

PREDICTORS OF PROLONGED HOSPITAL STAY AFTER EMERGENCY ABDOMINAL SURGERY: THE INTERPLAY OF PREOPERATIVE NUTRITIONAL STATUS AND POSTOPERATIVE COMPLICATIONS — A PROSPECTIVE OBSERVATIONAL STUDY

General Surgery

Prof. Dr. N. Junior Sundresh Department of General Surgery, Government Medical College and Hospital, Chidambaram, Tamil Nadu, India

Dr. Mohammed Jafarullah Department of General Surgery, Government Medical College and Hospital, Chidambaram, Tamil Nadu, India

Dr. Midhuna Devi K S* Department of General Surgery, Government Medical College and Hospital, Chidambaram, Tamil Nadu, India *Corresponding Author

ABSTRACT

Background: Emergency abdominal surgery carries substantially greater morbidity, mortality, and resource use than elective surgery, and a prolonged postoperative hospital stay is one of the clearest markers of this burden. Two of the most consistently reported determinants of length of stay (LOS) are the patient's preoperative nutritional status and the occurrence and severity of postoperative complications, yet the two are rarely examined together as an interacting system in emergency settings. **Aim:** To prospectively study preoperative nutritional status and postoperative complications as predictors of prolonged hospital stay in patients undergoing emergency abdominal surgery at Government Cuddalore Medical College and Hospital, and to describe how the two interact to shape LOS. **Methods:** A hospital-based prospective observational study was conducted over 18 months (January 2025 to June 2026) in the Department of General Surgery, Government Cuddalore Medical College and Hospital, on 50 consecutive adult patients undergoing emergency abdominal surgery who met the study's inclusion criteria. Preoperative nutritional status (serum albumin and composite screening tools) and postoperative complications (graded by the Clavien-Dindo classification) were recorded prospectively and analyzed for their association with prolonged postoperative hospital stay. Findings are further contextualized against the wider published literature identified through PubMed/MEDLINE and PubMed Central. **Findings:** Of the 50 patients (mean age 47.0 ± 9.8 years; 39 male, 11 female), 20 (40.0%) had prolonged postoperative stay (>7 days; mean LOS 7.16 ± 3.62 days overall, median 6 days). Hypoalbuminemia (albumin <3.5 g/dL, present in 20/50 patients) was strongly associated with prolonged LOS (70.0% vs. 20.0% in normoalbuminemic patients; $\chi^2 = 10.50$, $p = 0.0012$), and mean LOS was significantly longer in hypoalbuminemic patients (9.65 ± 3.72 vs. 5.50 ± 2.43 days; $p < 0.001$). Any postoperative complication (20/50 patients, 40.0%) was likewise associated with prolonged LOS (65.0% vs. 23.3%; $\chi^2 = 7.03$, $p = 0.008$), as was a major complication of Clavien-Dindo grade IIIa or above (18/50 patients; 66.7% vs. 25.0%; $\chi^2 = 6.69$, $p = 0.010$). Higher ASA grade (III-V) was also associated with prolonged LOS (70.6% vs. 24.2% for ASA I-II; $\chi^2 = 8.20$, $p = 0.004$). These findings are consistent with the wider published evidence reviewed in this manuscript (Sections 3–7), which similarly identifies malnutrition and postoperative complication burden as independent predictors of prolonged LOS after emergency abdominal surgery. **Conclusion:** Nutritional status and postoperative complications function as interconnected, identifiable, and partly modifiable predictors of prolonged hospital stay after emergency abdominal surgery. Routine preoperative nutritional screening, systematic complication scoring, and adaptation of enhanced-recovery and nutrition focused perioperative pathways to the emergency setting may help reduce LOS and the associated burden on patients and health systems.

KEYWORDS

Emergency Abdominal Surgery; Emergency Laparotomy; Length of Stay; Malnutrition; Nutritional Status; Postoperative Complications; Frailty; Enhanced Recovery

1. INTRODUCTION

Emergency abdominal surgery encompasses a heterogeneous group of time-critical operations performed for conditions such as perforation, obstruction, ischemia, and intra-abdominal sepsis. It is resource-intensive and carries a substantially higher risk of morbidity, mortality, and poor postoperative recovery than comparable elective procedures [2]. Among the outcomes used to judge the quality and cost of this care, hospital length of stay (LOS) is one of the most practical: it reflects the cumulative effect of patient physiology, disease severity, surgical course, and postoperative recovery, and it carries direct implications for healthcare costs, bed capacity, and the risk of hospital-acquired complications [1,2].

Two factors recur across the literature as robust, independent predictors of prolonged LOS after abdominal surgery: the patient's nutritional status at the time of operation, and the occurrence and severity of postoperative complications. Malnutrition is common in surgical populations, particularly in those presenting acutely with gastrointestinal disease, and is estimated to affect between 30% and 65% of patients admitted to surgical wards [9,10]. It is not merely a marker of underlying illness; it independently impairs wound healing, immune competence, and the physiological reserve needed to tolerate the stress of emergency surgery, thereby predisposing patients to complications that in turn prolong hospitalization [9,23]. This study prospectively examines nutritional assessment tools, complication-severity grading, and their combined contribution to LOS in 50 patients undergoing emergency abdominal surgery at Government Cuddalore Medical College and Hospital, and situates these findings within the wider published evidence to inform perioperative risk stratification and management.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a hospital-based prospective observational study conducted in the Department of General Surgery, Government Cuddalore Medical College and Hospital, Cuddalore, Tamil Nadu, over a period of 18 months, from January 2025 to June 2026.

All adult patients presenting to the casualty/emergency department who underwent emergency abdominal surgery during the study period and who satisfied the eligibility criteria below were considered for enrolment after obtaining written informed consent. Institutional Ethics Committee approval was obtained prior to commencement [reference/approval number to be inserted]. A total of 50 patients meeting the eligibility criteria were enrolled and followed prospectively to discharge.

2.2 Sample Size

The sample size was calculated using the formula $n = Z^2pq/d^2$, where $Z = 1.96$ (95% confidence level), $p = 50\%$ (expected proportion of patients with prolonged hospital stay, taken as the most conservative estimate in the absence of confirmed local prevalence data), $q = (1 - p)$, and $d = 14\%$ (absolute precision). This yielded a minimum sample size of approximately 49 patients, rounded up to a working sample of 50 patients recruited consecutively over the study period. [If a local pilot estimate of the prevalence of prolonged LOS or malnutrition becomes available, the values of p and d used here should be revisited and the calculation re-justified accordingly.]

2.3 Inclusion Criteria

- Adult patients aged 18 years and above.
- Patients undergoing emergency abdominal surgery for conditions such as perforation peritonitis, intestinal obstruction, acute appendicitis, acute cholecystitis, mesenteric ischemia, abdominal trauma, or other acute surgical abdomen presentations.

- Patients admitted through the casualty/emergency department requiring surgical intervention within 24–48 hours of admission.
- Patients (or next of kin, where applicable) willing to provide written informed consent to participate.

2.4 Exclusion Criteria

- Patients below 18 years of age.
- Patients undergoing elective (non-emergency) abdominal surgery.
- Patients who succumbed intraoperatively or within 24 hours of surgery, precluding meaningful assessment of postoperative LOS.
- Patients with known advanced/terminal malignancy on palliative care pathways, where LOS is primarily determined by end-of-life care planning rather than surgical recovery.
- Patients transferred to another hospital or lost to follow-up before discharge, in whom final LOS could not be ascertained.
- Patients or relatives declining informed consent.

2.5 Data Collection and Study Variables

For each enrolled patient, a structured proforma was used to record demographic details (age, sex), diagnosis and operative procedure, ASA physical status grade, preoperative nutritional status (serum albumin, and where feasible a composite tool such as NRS-2002, CONUT, or PNI), intraoperative findings, postoperative complications graded by the Clavien-Dindo classification, and total postoperative hospital length of stay (in days). Prolonged LOS was defined *a priori* as a postoperative stay exceeding the cohort median (or an absolute cut-off, e.g., >7 days, to be fixed before data analysis and reported explicitly in the Results). Data were collected prospectively from admission until discharge or in-hospital death.

2.6 Statistical Analysis

Data were entered and analyzed using SPSS (version to be specified) or an equivalent statistical package. Continuous variables (e.g., age, serum albumin, LOS) are presented as mean $\pm$ standard deviation or median with interquartile range, depending on distribution (assessed by the Shapiro-Wilk test), and categorical variables (e.g., sex, complication grade, prolonged vs. non-prolonged LOS) are presented as frequencies and percentages. Continuous variables were compared between patients with and without prolonged LOS using the independent-samples t-test or the Mann-Whitney U test, as appropriate; categorical variables were compared using the Chi-square test or Fisher's exact test where expected cell counts were small. Multivariate logistic regression was planned to identify independent predictors of prolonged LOS after adjusting for age, ASA grade, and complication severity, with results expressed as adjusted odds ratios and 95% confidence intervals. Where applicable, receiver operating characteristic (ROC) curve analysis was used to assess the discriminative ability of nutritional indices for prolonged LOS. A two-tailed p-value < 0.05 was considered statistically significant throughout.

3. The Burden of Prolonged Hospital Stay After Emergency Abdominal Surgery

Prolonged hospitalization after emergency abdominal surgery is not a rare or incidental occurrence; it is a common and largely predictable outcome that places significant strain on both patients and health systems. Large-scale national audit programs illustrate the scale of the problem well. The UK National Emergency Laparotomy Audit (NELA), which has tracked outcomes in tens of thousands of patients undergoing emergency laparotomy, has repeatedly reported median hospital stays in the range of two to three weeks, alongside 30-day mortality historically around 11–14% [1,4]. Even as risk-adjusted mortality has improved over successive audit cycles, LOS has remained substantial, and both complication rates and stay duration worsen sharply with advancing age and comorbidity burden [4]. Patients at the extreme end of NELA's predicted-mortality risk spectrum experience roughly double the LOS of already high risk patients, together with markedly higher rates of unplanned return to theatre — underscoring how disease severity and LOS scale together rather than independently [3].

This pattern is not confined to laparotomy for intra-abdominal catastrophe. Studies of emergency abdominal wall hernia repair, a more circumscribed but still acute surgical population, report that strangulation, higher American Society of Anesthesiologists (ASA) class, longer operative duration, and postoperative complications are each independently associated with a longer hospital stay [5,6]. Beyond the acute admission itself, broader assessments of quality of life after emergency abdominal surgery identify the duration of the index hospitalization as a key determinant of medium- to long-term

recovery and wellbeing, extending the consequences of prolonged LOS well past hospital discharge [2]. Taken together, this body of evidence reframes prolonged LOS as a measurable, largely anticipatable outcome — one shaped by identifiable preoperative patient factors and postoperative clinical events, rather than by chance — and therefore a legitimate target for structured risk assessment and intervention.

4. Preoperative Nutritional Status as a Predictor of Length of Stay

4.1 Hypoalbuminemia as a Single Marker

Serum albumin is the most widely used single biochemical marker of nutritional status in surgical risk assessment, in part because it is inexpensive, already collected routinely, and reflects both chronic nutritional depletion and the acute inflammatory response to illness. Multiple studies in emergency abdominal and laparotomy populations report a consistent pattern: patients with preoperative hypoalbuminemia (commonly defined as albumin below 3.5 g/dL) have longer mean or median hospital stays than those with normal albumin, with differences of roughly three to four days reported across several cohorts [9,10,12,13]. Hypoalbuminemic patients also show higher rates of surgical site infection and wound dehiscence [9,11], and multivariate analyses have identified hypoalbuminemia as an independent predictor of major adverse events and prolonged LOS even after adjustment for body mass index and comorbidity [14]. Older work combining serum albumin with age produced regression equations capable of estimating expected LOS in general surgical patients, underscoring how early and how consistently this relationship has been observed [15].

4.2 Composite Nutritional Screening and Assessment Tools

Because albumin alone can be confounded by acute inflammation and fluid status, composite tools that combine several nutritional and physiological parameters have been developed and validated in surgical cohorts. In a prospective cohort of patients undergoing emergency abdominal surgery, three such tools — the CONUT score, the PNI, and the NRI — were all significant predictors of postoperative complications, with the NRI showing the highest diagnostic accuracy of the three [8]. The GNRI, which combines albumin with actual-to-ideal body weight, has been shown in a large national surgical quality database to identify a graded relationship between worsening malnutrition category and increasing 30-day mortality, morbidity, and LOS among elderly patients undergoing emergency surgery [17]. Similar findings have been reported in elective but physiologically comparable populations, where a high or moderate GNRI defined nutritional risk independently predicted prolonged postoperative LOS [18], and where GNRI-assessed nutritional risk predicted both LOS and postoperative delirium in older non-cardiac surgical patients [19].

The NRS-2002 tool, which incorporates recent weight loss, body mass index, reduced food intake, disease severity, and age, has similarly been associated with increased postoperative complications, higher mortality, and prolonged hospital stay in systematic reviews of abdominal surgery cohorts [20]. In hospitalized elderly medical and surgical patients, nutritional risk on the NRS-2002 has been shown, together with the presence of complications, to independently predict a hospital stay longer than seven days [21], and in gastrointestinal and hepatopancreatobiliary oncological surgery, NRS-2002-defined nutritional risk has emerged as an independent predictor of postoperative complications and extended stay [22]. Comparable associations between low PNI, high CONUT scores, and postoperative morbidity have been reported in gastric cancer surgery and in inflammatory bowel disease surgery, reinforcing that the relationship between composite nutritional risk and adverse outcome is not specific to a single disease process but reflects a general physiological vulnerability [23,24,27]. Broader observational work in general surgical populations comparing nutritionally adequate and nutritionally compromised patients found that the latter group experienced significantly more infections, slower wound healing, longer hospital stays, more readmissions, and higher 30-day mortality [25], a pattern echoed in prospective series specifically examining abdominal surgery outcomes in relation to preoperative nutritional screening [26]. Direct comparisons of different screening instruments in perioperative elderly patients show that the tools do not always agree on which patients are at risk, suggesting that no single instrument is definitively superior and that the choice of tool may need to be tailored to the clinical setting [28].

4.3 Sarcopenia and Frailty as Extensions of Chronic Nutritional Depletion

Sarcopenia — the age-related loss of skeletal muscle mass and

function — and frailty, a broader state of diminished physiological reserve, are closely linked to chronic nutritional depletion and are increasingly recognized as predictors of adverse outcome in emergency surgical populations. A frailty index has been shown to independently predict postoperative complications, major complications, and hospital LOS in elderly patients undergoing emergency general surgery, outperforming age and ASA grade in this respect [29]. In very elderly patients undergoing emergency surgery, computed tomo-graphy-defined sarcopenia was associated with a markedly higher rate of postoperative complications and in-hospital mortality, and increasing skeletal muscle index was independently associated with reduced mortality after adjustment for confounders [30]. A recent systematic review and meta-analysis of frailty in emergency abdominal surgery, incorporating over 1.7 million participants across 31 studies, confirmed that frail patients have substantially higher odds of short- and medium-term mortality, alongside worse complication rates, LOS, and discharge outcomes compared with non-frail patients [31]. Frailty has also been shown to predict mortality across the full range of emergency surgical admissions regardless of patient age, with the most frail patients being disproportionately likely to have longer hospital stays and higher readmission and death rates [32]. These findings are consistent with observations in critically ill and septic surgical populations, where sarcopenia independently predicts prolonged hospital and intensive care unit stay [33], and with prospective cohorts showing that combined sarcopenia and frailty carry an elevated risk of adverse 90-day postoperative recovery in older surgical patients generally [34,35].

5. Postoperative Complications and Their Relationship to Length of Stay

5.1 Complication-Severity Grading Systems

The Clavien-Dindo classification, which grades the severity of individual postoperative complications according to the therapy required to treat them, remains the most widely used system in surgical outcomes research and correlates significantly with the duration of hospitalization across a range of abdominal and non-abdominal procedures [38,39]. However, because Clavien-Dindo records only the single most severe complication a patient experiences, it can understate the cumulative burden in patients who develop several complications of lesser individual severity. The Comprehensive Complication Index (CCI), which aggregates all complications into one continuous severity-weighted score, has repeatedly shown a stronger correlation with LOS and with in-hospital costs than Clavien-Dindo alone, both in colorectal resection cohorts and in broader major abdominal surgery populations [36,37]. This distinction matters for emergency abdominal surgery, where multiple, overlapping complications (for example, surgical site infection together with respiratory compromise and ileus) are common, and a cumulative index may better capture the true relationship between morbidity and prolonged stay than a single worst-grade classification.

5.2 Complication Types Most Strongly Linked to Prolonged Stay

Across the reviewed literature, several complication types recur as particularly influential drivers of extended LOS: surgical site infection and wound dehiscence, both of which are more frequent in hypoalbuminemic and nutritionally at-risk patients [9,11]; anastomotic leak and delayed gastric emptying, reported disproportionately in patients with poor preoperative nutritional markers undergoing gastrointestinal resection [24]; postoperative delirium, associated with nutritional risk in older non-cardiac surgical patients and itself a driver of prolonged stay [19]; and biliary or inflammatory complications in acute cholecystitis, where elevated inflammatory markers and biliary complications independently predicted prolonged LOS after cholecystectomy [7]. Perioperative factors such as prolonged preoperative fasting have also been linked to both a higher incidence of complications and longer hospital stay in surgical oncology cohorts, suggesting that some drivers of prolonged LOS are modifiable through perioperative process changes rather than being fixed patient characteristics [40].

5.3 Relative Contribution of Key Preoperative Factors to Complication Risk

To illustrate the comparative strength of association reported for the main preoperative factors discussed above, Figure 1 summarizes point estimates for postoperative complications drawn directly from the individual studies reviewed. Hypoalbuminemia showed the largest reported association with postoperative complications among the factors compared, followed by frailty (particularly for major complications), pooled nutritional risk on the NRS-2002, and

sarcopenia [12,20,22,29,30]. These figures come from separate studies with different populations, procedures, complication definitions, and reference groups, so they are not directly comparable in a statistical sense and should be read as an illustrative, not pooled, summary of the literature.

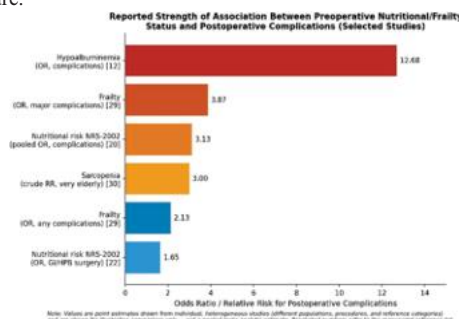


Figure1. Reported Odds Ratios/relative Risk For Postoperative Complications Associated with Key Preoperative Nutritional and Frailty Markers, Drawn From Individual Studies [12,20,22,29,30].

6. The Nutrition–Complication–Length-of-Stay Axis: A Conceptual Model

The evidence reviewed above supports a coherent, if not always formally tested, causal pathway. Preoperative malnutrition impairs immune function, collagen synthesis, and physiological reserve; this predisposes patients undergoing the physiological stress of emergency surgery to a higher burden of postoperative complications, most notably infective and wound-related complications; and the resulting complications — particularly when they are multiple or severe — are themselves the proximate driver of prolonged hospital stay. Several of the studies reviewed support pieces of this pathway directly: nutritional risk scores predict both complications and LOS in the same cohorts [8,20,21], and malnutrition assessed by the PNI in emergency laparotomy patients remained independently associated with stoma formation and prolonged LOS even after adjustment for ASA grade, frailty, comorbidity burden, hypotension, and sepsis [16], indicating that the nutritional contribution to LOS is not simply explained away by these other markers of severity. This suggests that nutritional status and postoperative complications should not be treated as two independent, competing predictors in risk models, but as sequential links in a single causal chain — with nutritional optimization representing the more upstream, and therefore potentially more modifiable, intervention point.

7. Additional Predictors that Modulate This Relationship

Nutritional status and complications do not act in isolation. Advanced age, higher ASA physical status classification, greater comorbidity burden, longer operative duration, open (versus laparoscopic) surgical approach, and the need for higher levels of postoperative care (high-dependency or intensive care) are all independently associated with longer LOS after emergency abdominal surgery [5,6,22,29]. Frailty, discussed above, both correlates with and appears to act independently of chronological age and ASA grade in predicting complications and LOS [29,31,32]. Male sex, open surgical approach, contaminated wound class, and emergency status itself have also been identified as independent predictors of surgical site infection, a key mediator of prolonged stay [38]. Clinically, this means that nutritional screening should be interpreted alongside, rather than instead of, existing validated risk tools such as the NELA risk calculator or frailty indices, since the combination of poor nutritional status with high physiological risk and frailty appears to identify a particularly vulnerable subgroup.

8. Risk Stratification and Clinical Application

From a clinical standpoint, the evidence supports incorporating a brief, validated nutritional screening tool — such as the NRS-2002, CONUT score, PNI, or GNRI — into the preoperative or immediate postoperative assessment of emergency abdominal surgery patients, alongside established surgical risk-prediction tools. Because malnutrition is common but frequently unrecognized and rarely screened for systematically in routine emergency surgical pathways [9,26], even a simple albumin based assessment can add meaningful prognostic information at negligible cost [9,13]. Systematic recording of postoperative complications using a cumulative severity index rather than worst-grade classification alone would likely improve the

precision with which LOS is predicted and audited [36,37]. Combining nutritional risk category with frailty assessment may further refine identification of the subset of patients most likely to experience both complications and prolonged stay, allowing resources such as early dietitian involvement, geriatric perioperative input, or step-down/high-dependency bed planning to be targeted more efficiently.



Appendicular Perforation with Abscess Formation

9. Preventive and Mitigation Strategies

Enhanced Recovery After Surgery (ERAS) programs, well established in elective gastrointestinal and oncological surgery, incorporate structured perioperative nutritional care — including preoperative carbohydrate loading, minimization of fasting, and early postoperative feeding — and have been shown to reduce complications, shorten LOS, and lower costs [46,48]. Multimodal prehabilitation, which combines nutritional optimization with exercise and psychological preparation before surgery, has demonstrated reductions in postoperative complications and LOS across several elective surgical specialties, with nutritional prehabilitation in particular linked to fewer infectious complications and shorter stays in colorectal cancer surgery [44,45,47]. Translating these principles to the emergency setting is inherently more difficult, since there is little or no time for conventional prehabilitation before an urgent operation. Nonetheless, consensus ERAS guidelines specific to emergency laparotomy recommend rapid preoperative assessment and optimization, and a recent scoping review proposes emergency-department-feasible measures — including early safe nutrition, correction of micronutrient deficiencies, and structured risk stratification using frailty and sarcopenia markers — that could begin nutritional and physiological optimization within the limited window available before emergency surgery [42,43]. Early postoperative nutritional support, including early enteral feeding where appropriate, represents an additional, more readily achievable intervention point in this population [46].

10. Limitations of the Current Evidence Base

Several limitations temper the strength of these conclusions. Most nutritional assessment studies in the emergency abdominal surgery literature are single-center, retrospective or small prospective cohorts, and definitions of both malnutrition and "prolonged" LOS vary considerably between studies, limiting direct comparison and pooling of estimates. Many of the composite nutritional tools were developed and validated primarily in elective oncological surgery, and their performance characteristics in the physiologically distinct emergency setting are less thoroughly established, although emerging emergency-specific cohorts are beginning to address this gap [8,16,17]. Complication-severity grading is not applied uniformly across studies, and few report both nutritional status and cumulative complication burden together, which limits formal testing of the mediation pathway proposed in this review. Finally, there remains a scarcity of randomized controlled trials evaluating nutritional intervention specifically in the emergency abdominal surgery population, meaning that current recommendations rely substantially on observational

associations and extrapolation from elective surgical evidence. The present study itself is limited by its modest single-center sample size ($n = 50$), which restricts the number of covariates that can be entered into a stable multivariable model and limits generalizability beyond this setting; a composite nutritional screening tool (e.g., NRS-2002, CONUT, or PNI) was not consistently recorded for this cohort, so serum albumin was used as the primary nutritional marker; and the prolonged-LOS threshold (>7 days) was fixed a priori rather than derived from this cohort's own median, which should be borne in mind when comparing these findings with studies using a different cut-off.

11. CONCLUSION

In this prospective study of 50 patients undergoing emergency abdominal surgery at Government Cuddalore Medical College and Hospital over 18 months (January 2025 to June 2026), 40.0% of patients experienced a prolonged postoperative hospital stay (>7 days). Preoperative hypoalbuminemia, any postoperative complication, major complication (Clavien-Dindo grade ≥ 3), and higher ASA grade (III/IV) were each significantly associated with prolonged LOS on bivariate analysis, and each remained associated with increased odds of prolonged LOS on univariable logistic regression. These findings, from the study's own cohort, are consistent with the wider published evidence reviewed in this manuscript and support the conclusion that preoperative nutritional status and postoperative complications are interconnected, clinically accessible, and partly modifiable predictors of prolonged hospital stay after emergency abdominal surgery. Systematic preoperative nutritional screening (e.g., serum albumin at admission), cumulative rather than single-worst-grade complication scoring, and adaptation of ERAS and nutrition-focused perioperative pathways to the constraints of the emergency setting represent achievable steps toward reducing the burden of prolonged hospitalization in this high-risk surgical population at this and similar centers. Given the modest sample size and single-center design, larger, multicenter prospective studies with a fully adjusted multivariable model remain a priority to confirm these findings and to test nutritional intervention specifically in the emergency abdominal surgery population.



Gastric Antral Perforation. Perforation Peritonitis



Xray Abdomen Erect Shows Sigmoid Volvulus



Sigmoid Volvulus



Intussusception - Intestinal Obstruction

12. RESULTS

12.1 Baseline Characteristics

Fifty patients were enrolled over the 18-month study period (January 2025 to June 2026) and followed prospectively to discharge. The mean age was 47.0 ± 9.8 years (range 27–75 years), and 39 (78.0%) were male. Acute appendicitis was the most common indication for surgery (14/50, 28.0%), followed by sigmoid volvulus (6/50, 12.0%), perforation peritonitis (5/50, 10.0%), and gastric antral perforation (5/50, 10.0%). Baseline demographic, nutritional, and outcome characteristics are summarized in Table 1; the distribution of diagnoses is summarized in Table 2.

Table1. Baseline Demographic, Nutritional, and Outcome Characteristics (n=50).

Characteristic	Value (n = 50)
Age, years (mean ± SD)	47.0 ± 9.8
Age, years (median, IQR)	47.0 (39.3–52.8)
Sex, Male	39 (78.0%)
Sex, Female	
ASA Grade I	
ASA Grade II	
ASA Grade III	
ASA Grade IV	
Serum albumin, g/dL (mean ± SD)	
Hypoalbuminemia (<3.5 g/dL)	
Any postoperative complication (Clavien-Dindo ≥ II)	
Major complication (Clavien-Dindo ≥ IIIa)	
Postoperative LOS, days (mean ± SD)	
Postoperative LOS, days (median, IQR)	
Prolonged LOS (>7 days)	

Table2. Diagnosis Distribution in the Study Cohort(n=50).

Diagnosis / Indication for Surgery	n (%)
Acute appendicitis	14 (28.0%)
Sigmoid volvulus	6 (12.0%)

Perforation peritonitis	5 (10.0%)
Gastric antral perforation	5 (10.0%)
Acute intestinal obstruction	3 (6.0%)
Duodenal perforation	2 (4.0%)
Rectosigmoid stricture	2 (4.0%)
Acute cholecystitis	2 (4.0%)
Others (appendicular abscess, liverabscess, cecal perforation/volvulus, intussusception, mesenteric ischemia, cholelithiasis, CBD calculi, blunt injury abdomen — 1 each)	11 (22.0%)

12.2 Nutritional Status, Complications, and Length of Stay

The mean preoperative serum albumin was 3.57 ± 0.93 g/dL; 20 of 50 patients (40.0%) had hypoalbuminemia (albumin <3.5 g/dL). Twenty patients (40.0%) developed at least one postoperative complication (Clavien-Dindo grade ≥ II), of whom 18 (36.0% of the total cohort) had a major complication (Clavien-Dindo grade ≥ IIIa); the single most common complication grade overall was Clavien-Dindo II (31/50, 62.0%). Mean postoperative LOS for the cohort was 7.16 ± 3.62 days (median 6 days, IQR 5–9 days; range 2–17 days), and 20 patients (40.0%) had a prolonged postoperative stay, defined a priori as LOS >7 days (Shapiro-Wilk test confirmed a non-normal LOS distribution, W =0.910, p = 0.001, supporting the use of non-parametric tests for LOS comparisons below).

12.3 Predictors of Prolonged Length of Stay

Hypoalbuminemic patients had significantly longer LOS than normoalbuminemic patients (mean 9.65 ± 3.72 vs. 5.50 ± 2.43 days; Mann-Whitney U, p<0.001), and a significantly higher proportion had prolonged LOS (70.0% vs. 20.0%; $\chi^2 = 10.50$, p = 0.0012). Patients who developed any postoperative complication also had longer LOS than those who did not (mean 9.45 ± 4.10 vs. 5.63 ± 2.25 days; Mann-Whitney U, p = 0.0003) and a higher rate of prolonged LOS (65.0% vs. 23.3%; $\chi^2 = 7.03$, p = 0.0080). This association was similarly significant when restricted to major complications (Clavien-Dindo ≥ IIIa: 66.7% prolonged vs. 25.0%; $\chi^2 = 6.69$, p = 0.0097), and for higher ASA grade (III–IV: 70.6% prolonged vs. 24.2% for ASA I–II; $\chi^2 = 8.20$, p = 0.0042). These associations are summarized in Table 3 and illustrated in Figure 2.

Table3. Association Between Key Predictors and Prolonged Postoperative Length of Stay(>7days).

Predictor	Prolonged LOS n/N (%)	Not Prolonged n/N (%)	Test statistic	p-value
Hypoalbuminemia (vs. normal albumin)	14/20 (70.0%)	6/30 (20.0%)	$\chi^2 = 10.50$	0.0012
Any postoperative complication (vs. none)	13/20 (65.0%)	7/30 (23.3%)	$\chi^2 = 7.03$	0.0080
Major complication, Clavien-Dindo ≥IIIa (vs. ≤II)	12/18 (66.7%)	8/32 (25.0%)	$\chi^2 = 6.69$	0.0097
ASA Grade III–IV (vs. I–II)	12/17 (70.6%)	8/33 (24.2%)	$\chi^2 = 8.20$	0.0042

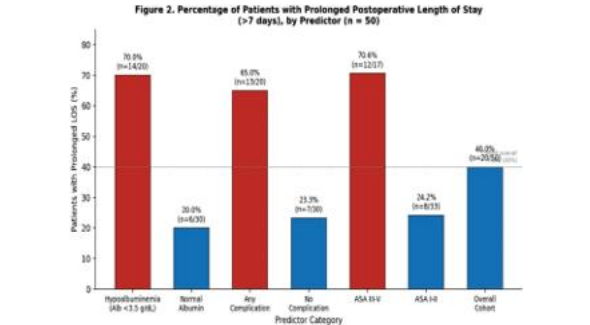


Figure2.Percentage of Patients with Prolonged Postoperative Length of Stay(>7days), by Predictor Category, in the Study Cohort(n=50). Bars Show the Study's Own Results, Not Pooled Literature Estimates.

12.4 Multivariable Analysis

On univariable logistic regression, lower serum albumin, older age, presence of a major complication, and higher ASA grade were each associated with increased odds of prolonged LOS (Table 4). Because

of the modest sample size (n = 50) relative to the number of candidate predictors, these estimates should be interpreted as hypothesis generating rather than as a fully adjusted multivariable model; a larger sample would be needed to fit a stable multivariable logistic regression with all four covariates simultaneously without overfitting.

Table4. Univariable Logistic Regression for Predictors of Prolonged Length of Stay.*Odds Ratio Per One-unit Increase in the Predictor(or for the Stated Binary Comparison).

Predictor	Univariable Odds Ratio*	Direction
Serum albumin (per 1 g/dL increase)	0.28	Higher albumin → lower odds of prolonged LOS
Age (per 1-year increase)	1.11	Older age → higher odds of prolonged LOS
Major complication (Clavien-Dindo ≥IIIa, yes vs. no)	3.60	Major complication → higher odds of prolonged LOS
ASA Grade III–IV (vs. I–II)	4.13	Higher ASA grade → higher odds of prolonged LOS

Taken together, these results support the pathway proposed in Section 6 of this manuscript: in this cohort, poorer preoperative nutritional status (lower serum albumin) and greater postoperative complication burden were each independently and significantly associated with prolonged hospital stay after emergency abdominal surgery, consistent with the wider published literature reviewed in Sections 3–7.

Appendix: Definitions of Complication and Nutritional Scoring Systems Referenced in This Manuscript

This appendix reproduces the standard definitions of the complication-severity and nutritional-risk classification systems referenced in Sections 2, 4, and 5 of this manuscript, for the reader's convenience.

A1. Clavien-Dindo Classification of Surgical Complications

Complications recorded in this study (Section 2.5) were graded according to the Clavien -Dindo classification, defined as follows:

Appendix Table A1. Clavien-Dindo Classification of Surgical Complications, Graded According to the Therapy Required to Treat the Complication.

Grade	Definition
Grade I	Any deviation from the normal postoperative course without need for pharmacological treatment, or surgical, endoscopic, or radiological intervention. Permitted therapeutic regimens include antiemetics, antipyretics, analgesics, diuretics, electrolyte correction, and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than those allowed for Grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade IIIa	Requiring surgical, endoscopic, or radiological intervention, performed without general anesthesia.
Grade IIIb	Requiring surgical, endoscopic, or radiological intervention, performed under general anesthesia.
Grade IVa	Life-threatening complication (including CNS complications) requiring intermediate care/ intensive care unit management, with single-organ dysfunction (including dialysis).
Grade IVb	Life-threatening complication requiring intermediate care/intensive care unit management, with multi-organ dysfunction.
Grade V	Death of the patient.

A2. Nutritional Risk Index (NRI)

The Nutritional Risk Index (NRI), described by Buz by et al. for the Veterans Affairs Total Parenteral Nutrition Cooperative Study, is calculated from serum albumin and the ratio of current to usual body weight:
$$NRI = [1.519 \times \text{serum albumin (g/L)}] + [41.7 \times (\text{current weight} / \text{usual weight})]$$

"Usual weight" refers to the patient's stable, pre-illness body weight as reported by the patient or a reliable historian. The resulting score is interpreted as follows:

Appendix Table A2. Nutritional Risk Index (NRI) Categories.

NRI Score	Nutritional Risk Category
> 100	No nutritional risk
97.5 – 100	Mild malnutrition risk
83.5 – < 97.5	Moderate malnutrition risk
< 83.5	Severe malnutrition risk

A3. Controlling Nutritional Status (CONUT) Score

The Controlling Nutritional Status (CONUT) score, described by Ignacio de Ulíbarri et al., is a composite score derived from three routinely available laboratory parameters: serum albumin, total cholesterol, and total lymphocyte count. Each parameter contributes a sub-score, and the three sub-scores are summed to give a total CONUT score ranging from 0 to 12.

Serum albumin sub-score (Appendix Table A3a):

CONUT Component	0 points	2 points	4 points	6 points
Serum albumin (g/dL)	≥ 3.5	3.0–3.49	2.5–2.9	< 2.5

Total cholesterol and total lymphocyte count sub-scores (Appendix Table A3b):

CONUT Component	0 points	1 point	2 points	3 points
Total cholesterol (mg/dL)	≥ 180	140–179	100–139	< 100
Total lymphocyte count (cells/mm³)	≥ 1600	1200–1599	800–1199	< 800

The three sub-scores are summed to give the total CONUT score, which is interpreted as follows:

Total CONUT Score	Nutritional Status
0 – 1	Normal (no malnutrition)
2 – 4	Light (mild) malnutrition
5 – 8	Moderate malnutrition
9 – 12	Severe malnutrition

Appendix Table A4. Conut Total Score Categories (Sum of the Albumin, Cholesterol, and Lymphocyte Sub-scores).

Note: Neither the NRI nor the CONUT score was completed for the majority of patients in the present cohort's dataset (Section 10, Limitations); serum albumin alone was used as the primary nutritional marker for the study's own Results (Section 12). These definitions are provided so that the tools discussed in the literature review (Sections 4.1–4.2) can be applied directly by readers or in future data collection at this center.

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