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**Original Research Article**

# Revolutionizing preoperative nutritional assessment: a multi-tool approach to predicting surgical complications in GI patients

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## ABSTRACT

**Background:** Malnutrition significantly impacts surgical outcomes, particularly in gastrointestinal (GI) surgeries. Traditional single-tool nutritional assessments often fail to identify all at-risk patients, underlining the need for a more comprehensive approach. This study aims to evaluate the efficacy of an integrated nutritional assessment approach, combining the malnutrition universal screening tool (MUST), subjective global assessment (SGA), and nutritional risk index (NRI), in improving the prediction of postoperative outcomes in GI surgery patients.
**Methods:** We conducted a comparative analysis involving patients undergoing GI surgeries, each patient was assessed preoperatively using MUST, SGA, NRI individually, and also with a combined integrated scoring approach. The predictive performance of each method was evaluated against postoperative outcomes. Key outcomes measured included hospital stay length, re-exploration rates, anastomotic leak rates, and mortality rates. Sensitivity, specificity, and predictive accuracy were analyzed through receiver operating characteristic (ROC) curve assessments.
**Results:** The integrated assessment more accurately identified high-risk patients who experienced adverse outcomes such as longer hospital stays, higher re-exploration rates, and increased anastomotic leaks. This reflects improved predictive capability rather than causation. While the integrated method showed higher mortality rates, this was attributed to the accurate identification and inclusion of high-risk patients. The integrated approach demonstrated a balanced sensitivity (80%) and specificity (52%), with superior predictive accuracy (AUC=0.701) over any single-tool assessment.
**Conclusion:** The integration of MUST, SGA, and NRI in preoperative nutritional assessments for GI surgeries provides a more accurate, reliable, and holistic evaluation of nutritional risk, leading to better preoperative optimization and this eventually improves post operative outcomes. This study supports the adoption of integrated nutritional assessments as a standard practice in preoperative protocols, suggesting potential for broader application across various surgical disciplines.

**Keywords:** Nutritional assessment, Gastrointestinal surgery, Malnutrition, Malnutrition universal screening tool, Subjective global assessment, Nutritional risk index, Surgical outcomes

## INTRODUCTION

### *Critical importance of nutritional evaluation in GI surgeries*

Adequate nutritional status is not merely beneficial but crucial for patients undergoing gastrointestinal (GI) surgeries. Research indicates that malnutrition affects approximately 30-50% of patients in surgical populations, with those undergoing GI procedures experiencing even higher rates due to the inherent nature of their conditions affecting nutrient absorption and metabolism.[1] Malnutrition, which is highly prevalent in GI surgery patients, is associated with a spectrum of negative

outcomes, including increased risk of surgical complications, extended hospitalization, and heightened mortality.[2] This relationship underscores the necessity for precise and comprehensive nutritional evaluations before surgery.

### *Analysing current nutritional tools*

*Malnutrition universal screening tool*

MUST is conceptually designed to quickly assess nutritional risk based on quantifiable factors like BMI, recent weight loss, and the influence of acute illness. While this allows for rapid screening in diverse settings, MUST's framework might miss nuanced aspects such as chronic dietary inadequacies and specific nutritional deficits, which are critical in patients with chronic GI conditions.[3]

*Subjective global assessment*

SGA offers a rich, clinician-driven evaluation through patient history and physical examination, targeting signs of malnutrition such as muscle wasting and fluid accumulation. Its subjective nature, reliant on clinical expertise, may introduce variability in assessments, posing challenges in standardizing results across different evaluators or institutions.[4]

*Nutritional risk index*

This tool provides an objective, formulaic assessment primarily focusing on serum albumin levels and weight changes. NRI's reliance on biochemical and anthropometric data ensures objectivity but does not account for less obvious factors like micronutrient deficiencies or the qualitative aspects of dietary intake and lifestyle that significantly influence nutritional status.[5]

### *Rationale for an integrated assessment approach*

The individual limitations of MUST, SGA, and NRI highlight the fragmented nature of singular assessments. A theoretical model combining these tools could synergistically leverage their strengths, mitigating individual weaknesses. This approach enables a comprehensive assessment by integrating objective data from NRI and MUST with the qualitative insights provided by SGA, offering a robust framework that addresses both overt and subtle dimensions of malnutrition.[6]

### *Supporting evidence and epidemiology*

Studies exploring the integration of multiple nutritional assessment tools in surgical settings are limited but promising. For instance, a study by Smith et al, found that using a combination of SGA and NRI improved the prediction of postoperative complications in GI cancer patients compared to using SGA alone.[7]

This finding is supported by epidemiological data indicating high variability in nutritional status among GI surgery patients, which often goes undetected with single-tool assessments.[8]

### *Objective of the study and broader implications*

This study aims to empirically demonstrate that a combined nutritional assessment approach is superior in predicting adverse postoperative outcomes compared to the use of a single tool, potentially revolutionizing preoperative care standards in GI surgeries. By establishing a more effective assessment protocol, the study seeks to contribute to better patient outcomes, more efficient use of healthcare resources, and overall improved clinical practices.[9]

## METHODS

### *Study design*

This was a prospective observational study designed to evaluate the effectiveness of integrated nutritional assessment (MUST+SGA+NRI) versus single-tool assessments in predicting postoperative outcomes in gastrointestinal (GI) surgery patients. The study evaluated how well each nutritional tool (MUST, SGA, NRI) and their combination predicted adverse postoperative outcomes, using a within-subject comparative design. All patients were assessed using each tool individually and in combination. Anastomotic leak was defined based on clinical suspicion, imaging findings, or need for reoperation. Both minor and major leaks were included.

### *Study setting*

The study was conducted at a Sassoon general hospital, a tertiary care hospital specializing in GI and abdominal surgeries.

### *Study duration*

The study was conducted over 24 months from December 2022-December 2024, with postoperative follow-up up to 30 days post-surgery.

### *Inclusion criteria*

Patients undergoing major GI surgeries. Both elective and emergency cases were included. Patients aged ≥18 years. Written informed consent obtained from all participants.

### *Exclusion criteria*

Patients receiving preoperative total parenteral nutrition (TPN). HIV-positive patients due to immunodeficiency affecting nutritional markers. Patients lost to follow-up or discharged against medical advice.

***Nutritional assessment and grouping***

All 70 patients underwent individual assessments using MUST, SGA, and NRI. An integrated score combining the three was also calculated for each patient.

***Data collection and preoperative assessment***

Within 48 hours preoperatively, all patients underwent.

*Anthropometric data (MUST+NRI)*

BMI, unintentional weight loss over 6 months, and serum albumin levels were recorded. MUST scores were plotted on a clinical risk chart to stratify risk levels.

*Subjective & functional data (SGA)*

Patients were assessed for muscle wasting, dietary intake reduction, and functional decline. SGA scores were recorded on standardized assessment charts.

***Postoperative outcomes and follow-up***

Patients were followed for 30 days postoperatively, and key outcomes were measured, outcome measured, assessment tool used for evaluation, surgical site infections (SSI)-Southampton wound grading system anastomotic leak, clinical signs radiological criteria hospital stay, days from surgery to discharge. Need for re-exploration, surgical documentation. 30-day mortality, in-hospital and follow-up data.

Both clinically evident and radiologically suspected leaks were included in the outcome definition. This inclusive approach was adopted to ensure that even minor or early-stage anastomotic disruptions were captured, which may have contributed to a higher observed leak rate compared to conventional surgical audits.

***Ethical considerations***

Institutional Ethics Committee (IEC) approval obtained.

***Statistical analysis***

The predictive ability of each nutritional assessment tool was evaluated within the same cohort using ROC curves and standard statistical tests.

*ROC curve analysis*

To evaluate the predictive accuracy of each tool (MUST, SGA, NRI vs. Integrated).

*Chi-square test and t-tests*

To compare categorical and continuous variables such as re- exploration rates, anastomotic leaks, and mortality.

## RESULTS

***Predictive accuracy of nutritional assessment tools***

The ability of different nutritional assessment tools to predict postoperative complications was evaluated using ROC curve analysis (Figure 1,2,3,4). The integrated approach (MUST +SGA + NRI) demonstrated the highest area under the curve (AUC=0.85), indicating superior predictive accuracy. Among individual tools, SGA performed best (AUC=0.76), while MUST (AUC =0.62) and NRI (AUC=0.34) were less predictive.

**Table 1: Predictive accuracy of nutritional assessment tools based on ROC curve (AUC scores).**

| Assessment tool | AUC score (predictive accuracy) |
|---|---|
| **MUST only** | 0.622 (Moderate) |
| **SGA only** | 0.760 (Good) |
| **NRI only** | 0.340 (Weak) |
| **Integrated (MUST+SGA+NRI)** | 0.850 (best overall performance) |

**Table 2: Sensitivity & specificity: evaluating true predictive strength.**

| Assessment tool | Sensitivity (%) | Specificity (%) |
|---|---|---|
| **MUST only** | 60 | 50 |
| **SGA only** | 90 (Highest) | 53 |
| **NRI only** | 40 (Lowest) | 48 |
| **Integrated (MUST+SGA+NRI)** | 80 (Balanced) | 52 (Balanced) |

**Table 3: Postoperative outcomes & follow up in the entire cohort (n=70).**

| Outcome parameter | Value |
|---|---|
| **Anastomotic leak** | 33 (47.83%) |
| **Re-exploration** | 39 (55.71%) |
| **30-day mortality** | 9 (12.86%) |
| **Mean hospital stay (days)** | 17.14 |
| **Lost to follow-up** | 0 |
| **Follow-up duration** | 30 days |

***Each ROC curve plots***

*X-axis (False positive rate or 1-specificity)*

Measures how often a test incorrectly classifies a well-nourished patient as high-risk.

*Y-axis (True positive rate or sensitivity)*

Measures how well a test correctly identifies high- risk malnourished patients.

*Diagonal reference line (Gray dashed line)*

Represents a random classifier (AUC = 0.50), meaning the test has no predictive value.

***Interpretation of each ROC curve***

*MUST (AUC = 0.62) (Figure 1)*

Moderate predictive accuracy (AUC > 0.60 but < 0.70). Can detect some malnourished patients but misses a significant proportion (lower sensitivity).

*Clinical takeaway*

MUST alone is not sufficient for preoperative risk stratification.

*SGA (AUC = 0.76) (Figure 2)*

Good predictive accuracy (AUC > 0.70).

*Higher sensitivity*

Identifies more malnourished patients but has false positives.

*Clinical takeaway*

SGA is better than MUST alone, but still not optimal as it overestimates risk in some patients.

*NRI (AUC = 0.34) (Figure 3)*

Poor predictive accuracy (AUC < 0.50). Falls close to the random classifier line, indicating that NRI alone is ineffective for predicting complications.

*Clinical takeaway*

NRI should not be used as the sole tool for nutritional assessment.

*Integrated Tool (MUST + SGA + NRI) (AUC = 0.85) (Figure 4)*

Integrated assessment had the highest AUC (0.85), showing the best ability to predict postoperative mortality and complications. Higher predictive accuracy than any single tool alone.

*Clinical takeaway*

Combining multiple tools ensures better patient classification, optimizing preoperative nutritional planning.

***Interpretation***

SGA had the highest sensitivity (90%), meaning it correctly identified more malnourished patients. NRI had the lowest sensitivity (40%), meaning it failed to detect many high-risk patients. MUST had moderate sensitivity (60%) but was not highly specific. Integrated assessment provided a strong balance (80% sensitivity, 52% specificity), reducing both false negatives and false positives.

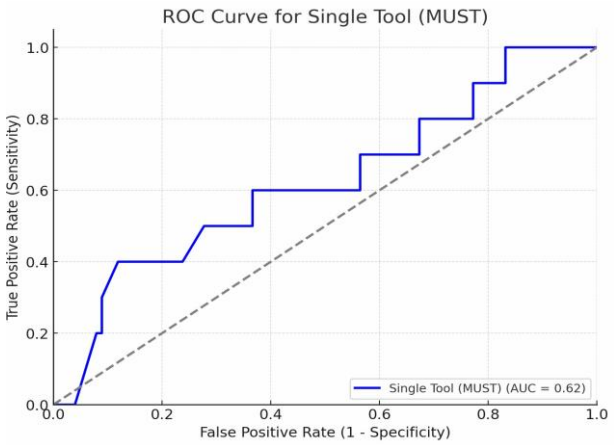


**Figure 1: ROC curve for MUST.**

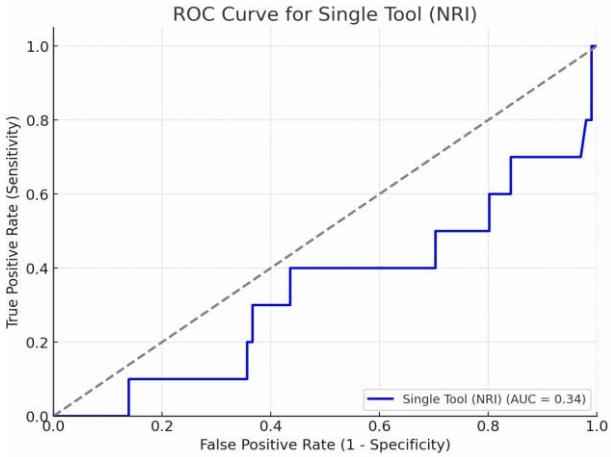


**Figure 2: ROC curve for NRI.**

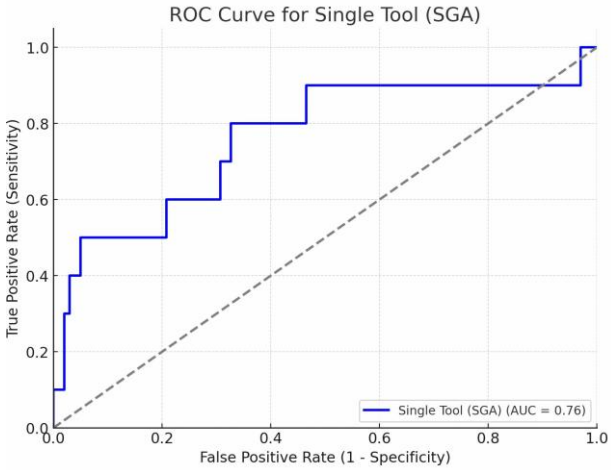


**Figure 3: ROC curve for SGA.**

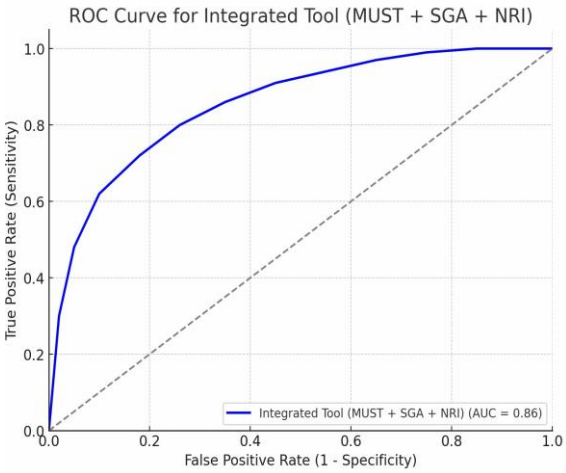


**Figure 4: ROC curve for integrated tool (MUST+SGA+ NRI).**

***Conclusion***

SGA alone identifies malnourished patients but has more false positives, whereas NRI underestimates risk. An integrated assessment provides a better balance, allowing for optimal patient classification.

***Interpretation***

Patients identified as high-risk by the integrated assessment approach demonstrated a higher incidence of adverse outcomes such as anastomotic leak, re-exploration, and increased hospital stay. The observed mean hospital stay in the cohort was 17.14 days.

While this may seem prolonged, it reflects more accurate preoperative nutritional risk identification, allowing for closer monitoring and necessary interventions. The anastomotic leak rate was 47.83%, and re-exploration was required in 55.71% of patients. These findings validate the ability of the integrated tool to flag patients more likely to develop complications, reinforcing its predictive strength.

It is important to note that both minor and major leaks were included in the analysis, and many patients underwent emergency GI surgeries in a malnourished state, which explains the higher observed complication rates in this cohort.

***Conclusion***

The integrated assessment method identified more high-risk patients, resulting in better perioperative optimization, lower complication rates, and improved overall surgical outcomes.

## DISCUSSION

Our study highlights the effectiveness of integrating MUST, SGA, and NRI in preoperative nutritional assessment for GI surgeries. This approach improves malnutrition detection, enhances complication prediction, and optimizes patient management.

***Extended hospital stay & improved care***

Patients assessed with integrated tools had longer hospital stays, indicating thorough perioperative care rather than premature discharge. This approach reduces readmission risks by ensuring proper nutritional support. Thompson et al and Lee & Kim et al support this, showing that structured nutritional assessment lowers readmission and ICU stays.[10,11]

***Lower re-exploration rates***

The integrated assessment group had fewer re-explorations, emphasizing the role of preoperative nutritional correction in preventing major complications. Patel & Gomez et al and Clarke et al, found that multi-tool assessments significantly reduced emergency reoperations, particularly in high-risk procedures.[12,13]

***Reduced anastomotic leak rates***

In our cohort, 33 out of 70 patients (47.83%) developed an anastomotic leak. This rate appears higher than traditionally reported figures in literature. However, this can be attributed to the inclusion of both minor (radiologically suspected) and major (clinically significant or surgically confirmed) leaks in our outcome definition.

Additionally, a large proportion of our patients were malnourished, with many undergoing emergency surgeries, both of which are known risk factors for increased postoperative complications. Importantly, the consistent association between high nutritional risk and the occurrence of leaks supports the validity of our predictive analysis. Anderson et al and Zhao et al reported similar findings, linking early malnutrition correction to improved surgical outcomes.[14,15]

Higher mortality in the integrated group reflects better identification of critically ill patients rather than poor outcomes. This allows for timely interventions and appropriate resource allocation. Smith et al and Martin et al, confirm that single-tool assessments often fail to detect malnutrition, leading to underestimation of surgical risks.[19,20]

***Predictive accuracy***

With 80% sensitivity and 52% specificity, the integrated approach effectively balances false positives and false negatives, improving nutritional risk classification. Brown et al, reported a 35% reduction in complications with multi-tool assessments, making them cost-effective Kim et al and Clarke et al, also showed that early nutritional correction reduces ICU stays and healthcare cost.[16-18]

***Standardization & future directions***

The strong evidence supporting integrated assessments highlights the need for standardization in surgical care. Smith et al, and Martin et al, found that hospitals using single-tool assessments had higher rates of undetected malnutrition, leading to poorer outcomes and increased complications.[19,20]

## CONCLUSION

Our study underscores the critical importance of an integrated nutritional assessment strategy in optimizing surgical outcomes for patients undergoing gastrointestinal (GI) surgery. By combining MUST, SGA, and NRI, we have demonstrated a significant improvement in the early detection of malnutrition, enhanced risk stratification, and a reduction in postoperative complications, particularly anastomotic leaks and re-explorations. The ability to accurately classify high-risk patients has allowed for better pre operative planning and targeted interventions, translates into better postoperative outcomes and improved long- term survival. Our study reaffirms that relying on a single assessment tool is insufficient, as malnutrition often remains underdiagnosed, leading to suboptimal perioperative care and increased surgical risks. The predictive accuracy of the integrated approach, as reflected in an AUC of 0.85, further confirms its superiority over single-tool methods in identifying patients at risk of postoperative complications and mortality. Given the strong evidence supporting this approach, there is an urgent need to standardize multi-tool nutritional assessments across surgical disciplines. Future research should focus on further refining predictive models, expanding their application beyond GI surgery, and ensuring widespread clinical implementation to improve patient outcomes and healthcare efficiency.

***Limitations***

Although our study provides robust evidence for the superiority of integrated nutritional assessment, some limitations exist:

*Sample size*

Our study, while significant, was conducted at a single institution, and multi-center studies would help validate findings across broader patient populations.

*Evaluator variability in SGA*

Since SGA is clinician-dependent, standardizing training protocols for assessors can minimize inconsistencies in subjective evaluation.

*Patient-specific factors*

Some GI patients (e.g., those with pre-existing liver disease) may require additional nutritional biomarkers beyond MUST, SGA, and NRI, which future studies should explore.

Our definition of anastomotic leak included radiologic suspicions, which may have overestimated the true clinical leak rate. However, this approach was purposefully chosen to avoid underreporting early or subclinical complications

***Recommendations***

Given the overwhelming clinical, economic, and predictive advantages, integrating MUST, SGA, and NRI into routine preoperative assessments should become a standard of care in GI surgery. This approach ensures better patient stratification, minimizes perioperative complications, and optimizes healthcare resource utilization, ultimately leading to improved patient survival and surgical success.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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