Preoperative planning in neurosurgery

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Preoperative planning in neurosurgery refers to the process of developing a detailed plan and strategy for the execution of specific tasks or projects. It involves breaking down complex objectives into smaller, more manageable tasks and identifying the resources, timelines, and budgets needed to achieve them.

Medical history

The patient is evaluated to ensure that they are healthy enough to undergo surgery. The evaluation may include a physical exam, medical history review, blood tests, and other diagnostic tests as needed.

A history and physical examination, focusing on risk factors for cardiac, pulmonary and infectious complications, and a determination of a patient's functional capacity, are essential to any preoperative evaluation. In addition, the type of surgery influences the overall perioperative risk and the need for further cardiac evaluation. Routine laboratory studies are rarely helpful except to monitor known disease states. Patients with good functional capacity do not require preoperative cardiac stress testing in most surgical cases. Unstable angina, myocardial infarction within six weeks and aortic or peripheral vascular surgery place a patient into a high-risk category for perioperative cardiac complications. Patients with respiratory disease may benefit from perioperative use of bronchodilators or steroids. Patients at increased risk of pulmonary complications should receive instruction in deep-breathing exercises or incentive spirometry. Assessment of nutritional status should be performed. An albumin level of less than 3.2 mg per dL (32 g per L) suggests an increased risk of complications. Patients deemed at risk because of compromised nutritional status may benefit from pre- and postoperative nutritional supplementation.

Neurosurgical procedure

Surgical Justification

see Surgical Justification.

Surgical objective

Steps

Operative planning typically involves the following steps:

Defining the objective: The first step is to clearly define the goal or objective that needs to be accomplished.

Breaking down the objective: Once the objective is defined, it needs to be broken down into smaller, more manageable tasks.

Identifying resources: Resources needed to accomplish the tasks need to be identified, including personnel, equipment, materials, and finances.

Assigning tasks: Once the resources are identified, tasks need to be assigned to specific individuals or teams.

Creating timelines: Timelines need to be established for each task, including start and end dates.

Monitoring progress: Progress needs to be monitored throughout the project to ensure that it stays on track.

Adjusting plans: If necessary, plans need to be adjusted to account for changes in circumstances or unforeseen events.

Overall, operative planning is an important process that helps ensure that tasks are executed efficiently and effectively, and that objectives are achieved within the desired time frame and budget.

Instruments

Instruments.
Position

Approach

Skin incision

Postoperative complications. Postoperative care.

Virtual reality’s utility in neurosurgery and the neurosciences is widely growing, and its use is quickly becoming an integral part of the patient care, neurosurgical training, operative planning, navigation, and rehabilitation 1).

Presurgical planning allows anticipating intraoperative difficulties, increasing efficiency, and reducing surgical risks.

A plethora of cutting-edge neuroimaging analyses have been developed and published yet they have not hitherto been realized as improvements in neurosurgical outcomes. In this paper we propose a novel interface between neuroimaging and neurosurgery for aiding translational research. Our objective is to create a method for applying advanced neuroimaging and network analysis findings to neurosurgery, and illustrate its application through the presentation of two detailed case vignettes.

METHODS:

This interface comprises a combination of network visualization, 3D printing, and ex-vivo neuronavigation to enable pre-operative planning according to functional neuroanatomy. Clinical cases were selected from a prospective cohort study.

The first case vignette describes a Low-grade glioma with potential language and executive function network involvement that underwent a successful complete resection of the lesion with preservation of network features. The second case describes a Low-grade glioma in an apparently non-eloquent location that underwent a subtotal resection but demonstrated unexpected and significant impairment in executive function post-operatively that subsequently abated during follow-up. In both examples the neuroimaging and network data highlight the complexity of the surrounding functional neuroanatomy at the individual level, beyond that which can be perceived on standard structural sequences.

The described interface has widespread applications for translational research including pre-operative planning, neurosurgical training, and detailed patient counseling. A protocol for assessing its
effectiveness and safety is proposed. Finally, recommendations for effective translation of findings from neuroimaging to neurosurgery are discussed, with the aim of making clinically meaningful improvements to neurosurgical practice.

In a study, Feigl et al., used a neuronavigation system with 3D volumetric image rendering to determine the anatomical relationship between the sagittal suture and the superior sagittal sinus (SSS) in patients with intracranial lesions. Furthermore, we discussed the applicability of such system in preoperative planning, residency training, and research. The study included 30 adult patients (18 female/12 male) who underwent a cranial computed tomography (CT) scan combined with venous angiography, for preoperative planning. The position of the sagittal suture in relation to the SSS was assessed in 3D CT images using an image guidance system (IGS) with 3D volumetric image rendering. Measurements were performed along the course of the sagittal sinus at the bregma, lambda, and in the middle between these two points. The SSS deviated to the right side of the sagittal suture in 50% of cases at the bregma, and in 46.7% at the midpoint and lambda. The SSS was displaced to the left of the sagittal suture in 10% of cases at the bregma and lambda and in 13% at the midpoint. IGSs with 3D volumetric image rendering enable simultaneous visualization of bony surfaces, soft tissue and vascular structures and interactive modulation of tissue transparency. They can be used in preoperative planning and intraoperative guidance to validate external landmarks and to determine anatomical relationships. In addition, 3D IGSs can be utilized for training of surgical residents and for research in anatomy.

Operative neurosurgery has entered an exciting era of image guided surgery or neuronavigation and application of this technology is beginning to have a significant impact in many ways in a variety of intracranial procedures. In order to fully assess the advantages of image guided techniques over conventional planning and surgery in selected cases, detailed prospective evaluation has been carried out during the advanced development of an optically tracked neuronavigation system.

Depending on the location of your surgery it may be required to have preoperative testing. In some cases blood work, EKG (heart tracing), or a chest X-ray may be needed. A chest x-ray is only done if you have a lung condition or a history of cigarette smoking. If any of these tests are needed they will be scheduled for you and will be done during pre-testing when you meet with the anesthesia staff. If it has been some time since you have seen your primary care physician and you have a lot of medical problems, it would be best that you see your medical doctor before your pre-test date.

fMRI for clinical routine is a reliable and rapid method for identification of functional brain areas prior to brain surgery adjacent to functional areas. This method allows direct monitoring of the data quality and visualization without being time consuming. Knowledge about the relation of functional areas to the brain lesions improves the preoperative planning, the operation strategy and decision making with patients.

A specific program to analyze images in DICOM format OsiriX(®), permits a appropriate surgical...
The use of 3D surgical planning made it possible to perform procedures more accurately and less invasively, enabling better postoperative outcomes. All sorts of neurosurgical emergency pathologies can be treated appropriately with no waste of time. The three-dimensional processing of images in the preoperative evaluation is easy and possible even within the emergency care. It should be used as a tool to reduce the surgical trauma and it may dispense methods of navigation in many cases.

 Simulator

Changing paradigms of neurosurgical training and limited operative exposure during the residency period have made it necessary to evaluate newer technologies for training. Virtual Reality (VR) technology provides a 3-dimensional reconstruction of routine imaging, along with the ability to see as well as interact. The application of VR technology in operative planning, which is an important part of neurosurgical training, has been incompletely studied so far.

A study shows that there is an improvement in understanding surgical aspects after the use of a VR system.

Virtual reality simulator for neurosurgery

Preoperative planning for functional neurosurgery

Preoperative planning for functional neurosurgery


