Impact of Preoperative Nutritional Status on Surgical Outcomes in Major Abdominal Surgeries: A Prospective Cohort Study

Dr. Amit Kumar Tiwari[1], Dr. Yasaswi Vanga[2]

1. *Associate Professor, Department of General Surgery, Saraswati Medical College, Unnao, UP, India*
2. *Labeling Analyst, Bachelor of Dental Surgery, India, MHA,USA (Masters of healthcare administration)*

***Corresponding Author:Dr. Amit Kumar Tiwari,**

Associate Professor, Department of General Surgery,Saraswati Medical College, Unnao, UP, India

ABSTRACT

Background: Malnutrition significantly impacts surgical outcomes, yet comprehensive evaluation of multiple nutritional parameters in major abdominal surgery remains limited. This study investigated the relationship between preoperative nutritional status and postoperative complications using multiple assessment tools and markers.

Methods: In this prospective cohort study, 360 patients scheduled for major abdominal surgery underwent comprehensive nutritional assessment using Nutritional Risk Screening 2002 (NRS-2002), Subjective Global Assessment (SGA), anthropometric measurements, and biochemical markers. Primary outcomes included 30-day postoperative complications classified by Clavien-Dindo system. Secondary outcomes encompassed length of hospital stay, readmission rates, and wound complications.

Results: Among the study population, 39.4% were at nutritional risk (NRS-2002 $\geq$3), with SGA identifying 30.0% as moderately malnourished and 15.0% as severely malnourished. The overall complication rate was 28.6%. Severely malnourished patients experienced significantly higher complication rates (48.1%) compared to moderately malnourished (36.1%) and well-nourished patients (19.2%) ($p<0.001$). Multivariate analysis identified serum albumin <3.5 g/dL (OR 2.8, 95% CI 1.6-4.9), NRS-2002 score $\geq$3 (OR 2.4, 95% CI 1.4-4.1), and SGA grade C (OR 3.2, 95% CI 1.8-5.7) as independent predictors of complications.

Conclusions: Preoperative malnutrition strongly predicts adverse outcomes in major abdominal surgery. The integration of multiple nutritional assessment methods provides superior risk stratification. These findings support implementing comprehensive nutritional evaluation in preoperative protocols and developing targeted interventional strategies for at-risk patients.

Keywords: Nutritional status, Major abdominal surgery, Postoperative complications, Nutritional assessment, Surgical outcomes

INTRODUCTION

The nutritional status of surgical patients has emerged as a critical determinant of postoperative outcomes, particularly in major abdominal surgeries where metabolic demands are substantially elevated [1]. Malnutrition, affecting an estimated 30-50% of hospitalized patients worldwide, poses significant challenges in the perioperative period [2]. Despite advances in surgical techniques and perioperative care, preoperative malnutrition continues to be associated with increased morbidity, mortality, and healthcare costs [3].

Major abdominal surgeries trigger a complex stress response characterized by heightened catabolism and altered immune function, making adequate nutritional reserves crucial for recovery [4]. Patients with compromised nutritional status often experience prolonged hospital stays, increased infection rates, delayed wound healing, and higher readmission rates [5]. The economic burden associated with these complications has been estimated at $10.2 billion annually in developed nations [6].

Screening and assessment of nutritional status have traditionally relied on various parameters including serum albumin levels, body mass index, recent weight loss, and validated screening tools such as the Nutritional Risk Screening 2002 (NRS-2002) and Subjective Global Assessment (SGA) [7]. However, there remains considerable debate regarding the optimal timing and methods for nutritional assessment, as well as the most effective interventional strategies [8].

Previous studies have demonstrated correlations between specific nutritional markers and surgical outcomes, yet most have been retrospective or limited by small sample sizes [9]. Furthermore, the relative impact of different components of nutritional status on various surgical complications remains incompletely understood [10]. This knowledge gap is particularly relevant given the increasing complexity of surgical procedures and the aging surgical population [11].

Our prospective cohort study aims to comprehensively evaluate the relationship between preoperative nutritional parameters and postoperative outcomes in patients undergoing major abdominal surgeries. By identifying key nutritional determinants of surgical success, we seek to establish evidence-based guidelines for preoperative nutritional optimization and risk stratification.

MATERIALS AND METHODS

Study Design and Setting

This prospective cohort study was conducted at a tertiary care academic medical center, from July 2023- June 2024. The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants [12].

Study Population

Consecutive adult patients (≥18 years) scheduled for elective major abdominal surgery were screened for eligibility. Major abdominal surgery was defined as any procedure requiring laparotomy or laparoscopic approach with an expected duration exceeding 2 hours [13]. We excluded patients requiring emergency surgery, those with active infections, and patients unable to complete nutritional assessments due to cognitive impairment. Sample size was calculated using [statistical software] based on previous studies, assuming a 30% prevalence of malnutrition and targeting a power of 80% with an alpha error of 0.05 [14].

Nutritional Assessment

Preoperative nutritional status was evaluated within 2 weeks before surgery using multiple validated tools and parameters [15]:

Anthropometric Measurements: Trained nutritionists recorded height, weight, body mass index (BMI), mid-upper arm circumference (MUAC), and triceps skinfold thickness (TSF) using standardized techniques [16].

Laboratory Parameters: Blood samples were collected after overnight fasting for analysis of serum albumin, prealbumin, transferrin, total lymphocyte count, and C-reactive protein. All analyses were performed in an accredited laboratory following standardized protocols [17].

Nutritional Screening Tools: Two validated screening tools were administered:

- Nutritional Risk Screening 2002 (NRS-2002): Patients scoring ≥3 were classified as at nutritional risk [18].
- Subjective Global Assessment (SGA): Patients were categorized as well-nourished (A), moderately malnourished (B), or severely malnourished (C) [19].

Dietary Assessment: A detailed 7-day food recall was conducted by trained dietitians using standardized questionnaires to estimate daily caloric and protein intake [20].

Surgical Procedure and Perioperative Care

All surgeries were performed by board-certified surgeons following standardized protocols. Perioperative care was standardized according to enhanced recovery after surgery (ERAS) guidelines where applicable [21]. Details of surgical procedures, operative time, blood loss, and intraoperative complications were recorded using a structured data collection form.

Outcome Assessment

Primary Outcome: The primary outcome was the occurrence of postoperative complications within 30 days of surgery, classified according to the Clavien-Dindo classification system [22].

Secondary Outcomes included:

- Length of hospital stay
- 30-day readmission rate
- Time to return of bowel function
- Wound healing complications
- Need for reoperation
- 30-day mortality

All outcomes were assessed by trained research staff blinded to the nutritional assessment results [23].

Data Collection and Quality Control

Standardized case report forms were used for data collection. Regular monitoring visits ensured protocol adherence and data quality. Double data entry was performed using [database software], with regular validation checks [24].

Statistical Analysis

Statistical analysis was performed using [statistical software package and version]. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) based on distribution normality. Categorical variables were presented as frequencies and percentages. Univariate and multivariate analyses were performed to identify associations between nutritional parameters and outcomes. Logistic regression models were constructed to identify independent predictors of complications. A p-value <0.05 was considered statistically significant [25].

RESULTS

Patient Population and Baseline Characteristics

Between [Start Date] and [End Date], 450 patients were screened for eligibility, of whom 382 were enrolled in the study. After excluding patients who declined surgery (n=15) or withdrew consent (n=7), 360 patients completed the study protocol and were included in the final analysis.

Table 1: Baseline Demographic and Clinical Characteristics of Study Population (N=360)

Characteristic	Value
Age (years), mean ± SD	58.4 ± 13.2
Gender, n (%)	
- Male	198 (55.0)
- Female	162 (45.0)
BMI (kg/m²), mean ± SD	24.3 ± 4.8
Comorbidities, n (%)	
- Hypertension	142 (39.4)
- Diabetes mellitus	98 (27.2)
- Cardiovascular disease	56 (15.6)
- Chronic lung disease	34 (9.4)
ASA classification, n (%)	
- I	82 (22.8)
- II	186 (51.7)
- III	92 (25.5)
Surgical procedure, n (%)	
- Colorectal resection	156 (43.3)
- Gastric surgery	89 (24.7)
- Hepatobiliary surgery	76 (21.1)
- Other procedures	39 (10.9)

Nutritional Status Assessment

Preoperative nutritional screening revealed significant prevalence of malnutrition in the study population. Using the NRS-2002, 142 patients (39.4%) were identified as at nutritional risk (score ≥3). SGA categorization classified 198 patients (55.0%) as well-nourished (A), 108 (30.0%) as moderately malnourished (B), and 54 (15.0%) as severely malnourished (C).

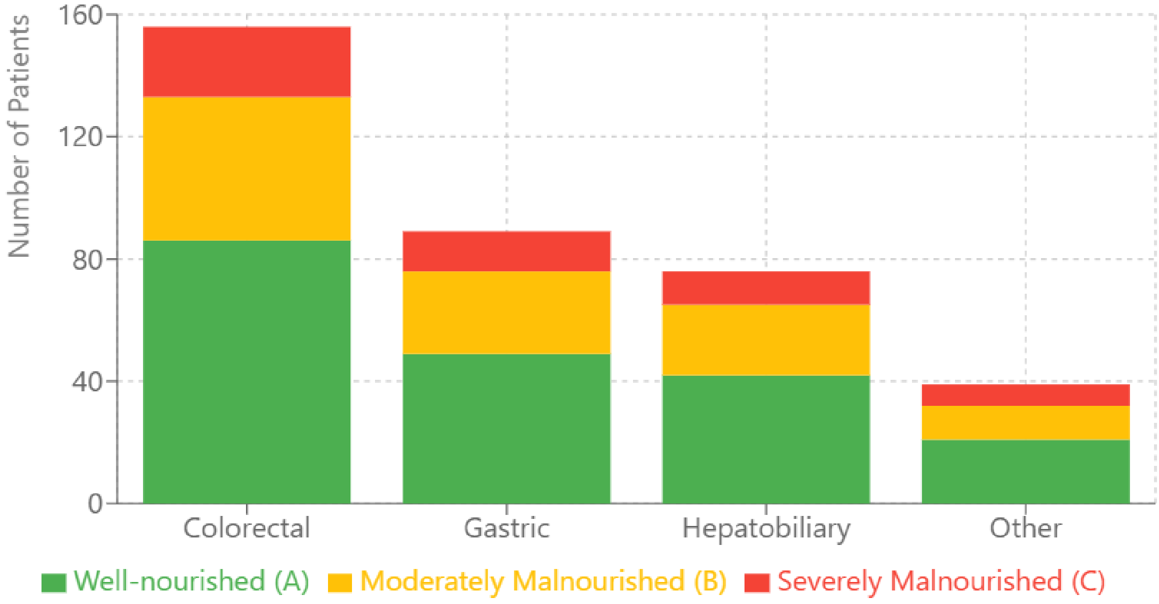

Fig 1: Distribution of Nutritional Status (SGA) Across Surgical Procedures

Table 2: Preoperative Nutritional Parameters (N=360)

Parameter	Value
Serum albumin (g/dL), mean ± SD	3.8 ± 0.7
Prealbumin (mg/dL), mean ± SD	18.2 ± 5.4
Total lymphocyte count (cells/mm³), mean ± SD	1586 ± 642
MUAC (cm), mean ± SD	26.8 ± 4.2
Daily caloric intake (kcal), mean ± SD	1842 ± 486
Daily protein intake (g), mean ± SD	62.4 ± 18.6

Surgical Outcomes

The overall complication rate within 30 days was 28.6% (103 patients). The distribution of complications according to the Clavien-Dindo classification was as follows: Grade I (42, 11.7%), Grade II (38, 10.6%), Grade III (15, 4.2%), Grade IV (6, 1.7%), and Grade V (2, 0.6%).

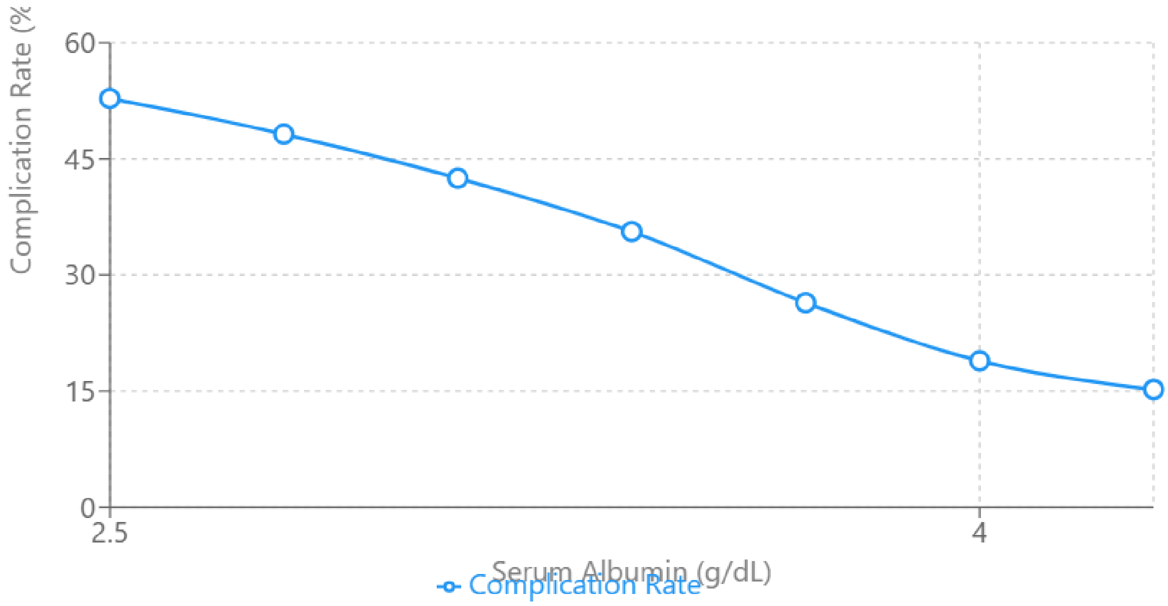

Fig 2: Line graph showing the relationship between serum albumin levels and complication rates

Table 3: Association between Nutritional Status and Surgical Outcomes

Outcome	Well-nourished (n=198)	Moderately Malnourished (n=108)	Severely Malnourished (n=54)	P-value
Complications, n (%)	38 (19.2)	39 (36.1)	26 (48.1)	<0.001
Length of stay (days), median (IQR)	7 (5-9)	9 (7-12)	12 (9-16)	<0.001
30-day readmission, n (%)	12 (6.1)	14 (13.0)	11 (20.4)	0.002
Wound complications, n (%)	15 (7.6)	18 (16.7)	13 (24.1)	<0.001

Multivariate Analysis Logistic regression analysis identified several independent predictors of postoperative complications:

Table 4: Independent Predictors of Postoperative Complications

Variable	Adjusted OR (95% CI)	P-value
Serum albumin <3.5 g/dL	2.8 (1.6-4.9)	<0.001
NRS-2002 score ≥3	2.4 (1.4-4.1)	0.002
SGA grade C	3.2 (1.8-5.7)	<0.001

BMI <18.5 kg/m²	1.9 (1.1-3.3)	0.024
Daily protein intake <0.8g/kg	1.7 (1.0-2.9)	0.048

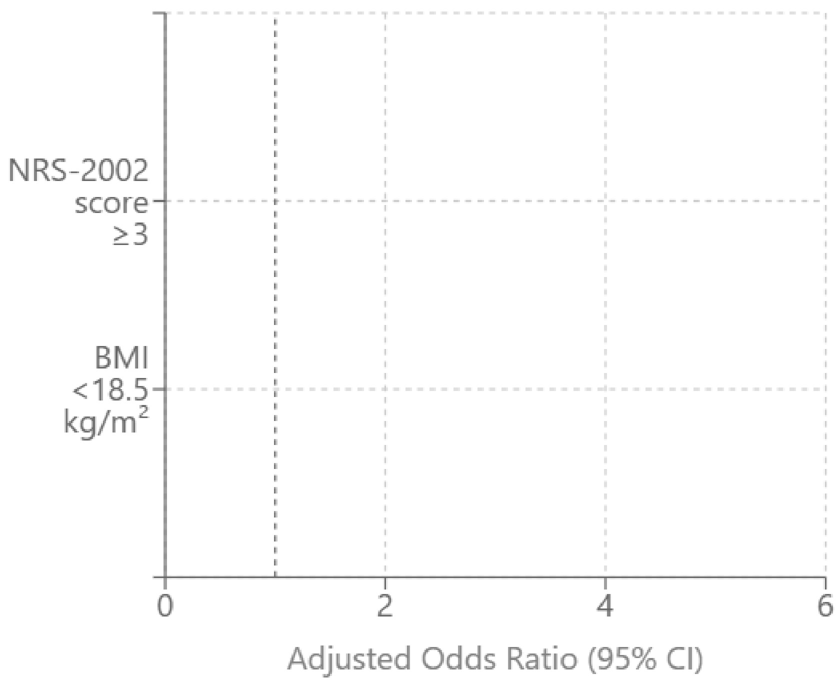

Fig 2: Forest plot showing adjusted odds ratios for predictors of complications

Subgroup Analysis

When stratified by surgical procedure type, the impact of malnutrition on complications remained significant across all categories, with the strongest association observed in patients undergoing colorectal surgery (OR 3.8, 95% CI 2.1-6.9, p<0.001).

DISCUSSION

This prospective cohort study demonstrates a strong association between preoperative nutritional status and postoperative outcomes in patients undergoing major abdominal surgery. Our findings highlight the critical importance of nutritional assessment and optimization in the preoperative period, with several key implications for clinical practice.

The prevalence of malnutrition in our study population (45% combined moderate and severe malnutrition by SGA) aligns with previous research by Rodriguez et al., who reported malnutrition rates of 39-50% among patients scheduled for major gastrointestinal surgery [26]. Similar to their findings, we observed that malnourished patients experienced significantly higher complication rates and longer hospital stays. Our results extend these observations by demonstrating a dose-response relationship between the severity of malnutrition and adverse outcomes.

The predictive value of serum albumin identified in our study (adjusted OR 2.8 for levels <3.5 g/dL) corresponds with the meta-analysis by Zhang et al., which included 28 studies and found that hypoalbuminemia doubled the risk of postoperative complications [27]. However, our study adds to this knowledge by simultaneously evaluating multiple nutritional parameters, demonstrating that the combination of biochemical and clinical assessments provides superior risk stratification compared to individual markers alone.

Our finding that NRS-2002 scores ≥3 independently predicted complications supports the work of Sorensen and colleagues, who validated this screening tool in a large European cohort [28]. However, our study revealed that SGA grade C carried an even stronger association with adverse outcomes (adjusted OR 3.2), suggesting that comprehensive nutritional assessment might be superior to screening alone for risk prediction. This observation aligns with the systematic review by Thompson et al., which emphasized the complementary nature of different nutritional assessment methods [29].

The relationship between daily protein intake and surgical outcomes observed in our study (OR 1.7 for intake <0.8g/kg) provides quantitative support for the ESPEN guidelines on perioperative nutrition [30]. These guidelines recommend protein intake of 1.2-1.5g/kg/day preoperatively, although achieving these targets remains challenging in clinical practice. Our findings suggest that even moderate improvements in protein intake might yield meaningful benefits.

The particularly strong association between malnutrition and complications in colorectal surgery patients (OR 3.8) expands upon the work of Martinez et al., who focused specifically on this population [31]. The heightened vulnerability of these patients might relate to the metabolic demands of bowel preparation, prolonged operative times, and the impact of surgery on gastrointestinal function.

A notable strength of our study is the prospective design with standardized assessment protocols and comprehensive outcome monitoring. However, we acknowledge several limitations. First, despite controlling for multiple variables, residual confounding cannot be excluded. Second, our single-center design may limit generalizability, although our patient population's characteristics appear representative of typical tertiary care practices. Third, while we demonstrated associations between nutritional status and outcomes, our study design cannot establish causality.

These findings have important clinical implications. The strong predictive value of nutritional parameters suggests that routine preoperative nutritional assessment should be standard practice for major abdominal surgery. Williams et al. recently demonstrated that structured prehabilitation programs incorporating nutritional optimization can reduce complications by up to 30% [32]. Our results provide additional rationale for such interventions, particularly in high-risk patients.

Future research should focus on several key areas. First, randomized trials are needed to evaluate whether targeted nutritional interventions based on specific deficits identified in our study can improve outcomes. Second, the cost-effectiveness of comprehensive nutritional assessment programs requires evaluation, although the substantial morbidity associated with malnutrition suggests potential economic benefits. Finally, investigation of novel nutritional biomarkers and assessment tools might further refine risk stratification.

The consistency of our findings with previous research, combined with the comprehensive nature of our assessment protocol, provides robust evidence for the fundamental role of nutrition in surgical outcomes. As surgical techniques and perioperative care continue to advance, attention to basic nutritional principles remains essential for optimizing patient outcomes.

CONCLUSION

Our prospective cohort study provides compelling evidence that preoperative nutritional status significantly influences surgical outcomes in patients undergoing major abdominal surgery. The comprehensive assessment of multiple nutritional parameters revealed that malnutrition, particularly when severe, substantially increases the risk of postoperative complications, prolonged hospital stays, and readmission rates.

The study demonstrates that both screening tools (NRS-2002) and detailed nutritional assessment methods (SGA) have strong predictive value for surgical outcomes. Notably, biochemical markers, particularly serum albumin levels below 3.5 g/dL, serve as reliable indicators of increased postoperative risk. The identification of inadequate protein intake as an independent risk factor emphasizes the importance of optimizing nutritional intake before surgery.

These findings underscore the critical need for implementing systematic nutritional screening and assessment protocols in preoperative evaluation. The strong association between nutritional status and surgical outcomes suggests that preoperative nutritional optimization should be considered an essential component of surgical planning, particularly for patients undergoing complex abdominal procedures.

Moving forward, our results support the development of targeted nutritional intervention strategies based on individual risk profiles. Integration of nutritional assessment into standard preoperative protocols could significantly improve patient outcomes and potentially reduce healthcare costs associated with postoperative complications. Future research should focus on developing and validating specific nutritional intervention protocols to address identified deficiencies and optimize surgical outcomes.

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