# Preoperative risk stratification

- Hospital frailty risk score in predicting outcomes after simultaneous colon and liver resection for colorectal cancer liver metastasis in older adults: Evidence from the Nationwide Inpatient Sample 2015-2018
- Patient nutritional status is associated with surgical site infections in meningioma patients undergoing craniotomy for tumor resection
- The Role of Preoperative Immunonutritional Scores in Predicting Complications After Subthalamic Nucleus Deep Brain Stimulation in Parkinson's Disease
- Preoperative hemorrhagic risk stratification in pediatric moyamoya disease: a multi-institutional propensity score-matched analysis
- Temporal muscle thickness as a preoperative predictor of motor aphasia in Moyamoya disease
- Performance analysis of large language models in multi-disease detection from chest computed tomography reports: a comparative study: Experimental Research
- Predictors of temporalis muscle atrophy and head asymmetry following frontotemporal craniotomy: A retrospective analysis of clinical factors and volumetric comparison
- Changes in preoperative and postoperative blood flow parameters are closely associated with in-stent stenosis after flow diverter treatment in unruptured intracranial aneurysms: a retrospective cohort study

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## Abstract

Preoperative risk stratification is a critical process in the evaluation of patients undergoing neurosurgical procedures. The assessment aims to comprehensively evaluate a patient's overall health and specific risk factors to inform surgical decision-making, predict potential complications, and optimize patient care and outcomes. This abstract highlights the key components and considerations involved in preoperative risk stratification:

Patient History and Physical Examination: A thorough evaluation of the patient's medical history and physical condition is fundamental. This includes assessing age, medical conditions, surgical history, allergies, medications, and lifestyle factors.

Coexisting Medical Conditions: Chronic medical conditions such as diabetes, hypertension, heart disease, pulmonary disease, kidney disease, and neurological disorders are identified and evaluated for their impact on surgical risk.

Medication Review: An assessment of the patient's current medications, including prescription drugs, over-the-counter medications, and supplements, is conducted to address any potential effects on bleeding or anesthesia.

Functional Status: The patient's ability to perform daily activities, mobility, and overall functional status is evaluated to determine their readiness for surgery and postoperative recovery potential.

Laboratory and Diagnostic Tests: Blood tests, imaging studies, and other diagnostic tests are ordered to assess organ function, detect anemia, electrolyte imbalances, infections, and underlying medical issues.

Cardiovascular Risk Assessment: A thorough evaluation of cardiovascular risk factors, including heart disease history, previous surgeries, arrhythmias, and cardiac risk factors like smoking and obesity, is conducted.

Pulmonary Risk Assessment: Respiratory function is assessed, and conditions such as chronic obstructive pulmonary disease (COPD), asthma, or obstructive sleep apnea are considered due to their impact on postoperative complications.

Renal and Hepatic Function: The status of renal and hepatic function is determined, as impaired organ function can affect medication metabolism and elimination.

Nutritional Status: The patient's nutritional status is evaluated to identify malnutrition, which can increase the risk of wound healing problems and infections.

Psychosocial Assessment: Mental health, cognitive function, social support, and substance abuse history are considered, as they can influence adherence to postoperative care and recovery.

Surgical Complexity: The complexity, duration, and invasiveness of the planned surgical procedure are assessed, with high-risk surgeries requiring additional precautions.

Anesthesia Risk: Collaboration with an anesthesiologist helps evaluate the patient's suitability for anesthesia, discussing anesthesia choice, potential complications, and concerns.

Risk Stratification Tools: Validated risk stratification tools and scoring systems, such as the American Society of Anesthesiologists (ASA) Physical Status Classification System or the Revised Cardiac Risk Index (RCRI), help quantify surgical risk.

Shared Decision-Making: Engaging in shared decision-making with the patient involves discussing the potential benefits, risks, alternatives, and expected outcomes of the surgery while considering the patient's preferences and values.

Optimization and Preoperative Planning: A comprehensive plan is developed to optimize the patient's health before surgery, which may include medication adjustments, disease management, nutritional support, smoking cessation, and physical conditioning.

Multidisciplinary Approach: Involvement of a multidisciplinary team, including surgeons, anesthesiologists, nurses, and specialists, ensures a comprehensive preoperative risk assessment and planning process.

Documentation: Maintaining accurate and thorough documentation of the preoperative assessment and discussions with the patient is essential for effective risk stratification.

The preoperative risk stratification process serves as a crucial tool for guiding surgical candidacy decisions, planning perioperative care, and implementing interventions to mitigate surgical risks. It also aids in setting realistic expectations for patients and optimizing their overall health before the procedure. Additionally, preoperative radiomic and clinical models may be utilized to predict postoperative residual tumor regrowth in certain neurosurgical cases, enhancing patient care and individualized treatment decisions.

# Introduction

Preoperative risk stratification plays a pivotal role in enhancing patient outcomes and guiding clinical decision-making in various neurosurgical contexts. It involves assessing a patient's individual risk factors and medical status to predict surgical complications, optimize care plans, and determine the suitability of specific interventions. Several recent studies have shed light on the significance of preoperative risk factors and the use of innovative approaches for risk assessment in neurosurgery.

Metastatic Brain Tumor Resection: In the realm of metastatic brain tumor resection, recent research has identified specific preoperative laboratory values that independently predict adverse postoperative outcomes. Notably, hypoalbuminemia, thrombocytopenia, and anemia have emerged as robust predictors of poorer surgical outcomes. These baseline laboratory parameters may hold the potential to serve as essential components in the preoperative risk stratification of metastatic brain tumor patients, aiding clinicians in making more informed decisions about surgical candidacy and patient management.

Risk Analysis Index (RAI) for Brain Metastases Surgery: Increasingly, the Risk Analysis Index (RAI) is being recognized as a valuable tool for assessing frailty status in patients undergoing brain metastases surgery. Studies have demonstrated a significant association between RAI-measured frailty status and various adverse outcomes, including increased complication rates, extended length of stay, non-home discharge, and mortality. This highlights the potential utility of preoperative frailty assessment using the RAI in preoperative surgical planning and risk stratification to improve patient selection and outcomes.

Hypoglossal Nerve Stimulation (HNS) for Sleep Apnea: Preoperative risk stratification has extended its reach to evaluate the individual patient factors that influence the outcomes of hypoglossal nerve stimulation (HNS) therapy for sleep apnea. Notably, body mass index (BMI) has emerged as a significant independent risk factor for treatment response. Patients with higher BMI may experience reduced benefits from HNS therapy, underscoring the importance of careful patient selection to optimize treatment outcomes, particularly in those with elevated BMI.

Diffusion MRI Tractography in Neurosurgery: The integration of diffusion magnetic resonance imaging (MRI) tractography has transformed preoperative planning for various neurosurgical procedures. It enables the visualization and quantification of white matter tracts within the brain, aiding in the avoidance of permanent functional disability during surgery. By providing insights into normal white matter connectivity and structural changes, tractography supports patient risk stratification, helping neurosurgeons make more informed decisions.

Radiomics for NF-PitNETs: In the realm of neurosurgery for nonfunctioning pituitary adenomas (NF-PitNETs), innovative radiomics-clinical predictive models have been developed to identify patients at increased risk of postoperative residual tumor regrowth. These models, combining radiomic and clinical features, have the potential to facilitate individualized treatment decisions and optimize patient care.

Pre-operative Urinalysis for Neurosurgery: While preoperative urinalysis is a routine assessment in neurosurgical practice, recent research has suggested a limited role for it in predicting the risk of readmission due to Surgical Site Infection (SSI). This highlights the need for ongoing evaluation of preoperative assessment tools to enhance their relevance and effectiveness.

Comorbidity Assessment in Spinal Tumor Surgery: Comorbidity assessment, particularly using the Charlson comorbidity index, has demonstrated superior predictive capacity compared to other

assessment tools in the context of spinal tumor surgery. These assessments are instrumental in preoperative risk stratification for patients in this high-risk surgical group, ultimately contributing to improved patient outcomes.

Collectively, these recent developments underscore the evolving landscape of preoperative risk stratification in neurosurgery, emphasizing the importance of tailored approaches and innovative tools to enhance patient care and surgical decision-making.

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Several pre-operative lab values independently predicted worse outcomes for metastatic brain tumor resection patients. Hypoalbuminemia, thrombocytopenia, and anemia had the strongest association with the study's adverse postoperative outcomes. These baseline lab values may be considered for preoperative risk stratification of metastatic brain tumor patients [1)]

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Increasing Risk Analysis Index (RAI)-measured frailty status is significantly associated with increased complication rates, extended length of stay (eLOS), non-home discharge (NHD), and mortality following brain metastases surgery . Preoperative frailty assessment using the RAI may aid in preoperative surgical planning and risk stratification for patient selection [2)].

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To improve preoperative risk stratification, a study analyzed individual patient factors that affect outcomes of hypoglossal nerve stimulation (HNS).

Fourteen patients treated with unilateral HNS (Inspire Medical Systems, Inc, Maple Grove, Minnesota) were analyzed retrospectively. Assessed risk factors included: hypertension, diabetes mellitus, depression, smoking, alcohol consumption, body mass index (BMI), and disease duration. Treatment success was defined as a reduction in the postoperative apnea-hypopnea index (AHI) to ≤ 20 events/h, with a relative reduction of at least 50% compared to baseline.

A significant reduction in the AHIpost was observed in all patients ($p<0.0001$). BMI correlated significantly with postoperative AHI scores (95% CI 0.1519 to 0.8974;$p=0.018$). Significant treatment success was observed in 50% of patients. Compared with the “Excellent Responder group”, the “Responder group” demonstrated a significantly higher BMI (95% CI 1.174 to 6.226; $p=0.0078$). Diabetes, hypertension, disease duration, smoking, depression, and alcohol consumption were not significantly associated with AHI reduction.

The findings suggest that BMI may be an independent risk factor for the response to hypoglossal nerve stimulation, with patients who had less benefit from therapy having significantly higher BMI than “Excellent Responders”. Therefore, carefully selecting patients is crucial in obtaining optimal outcomes with HNS therapy, especially those with a high BMI [3)].

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Diffusion magnetic resonance imaging tractography is a noninvasive technique that enables the visualization and quantification of white matter tracts within the brain. It is extensively used in preoperative planning for brain tumors, epilepsy, and functional neurosurgical procedures such as deep brain stimulation. Over the past 25 years, significant advancements have been made in imaging

acquisition, fiber direction estimation, and tracking methods, resulting in considerable improvements in tractography accuracy. The technique enables the mapping of functionally critical pathways around surgical sites to avoid permanent functional disability. When the limitations are adequately acknowledged and considered, tractography can serve as a valuable tool to safeguard critical white matter tracts and provide insight regarding changes in normal white matter and structural connectivity of the whole brain beyond local lesions. In functional neurosurgical procedures such as deep brain stimulation, it plays a significant role in optimizing stimulation sites and parameters to maximize therapeutic efficacy and can be used as a direct target for therapy. These insights can aid in patient risk stratification and prognosis [4].

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retrospectively enrolled 114 patients diagnosed as NF-PitNET with postoperative residual tumors after the first operation, and the diameter of the tumors was greater than 10 mm. Univariate and multivariate analyses were conducted to identify independent clinical risk factors. We identified the optimal sequence to generate an appropriate radiomic score (Rscore) that combined pre- and postoperative radiomic features. Three models were established by logistic regression analysis that combined clinical risk factors and radiomic features (Model 1), single clinical risk factors (Model 2) and single radiomic features (Model 3). The models' predictive performances were evaluated using receiver operator characteristic (ROC) curve analysis and area under curve (AUC) values. A nomogram was developed and evaluated using decision curve analysis. Results: Knosp classification and preoperative tumor volume doubling time (TVDT) were high-risk factors ($p < 0.05$) with odds ratios (ORs) of 2.255 and 0.173. T1WI&T1CE had a higher AUC value (0.954) and generated an Rscore. Ultimately, the AUC of Model 1 {0.929 [95% Confidence interval (CI), 0.865-0.993]} was superior to Model 2 [0.811 (95% CI, 0.704-0.918)] and Model 3 [0.844 (95% CI, 0.748-0.941)] in the training set, which were 0.882 (95% CI, 0.735-1.000), 0.834 (95% CI, 0.676-0.992) and 0.763 (95% CI, 0.569-0.958) in the test set, respectively. Conclusions: We trained a novel radiomics-clinical predictive model for identifying patients with NF-PitNETs at increased risk of postoperative residual tumor regrowth. This model may help optimize individualized and stratified clinical treatment decisions [5].

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The risk of readmission due to Surgical Site Infection was very low across a study cohort, suggesting a limited role of pre-operative urinalysis for elective neurosurgical procedures [6]

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The Charlson comorbidity index demonstrated superior predictive capacity compared to Modified frailty index and ASA scores and may be valuable as a preoperative risk assessment tool for patients undergoing spinal tumor surgery. The validation of assessment scores is important for preoperative risk stratification and improving outcomes in this high-risk group [7].

# Multiple Choice Test on Preoperative Risk Stratification in Neurosurgery

What is the primary goal of preoperative risk stratification in neurosurgery?

a. To select the most cost-effective surgical procedures b. To minimize the patient's preoperative anxiety c. To assess the surgeon's skills and experience d. To evaluate a patient's overall health and

specific risk factors before surgery

Which of the following is NOT a component of preoperative risk stratification?

a. Medication Review b. Dental Examination c. Cardiovascular Risk Assessment d. Laboratory and Diagnostic Tests

In the context of metastatic brain tumor resection, which lab values are identified as predictors of adverse postoperative outcomes?

a. High creatinine levels b. Elevated white blood cell count c. Hypoalbuminemia, thrombocytopenia, and anemia d. Low blood glucose levels

What is the Risk Analysis Index (RAI) used for in neurosurgery?

a. Assessing patient's musical abilities b. Evaluating the risk of postoperative infection c. Measuring frailty status in brain metastases surgery d. Calculating the cost of neurosurgical procedures

In the study on hypoglossal nerve stimulation (HNS) for sleep apnea, what was identified as an independent risk factor for treatment response?

a. Hypertension b. Smoking c. Depression d. Body mass index (BMI)

How does diffusion magnetic resonance imaging tractography contribute to preoperative planning in neurosurgery?

a. It provides real-time surgical guidance during the procedure. b. It quantifies the number of surgical instruments required. c. It enables visualization of white matter tracts and helps avoid functional damage. d. It measures blood flow within the brain.

What is the purpose of developing radiomics-clinical predictive models in neurosurgery?

a. To predict the winning lottery numbers b. To identify patients at risk of postoperative tumor regrowth c. To determine the best time for postoperative vacations d. To recommend postoperative dietary plans

What did recent research suggest about pre-operative urinalysis in elective neurosurgical procedures?

a. It is a highly reliable predictor of surgical success. b. It is crucial for assessing cognitive function. c. Its role in predicting Surgical Site Infection (SSI) risk is limited. d. It can replace the need for preoperative physical examinations.

Which assessment tool demonstrated superior predictive capacity compared to others in the context of spinal tumor surgery?

a. Modified frailty index b. ASA scores c. Charlson comorbidity index d. Surgical complexity index

In preoperative risk stratification, what role does shared decision-making play?

a. It determines the patient's eligibility for surgery. b. It evaluates the surgeon's expertise. c. It involves discussing surgical benefits and risks with the patient. d. It measures the patient's BMI.

Answers:

d. To evaluate a patient's overall health and specific risk factors before surgery b. Dental Examination c. Hypoalbuminemia, thrombocytopenia, and anemia c. Measuring frailty status in brain metastases surgery d. Body mass index (BMI) c. It enables visualization of white matter tracts and helps avoid functional damage. b. To identify patients at risk of postoperative tumor regrowth c. Its role in predicting Surgical Site Infection (SSI) risk is limited. c. Charlson comorbidity index c. It involves discussing surgical benefits and risks with the patient.

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