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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