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A Review on the Effects of Multiple Nutritional Scores on Wound Healing after Neurosurgery.

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Abstract: Neurosurgery is characterized by high complexity and risk, with postoperative wound healing being a critical factor in surgical success. Wound healing encompasses not only local tissue repair processes but is also influenced by systemic nutritional status. Consequently, both preoperative and postoperative nutritional assessment and support are essential for enhancing recovery and minimizing complications. Malnutrition or overnutrition can negatively impact postoperative wound healing. By utilizing appropriate nutritional scoring tools, healthcare providers can identify potential nutritional risks following surgery and implement corresponding interventions to optimize the recovery process and decrease the likelihood of complications. This review aims to investigate the application and correlation of various nutritional scores in relation to wound healing after neurosurgery. Through a comprehensive review and analysis, the impact of these scores on postoperative wound healing will be evaluated, providing a scientific foundation for clinical practice. The study on postoperative wound healing in neurosurgery is included, and the relationship between different nutritional scores is thoroughly assessed through review analysis to predict their effects on postoperative healing. Future research should further examine the effectiveness of different nutritional scoring tools in specific neurosurgical contexts and integrate individualized nutrition support strategies to offer patients more precise postoperative care plans.

Keywords: Nutrition Score; Wound Healing; Postoperative Recovery; Neurosurgery Patients.

1. Introduction

Neurosurgery is characterized by high complexity and significant risks, as it often involves critical neural structures such as the brain and spinal cord. These operations are challenging and can greatly impact the patient's physiological functions. Effective postoperative wound healing is a crucial factor in the success of such surgeries. Wound healing encompasses not only local tissue repair processes but is also influenced by the patient's systemic nutritional status. Consequently, both preoperative and postoperative nutritional assessment and support are vital for enhancing postoperative recovery and minimizing complications[1].Malnutrition and overnutrition can adversely affect postoperative wound healing. Utilizing appropriate nutritional scoring tools can help predict potential nutritional risks for patients following surgery, enabling the implementation of targeted intervention measures to optimize the postoperative recovery process and decrease the incidence of complications[2].

A good nutritional state is fundamental for body repair and rehabilitation, significantly influencing postoperative wound healing in patients undergoing neurosurgery. Nutritional scores provide an objective analysis of patients' nutritional status. These scores primarily encompass nutritional score tables, anthropometric indicators, and biochemical and laboratory measurements. A comprehensive review of the literature reveals several commonly used nutritional score tables, including NRS2002 (Nutritional Risk Screening 2002), MUST (Malnutrition Universal Screening Tool), SGA (Subjective Global Assessment), MNA (Mini Nutritional Assessment), GNRI (Geriatric Nutritional Risk Index), and mNUTRIC (Modified Nutrition Risk in Critically Ill).

2. Common Nutritional Scoring Methods.

2.1. NRS2002

The NRS2002 nutrition score is an effective tool for assessing nutritional risks in patients with neurosurgery and is closely related to postoperative wound healing. Including nutritional status impairment score, disease severity score and age score, patients with high NRS2002 score (≥3 points) have significantly increased the risk of postoperative wound infection and delayed healing. Nutritional risk screening for hospitalized patients, taking into account changes in nutritional status and the severity of the disease, is recommended by multiple guidelines. A study described a patient with steroid skin injury who eventually healed well by evaluating the patient's nutritional risk using NRS2002 and taking personalized nutritional support measures (such as high-protein nutritional powder supplementation, caloric control, etc.)[3]. Sabine A. Eming explores the molecular mechanisms of wound healing, including key processes such as inflammation, angiogenesis, matrix deposition and cell recruitment. Studies have pointed out that poor wound healing is often associated with underlying diseases (such as diabetes, vascular disease, or aging), and patients with higher NRS2002 scores may exacerbate these pathological processes due to malnutrition. Therefore, early identification and improvement of patients' nutritional status is to improve Important means of wound healing quality[4].Another study from northern China compared the effects of NRS2002 and MNA-SF in elderly surgical patients. The results showed that NRS2002 scores were significantly correlated with poor wound healing, while MNA-SF (short- There was no significant correlation with the form Mini Nutritional Assessment score. NRS2002 has higher sensitivity in

assessing nutritional risk in elderly patients with surgery, especially in predicting poor wound healing[5].

In short, early screening and intervention with NRS2002 can effectively reduce the risk of postoperative complications in neurosurgery. The application of NRS2002 in neurosurgery wound care can effectively identify high-risk patients and use targeted nutritional interventions to Promote wound healing. In addition, standardized management of wound care pathways is crucial to reduce infection risk and accelerate the healing process. Therefore, preoperative nutritional screening with NRS2002, combined with nutritional intervention, can significantly improve postoperative wound healing and overall Prognosis.

2.2. MUST

The MUST score mainly includes three aspects: 1) Calculate BMI through height and weight to assess whether the body weight is too low (<18.5 kg/m²). 2) Evaluate the weight loss over the past 3-6 months; the higher the proportion of weight loss, the greater the risk. 3) If a patient has been unable to eat normally due to acute illness for at least 5 days, the risk increases. Nutritional screening is the first step that all healthcare professionals can perform to identify patients who may be at nutritional risk or potential risk and may benefit from appropriate nutritional interventions led by registered dietitians. This screening considers factors such as BMI, weight loss, and reduced food intake due to illness. Guidelines indicate that malnutrition is one of the important factors contributing to delayed healing of chronic wounds. Through nutritional screening and assessment, high-risk patients can be identified, and targeted nutritional interventions can be implemented. The guidelines also mention that nutritional support not only helps accelerate wound healing but also reduces the risk of postoperative complications[6].Energy and protein are the basis of wound healing, and lack can lead to delayed healing[7].Vitamins (such as vitamins C and D), minerals (such as zinc), and fatty acids are essential for wound healing[8].Using scientific nutritional assessment tools (such as the MUST scale), it is possible to identify patients' nutritional risks and develop personalized nutritional intervention plans. Implementing nutritional interventions in the early stages of wound healing can significantly enhance the healing process and reduce the occurrence of complications.

These studies provide important guidance for clinicians, helping them to better manage the wound healing process in neurosurgical patients, thereby improving their quality of life and prognosis.

2.3. SGA

SGA as a widely used clinical tool for evaluating nutritional status based on medical history and physical examination[9].Developed by Canadian researchers Detsky et al. in 1987, SGA is characterized by its simplicity and ease of use, making it particularly suitable for hospitalized patients or resource-limited settings. The assessment includes evaluating weight changes, dietary intake alterations, metabolic stress, functional capacity, and physical examination findings such as muscle wasting, edema, and subcutaneous fat thickness. Based on these factors, patients are categorized into three nutritional grades: A (well-nourished), B (mild to moderate malnutrition), and C (severely malnourished)[10].

The SGA scoring system integrates patient-reported symptoms with objective physical findings to provide a comprehensive nutritional evaluation. For instance, a weight loss exceeding 10% often indicates severe malnutrition. A study conducted at the Malabar Cancer Centre in India involved 237 head and neck cancer patients undergoing surgery. Using SGA, 65.8% of patients were classified as well-nourished (Grade A), 32% as moderately malnourished (Grade B), and 2.5% as severely malnourished (Grade C). This classification showed moderate agreement with the Preoperative Nutrition Score (PNS), with a Kappa coefficient of 0.54. The study highlighted SGA's utility in identifying nutritional risks early and facilitating appropriate interventions during perioperative care[11].

SGA's advantages include its simplicity, broad applicability, and reliance on readily available information without the need for complex equipment or laboratory tests. Initially designed for surgical patients, it has since been adapted for use in various conditions, including cancer, liver cirrhosis, and chronic obstructive pulmonary disease [12]. SGA can predict the postoperative recovery and complication risk of patients to a certain extent. However, it also has limitations, mainly reflected in its strong subjectivity. Since SGA relies on the subjective judgment of doctors, it may be influenced by the experience or biases of the evaluators, leading to inconsistent results. Secondly, its sensitivity is relatively low; SGA has limited detection ability for early or mild malnutrition, which may underestimate the nutritional status of patients. Lastly, it lacks objective indicators, as SGA does not include biochemical tests and physical measurements, so it may not fully reflect the nutritional status of patients in certain situations.

Despite these challenges, SGA remains a valuable tool in clinical practice, especially in settings with limited resources. Its ability to predict postoperative recovery and complications further underscores its importance. By combining SGA with other objective indicators or modified tools like PG-SGA or RFH-GA, the accuracy and reliability of nutritional assessments can be enhanced.

2.4. MNA

MNA is a rapid and non-invasive assessment tool suitable for the elderly population, particularly valuable in hospitalized patients. The short form of MNA-SF maintains high accuracy while reducing the number of items, making it an important tool for clinical screening of malnutrition. It quickly evaluates a patient's nutritional status through fewer items, such as physical activity, mental state, diet, and weight, with a scoring range and corresponding nutritional status classification[13].Some literature discusses the application of MNA in chronic wound care, indicating that assessing a patient's nutritional status with MNA can improve wound healing outcomes. Studies show that good nutritional status helps accelerate the wound healing process, and MNA plays a significant role in managing chronic wounds. By identifying malnutrition risks early and taking intervention measures, it can significantly improve patient healing outcomes[14].

2.5. GNRI

GNRI) is a simple tool based on height, weight, and serum albumin levels that is used to assess the nutritional status of elderly patients. In patients with traumatic brain injury (TBI), the predictive value of GNRI is higher than that of assessments based solely on serum albumin levels. The GNRI is a simple and effective tool that can be used to evaluate the

nutritional status of elderly patients and its impact on postoperative complications and prognosis. A study explored the application of the Global Nutritional Risk Index (GNRI) in elderly patients with traumatic brain injury, particularly focusing on patients in high-risk and low-risk GNRI groups. In patients with TBI, the predictive value of GNRI is higher than that of assessments based solely on serum albumin levels. GNRI is closely related to patient mortality, complications, and overall prognosis, especially in the high-risk group, where lower GNRI values are associated with higher mortality rates. The cut-off values for GNRI are defined as follows: GNRI <82 indicates high risk, GNRI 82 to 92 indicates moderate risk, and GNRI >98 indicates low risk[15]. In terms of postoperative complications and tumor metastasis, patients in the low GNRI group have poorer outcomes, suggesting that malnutrition may suppress the immune system and increase the risk of postoperative complications and tumor metastasis. As a simple, low-cost, and effective tool, GNRI helps identify high-risk patients early and allows for timely interventions[16].Multivariate analysis shows that low GNRI is an independent poor prognostic factor, indicating that preoperative nutritional status has an important impact on postoperative recovery[17].

In terms of neurosurgical wound healing, good nutritional status can promote wound healing, while malnutrition may lead to delayed healing or even increased complications. Therefore, in neurosurgical procedures, evaluating patients' nutritional risk through GNRI and implementing targeted nutritional intervention measures are crucial for improving postoperative recovery and reducing the risk of complications.

2.6. mNUTRIC

Nutrition scoring plays a crucial role in postoperative wound healing. For example, the Nutritional Risk in the Critically Ill (NUTRIC) score is used to assess the nutritional status of patients after neurosurgery and is closely related to their prognosis. Studies have shown that patients with higher NUTRIC scores tend to have lower levels of serum albumin, prealbumin, and transferrin after surgery, as well as longer hospital stays and higher mortality rates. Therefore, evaluating a patient's nutritional status through nutrition scoring systems (such as NUTRIC or mNUTRIC) can provide a basis for formulating personalized nutritional support plans [18].Adequate nutritional support can significantly improve postoperative wound healing. For instance, in one study, patients who received specific nutritional support measures had lower scores for postoperative wound redness and swelling compared to the control group, and their anxiety levels were also significantly reduced[19].Additionally, appropriate nutritional supplementation (such as proteins, amino acids, vitamins, and minerals) can promote collagen synthesis and immune function during the wound healing process [20].Malnutrition can delay wound healing, increase the risk of infection, and lead to the occurrence of chronic wounds [21, 22]. For example, a low-protein diet may affect immune function and collagen synthesis, thereby slowing down wound healing. Therefore, identifying and correcting malnutrition is crucial in postoperative care[23].

Although existing studies have demonstrated the impact of nutrition scoring and nutritional support on postoperative wound healing, further research is needed to explore how to combine multiple nutrition scoring tools to more accurately predict the risk of postoperative complications and develop corresponding nutritional intervention strategies.

2.7. Biochemical and Laboratory Tests

Biochemical and laboratory test indicators (such as serum albumin) are important tools for assessing the nutritional status during the wound healing process in neurosurgery. In patients undergoing neurosurgery, monitoring serum albumin levels can effectively predict wound healing outcomes. Studies have shown that serum albumin levels within the range of 3.5-5.5 g/dL indicate good wound healing conditions. Additionally, serum albumin levels are significantly positively correlated with wound healing time, suggesting their important role in promoting tissue repair and accelerating wound healing[24]. These indicators can help doctors evaluate the patient's protein metabolism status, degree of inflammation, and immune function levels, thereby formulating personalized nutritional intervention plans [25]. However, it is important to note that a single indicator may have limitations and should be analyzed comprehensively in conjunction with the patient's specific situation.

3. Conclusion and Discussion

3.1. The Importance of Nutritional Status for Postoperative Recovery

Good nutritional status is the foundation of body repair and recovery, promoting wound healing, reducing the risk of infection, shortening hospital stays, and improving patients' quality of life. Studies have shown that malnutrition significantly increases the incidence of postoperative complications, including infections, delayed healing, prolonged hospital stays, and mortality rates[26, 27]. For example, the incidence of postoperative infectious complications in malnourished patients can reach up to 18.2%, while it is only 5.3% in well-nourished patients [26]. Additionally, nutritional support can optimize postoperative recovery by improving immune function, promoting cellular homeostasis, and tissue repair[28].

3.2. Application of Nutritional Assessment Tools

To accurately assess patients' nutritional status, commonly used nutritional scoring tools in clinical practice include NRS2002, MUST, SGA, and MNA[27]. These tools help doctors identify high-risk patients and take timely targeted interventions. For instance, preoperative nutritional support for patients with a NRS2002 score ≥5 for seven days before surgery can significantly reduce the incidence of postoperative complications[29]. Moreover, muscle mass assessment is considered an even more important nutritional evaluation indicator in neurosurgical intensive care patients[30, 31].

3.3. Timing and Methods of Nutritional Support

Early postoperative nutritional support is considered an important strategy for optimizing recovery. Studies have shown that initiating enteral or parenteral nutrition within 48 hours after surgery can reduce hypermetabolic responses, lower the risk of infection, and promote wound healing[32]. For patients who cannot eat independently, nasogastric feeding or total parenteral nutrition support are common choices. Additionally, supplementing specific nutrients (such as ω-3 fatty acids, amino acids, and vitamins) has been proven to have a positive effect on postoperative

recovery[33].

3.4. Risks of Malnutrition and Overnutrition

Both malnutrition and overnutrition can adversely affect postoperative recovery. For example, excessive caloric intake may lead to obesity and metabolic disorders, while malnutrition weakens immune function and increases the risk of infection[34]. Therefore, individualized nutritional plans are crucial and should be tailored based on factors such as patients' age, gender, type of surgery, and postoperative recovery status.

3.5. Importance of Nutritional Education

Postoperative nutritional education is significant for patients and their families to understand dietary needs and maintain a balanced diet. Through education, patients can better comply with treatment plans and maintain good nutritional status during postoperative life. Additionally, medical teams should regularly monitor patients' nutritional indicators and adjust nutritional support plans as needed[35].

3.6. Future Research Directions

Although various nutritional assessment tools and interventions are currently available, specific studies on neurosurgical patients still require further exploration. For example, how to more accurately predict and manage nutritional risks during the perioperative period, and how to optimize nutritional support plans by integrating modern technologies (such as artificial intelligence and big data analysis), are important directions for future research [36].

The postoperative recovery of neurosurgical patients is closely related to their nutritional status. Comprehensive preoperative and postoperative nutritional assessments and support can significantly improve recovery outcomes, reduce complication rates, and enhance quality of life. Future research should further explore the implementation methods of individualized nutritional plans and optimize patients' nutritional management strategies using modern technological means.

References

[1] Zhu, C., et al., The effect of dexmedetomidine on postoperative wound healing in neurosurgical patients: A meta-analysis. Int Wound J, 2024. 21(4): p. e14585.

[2] Nithya, D.J., Effect of Nutritional Status and Anemia in the Wound Healing Process of Post Cesarean Section Patients. ″International Journal of Health Sciences″, 2023.

[3] Yaping, S., et al., Nursing Care of Skin Damage of Elbow Gottron's Disease in a Case of Amyopathic Dermatomyositis Based on Multidisciplinary Cooperation. Fortune Journal of Rheumatology, 2019. 01(02).

[4] Eming, S.A., P. Martin and M. Tomic-Canic, Wound repair and regeneration: mechanisms, signaling, and translation. Sci Transl Med, 2014. 6(265): p. 265sr6.

[5] Zhou, J., et al., Comparison of two nutrition assessment tools in surgical elderly inpatients in Northern China. Nutr J, 2015. 14: p. 68.

[6] Wynne, M., HSE National Wound Management Guidelines 2018. CSPD004/2018 ed. 2018.

[7] Demling, R.H., Nutrition, anabolism, and the wound healing process: an overview. Eplasty, 2009. 9: p. e9.

[8] Feighery, C.F. and R. McManus, Symposium on 'The challenge of translating nutrition research into public health nutrition'. Session 3: Joint Nutrition Society and Irish Nutrition and Dietetic Institute Symposium on 'Nutrition and autoimmune disease'. Recent advances in genetic understanding of coeliac disease. Proc Nutr Soc, 2009. 68(2): p. 122-6.

[9] Jensen, G.L., Global Leadership Conversation: Addressing Malnutrition. JPEN J Parenter Enteral Nutr, 2016. 40(4): p. 455-7.

[10] Steiber, A.L., et al., Subjective Global Assessment in chronic kidney disease: a review. J Ren Nutr, 2004. 14(4): p. 191-200.

[11] Talwar, B., et al., Nutritional management in head and neck cancer: United Kingdom National Multidisciplinary Guidelines. J Laryngol Otol, 2016. 130(S2): p. S32-S40.

[12] Guimaraes, S.M., et al., Nutrition in acute renal failure. Sao Paulo Med J, 2005. 123(3): p. 143-7.

[13] Guigoz, Y., The Mini Nutritional Assessment (MNA) review of the literature--What does it tell us? J Nutr Health Aging, 2006. 10(6): p. 466-85; discussion 485-7.

[14] Serena, T.E., Nutrition in patients with chronic non-healing ulcers: a paradigm shift in wound care. Chronic Wound Care Management and Research, 2018. 5-9(5).

[15] Su, W.T., et al., Geriatric Nutritional Risk Index as a Prognostic Factor for Mortality in Elderly Patients with Moderate to Severe Traumatic Brain Injuries. Risk Manag Healthc Policy, 2021. 14: p. 2465-2474.

[16] Tang, S., et al., The Value of Geriatric Nutritional Risk Index in Evaluating Postoperative Complication Risk and Long-Term Prognosis in Elderly Colorectal Cancer Patients. Cancer Manag Res, 2020. 12: p. 165-175.

[17] Hayama, T., The preoperative geriatric nutritional risk index (GNRI) is an independent prognostic factor in elderly patients underwent curative resection for colorectal cancer. Scientific Reports, 2022.

[18] The mNUTRIC score has a significant effect on... Prognostic value of severe patients _ Fan Feiyang.

[19] Chu, Y., et al., Role of nutritional support in nursing practice for improving surgical site wound healing in patients post-surgery with risk of pressure ulcers. Int Wound J, 2024. 21(4): p. e14855.

[20] Quain, A.M. and N.M. Khardori, Nutrition in Wound Care Management: A Comprehensive Overview. Wounds, 2015. 27(12): p. 327-35.

[21] Stechmiller, J.K., Understanding the role of nutrition and wound healing. Nutr Clin Pract, 2010. 25(1): p. 61-8.

[22] Todorovic, V., Food and wounds: nutritional factors in wound formation and healing. Br J Community Nurs, 2002: p. 43-4, 46, 48 passim.

[23] Barchitta, M., et al., Nutrition and Wound Healing: An Overview Focusing on the Beneficial Effects of Curcumin. Int J Mol Sci, 2019. 20(5).

[24] Sugiartanti, M.F., Pengaruh Kadar Albumin Serum terhadap Penyembuhan Luka pada Pasien Pascaoperasi Laparotomi dan Lumbotomi di RSD dr. Soebandi Jember. e-Jurnal Pustaka Kesehatan, 2018. 3(6).

[25] Prieto, M.B. and J.L. Cid, Malnutrition in the critically ill child: the importance of enteral nutrition. Int J Environ Res Public Health, 2011. 8(11): p. 4353-66.

[26] Dagnelie, P.C., P.C. Willems and N.R. Jorgensen, Nutritional status as independent prognostic factor of outcome and mortality until five years after hip fracture: a comprehensive prospective study. Osteoporos Int, 2024. 35(7): p. 1273-1287.

[27] Arsava, E.M., Nutritional Approach and Treatment in Patients with Stroke, An Expert Opinion for Turkey. 2018. 226-242(24).

[28] Poblete, R.A., et al., Optimization of Nutrition after Brain Injury: Mechanistic and Therapeutic Considerations. Biomedicines, 2023. 11(9).

[29] Xu, J.Y., et al., Preoperative Nutrition Support May Reduce the Prevalence of Postoperative Pancreatic Fistula after Open Pancreaticoduodenectomy in Patients with High Nutritional Risk Determined by NRS2002. Biomed Res Int, 2021. 2021: p. 6691966.

[30] Bae, E., Comparative assessment of nutritional characteristics of critically ill patients at admission and discharge from the neurosurgical intensive care unit in Korea: a comparison study. Annals of Clinical Nutrition and Metabolism, 2023. 97(15): p. 108.

[31] Vigneron, C., et al., Assessment of Functional and Nutritional Status and Skeletal Muscle Mass for the Prognosis of Critically Ill Solid Cancer Patients. Cancers (Basel), 2022. 14(23).

[32] Giridhar, V.U., Role of nutrition in oral and maxillofacial surgery patients. 2016.

[33] Bao, L., et al., The impact of early nutritional support on postoperative wound healing in patients with complex fractures: A meta-analysis review. Int Wound J, 2024. 21(3): p. e14782.

[34] Dionyssiotis, Y., Nutritional Alterations Associated with Neurological Neurosurgical Diseases. The Open Neurology Journal, 2016. 32(10): p. 41.

[35] Ryu, K.W., et al., Long-term effect of simplified dietary education on the nutritional status of patients after a gastrectomy. PLoS One, 2021. 16(5): p. e0252168.

[36] Jiang, S., R. Wang and H. Zhang, Integrated Learning Model-Based Assessment of Enteral Nutrition Support in Neurosurgical Intensive Care Patients. Biomed Res Int, 2022. 2022: p. 4061043.3.