Neurocritical Care

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When a neurosurgeon should care about pneumonia: the case for Pneumocystis jirovecii pneumonia prophylaxis in neurosurgical patients

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Background: *Pneumocystis jirovecii* pneumonia (PJP) is an opportunistic interstitial fungal pneumonia. The incidence of PJP in HIV-positive populations is decreasing, while it is increasing in HIV-negative immunocompromised populations, such as neurosurgical patients treated with high-dose corticosteroids. Morbidity and mortality can be severe owing to acute respiratory failure. **Methods:** Two cases are described and a literature review performed to determine the incidence of PJP in the neurosurgery population. A standardized care pathway is proposed to reduce preventable harm. **Results:** Long-term, high-dose corticosteroid regimens (≥4 mg dexamethasone daily for ≥4 weeks) with taper are associated with increased risk of PJP infection. Additional risk factors for infection in HIV-negative patients include CNS malignancy and concurrent radiation therapy. TMP-SMX is the first-line agent for PJP prophylaxis. **Conclusions:** Clinicians should maintain a high index of suspicion of PJP and adopt a standardized protocol for prophylaxis in neurosurgical patients treated with high-dose corticosteroids.

Neuroimaging

P.104

The diagnostic value of the nerve root sedimentation sign for symptomatic lumbar stenosis

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Background: Previous studies have shown varied results with respect to the diagnostic utility of a positive nerve root sedimentation sign (SedSign) on MRI for symptomatic lumbar stenosis. The objective of this study was to analyze the clinical characteristics of SedSign utilizing a validated classification for low back and leg pain (Saskatchewan Spine Pathway classification; SSPc). **Methods:** This was a retrospective review of prospectively-collected data in 367 consecutive adult patients presenting to a spine surgeon with back and/or leg pain between January 1, 2012 and May 31, 2018. Inter- and intra-rater reliability for SedSign was 73% and 91%, respectively (3 examiners). **Results:** SedSign was positive in 111 (30.2%) and negative in 256 (69.8%) of patients. On the univariate analysis, a positive SedSign was correlated with age, male sex, several components of ODI, EQ5D mobility, cross-sectional area (CSA) of stenosis, and SSPc pattern 4 (intermitted leg dominant pain). On multivariate analysis, SedSign was associated with age, male sex, CSA stenosis and ODI sub-score for walking distance. The sensitivity and specificity of SedSign for neurogenic claudication was 50.3 and 82.9, respectively (positive predictive value 65.8%, negative predictive value 71.9%). **Conclusions:** The SedSign has high specificity for neurogenic claudication, but the sensitivity is poor.

Neuroscience Education

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The "Comprehensive 3D Skull Base Lab"-- enhancing resident education with virtual/augmented reality and 3D printing at Northwestern University

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Background: Due to increasingly limited access to cadavers and first-hand operative experience, there is an increasing need for innovative modalities in neurosurgical education. Recent developments in computer modelling, virtual/augmented reality, and video game technology have created new opportunities for novel teaching tools. We set out to develop a library of 3D models of normal anatomy and pathologic states for use in conjunction with an interactive simulated environment and 3D printing for teaching of neurosurgical residents. **Methods:** Anatomically accurate 3D models were developed using CT/MRI data from multiple patients using open source segmentation and 3D animation software. An interactive simulated environment was then created using a 3D game engine and used in conjunction with a virtual/augmented reality system. 3D models were also used to for 3D printing. **Results:** 3D models and an interactive simulated environment were used in conjunction with various viewing modalities, including 3D video, 360 video, and virtual reality headsets, as well as 3D printing. These teaching tools were successfully implemented in neurosurgery didactic teaching sessions and in the skull base lab. Additional benefits were seen with patient engagement and marketing. **Conclusions:** 3D modeling and animation show considerable promise for neurosurgical education, with additional benefits for patient engagement, marketing, and social media.

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A pilot-project for neurosurgery competency-based design implementation

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Background: In preparation for July 2019 rollout of competency-based design (CBD) in Canadian neurosurgery residency training, the University of Calgary launched a pilot-program of five representative EPAs using the One45 program. Our study objectives were to examine the uptake of CBD with residents and faculty and to quantify CBD implementation barriers. **Methods:** Phase one of the One45-based CBD pilot-program launched on November 1st, 2018 and ended on January 8th, 2019, after which a questionnaire was sent to each participating resident. The questionnaire examined number of EPAs initiated, measures of favourability, importance, ease of use, and barriers encountered. **Results:** Results obtained from the survey

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show 93.8% response rate (15/16 residents). 66.7% of residents feel that CBD is moderately important or higher to their education. Over the 10 study weeks, there were only 8 completed EPAs (expected was 50), five of which were completed by a single resident. Major expressed barriers of implementation of CBD were time involved (50.0%) and technical unfamiliarity with the platform itself (50.0%). **Conclusions:** This study demonstrates the critical importance of piloting a CBD program prior to official implementation as immediate buy-in was significantly slower than anticipated. Technical and time barriers exist which need to be rectified in advance of July 2019.

Neurotrauma

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Traumatic spinal cord injuries among aboriginal and non-aboriginal populations of Saskatchewan: a prospective outcomes study

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Background: People of aboriginal ancestry are more likely to suffer traumatic spinal cord injury (TSCI) compared to other Canadians; however, outcome studies are limited. This study aims to compare aboriginal and non-aboriginal populations with acute TSCI with respect to: pre-injury baseline, injury severity, treatment, outcomes, and length-of-stay characteristics. **Methods:** This was a retrospective analysis of 159 patients with TSCI prospectively enrolled in the prospective Rick Hansen Spinal Cord Injury Registry (RHSCIR), Saskatoon site between February 13, 2010 and December 17, 2016. **Results:** Sixty-two patients consented to the full dataset, which includes ethnic background: 21 'aboriginal' (33.9%); 41 'non-aboriginal' (66.1%). Aboriginal patients were younger, had fewer medical comorbidities and had similar severity of neurological injury and similar outcomes compared to non-aboriginal patients. However, the time to discharge to the community was significantly longer (median 104.0 days versus 38.5 days, p=0.021). While 35% of non-aboriginal patients were discharged home from the acute care site, no aboriginal patients were transferred home directly. **Conclusions:** This study suggests a need for better allocation of resources for transition to the community for First Nations patients with TSCI in Saskatchewan. We plan a further study to assess outcomes from TSCI for First Nations patients across Canada.

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Management of a maxillofacial, transclival penetrating injury

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Background: Penetrating traumatic injuries to the clivus are rare. We describe the case of a 79-year-old man who presented to the emergency room with a butter knife protruding from his left cheek. Imaging showed the blade entering just beneath the left zygoma and transecting the clivus to terminate within the prepontine cistern. The tip of the knife abutted the right anterior inferior cerebellar artery and lower basilar artery. **Methods:** He was brought to the interventional neuroradiology OR with knife in place, by a combined surgical team of ENT, neurosurgery, and neuroradiology. Under local anaesthetic and intravenous sedation, vascular access to the distal left vertebral artery was obtained and a balloon positioned. Traction was applied to the knife and the knife was successfully removed avoiding any angular or rotational movements. An immediate angiogram showed no evidence of arterial injury. **Results:** The patient recovered uneventfully and was discharged home with no neurological deficit. Follow-up CT/CTA was performed a month later and confirmed no pseudoaneurysm or other complication. **Conclusions:** Management of penetrating skull base injuries by a multidisciplinary surgical team is advisable. Vascular imaging is crucial. Positioning of balloons within large vessels close to the penetrating object is recommended to control bleeding that may occur on removal.

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Systematic review of civilian pediatric intracranial gunshot wounds

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Background: Pediatric craniocerebral gunshot wounds occur in the context of both accidental and intentional trauma. Unique physiologic factors merited research into prognostic factors and treatment priorities in the pediatric population. **Methods:** A systematic search of MEDLINE, EMBASE, Web of Science, LILACS, Cochrane Registered Trials and Systematic Reviews, ISRCTN, and ClinicalTrials.gov was conducted. Selection criteria included all studies published in any language since 2000 which described intracranial isolated gunshot wounds in a civilian individual or population of pediatric age. Post-mortem and epidemiological studies were excluded. Screening was conducted through Covidence. **Results:** Initial database search revealed 349 unique studies for abstract and title screening. Fifty studies were selected for full text screening. Nine studies were included in the final review. Study quality was assessed with the Newcastle-Ottawa Scale. Case series noted bullet migration, pituitary deficiency, neurovascular and neuropsychological concerns. Three single-center retrospective studies of 71, 30, and 48 pediatric patients suggested multiple negative prognostic signs on initial presentation. Early aggressive surgical treatment was recommended by some authors. **Conclusions:** This systematic review analyzed the best current understanding of evidence for prognostic factors and treatment considerations of intracranial gunshot wounds in the pediatric neurotrauma context. Areas for future research with larger multi-center studies were highlighted.

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