

cerebrovascular reactivity limit their use. Near infrared spectroscopy (NIRS) based indices of cerebrovascular reactivity are minimally invasive and have improved spatial resolution. The precise relationship between NIRS and ICP based indices is quantified utilizing times series analysis and advanced statistical techniques. Methods: High-resolution physiologic data was collected in a cohort of adult moderate to severe TBI patients at a single quaternary care site. From this data both ICP and NIRS based indices of cerebrovascular reactivity were derived. The times series structure of these indices was determined and used to correct for autocorrelation in a linear mixed effects model of ICP based indices from NIRS based indices of cerebrovascular reactivity. Results: A total of 83 patients were included in this study. Times series analysis coupled with mixed effects modeling was utilized to examine the relationship between ICP and NIRS based indices of cerebrovascular reactivity. Conclusions: Times series analysis coupled with mixed effects modeling allows for a more complete understanding of the relationship between ICP and NIRS based indices of cerebrovascular reactivity in the setting TBI.

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Traumatic penetrating head injury by crossbow projectiles: a case report and literature review

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Background: Penetrating head injury secondary to crossbows is a rare encounter in neurosurgical practice with only few cases reported in the literature. Methods: Chart review and literature review. Results: A 31-year-old man with a previous psychiatric history sustained a self-inflicted injury using a crossbow he bought from a department store. The patient arrived neurologically intact. He was not able to verbalize due to jaw fixation with the arrow. The trajectory of the object showed an entry point at the floor of the oral cavity and an exit through the calvarium just off the midline. The oral and nasal cavities, along with the palate and the skull base, and the left frontal lobe were all breached (figure). No vascular injury was identified on imaging (figure). The arrow was surgically removed in the operating room after establishing an elective surgical airway. A planned delayed CSF leak repair was performed. The patient made a substantial recovery and was discharged home in good status. Conclusions: - Multidisciplinary team is key.

Vascular imaging should be done pre and post-intervention.

Surgical approach is determined by the trajectory.

Psychiatric illness and access to weapons are major risk factors.

Elective surgical airway might be indicated.

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Memantine inhibits cortical spreading depolarization and improves neurovascular function following traumatic brain injury: results of a randomized pre-clinical trial

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Background: Cortical spreading depolarization (CSD) is associated with poor outcomes following traumatic brain injury (TBI). Here we aimed to: (1) determine the effect of NMDA-receptor antagonism on CSDs in healthy and TBI animals *in vivo*; and (2) conduct a randomized pre-clinical trial (RCT) of memantine for prevention neurological decline following repetitive mild TBI (rmTBI). Methods: Rodents received either one moderate (n = 23) or four daily mild (rmTBI; n = 30) head impacts (weight drop). Sham animals received brief anesthetic without TBI (n = 40). 93 animals underwent cranial window surgery with electrocorticographic (ECoG) monitoring and electrically triggered CSDs. Ketamine (100uM topical or 25 mg/kg IP) and memantine (10 mg/kg IP) were tested *in vivo*. An RCT was conducted (N=31) using memantine (10 mg/kg) or saline (2.5 cc/kg) for rmTBI with daily neurobehavioural testing. Results: In TBI animals, ketamine or memantine inhibited CSDs in 44-88%, and 50-67% of cases, respectively. Near-DC/AC-ECoG amplitude was reduced by 44-75% and 52-67%, and duration by 39-87% and 61-78%, respectively. RCT animals that received memantine had higher mean neurological scores (9.27 (SD 3.08) vs. 5.56 (SD 3.05), p< 0.001) vs. saline. Conclusions: Memantine suppressed CSDs following TBI, *in vivo*. In a pre-clinical RCT of rmTBI, memantine prevented neurological decline.

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Chronic subdural hematoma drainage under local vs. general anesthesia: systematic review and meta-analysis

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Background: Chronic subdural hematoma (CSDH) is one of the most encountered conditions seen in neurosurgery. Although mainstay treatment of cSDH has been burr hole drainage, no consensus yet exists on optimal anesthetic technique for surgical treatment between general (GA) and local (LA) anesthesia. Methods: A search was conducted in MEDLINE (1946 to November 11, 2022), Embase (1974 to November 11, 2022), and PubMed (up to November 11, 2022). We followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines to systematically screen studies.

Results: Our literature search identified 521 studies, out of which 20 were included. There were a total of 1750 patients who underwent CSDH drainage under LA. The weighted mean age was 71.0 years, and 27.1% were female. Postoperative complication rate was significantly lower in the LA group (odds ratio 0.44, $p = 0.004$). The mean operative time (mean difference -29.28 minutes, $p < 0.0001$) and length of admission (mean difference -1.58 days, $p = 0.0002$) were significantly shorter in the LA group. Conclusions: In this meta-analysis, LA shows benefits in shorter operative time, shorter admission length, and fewer postoperative complications. This makes local anesthesia a less invasive alternative to general anesthesia especially in elderly patients.

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Metabolic acidosis and functional outcome after aneurysmal subarachnoid hemorrhage: an exploratory analysis

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Background: Little data exists on the impact of metabolic acidosis in aneurysmal subarachnoid hemorrhage (aSAH). Given its detrimental effects in critically ill patients, we inquired whether in patients with aSAH, metabolic acidosis (bicarbonate < 22 mmol/L) was associated with an increased risk of worse outcomes at 3 months (mRS > 2). Methods: We performed a retrospective analysis of the CONSCIOUS-1 randomized control trial dataset including all patients who had at least three bicarbonate levels drawn. Bivariate and multivariate logistic regression models were used to assess for independent relationship between metabolic acidosis and functional outcome at 3 months. Delayed cerebral ischemia (DCI) was assessed for potential effect modification. Results: Three hundred and nineteen patients were included in our analysis. There was no difference in the proportion of poor outcome between those with or without metabolic acidosis on bivariate analysis (OR=1.022, $p=0.949$). However, amongst individuals who develop DCI, there was increased odds of unfavorable outcome when patients developed metabolic acidosis (OR=7.588, $p=0.023$). Conclusions: Individuals who develop delayed cerebral ischemia may benefit from having their bicarbonate level carefully monitored. More studies are needed to determine how the development of metabolic acidosis can be mitigated, and whether its prevention leads to improved outcomes.

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Delayed cerebral ischemia and cognitive outcomes after aneurysmal subarachnoid hemorrhage: an exploratory analysis

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Background: Neuropsychological outcomes are an important component of the morbidity after aneurysmal subarachnoid

hemorrhage (aSAH). Data on the relationship between delayed cerebral ischemia (DCI) and neuropsychological outcomes remains sparse. We herein assess the relationship between DCI and neuropsychological outcomes, as measured by the Montreal Cognitive Assessment score (MoCA) at 90 days in patients with aSAH. Methods: We performed a *post-hoc* analysis of the Nimodipine Microparticles to Enhance Recovery While Reducing Toxicity After Subarachnoid Hemorrhage (NEWTON-2) clinical trial. Patients were grouped based on whether they developed delayed cerebral ischemia. We assessed the relationship between MoCA scores and DCI with Student's t-test and regression modeling. Age, sex, history of hypertension, and WFNS grade were included as covariates in the model. Results: Two-hundred and fifteen patients were included in our analysis. Mean MoCA score at 90 days in our population was 22. Mean MoCA scores were significantly lower in patients who developed DCI compared to those who did not (23.7 vs 18.4, $p < 0.001$). Age, WFNS grade, and development of DCI were independently associated with MoCA scores in the regression model ($p < 0.05$). Conclusions: DCI is a predictor of decreased neuropsychological outcomes in aSAH survivors and may contribute to the morbidity burden in this population.

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Prediction of cerebral vasospasm using radiographical and clinical features: a machine learning model

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Background: Cerebral vasospasm is a feature of delayed cerebral ischemia that can occur after subarachnoid hemorrhage from cerebral aneurysm rupture. CTA is the universal first line diagnostic modality (sensitivity 79.6%, specificity 93.1%). We aim to determine whether specific vasospasm-associated radiographical and clinical features predicts cerebral vasospasm with comparable accuracy. Methods: Our cohort included 403 patients between 2006-2019. We used clinical predictive features including: day since rupture, transcranial doppler Lindegaard ratio, MCA velocity, ICA velocity, physical examination, and radiographical predictive features including: volume of hematoma, artifact, aneurysm, as our training dataset with true positives being digital subtraction angiography confirmed vasospasm. We used a decision-tree classifier from Scikit-learn library for training and testing of the model. Results: Our model trained on clinical and radiographical predictive features achieved sensitivity 93%, specificity 67%, F1 score 0.88. When using only radiographical features, we reached sensitivity 90%, specificity 55%, F1 score 0.83. When using only clinical features, we reach sensitivity 70%, specificity 93%, F1 score 0.87. Conclusions: We show that our vasospasm predictive model achieves adequate sensitivity, specificity, and F1 scores when compared to CTA. With further increase in dataset and fine-tuning of hyperparameters, it is possible that our model may be used to optimize the vasospasm management pipeline.