Artificial Intelligence for Preoperative Planning in Neurosurgery

- Predicting critical surgical characteristics of intracranial meningiomas on MRI-A prospective study on 100 consecutive patients
- Development of an artificial intelligence-based convolutional neural network for sellar barrier classification using magnetic resonance imaging
- C2 pars interarticularis length on the side of high-riding vertebral artery with implications for pars screw insertion
- From error to prevention of wrong-level spine surgery: a review
- Artificial Intelligence-Based Radiomic Model in Craniopharyngiomas: A Systematic Review and Meta-Analysis on Diagnosis, Segmentation, and Classification
- Individual-level cortical morphological network analysis in idiopathic normal pressure hydrocephalus: diagnostic and prognostic insights
- Generating a Synthetic Lumbar CT from a Standard MRI Protocol
- Is FLAIRectomy Directly Correlated with Prolonged Survival in Glioblastoma? A Prospective National Multicenter Study on Correlation Between Extent of Tumor Resection and Clinical Outcome

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Artificial intelligence (AI) plays a crucial role in preoperative planning for neurosurgery by providing neurosurgeons with valuable insights and tools for better decision-making and patient care:

Image Analysis and Segmentation:

AI algorithms can analyze medical images, such as MRI and CT scans, to identify and segment brain structures, tumors, lesions, and critical anatomical regions. Accurate segmentation assists in visualizing and understanding the patient's anatomy, which is essential for surgical planning.

Tumor and Lesion Detection:

AI can automatically detect and classify brain tumors, lesions, and abnormalities in medical images. Detection algorithms help neurosurgeons identify the location, size, and characteristics of the pathology.

Virtual 3D Reconstruction:

AI software can create 3D reconstructions of the patient's brain based on 2D medical images. This 3D visualization provides a more detailed and intuitive representation of the brain's structure.

Surgical Simulation and Navigation:

AI-powered navigation systems offer interactive surgical planning and simulation. Surgeons can plan and practice complex procedures on virtual 3D models before the actual surgery, optimizing the surgical approach and minimizing risks.

Risk Assessment:

AI models can assess patient-specific risk factors by analyzing a range of variables, including medical history, image data, and lab results. This information helps surgeons tailor their approach and counseling for the patient.

Dose Planning for Radiation Therapy:

In cases where radiation therapy is part of the treatment plan, AI can assist in optimizing the radiation dose distribution to minimize damage to healthy brain tissue while targeting the tumor.

Data Integration:

AI systems can integrate patient data, including clinical records, imaging data, and research findings. This comprehensive data view enables neurosurgeons to make well-informed decisions based on all available information.

Treatment Recommendations:

AI can suggest treatment options and surgical strategies based on historical data and medical guidelines. These recommendations assist neurosurgeons in selecting the most appropriate approach.

Predictive Models:

AI models can predict surgical outcomes, potential complications, and postoperative patient recovery based on patient-specific factors. This information helps set realistic expectations for patients and prepares the surgical team.

Personalized Surgery Plans:

Preoperative planning is personalized to each patient's unique needs and pathology. AI ensures that surgical strategies are tailored to individual cases, optimizing the chances of success. The integration of AI in preoperative planning for neurosurgery not only enhances the precision of the surgical approach but also reduces the risks associated with the procedure. By providing neurosurgeons with advanced tools for analyzing and visualizing patient data, AI contributes to better decision-making,

improved patient outcomes, and a more efficient use of healthcare resources. However, it's essential for AI-based tools to be validated and used as complementary resources, with the ultimate clinical decisions still made by experienced healthcare professionals.
