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Development and predictive validation of an intelligent surgical bimanual skills continuous assessment system

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Background: Surgeons' bimanual dexterity may correlate with the surgical outcome. Continuous assessment of psychomotor performance enables action-oriented feedback and error avoidance guidance. We outline an artificial intelligence (AI) application to continuously assess surgical bimanual skills and its predictive validation on surgical trainee performance throughout a neurosurgery residency program. Methods: Participants (n=50, 14 experts/neurosurgeons, 14 senior residents, 10 junior residents, 12 novices/medical students) performed two simulated subpial tumour resections a total of 300 times. A deep neural network was developed using expert/neurosurgeon and novice/medical student data to score bimanual performance at 0.2-second intervals between a score of 1.00 and -1.00. An average score was calculated for each task. Results: The average performance score differentiated among four expertise levels, p<.001. Neurosurgeons scored significantly higher than senior residents (p=.045) and junior residents scored significantly higher than medical students (p=.04). The intelligent system also differentiated between senior and junior trainee levels (p=.004). The performance score linearly correlated with resident year of neurosurgical training (adjusted R2=27.7%). Conclusions: The AI-powered intelligent system outlined is the first expert surgeon-data-based technical skills continuous assessment system, with predictive validity throughout a neurosurgical residency program. Intelligent systems may aid in the competency-based approach in surgery by accurately assessing trainee skills.

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Primary intracranial melanoma complicated by cerebral venous sinus thrombosis: a case report and literature review

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Background: Melanocytic tumors of the central nervous system (CNS) such as meningeal melanoma are exceedingly rare tumours derived from leptomeningeal melanocytes. Primary meningeal melanomas account for 0.1% of intracranial neoplasms with an incidence of approximately 0.5 per 10 million. Methods: We report the case of a previously healthy 47 year old male who presented with bilateral tonic-clonic seizure. Magnetic resonance imaging (MRI) demonstrated a homogenously-enhancing right temporal extra-axial lesion. The patient was stabilized on anti-epileptic medications and dexamethasone prior to proceeding with complete surgical resection of the lesion. Review of the current literature was conducted. Results: Macroscopically, the extra-axial lesion was heavily pigmented with invasion of the surrounding dura and skull. Histopathology revealed a poorly differentiated neoplasm with nuclear atypia and melanin-containing cells with strong SOX10 positivity and variable S100 positivity. Systemic workup was negative including absent ocular or cutaneous melanomas. Oncopanel was negative including absent BRAF mutation. He began checkpoint inhibitor therapy and subsequently developed cerebral venous sinus thrombosis (CVST) managed with anticoagulation. At 6 month follow-up, he was neurologically intact, working full-time, and had resumed immunotherapy. Conclusions: Primary intracranial melanoma is a rare tumour that can appear radiographically similar to meningioma. Surgical resection remains the mainstay of therapy for best long-term prognosis.

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Spinal cord injury associated with Wilms tumor metastasis: case report and literature review

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Background: A 19-month-old boy with recent Wilms tumor resection presented with ASIA B spinal cord injury secondary to rapid progression of a T12 epidural lesion suspicious for metastatic disease. Methods: The case is presented and the literature was reviewed for prior cases of Wilms tumor with spinal metastasis. Results: Emergent tumor debulking for spinal cord decompression via T11-L1 laminectomies with right T11-L1 facetectomies was performed. Allograft bone was placed to facilitate fusion. No direct connection to the renal tumor was appreciated on imaging or intraoperatively. There was no evidence of additional metastases. Pathology demonstrated similar histomorphology and immunohistochemical profile as the original left kidney tumor resection (Wilms tumor, favorable histology). Notably, no focal or diffuse anaplasia, or aggressive non-Wilms component such as clear cell sarcoma or rhabdoid tumor of the kidney, were identified. Treatment plan consisted of 25 Gy of radiation and 29 weeks of chemotherapy. At 6-weeks the patient had regained baseline lower extremity function with no bowel or bladder dysfunction. Conclusions: Spinal cord compression secondary to spinal metastasis of Wilms tumor in the absence of global metastatic disease is rare. Prompt identification, surgical decompression, and multimodality therapy is essential to prevent persistent neurological deficits.

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Adult gangliocytoma arising within the lateral ventricle: A case report and review of the literature

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Background: Gangliocytomas are rare neuronal tumors with an incidence of less than 1% of all CNS neoplasms. They are mostly seen in the pediatric age group, localizing within the cerebral cortex, most often the temporal lobe. Methods: We report a case of an intracranial gangliocytoma arising within the lateral ventricle in an adult patient. Our 66-year-old female patient started experiencing progressive generalized weakness, headaches, and confusion prior to presentation. Her neurological examination did not reveal any focal neurological deficits. MRI

of the brain showed a diffusely enhancing lobulated mass situated within the frontal horn of the right lateral ventricle with extension into the foramen of Monro and obstructive hydrocephalus. Results: The patient underwent an interhemispheric trans-callosal approach with gross total resection and relief of her hydrocephalous. Pathological examination showed clusters of highly pleomorphic neuron-like cells without evidence of neoplastic glial cells. Histopathological and immunohistochemistry findings were consistent with the diagnosis of gangliocytoma (World Health Organization grade 1). Conclusions: Gangliocytomas are rare low-grade CNS neoplasms that can present in an older population within unusual locations and should be included within the differential whenever a suspicious lesion is encountered.

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Dural arteriovenous fistulas with associated intracranial tumors: review of literature

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Background: Intracranial dural arteriovenous fistulas (DAVF) are relatively rare vascular malformations. While the pathophysiology of their formation is unknown, they are believed to be acquired lesions related to intracranial venous hypertension and dura sinus thrombosis. There have been rare reports of intracranial tumors associated with DAVF. Here we complete a systematic search of the literature. Methods: A systematic PRISMA search of the literature was conducted to identify papers in which an intracranial tumor was associated with sinus thrombosis and DAVF. 24 relevant studies were identified and analyzed, along with a case illustration. Results: A total of 38 cases of DAVF formation with concomitant intracranial tumor were identified. The median age was 60, the majority of tumors being meningiomas (71%), and involved primarily the transverse sigmoid sinus (52%) and superior sagittal sinus (16%). The most cases involved an occlusion (39%) or partial occlusion (24%) of the related sinus. The DAVF were classified as Borden Types I (35%), II (32%) or III (24%). Endovascular treatment was the most common intervention (56%), followed by a combined approach (28%) vs surgery alone (16%), all reporting resolution. Conclusions: This highlights that DAVFs can be rarely associated with intracranial tumors, and highlights the patterns of these lesions and their treatments.

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RANO-BM response criteria verification study in a SRS-treated cohort

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Background: Brain metastases are frequently seen in neurosurgical practice. Standardised criteria are created to better classify these common pathologies in research studies. This study's goal was to evaluate RANO-BM criteria's current thresholds in a cohort of patients with brain metastases managed by SRS. Methods: We performed a retrospective metastasis-level analysis of patients treated with SRS for brain metastases. The data collected included cohort demographics, metastases characteristics, outcomes, and the rate of true positives, false negatives, true negatives and false positives as defined by RANO-BM criteria at last follow-up before second SRS. Results: 251 metastases in 50 patients were included in the analysis. RANO-BM criteria using current thresholds yielded a sensitivity of 38%, a specificity of 95%, a positive predictive value of 71% and a negative predictive value of 84%. Modified RANO-BM criteria using absolute diameter differences of 2.5 mm yielded a sensitivity of 83%, a specificity of 87%, a positive predictive value of 67% and a negative predictive value of 94%. Pseudoprogression occurred significantly earlier than tumor progression, with a median time of onset of 6.9 months and 12.1 months respectively. Conclusions: Current RANO-BM criteria unreliably identifies clinically relevant tumor progression, but are useful in assessing diameter increases caused by tumor progression and pseudoprogression.

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Exploring the Canadian management of aSAH and delayed cerebral ischemia

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Background: Delayed Cerebral Ischemia (DCI) is a complication of aneurysmal subarachnoid hemorrhage (aSAH) and is associated with significant morbidity and mortality. A paucity of high-quality evidence is available to guide the management of DCI. As such, our objective was to evaluate practice patterns of Canadian physicians regarding the management of aSAH and DCI. Methods: The Canadian Neurosurgery Research Collaborative (CNRC) performed a cross-sectional survey of Canadian neurosurgeons, intensivists, and neurologists who manage aSAH. The survey was distributed to members of the Canadian Neurosurgical and Neurocritical Care Societies, respectively. Responses were analyzed using quantitative and qualitative methods. Results: The response rate was 129/340 (38%). Agreement among respondents included the need for intensive care unit admission, use of clinical and radiographic monitoring, and prophylaxis for prevention of DCI. Indications for starting hyperdynamic therapy varied. There was discrepancy in the proportion of patients felt to require intravenous milrinone, intra-arterial vasodilators, or physical angioplasty for treatment of DCI. Most respondents reported their facility does not utilize a