratory distress and imaging showed the edema was limited to the anterior tongue. There is at least one similar case report of delayed onset anterior tongue edema with no respiratory compromise. There is also a case report of immediate onset macroglossia that was determined to be isolated to the tongue and was successfully extubated at 72 hours, well before resolution of the macroglossia. This may suggest that patients with isolated tongue edema may be managed without advanced airways and that imaging may help guide management.

**References:**

[SNACC-108] Trans-odontoid Screw Migration and Airway Management in the Neurosurgical Patient
Nookala A, Welch T. Mayo Clinic, Rochester, MN.

Introduction: The most common second body cervical spine fracture is the odontoid fracture. Odontoid fractures have a biphasic age distribution that peaks at ages 20 to 30 (trauma) and in the elderly 70-80 years old. Many odontoid fractures are treated surgically.1

Case Description: A 59-year-old male with a past medical history of hypertension and gastroesophageal reflux disease presented to an outside emergency room after a mountain bike accident. The patient was the helmeted and fell off his bike over the handle bars. Computerized topography (CT scan) of his cervical spine showed a mildly displaced odontoid fracture. The patient was placed in a C-collar and transferred to our institution for surgical intervention. The patient was taken to the operating room for odontoid screw placement and anterior fusion. The patient had an uncomplicated induction with an easy indirect laryngoscope intubation and a video laryngoscope scope. The patient had an uncomplicated post-operative course and was discharged on postoperative day 1. He continued to have interval follow up with Neurosurgery. At the 3-month follow-up the patient complained of difficulty swallowing and a scratchy throat. He was found to have anterior migration of the transodontoid screw into the retropharynx with a thin layer of mucosa overlying the mass (Fig. 1). The patient returned to operating room for removal of the odontoid screw placement and anterior fusion. The patient had an uncomplicated induction with an easy indirect laryngoscopy with a video laryngoscope. The patient had an uncomplicated post-operative course and was discharged on postoperative day 1. He continued to have interval follow up with Neurosurgery. At the 3-month follow-up the patient complained of difficulty swallowing and a scratchy throat. He was found to have anterior migration of the transodontoid screw into the retropharynx with a thin layer of mucosa overlying the mass (Fig. 1). The patient returned to operating room for removal of the transodontoid screw and posterior cervical spine fusion. The patient’s preanesthetic evaluation revealed a Mallampatti II, small mouth opening, and decreased neck mobility. There was significant concern of the screw eroding into the retropharynx, and potential to rupture overlying mucous upon any trauma from airway instrumentation. The anesthetic plan included an IV induction with a videolaryngoscopy intubation and a fiberoptic scope available. Otolaryngology and Neurosurgery were in the operating room available during induction and intubation. Standard ASA monitors and an arterial line were placed. Induction was uncomplicated, and the airway was secured with a videolaryngoscopy without trauma to the overlying mucosa of the migrated screw.

Discussion: Transodontoid screw complications can include dysphasia, nonunion, screw breakout, and screw migration. Close follow-up is suggested to monitor for common complications.2 It is important to communicate with the surgical service, and have multiple resources available when securing an airway after anterior screw migration.

References:

Figure 1: Anterior migration of trans-odontoid screw in CAT scan and nasopharyngeal scope

[SNACC-109] Craniotomy and Trans-orbital Approach for an E-cigarette Removal
Santos C, Villarinho L, Walsh K, Tuma Santos C, Bacon D. University of Mississippi Medical Center, Jackson, MS.

Introduction: Traumatic brain injuries (TBIs) are considered a major cause of death in individuals younger than 45 years old. Male young adults, late teenagers, and elderly people are at the highest risk. TBIs can be blunt or penetrating. Even though blunt injuries occur more often, a penetrating trauma carries worse prognosis. We present a patient with a penetrating TBI who was admitted following a motor vehicle collision with a foreign body extending from the right medial orbit to middle fossa involving the right temporal lobe.

Case Report: A 31-year-old male patient with unknown past medical history transferred from an outside hospital following a motor vehicle collision. Admitted due to a transorbital intracranial foreign body. Patient was ETOH intoxicated (147), with urine drug screen positive for amphetamines and cannabis. He was confused and combative, but moving all extremities. The right eye was swollen shut, dilated right pupil, and ophthalmoplegia observed. Unable to determine visual field due to combativeness. CT head showed an elongated metallic/plastic object that entered the right orbit via the medial canthus and penetrated intracranial by fracturing the orbital roof lateral to the optic canal (Fig. 1). CTA showed patent intracranial vessels without severe vascular injury. Neurosurgery indicated a level A dual approach, trans-orbital and craniotomy for a foreign body removal. Patient was transferred to the operating room and had general anesthesia with endotracheal tube and standard ASA monitors. Intraoperative period was unremarkable and patient was transferred to neurosurgical intensive care unit for postoperative care. Reevaluated by Ophthalmology 1 week after discharge, unable to see out of right eye, with intact extraocular movements, and normal intraocular pressure.

Conclusions: Hundreds of patients are evaluated at daily basis in the Emergency Departments due to TBI. It is also known that motor vehicle collisions caused by intoxicated drivers are a major social/health problem that needs to be addressed aiming prevention based on education, and exemplary law enforcement/judiciary zero tolerance policies. Penetrating TBIs are less common than blunt traumas; however, they must be treated aggressively to decrease morbidity and mortality.
Symptomatic brain metastases is crucial. This case presents the man-
the primary cancer is key to prolonging survival, aggressive treatment of
symptomatic brain metastasis during their disease course. Recent data shows that me-

der bers of the largest brain metastasis.

On physical examination, left lung sounds were absent. The patient

treatment of the planned craniotomy with the understanding that the patient was high

After a standard IV induction, the patient was easily mask ventilated with

and shoulders, elevated CK, and eventually cardiovascular and respiratory

A 66-year-old male with NSCLC currently receiving lung XRT presented

After a standard IV induction, the patient was easily mask ventilated with

in 2015, 158,000 Americans died from lung cancer. In all, 57% of patients

Peters K, Paisanathan C. University of Illinois at Chicago, Chicago, IL.

In 2015, 158,000 Americans died from lung cancer. In all, 57% of patients

Critically, the patient had no prior history of dysrhythmia or supraventricular

Discussion: LGMD is a neuromuscular disease that encompasses different

1. Klingler W, Lehmann-Horn F, Jurkat-Rott K. Complications of anaes-

References:

1. Presley C, Lilienbaum R. The treatment of advanced lung cancer in the

2. Enders F, Geisenberger C, Jungk C, et al. Prognostic factors and long-

3. Bougie E, Masson-Cote L, Mathieu D. Comparison between surgical

[SNACC-111] Cardiomyopathy in Limb-Girdle Muscular Dystrophy: A Case Presentation and Perioperative Implications
Feldheim T, Mohamed B. University of Florida College of Medicine, Gainesville, FL.

Introduction: Patients with neuromuscular disorders present a myriad of

Case Presentation: A 69-year-old female presented with a 6-month history of

Conclusions: Perioperative considerations for patients with LGMD


3. Bougie E, Masson-Cote L, Mathieu D. Comparison between surgical

[SNACC-110] One Lung Isolation During Craniotomy for Re-

section of Non–Small Cell Lung Cancer Brain Metastases
Peters K, Paisanathan C. University of Illinois at Chicago, Chicago, IL.

In 2015, 158,000 Americans died from lung cancer. In all, 57% of patients

Non–small cell lung cancer (NSCLC) is the most common metastatic brain tumor in adults. While treatment of

the left lung. Mass effect caused near complete occlusion of the left pulmo-

nary artery. Multiple air-fluid levels were seen in the left lung consistent

with extreme necrosis. After medical optimization by a multidisciplinary

team, the patient was offered surgical resection via craniotomy for

Case Presentation: A 69-year-old female presented with a 6-month history of

postmenopausal bleeding and pelvic mass scheduled for open total abdomi-

nal hysterectomy. She had a past medical history of hypertension and

chronic kidney disease. She endorsed bilateral lower extremity weakness

which got progressively worse limiting her activity. Preliminary neurology

diagnosis was LGMD. Preoperative evaluation included transthoracic

echocardiogram which showed cardiomyopathy with left ventricular ejection

fraction of 35%. Cardiology was consulted and left heart catheterization

showed normal coronary arteries. Anesthetic plan was to avoid triggers for

malignant hyperthermia, careful use of neuromuscular blockade, judicious

use of intravenous fluids and other implications for cardiomyopathy. Her

perioperative course was uneventful and she was successfully extubated.

Discussion: LGMD is a neuromuscular disease that encompasses different

heterogenous mutations. There are variations in phenotypes based on the

subtype but almost all LGMD have proximal limb weakness of the thighs

and shoulders, elevated CK, and eventually cardiovascular and respiratory

weakness. Cardiac workup including evaluation for cardiomyopathy and
dysrhythmia is warranted. LGMD patients are at risk of post-operative

respiratory depression secondary to diaphragmatic weakness; thus, shorter

acting agents such as propofol and remifentanil are recommended. Judici-

ous use of short-acting neuromuscular blocking agents (NMB) is also

recommended. The use of Sugammadex has made it easier to utilize non-

depolarizing NMB agents. Several subtypes of LGMD are associated with

malignant hyperthermia-like reactions and rhabdomyolysis when exposed to

sucinylcholine as well as volatile anesthetics; it is recommended to avoid

these medications. Furthermore, sucinylcholine use can lead to severe

hyperkalemia. Conclusions: Perioperative considerations for patients with LGMD

should focus on the possibility of cardiomyopathy, dysrhythmia, respi-

ratory muscle weakness, and malignant hyperthermia-like reactions.

References:

1. Klingler W, Lehmann-Horn F, Jurkat-Rott K. Complications of anaes-


3. Kabade SD, Bhisale R, Karthik SL. Case of limb-girdle muscular
dystrophy for total thyroidectomy: anaesthetic management. Indian J


2014;42:103-105.

[SNACC-112] Blood Conservation Strategies for Cerebellar
Hemangioblastoma Resection: A Case Report
Martin A, Piepsey K, Rajan S. CCF, Cleveland, OH.

Background: Von Hippel Lindau Syndrome (VHL) is manifested by a variety of benign and malignant tumors, including hemangioblastomas, pheocro-

mocytomas and renal cell carcinoma (RCC). Brain hemangioblastomas are

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capillary vessel-rich benign neoplasms that can affect 80% of patients with VHL. Surgery can be associated with significant bleeding leading to increase in postoperative morbidity. Homologous blood transfusion has the potential to cause infections, anaphylaxis, hemolytic reactions, and lung injury. Oftentimes, anesthesiologists will face situations where blood transfusion is to be avoided if possible. Blood conservation strategies are being introduced to our practice with the aim of reducing the exposure to allogenic blood. Acute normovolemic hemodilution (ANH) and cell salvage are 2 intraoperative strategies that have been proved to reduce the need for blood transfusion. Case Description: A 35-year-old female with history of VHL presented for left side craniectomy for a cerebellar hemangioblastoma. She also had history of RCC status post bilateral nephrectomy, on hemodialysis and on the list for kidney transplant. The patient was advised to avoid blood transfusion to reduce the risk of alloimmunization. She was seen at our Pre-Anesthesia Clinic to discuss blood conservation techniques as she also had chronic anemia (hemoglobin of 10 g/dL, on darbepoetin injections regularly) and was scheduled for a high-risk procedure. Alternative options for blood transfusion were discussed. Because of her chronic anemia and impaired renal function with the risk for volume overload, ANH was not indicated. It was decided to proceed with the use of cell saver and to use transfusion only as a last resort. Craniectomy was successfully performed and the estimated blood loss (EBL) was 50 mL. Because of the low EBL blood conservation strategy was not needed. Hemoglobin remained stable and she was discharged on postoperative day 4.

Discussion: Blood conservation strategies exist to reduce the need for blood transfusion and its potential risks. Acute normovolemic hemodilution entails the removal of blood from a patient to reduce to red cell mass of the blood lost during surgery. Euvolemia is maintained by crystalloid or colloid replacement. At the end of the surgery the blood removed is reinfused. The risks associated with ANH include volume overload and dilutional coagulopathy. Baseline anemia with hemoglobin <11 g/dL is a contra-indication. Blood salvage is the use of cell saver to separate, wash, and concentrate red blood cells to be reinfused into the patient. Although the case went successfully without the need for blood conservation techniques, anesthesiologists should always be prepared for complications and should be familiar with these techniques that can be used intraoperatively to effectively reduce the exposure to allogenic blood.

References:

[SNACC-113] Postoperative Swelling of Submandibular Gland Following Park Bench Position for Cerebello Pontine Angle Tumor: A Rare Complication


Learning objective: (1) Prolonged neurosurgical procedures require specific and often unique positions to maximize anatomic exposure for long durations.
(2) Retrosigmoid-suboccipital craniotomy for cerebellopontine angle tumour, requires placing the patient in Park Bench position with rotation and flexion of the head.
(3) A rare and serious complication is postoperative submandibular sialadenitis due to obstruction of Wharton’s duct caused by extreme rotation of head, compression by endotracheal tube on the tongue, suction catheter mediated injury or salivary stagnation and formation of stone along with diffuse soft tissue swelling of the neck. This can cause severe respiratory distress postoperatively.
(4) Maintaining adequate intraoperative hydration, avoid kinking of endotracheal tube and soft tissue during positioning, maintain proper perioperative hygiene, are some prophylactic measures to prevent it. (5) It has a good prognosis with conservative management.

Case Description: A 42-year-old, ASA-I, male patient diagnosed with right vestibular schwannoma, posted for retrosigmoid-suboccipital craniotomy and excision in a right Park Bench position. Patient was extubated at uneventfully after 8 hours of surgery. Postoperatively in ICU within 4 hours he started developing acute left-sided hemi-facial swelling which was diagnosed as acute submandibular sialadenitis with diffuse soft tissue swelling of the same sided oropharyngeal mucosa. The patient consequently developed respiratory distress and stridor, requiring immediate reintubation. The swelling gradually diminished and he could be extubated on the second postoperative day. Complete resolution took about 5 days with conservative treatment.

[SNACC-114] Shaking Spell during a Repeat Epidural Blood Patch: Convulsive Syncope, Epileptic Seizure, or Local Anesthetic Toxicity? A Diagnostic Dilemma


Introduction: Distinguishing convulsive syncope from seizures related to epilepsy or local anesthetic toxicity can be a diagnostic challenge. While there are many shared clinical signs including shaking, loss of consciousness, and incontinence, management strategies are unique and hence, it is crucial to obtain an accurate and prompt diagnosis.

Case Description: A 37-year-old gentleman with a history of chronic headaches, hemihypenesthesia continua with chronic cerebrospinal fluid (CSF) leak, congenital scoliosis status postextensive hardware instrumentation, familial connective tissue disorder status post aortic root replacement with aortic...
Introduction: Prolonged anesthesia or multiple short periods of anesthesia exposure of infant rats to sub-anesthetic doses of SEVO induces a very modest increase in brain cell apoptosis and co-administration of DEX at low doses does not alter drug-induced neuroapoptosis. In contrast, exposure to SEVO 1.1% or coadministration of DEX at high doses with SEVO 1.1% induces significant apoptosis in several brain regions and was most prominent in the subiculum region of the hippocampus.

Results: Rats exposed to SEVO 1.1% without DEX had decreased righting reflex scores and respiratory rates as compared with controls but were highly responsive to toe pinch indicating that they were sedated but not deeply anesthetized. Rats co-administered with SEVO 1.1% and DEX (1 to 25) had slightly decreased righting reflex scores but similar toe pinch scores than rats exposed to SEVO 1.1% alone. In contrast, most rats exposed to SEVO 1.8% or SEVO 2.5% had very low scores for both righting reflex and toe pinch indicating that most rats were deeply anesthetized. There was not mortality in animals treated with SEVO 1.1% with and without DEX or with SEVO 1.8% alone. Brain cell apoptosis induced by exposure to SEVO 1.1% to 2.5% increased dose-dependently from ~3 to ~13 times with respect to control in several brain regions. Coadministration of low doses of DEX (1) with SEVO 1.1% did not alter significantly apoptosis induced by SEVO 1.1% alone. In contrast, we observed a larger increase in apoptosis in rats co-administered with SEVO 1.1% and high doses of DEX (10 and 25). This brain injury was more prominent in the subiculum region of the hippocampus.

Conclusion: Prolonged exposure of infant rats to sub-anesthetic doses of SEVO induces a very modest increase in brain cell apoptosis and co-administration of DEX at low doses does not alter drug-induced neuroapoptosis. In contrast, exposure to SEVO 1.1% or coadministration of DEX at high doses with SEVO 1.1% induces significant apoptosis in several brain regions and was most prominent in the subiculum.

Reference:

[SNACC-115] Dexmedetomidine at Clinical Doses Provides Protection Against Sevoflurane Induced Brain Cell Apoptosis While at Higher Doses it Potentiates Anesthetic-induced Injury in Neonatal Rats

Perez-Zoghi J*, Zhu W†, Grafe M‡, Brambrick A*, *Columbia University, College of Physicians & Surgeons, New York Presbyterian Hospital, New York, NY; ‡Oregon Health & Science University, Portland, OR.

Introduction: Prolonged anesthesia or multiple short periods of anesthesia in infants is a current medical concern as it induces structural brain injury and developmental functional alterations in several animal species. In a previous work (Perez-Zoghi et al. 2017) we showed that 6 hours exposure of infant rats at post-natal day 7 (P7) to sevoflurane (SEVO) at a dose (2.5%) induced a surgical plane of anesthesia and resulted in robust apoptotic cell death in several cortical and subcortical brain regions. We also showed that co-administration of sedative dexmedetomidine (DEX) at low doses (1 µg/kg) with SEVO 2.5% significantly reduced this brain injury while higher doses of DEX (5 µg/kg and higher) with SEVO 2.5% induced mortality of infant rats. We extended this investigation to find the effects of low-levels of anesthetics with or without sedatives at sub-anesthetic doses. We hypothesized that brain cell apoptosis caused by SEVO exposure and protection provided by DEX are dose-dependent.

Methods: All animal procedures were approved by the IACUC at OHSU. We exposed P7 rats to either SEVO 1.1%, 1.8%, or 2.5% with oxygen 30% (vol%, balance N2), or oxygen 30% (control). In addition, a subgroup of rats exposed were coadministered DEX at 1, 5, 10, 25 µg/kg. Responsiveness of infant rats to toe pinch and righting reflex and respiratory rates determined during exposure. Blood gas analysis was performed to determine physiological and metabolic parameters. Brain cell apoptosis was unbiasedly quantified in selected regions of the frontal, central and posterior brain using caspase-3 immunohistochemistry and computerized methods. Parametrical and nonparametrical statistics were used.

Results: Rats exposed to SEVO 1.1% without DEX had decreased righting reflex scores and respiratory rates as compared with controls but were highly responsive to toe pinch indicating that they were sedated but not deeply anesthetized. Rats co-administered with SEVO 1.1% and DEX (1 to 25) had slightly decreased righting reflex scores but similar toe pinch scores than rats exposed to SEVO 1.1% alone. In contrast, most rats exposed to SEVO 1.8% or SEVO 2.5% had very low scores for both righting reflex and toe pinch indicating that most rats were deeply anesthetized. There was not mortality in animals treated with SEVO 1.1% with and without DEX or with SEVO 1.8% alone. Brain cell apoptosis induced by exposure to SEVO 1.1% to 2.5% increased dose-dependently from ~3 to ~13 times with respect to control in several brain regions. Coadministration of low doses of DEX (1) with SEVO 1.1% did not alter significantly apoptosis induced by SEVO 1.1% alone. In contrast, we observed a larger increase in apoptosis in rats co-administered with SEVO 1.1% and high doses of DEX (10 and 25). This brain injury was more prominent in the subiculum region of the hippocampus.

Conclusion: Prolonged exposure of infant rats to sub-anesthetic doses of SEVO induces a very modest increase in brain cell apoptosis and co-administration of DEX at low doses does not alter drug-induced neuroapoptosis. In contrast, exposure to SEVO 1.1% or coadministration of DEX at high doses with SEVO 1.1% induces significant apoptosis in several brain regions and was most prominent in the subiculum.

Reference:

[SNACC-116] Forebrain Ischemia Causes Increased Expression of mir-338 and INSM1 in the Rat Hippocampus


Background: Cognitive dysfunction remains a devastating outcome in survivors of cardiac arrest. The principle source of cognitive impairment is attributed to delayed death of hippocampal cornu ammonis 1 (CA1) neurons following blood loss to the brain. Treatments that directly target CA1 neurons have not had translational clinical success. Astrocytes regulate the survival of CA1 neurons following injury, and treatments targeting astrocytes have been shown to augment survivability of hippocampal astrocytes. We identified miR-338, a known modulator of astrocyte function, as a potential regulator of the transcriptional repressor INSM1, a critical epigenetic regulator of cell fate.

Methods: To test the hypothesis that miR-338 regulates astrocyte-mediated neuronal survival following forebrain ischemia by targeting INSM1, we assessed hippocampal subregional expression patterns of INSM1 and miR-338 via RT-qPCR and combined in situ hybridization/imunofluorescent microscopy 1, 3, and 7 days following 10 minutes 2-vessel occlusion plus hypotension in rats. Subregional expression of miR-338 and INSM1 was evaluated with RT-qPCR using TaqMan primers.

Results: We observed that prior to injury, INSM1 is highly expressed in the ischemia-resistant dentate gyrus relative to the ischemia-sensitive CA1. Following global cerebral ischemia, expression of INSM1 in the CA1 progressively increased, equaling DG expression after 7 days. We confirmed that increased expression in the CA1 was localized to both astrocytes and neurons. The CA1 and DG have similar miR-338 expression at baseline. Expression of miR-338 was rapidly elevated in the CA1 after global cerebral ischemia but remained stable in the DG.

Conclusion: MiR-338 may regulate the epigenetic response to injury in the neurodegeneration-vulnerable hippocampal CA1 by targeting INSM1. Immediate future experiments will validate the functional relationship between miR-338 and INSM1, as well as assess cognitive behavioral outcomes following miR-338 inhibition in vivo.

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[SNACC-117] Microglial TNF Alpha is not Responsible for Delayed Neuronal Death After Cardiac Arrest

Koerner I, Matsushita K. Ohsu, Portland, OR.

Cardiac arrest causes neuronal loss in ischemia-vulnerable brain regions, including the hippocampus. This leads to memory loss and cognitive dysfunction that reduce quality of life in survivors. We have previously found that neuronal death and memory deficit are reduced when microglia are ablated before cardiac arrest. Others have shown that TNF alpha is a major contributor to microglia-mediated neuronal death in vitro. As microglia upregulate TNF alpha after cardiac arrest, we hypothesized that TNF alpha released from activated microglia is responsible for neuronal death and memory dysfunction after cardiac arrest.

Methods: We crossed TACElox mice to CX3CR1CreER+ mice expressing tamoxifen-inducible Cre recombinase to create mice that lack the TNF alpha converting enzyme TACE (aka ADAM17) in microglia and peripheral macrophages (CX3CR1CreER+/−TACElox+/+). These mice produce TNF alpha, but are unable to release it from their CX3CR1 positive microglia and macrophages. We induced Cre-recombination with a tamoxifen pulse 30 days before exposing mice to cardiac arrest and resuscitation. This delay allows for the short-lived peripheral macrophages to be completely turned over and replaced by TACE intact cells, while the low-turnover brain microglia continue to lack functional TACE. We used CX3CR1CreER+/−TACElox+/+ mice that do not undergo Cre recombination and have intact TACE as controls. Control mice received tamoxifen to exclude nonspecific drug effects. Mice were subjected to potassium chloride induced cardiac arrest. Cardiopulmonary resuscitation was initiated after 10 minutes of cardiac arrest by injection of epinephrine and chest compressions at a rate of 300/minute. Three days later, hippocampal tissue was harvested. Neuronal death in the ischemia sensitive CA1 region was quantified after H&E staining. We tested memory function in an additional cohort of mice using trace fear conditioning testing 10 days after cardiopulmonary resuscitation.

Results: Neuronal death in the hippocampus was not different between groups. Mice lacking microglial TACE performed worse in fear conditioning testing than control mice.

Conclusions: Mice whose microglia cannot release TNF alpha are not protected from delayed neuronal death after cardiac arrest, suggesting that microglial TNF alpha is not a major contributor to neuronal death. It is possible, and requires further testing, that TNF alpha released from astrocytes is sufficient to mediate neuronal death. Surprisingly, memory deficit is exacerbated in mice with TACE deficient microglia, suggesting that microglial TNF alpha may be beneficial for functional recovery. Future investigations will determine the role of microglia TNF alpha in neurogenesis and synaptic plasticity after cardiac arrest.

References:

[SNACC-118] The Risk Factor of Postoperative Transient Neurological Events in Pediatric Patients of Moyamoya Disease: A Retrospective Study

Matsuura H, Yoshitani K, Ohnishi Y. Consider This Abstract for a Travel Award, Suita, Japan.

Background: Moyamoya disease (MMD) is a cerebrovascular disease characterized by bilateral stenosis of the intracranial internal carotid arteries and an abnormal collateral vascular network at the base of the brain. Previous studies indicated that postoperative stroke and cerebral hyperperfusion had occurred 27.5% to 50% of patients (1 to 4) per surgery. Particularly, the pediatric patients with MMD are exposed to the risk of transient neurological events (TNE), such as emergence delirium, dehydration, and anxiety, but to our knowledge, there have been few studies that identified the risk factors of postoperative TNE in pediatric patients.
cases. Therefore we investigated the incidence and the risk factors of TNE in pediatric patients with superficial temporal artery-middle cerebral artery (STA-MCA) bypass procedure retrospectively.

Method: After Institutional Review Board approval, we retrospectively reviewed medical records of MMD patients younger than 15 years old with STA-MCA bypass surgery under general anesthesia at one cerebrovascular center in Japan between January 1999 and March 2016. The primary outcome was TNE. Candidates of risk factors of TNE, age, sex, anesthetic agent (propofol or sevoflurane), premedications, sedation (propofol or dexmedetomidine), and crying, were examined by multivariable logistic regression analysis.

Results: A total of 277 cases of 154 pediatric patients received STA-MCA bypass surgery, and 154 cases (39%) suffered TNE within 1 week after operation. Crying (odds ratio, 3.4; 95% confidence interval, 1.87-6.18; P < 0.001) was an independent risk factor of TNE, and sedation protected incidence of TNE (odds ratio, 0.50; 95% confidence interval, 0.28-0.89; P = 0.018), but there was no significant difference in propofol or dexmedetomidine.

Conclusions: In pediatric patients of MMD, crying induced postoperative TNE and the sedatives reduced the risk of TNE.

References:

Intraoperative Measurement of Regional Cerebral Blood Flow By Near-Infrared Spectroscopy In Patients Undergoing Superficial Temporal Artery To Middle Cerebral Artery Bypass Surgery for Moyamoya Disease

Tsukinaga A, Yoshitani K, Kato S, Ohnishi Y. National Cerebral and Cardiovascular Center, Suita, Osaka, Japan.

Background: Superficial temporal artery to middle cerebral artery (STA-MCA) bypass surgery developed for prevention of stroke in patients with Moyamoya disease (MMD). However, there has been no quantitative evaluation whether STA-MCA bypass increases regional cerebral blood flow (rCBF) intraoperatively to date. Recently advanced near-infrared spectroscopy (NIRS) has enabled to measure relative change in rCBF following injection of indocyanine green (ICG).1 On the basis of that technology, we developed a quantitative method measuring rCBF. The purpose of this study was to examine whether STA-MCA bypass graft increases rCBF by measuring rCBF intraoperatively by our novel technology of NIRS and ICG.

Method: Thirteen patients undergoing elective STA-MCA bypass surgery for MMD were enrolled. We measured rCBF pre and post bypass intraoperatively by using NIRS and intravenous injection of ICG. rCBF was calculated by using the maximum gradient model combining the change of arterial blood concentration (i) and maximum arterial blood concentration of ICG in the brain tissue (ii). First, the curve of the change in ICG concentration in the brain tissue was drawn using the software, NIRO ICG (Hamamatsu Photonics, Japan). The original curve includes both arterial and venous components of the brain tissue. The curve of ICG concentration of arterial blood was separated by applying the frequency filter to pulse wave component in the curve of ICG concentration (i). Second, the maximum blood concentration of ICG was obtained by DDG analyzer (Nihon Kohden, Japan) (ii). Combining the 2 results [(i) and (ii)], rCBF was calculated. rCBF measured by NIRS (rCBF_N) at pre and post bypass was compared with preoperative and postoperative rCBF measured by Positron emission tomography (rCBF_P) of the anterior cerebral artery area corresponding to the measurement site by NIRS. We used paired t test in statistical analysis.

Results: rCBF_N was significantly increased in the operated side (pre: 25.5 ± 12.5 mL/100 g/min, post: 37.5 ± 9.3 mL/100 g/min, P = 0.04), but not in the nonoperated side (pre: 25.7 ± 13.7 mL/100 g/min, P = 0.51). Postoperative rCBF_P was significantly increased in the both side compared with preoperative rCBF_P in operated side (pre: 30.7 ± 5.4 mL/100 g/min, post: 37.5 ± 9.3 mL/100 g/min, P = 0.01; nonoperated side; pre: 31.4 ± 0.6 mL/100 g/min, post: 39.4 ± 11.7 mL/100 g/min, P = 0.01) (Fig.).

Conclusions: Intraoperative rCBF_N pre and post STA-MCA bypass surgery were significantly increased similarly with rCBF_P. rCBF_N could be a quantitative assessment of STA-MCA bypass surgery.

References:

Noninvasive Intraoperative Cerebral Autoregulation: Monitoring and Retrospective Calculation of Optimal Arterial Blood Pressure In Elective Neurosurgical Patients


Abstracts
Background and Objectives: Cerebral autoregulation (CA) may be assessed with the cerebral oximetry index (COx) that correlates a surrogate marker of the cerebral blood flow (regional saturation of oxygen, rSO2) with either cerebral perfusion pressure (CPP) or arterial blood pressure (ABP). An automated curve fitting method with specific software (ICM+®) calculates the “optimal ABP” (ABPOPT), defined as the ABP level where COx reaches its lowest value in an individual patient. Besides the technical challenges, we hypothesized that on-line monitoring of the COx index in patients undergoing long neurosurgical procedures allows a retrospective definition of their intraoperative ABPOPT.

Measurements and Main Results: Retrospective analysis of prospectively collected data in the neurosurgical theater at Hospital Clinic de Barcelona. A total of 66 patients with continuous (>2 h) intraoperative monitoring of invasive ABP and rSO2 with ICM+® software were included.

COx was calculated online as the correlation between 10-second averaged values of rSO2 and mABP over a 300 seconds period (30 values). CA was considered intact for COx < 0.3 and impaired for COx ≥ 0.3. ABPOPT could be calculated in 49 (74%) of the 66 patients analyzed. The relationship between the baseline ABP value at admission (ABPBV), ABPOPT and the average “real” intraoperative ABP (ABPR) in these patients was also studied. Ten patients (20.41%) kept their average ABPR below 20% of their ABPBV. In 50 patients (61.22%) the average ABPR was lower than the ABPOPT.

Conclusions: On-line CA monitoring with noninvasive COx index is feasible and allows a retrospective calculation of the ABPOPT values in most of the patients of the study. The fact that ABPR was below calculated ABPOPT in a significant number of patients deserves further analysis.

References:

[SNACC-121] Perioperative Use of IV Milrinone for Cerebral Hypoperfusion in Extracranial to Intracranial Bypass Surgery: A Case Series


Background: Extracranial to intracranial (EC-IC) bypass surgery is increasingly offered to patients with Moyamoya disease as well as other cerebrovascular disorders (eg, radiation vasculopathy, tumour invasion). Despite advances in surgery, anesthesia and neuromonitoring, these patients are vulnerable to cerebral ischemia during and following surgery. The use of phosphodiesterase inhibitors, including milrinone, has been advocated in the treatment of cerebrovasospasm in the context of subarachnoid hemorrhage.1,2 Their use has not yet been described in other settings such as EC-IC bypass surgery. Our study objective was to describe a series of patients in which milrinone was used to successfully reverse symptoms of cerebral ischemia during or following cerebrovascular bypass surgery.

Methods: After institutional ethical approval, we retrospectively identified all patients who underwent EC-IC or other intracranial vascular bypass surgery at our hospital and received intravenous milrinone between September 1, 2015 and April 11, 2018. Patient demographics and comorbidities, intraoperative and postoperative course, clinical indication for milrinone and neurological outcome was extracted from the medical record.

Results: Five patients met the inclusion criteria: 3 male and 2 female with an average age of 42 (SD = 17) years. Three patients had EC-IC bypass surgery, 2 patients underwent encephalo-duro-artério-synangiosis. Milrinone was commenced when there was a change in neuromonitoring (n = 2) or in the presence of new postoperative nonhemorrhagic neurology (n = 3). Milrinone was used in the range of 0.125 to 1 mcg/kg/min for a variable duration (range: 4 h to 5 d). All patients were treated with norepinephrine to maintain a mean arterial pressure > 100 mm Hg and a systolic blood pressure < 160 mm Hg. In all cases, the patients made an almost complete recovery to baseline neurological status, including reversal of a new hemiparesis in 3 of the patients. No significant complications related to the use of milrinone were noted.

Conclusions: Our case series provides a novel description of the use of intravenous milrinone to reverse vasospasm and symptoms of cerebral ischemia in the context of cerebrovascular bypass surgery in adults. Our preliminary report suggests the need for further research to define the role of intravenous milrinone to reverse cerebral vasospasm in the context of cerebrovascular bypass surgery.

References: