

$p = 0.01$) and occurred in patients with longer lengths of stay ($p < 0.0001$) and discharge destination other than home ($p = 0.001$). **Conclusions:** The presence of medical comorbidities and advanced age are not reasons to exclude patients with GBM from surgical consideration. Postoperative complication is the most significant predictor of survival in elderly patients and can be avoided by a short length of stay and discharge home.

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The Rising Incidence and Prevalence of Brain Tumours: a Canadian epidemiological study

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Background: Primary malignant brain tumours account for over one third of all brain tumours and are associated with high morbidity and mortality. The purpose of this paper is to estimate the rate and trends of incidence and prevalence for primary malignant CNS tumours in Canada from 1992 to 2017. **Methods:** An epidemiological study using publicly available data from Statistics Canada: Canadian Cancer Registry (CCR) from 1992 to 2017 for all of Canada was conducted. Incidence and prevalence per 100,000, age-standardized incidence, and age-standardized prevalence per 100,000 person-years of primary malignant CNS tumours were calculated and stratified by sex and age: pediatric (0-19), adult (20-64), and elderly (>64) populations. **Results:** During the study period, incidence and prevalence increased by 27.3% and 28.8%, respectively. Males accounted for 56% of all diagnoses and experienced decreased survival compared to females one year after diagnosis (p -value = 0.04). Age-standardized rates of incidence and prevalence were highest in elderly populations. **Conclusions:** Overall, the incidence of primary malignant CNS tumours has increased from 1992 to 2017 with males and the elderly disproportionately affected. Increased healthcare resources and awareness are needed to better identify and deliver evidence-based care for these patients.

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Surgery for recurrent GBM: deciding when to operate

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Background: Previous studies have found conflicting results regarding the role of repeat surgery on overall survival (OS) in patients with GBM. We used a novel approach that includes time to tumour recurrence as an additional prognostic factor in order to determine which patients benefit most from repeat surgery. **Methods:** A retrospective chart review from 1992-2018 was performed on all adult (≥ 18 years old) patients with primary GBM that received surgery for recurrent disease and compared to publicly available data from The Cancer Genome Atlas (TCGA) of adult patients with primary GBM that did not undergo surgery for recurrent disease. **Results:** A total of 672 adult patients with GBM were included in the study, including 87 that received surgery at tumour recurrence (surgery cohort). The surgery cohort

had longer OS and similar complication rates to those that did not receive surgery at recurrence, independent of time to tumour recurrence ($p < 0.0001$ and $p = 0.4$, respectively). Within the surgery cohort, patients with tumour recurrence >6 months demonstrated additional survival benefit ($p < 0.0001$). **Conclusions:** Surgery for recurrent GBM leads to improved survival without increased complications. Patients with tumour recurrence >6 months benefit most from repeat surgery.

NEUROCRITICAL CARE

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Assessment of External Ventricular Catheter Associated Infections at the Ottawa Hospital: Literature Review and Quality Improvement Initiative

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Background: External ventricular drains are a lifesaving intervention in the management of acute hydrocephalus. EVD associated infections vary significantly, and expert panels recommend reviewing institutional policies if infection rates exceed 10%. The audit aims to identify the infection rate at our institution, whereas the literature review aims to synthesize a new institutional EVD best practice guideline. **Methods:** An audit of EVD catheters inserted in the time period between 07/01/2019 and 10/25/2020 was conducted. Statistical analysis to calculate absolute incidence, infections per 1000 days of catheter use. A literature review to identify best practices for the insertion and management of EVDs was conducted. **Results:** 75 patients required a total of 105 EVD catheters. There were 16 (15.3%) EVD related infections, equating to 14.3 infections per 1000 days. Fifty percent of patients developed an EVD related infection within 9 days of insertion. Most infections were induced by skin flora (87.5%). A comprehensive step-by-step EVD insertion and management protocol was developed aiming to reduce the risk of infection. **Conclusions:** The incidence of EVD associated infections at the Ottawa Hospital is significantly higher than acceptable rates as suggested by expert panels. A new evidence-based best practice guidelines should be implemented. A follow-up audit is necessary.

NEUROIMAGING

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Application of the Anatomical Fiducials Framework to a Clinical Dataset of Patients with Parkinson's Disease

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Background: Establishing spatial correspondence between subject and template images is necessary in neuroimaging research and clinical applications. A point-based set of anatomical

fiducials (AFIDs) was recently developed and validated to provide quantitative measures of image registration. We applied the AFIDs protocol to magnetic resonance images (MRIs) obtained from patients with Parkinson's Disease (PD). **Methods:** Two expert and three novice raters placed AFIDs on MRIs of 39 PD patients. Localization and registration errors were calculated. To investigate for unique morphometric features, pairwise distances between AFIDs were calculated and compared to 30 controls who previously had AFIDs placed. Wilcoxon rank-sum tests with Bonferroni corrections were used. **Results:** 6240 AFIDs were placed with a mean localization error (\pm SD) of $1.57\text{mm}\pm 1.16\text{mm}$ and mean registration error of $3.34\text{mm}\pm 1.94\text{mm}$. Out of the 496 pairwise distances, 40 were statistically significant ($p < 0.05/496$). PD patients had a decreased pairwise distance between the left temporal horn, brainstem and pineal gland. **Conclusions:** AFIDs can be successfully applied with millimetric accuracy in a clinical setting and utilized to provide localized and quantitative measures of registration error. AFIDs provide clinicians and researchers with a common, open framework for quality control and validation of spatial correspondence, facilitating accurate aggregation of imaging datasets and comparisons between various neurological conditions.

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Prediction of Pituitary Adenoma Recurrence using the SIPAP Classification

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Background: Pituitary tumor recurrence following endoscopic endonasal transsphenoidal surgery (EETS) has been reported widely. We evaluated a modified score using the SIPAP classification system, combining the suprasellar and parasellar extension scores of the pituitary tumor, to determine its impact on adenoma recurrence. **Methods:** A retrospective cohort study design with patient characteristics, tumor type, endocrine, operation, imaging data collected. Preoperative MRI images were reviewed and SIPAP classification applied. Postoperative data were extracted for the follow-up period available for each patient. The suprasellar score and the highest parasellar scoring from both sides were numerically summed in a bilateral suprasellar and parasellar (SaP) score and combined to make 4 grades. **Results:** 276 patients were identified, 56.5% of the cohort was male. The mean cohort age was 54 years old. The mean follow up period was 32 months. Patient perioperative tumor grade according to SaP classification and recurrence rate was: Grade 1: 11%; Grade 2: 10%; Grade 3: 15%; Grade 4: 22%. The results followed a pattern of logarithmic curve. **Conclusions:** The SaP classification was useful in determining the pituitary tumor expected recurrence following EETS. The advanced tumors had the highest recurrence rates. Use of the SaP score may allow for more accurate preoperative counselling of patients with pituitary adenoma.

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Reduced radiation CT imaging for augmented reality spinal surgery applications

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Background: There is growing evidence for the use of augmented reality (AR) in pedicle screw placement in spinal surgery to increase surgical accuracy, improve clinical outcomes and reduce the radiation exposure required for intraoperative navigation. Auto-segmentation is the cornerstone of AR applications because it correlates patient-specific anatomy to structures segmented from preoperative computed tomography (pCT) images. These AR techniques allow for a reduction in the radiation dose required to acquire CT images while maintaining accurate segmentation. **Methods:** In this study, we methodically increase the noise that is introduced into CT images to determine the image quality threshold that is required for auto-segmentation on pCT. We then enhance the images with denoising algorithms to evaluate the effect on the segmentation. **Results:** The pCT radiation dose is decreased to below the current lowest clinical threshold and the resulting images still produce segmentations that are appropriate for input into AR applications. The application of denoising algorithms to the images resulted in increased artifacts and decreased bone density. **Conclusions:** The CT image quality that is required for successful AR auto-segmentation is lower than that which is currently employed in spine surgery. Future research is required to identify the specific, clinically relevant radiation dose thresholds.

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Primary motor cortex metabolite levels correlate with dexterity following spinal surgery for degenerative cervical myelopathy

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Background: Spinal cord compression from degenerative cervical myelopathy is characterized by progressive loss of hand dexterity, alongside changes in the metabolite profiles in the brain and spinal cord. Correlating the changing metabolite profile with measures of dexterity following decompression surgery may assist in identifying which patients may benefit most from surgery. **Methods:** Thirty operative myelopathy patients consented to receive spectroscopy and GRASSP-M dexterity assessments both preoperatively and 6-weeks postoperatively. Magnetic resonance spectroscopy (TE=135) was performed in the motor cortex using a 3 Tesla Siemens MRI scanner at Robarts Research Institute. Spearman correlations were used to evaluate associations between metabolite levels and dexterity ($p < 0.05$ was