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Original Article

Surgery Section

Association of MUST and CIPA Nutritional Risk Classification with Postoperative Complications in Adult Surgical Patients: A Prospective Observational Study

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ABSTRACT

Introduction: Malnutrition is frequently underdiagnosed among surgical patients and is associated with increased postoperative morbidity, prolonged hospital stay, and higher readmission rates. Early identification using validated nutritional screening tools is crucial for improving surgical outcomes.

Aim: To assess nutritional risk using the Malnutrition Universal Screening Tool (MUST) and Control of Food Intake, Protein and Anthropometry (CIPA), and to evaluate the association of nutritional risk with postoperative complications in adult surgical patients.

Materials and Methods: This prospective observational study was conducted in the Department of General Surgery at the All India Institute of Medical Sciences (AIIMS), Nagpur, from April 2024 to December 2025. A total of 220 adult patients undergoing elective or emergency surgery were enrolled. Nutritional screening was performed preoperatively using MUST and CIPA. Patients were followed for postoperative complications graded according to the Clavien-Dindo classification. Statistical analysis was performed using IBM SPSS Statistics version 26.0.

Results: The study included 220 patients with a mean age of 47.9±17.1 years. There were 124 (56.4%) males and 96 (43.6%) females. CIPA identified 51 (23.2%) patients as malnourished, whereas 46 (20.9%) patients were classified as medium-to-high nutritional risk by MUST. Postoperative complications were significantly more frequent among malnourished patients identified by both CIPA (30/51 vs. 10/169; $p<0.001$) and MUST (27/46 vs. 13/174; $p = 0.002$). Both screening tools demonstrated moderate agreement ($\kappa=0.64$). Surgical site infection was the most common complication (30 patients; 13.6%), followed by wound gaping (5 patients) and anastomotic leak (2 patients). Mortality occurred in 3 (1.4%) patients.

Conclusion: Both MUST and CIPA were effective nutritional screening tools and demonstrated moderate agreement in identifying patients at nutritional risk.

Keywords: Control of food intake, Malnutrition, Malnutrition universal screening tool, Nutritional screening, Postoperative complications, Protein and anthropometry, Surgical patients

INTRODUCTION

Malnutrition is a significant yet often overlooked problem among hospitalised patients, with reported prevalence varying across different patient populations and clinical settings [1]. It impairs immune function, wound healing, and physiological reserve, increasing postoperative complications, prolonging hospital stays, and raising mortality [2,3]. Despite strong evidence linking malnutrition to poor surgical outcomes, routine nutritional screening is not uniformly implemented in surgical settings [4].

The aetiology of malnutrition in surgical patients is multifactorial, involving inadequate nutritional intake, impaired absorption, altered metabolic requirements, and increased nutrient losses [5].

Several validated nutritional screening tools are available for assessing nutritional status in clinical practice. These include the MUST [6], the CIPA nutritional screening tool [7], the Subjective Global Assessment (SGA) [8], the Nutritional Risk Screening 2002 (NRS-2002) [9], the Mini Nutritional Assessment (MNA) [10], and the Prognostic Nutritional Index (PNI) [11]. These tools incorporate various combinations of anthropometric measurements, weight loss, dietary intake, clinical assessment, and biochemical parameters to identify patients at nutritional risk.

The MUST is a widely validated screening instrument that incorporates Body Mass Index (BMI), unintentional weight loss, and the acute disease effect to stratify patients according to nutritional risk [6]. The CIPA nutritional screening tool is a simpler instrument that incorporates recent food intake, serum albumin concentration, and anthropometric parameters [7].

Therefore, the present study was undertaken to compare nutritional risk classification using the MUST and CIPA and to evaluate their association with postoperative complications in adult surgical patients.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery, AIIMS, Nagpur, from April 2024 to December 2025, after obtaining approval from the Institutional Ethics Committee (IEC/Pharmac/2024/813; April 2024). Written informed consent was obtained from all participants prior to enrolment in the study.

Inclusion and Exclusion criteria: The study included adult patients aged 18 years and above who were admitted for elective or emergency surgical procedures. Patients admitted to the intensive care unit preoperatively, pregnant women, patients with incomplete clinical data, and those who did not provide written informed consent were excluded from the study.

Sample size: The sample size was calculated using the single population proportion formula based on a reported malnutrition prevalence of 35.7 % among hospitalised surgical patients from the CIPA validation study [7]. A confidence level of 95% and an absolute precision of 6.5% were considered. The calculated minimum sample size was 208 patients. After accounting for an anticipated

5% attrition due to incomplete records or loss to follow-up, the final sample size was rounded to 220 participants.

Data collection: All enrolled patients underwent a comprehensive clinical evaluation within 24 hours of hospital admission. We recorded baseline demographic characteristics, including age and sex. Biochemical investigations, including serum albumin estimation, were performed as part of the routine preoperative work-up.

Nutritional Assessment

Nutritional risk was assessed using the MUST based on: BMI, Unintentional weight loss, and acute disease effect.

The total MUST score was calculated by summing the scores for BMI, unintentional weight loss, and acute disease effect. Patients were categorised as low-risk (score 0), medium-risk (score 1), or high-risk (score ≥2) according to the original MUST criteria. For statistical analysis, patients were regrouped into low-risk (score 0) and medium-to-high-risk (score ≥1) categories [6].

Nutritional status was also assessed using the CIPA nutritional screening tool. The assessment incorporated: Recent food intake, Serum albumin concentration and anthropometric parameters

CIPA screening was considered positive when at least one of the following criteria was met: food intake <50% of the prescribed intake during the preceding 72 hours, serum albumin <3.0 g/dL or BMI <18.5 kg/m². In patients in whom BMI could not be determined, a mid-upper arm circumference (MUAC) ≤22.5 cm was considered positive. Patients meeting none of these criteria were classified as CIPA-negative [7].

The primary outcome was the occurrence of postoperative complications during the postoperative hospital course, graded according to the Clavien-Dindo classification. Complications were assessed throughout the postoperative hospital stay, and the highest Clavien–Dindo grade was assigned to patients who developed multiple complications. For, the primary analysis, patients were categorised as having no complication (Grade 0) or at least one postoperative complication (Grade ≥ I) [12].

STATISTICAL ANALYSIS

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean±Standard Deviation (SD). Categorical variables were presented as frequency and percentage. Categorical variables were analysed using the Chi-square test. We assessed agreement between MUST and CIPA using Cohen's kappa coefficient (κ).

RESULTS

The mean age was 47.9±17.1 years. The largest proportion of patients (58; 26.4%) belonged to the 41-50 year age group [Table/Fig-1]. There were 124 (56.4%) males and 96 (43.6%) females.

Age parameter	Value
Continuous data	
Mean±SD	47.9±17.1 years
Minimum	18 years
Maximum	80 years
Categorical distribution	
18-30 years	35 (15.9%)
31-40 years	41 (18.6%)
41-50 years	58 (26.4%)
51-60 years	48 (21.8%)
61-70 years	28 (12.7%)
>70 years	10 (4.5%)
Total	220 (100.0%)

[Table/Fig-1]: Age distribution of study participants (n=220).

Using the CIPA nutritional screening tool, 51 (23.2%) patients were identified as malnourished, whereas 169 (76.8%) patients were classified as nutritionally normal [Table/Fig-2].

CIPA Result	Frequency (n)	Percentage (%)
Negative	169	76.8
Positive	51	23.2
Total	220	100.0

[Table/Fig-2]: Incidence of malnutrition by CIPA scoring (N=220).

Using the MUST, 46 (20.9%) patients were categorised as having medium-to-high nutritional risk, whereas 174 (79.1%) patients were classified as low risk [Table/Fig-3].

MUST Score	Risk category	Frequency (n)	Percentage (%)
0	Low-risk	174	79.1
1	Medium-risk	10	4.5
2	High-risk	29	13.2
3	High-risk	5	2.3
4	High-risk	1	0.5
5	High-risk	1	0.5
Total		220	100.0
Regrouped			
Score 0 (Low-risk)		174	79.1
Score ≥1 (Medium-High-risk)		46	20.9

[Table/Fig-3]: Incidence of malnutrition by MUST Scoring (N=220).

Agreement analysis demonstrated an overall concordance of 88.6% between the two nutritional screening tools. The Cohen's kappa coefficient (κ) was 0.64, indicating moderate agreement between MUST and CIPA [Table/Fig-4].

	MUST Low-risk (Score 0)	MUST Medium-high risk (Score ≥1)	Total
CIPA negative	159 (72.3%)	10 (4.5%)	169 (76.8%)
CIPA positive	15 (6.8%)	36 (16.4%)	51 (23.2%)
Total	174 (79.1%)	46 (20.9%)	220 (100.0%)

[Table/Fig-4]: Agreement statistics.
Kappa coefficient: 0.64 (Moderate agreement); CIPA+/MUST+: 36 patients (16.4%); CIPA-/MUST-: 159 patients (72.3%); Discordant cases: 25 patients (11.4%)

Postoperative complications were significantly more frequent among patients identified as malnourished by both nutritional screening tools [Table/Fig-5].

	Complications absent (Grade 0)	Complications present (Grade ≥I)	Total	p-value
CIPA screening				
CIPA negative	159 (94.05%)	10 (5.95%)	169	<0.001*
CIPA positive	21 (41.17%)	30 (58.83%)	51	
MUST screening				
MUST Low-risk (0)	161 (92.52%)	13 (7.48%)	174	0.002*
MUST Medium-high risk (≥1)	19 (41.30%)	27 (58.7%)	46	

[Table/Fig-5]: Postoperative complications by nutritional screening status.
Chi-square test

Overall, postoperative complications occurred in 40 (18.2%) patients. The most common complication was surgical site infection, observed in 30 (13.6%) patients, followed by wound gaping in 5 (2.3%) patients and anastomotic leak in 2 (0.9%) patients, whereas three patients experienced mortality.

DISCUSSION

In the present study, malnutrition was identified in approximately one-fifth to one-fourth of patients, depending on the nutritional screening tool used.

Several studies have demonstrated that poor preoperative nutritional status is associated with increased postoperative complications, prolonged hospital stay, and increased healthcare expenditure. Bozzetti F et al., evaluated 1,410 patients undergoing major gastrointestinal cancer surgery and reported that preoperative weight loss (p = 0.019) and hypoalbuminaemia (p = 0.019) were independent predictors of postoperative complications on multivariable analysis, along with advanced age and pancreatic surgery [13]. Overall, 7.2% of patients developed major complications, whereas 31.6% experienced minor complications. The study further demonstrated that perioperative nutritional support significantly reduced postoperative morbidity, particularly infectious complications, with immune-enhancing enteral nutrition providing the greatest benefit. These findings emphasise the importance of identifying and correcting malnutrition before surgery to improve postoperative outcomes [13].

Furthermore, the European Society for Clinical Nutrition and Metabolism (ESPEN) consensus statement recommends that the diagnosis of malnutrition should incorporate both phenotypic and aetiological criteria rather than relying on a single nutritional parameter [14].

The present study demonstrated moderate agreement between the MUST and the CIPA nutritional screening tool (κ = 0.64). This finding is comparable to that reported by Gerasimidis K et al., who observed moderate agreement (κ = 0.57) between the Glasgow Nutritional Screening Tool and MUST [15].

In the present study, among CIPA-positive patients, 58.8% developed postoperative complications compared with 5.9% of CIPA-negative patients. Similarly, 58.7% of patients categorised as medium-to-high nutritional risk by MUST developed postoperative complications compared with 7.5% of patients classified as low risk.

Correia MI and Waitzberg DL reported significantly higher morbidity (27.0% vs. 16.8%), mortality (12.4% vs. 4.7%), and longer hospital stay (16.7 vs. 10.1 days) among malnourished hospitalised patients [2]. Norman K et al., in their systematic review, concluded that disease-related malnutrition is consistently associated with impaired wound healing, increased postoperative infectious complications, prolonged hospital stay, and increased mortality [3]. Similarly, Bozzetti F et al., in a series of 1,410 patients undergoing major abdominal surgery for gastrointestinal cancer, reported 101 (7.2%) major and 446 (31.6%) minor postoperative complications. On multivariable analysis, weight loss (p = 0.019) and low serum albumin (p = 0.019) were independent risk factors for postoperative complications. Nutritional support was associated with reduced postoperative morbidity (p = 0.001), with the protective effect increasing from total parenteral nutrition to enteral nutrition and immune-enhancing enteral nutrition, and the effect was particularly evident for infectious complications [13].

Nutritional screening should be incorporated into the standard preoperative assessment of all surgical patients. Early identification of patients at nutritional risk allows timely nutritional intervention, optimisation before surgery, and potentially improved postoperative outcomes.

Limitation(s)

It was conducted at a single tertiary-care centre, which may limit the generalisability of the findings. Furthermore, serum albumin, although included in the CIPA screening tool, may be influenced by inflammation and other non-nutritional factors. We did not perform multivariable analysis adjusting for potential confounders such as age, sex, and type or urgency of surgery; therefore, we could not establish the independent association between nutritional risk and postoperative complications.

CONCLUSION(S)

Malnutrition is common among surgical patients and is significantly associated with adverse postoperative outcomes. Both the MUST and the CIPA nutritional screening tool were effective in identifying patients at nutritional risk and demonstrated moderate agreement.

REFERENCES

[1] Barker LA, Gout BS, Crowe TC. Hospital malnutrition: Prevalence, identification and impact on patients and the healthcare system. Int J Environ Res Public Health. 2011;8(2):514-27.
[2] Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr. 2003;22(3):235-39.
[3] Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. Clin Nutr. 2008;27(1):5-15.
[4] Weimann A, Braga M, Carli F, Higashiguchi T, Hübner M, Klek S, et al. ESPEN practical guideline: Clinical nutrition in surgery. Clin Nutr. 2021;40(7):4745-61.
[5] Gillis C, Wischmeyer PE. Prehabilitation, enhanced recovery, and perioperative nutrition in surgical patients. Lancet Gastroenterol Hepatol. 2024;9(1):38-50.
[6] Malnutrition Advisory Group (MAG). The 'MUST' report: Nutritional screening of adults: A multidisciplinary responsibility: Development and use of the 'Malnutrition Universal Screening Tool' ('MUST') for adults. Redditch: British Association for Parenteral and Enteral Nutrition (BAPEN); 2003.
[7] Suárez-Llanos JP, Mora-Mendoza A, Benítez-Brito N, Pérez-Méndez L, Pereyra-García-Castro F, Oliva-García JG, Palacio-Abizanda JE. Validity of the new nutrition screening tool Control of Food Intake, Protein, and Anthropometry (CIPA) in non-surgical inpatients. Arch Med Sci. 2018;14(5):1020-24. Doi: 10.5114/aoms.2017.66084. Epub 2017 Feb 20. PMID: 30154883; PMCID: PMC6111349.
[8] Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr. 1987;11(1):8-13.
[9] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z; Ad Hoc ESPEN Working Group. Nutritional Risk Screening (NRS 2002): A new method based on an analysis of controlled clinical trials. Clin Nutr. 2003;22(3):321-36.
[10] Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S, et al. The Mini Nutritional Assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition. 1999;15(2):116-22.
[11] Onodera T, Goseki N, Kosaki G. Prognostic nutritional index in gastrointestinal surgery of malnourished cancer patients. Jpn J Surg. 1984;14(1):33-36.
[12] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240(2):205-13.
[13] Bozzetti F, Gianotti L, Braga M, Di Carlo V, Mariani L. Postoperative complications in gastrointestinal cancer patients: The joint role of the nutritional status and the nutritional support. Ann Surg. 2007;246(5):707-15.
[14] Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition: An ESPEN Consensus Statement. Clin Nutr. 2015;34(3):335-40.
[15] Gerasimidis K, Drongitis P, Murray L, Young D, McKee RF. Comparison of a local nutritional screening tool with the Malnutrition Universal Screening Tool (MUST) in hospitalised patients. Eur J Clin Nutr. 2007;61(7):916-21.

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