

Preoperative serum albumin as a predictor of postoperative morbidity and mortality in major gastrointestinal surgery: A retrospective study

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Abstract

Preoperative hypoalbuminemia has been associated with adverse surgical outcomes and may serve as a predictor of postoperative morbidity and mortality in patients undergoing gastrointestinal surgery. This retrospective observational study was conducted at Nepal Medcity Hospital from January 2023 to December 2025 and included 122 patients undergoing major gastrointestinal surgical procedures. Patients were categorized into two groups based on preoperative serum albumin levels: hypoalbuminemia (<3.5 g/dL) and normal serum albumin (≥ 3.5 g/dL). The mean age of the study population was 60.71 ± 14.89 years, and 56.6% were male. Fifty-six patients had hypoalbuminemia, while 66 had normal serum albumin levels. Overall postoperative complications occurred in 38 patients (31.15%). Patients with hypoalbuminemia had a significantly higher rate of postoperative complications compared with those with normal serum albumin levels (46.43% vs. 18.18%; $p=0.0009$). Surgical site infection was the most common complication, followed by anastomotic leak and delayed gastric emptying. Postoperative pneumonia occurred exclusively in the hypoalbuminemia group ($p=0.0418$). The overall mortality rate was 8.20%, with significantly higher mortality in patients with hypoalbuminemia than in those with normal serum albumin levels (14.29% vs. 3.03%; $p=0.0426$). These findings demonstrate that preoperative hypoalbuminemia is significantly associated with increased postoperative morbidity and mortality following major gastrointestinal surgery and may serve as a reliable predictor of adverse postoperative outcomes.

Keywords: Preoperative serum albumin; Hypoalbuminemia; Gastrointestinal surgery; Postoperative complications

1. Introduction

Gastrointestinal surgeries are commonly associated with significant postoperative morbidity and mortality, particularly in patients with poor nutritional status. Malnutrition is frequently encountered among hospitalized surgical patients, with studies suggesting that nearly one-third to one-half of patients are malnourished at the time of hospital admission. Poor nutritional status adversely affects wound healing, immune response, postoperative recovery, and overall clinical outcomes. (1, 2)

Serum albumin is one of the most widely utilized biochemical markers for assessing nutritional status and perioperative surgical risk. Albumin plays a crucial physiological role in maintaining plasma oncotic pressure, transport of various endogenous and exogenous substances, antioxidant activity, and modulation of inflammatory responses. (3) Hypoalbuminemia, commonly defined as serum albumin levels below 3.5 g/dL, has been associated with impaired collagen synthesis, delayed wound healing, reduced immune competence, and increased susceptibility to postoperative infections and anastomotic leakage. (4, 5)

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Several studies have demonstrated a significant association between preoperative hypoalbuminemia and adverse postoperative outcomes in patients undergoing major surgeries, including gastrointestinal procedures. Patients with low serum albumin levels have been shown to experience higher rates of surgical site infection, pneumonia, delayed recovery of bowel function, anastomotic leak, prolonged hospital stay, and postoperative mortality. (6, 7) Gastrointestinal surgery patients are particularly vulnerable because malignancy, reduced oral intake, intestinal obstruction, impaired absorption, and chronic catabolic states frequently contribute to malnutrition and hypoalbuminemia. (8)

Despite growing evidence regarding the prognostic importance of serum albumin, limited data are available from Nepal assessing its predictive value in major gastrointestinal surgeries. Early identification of high-risk patients using a simple and cost-effective laboratory parameter may help optimize perioperative management and improve surgical outcomes.

Therefore, this study was conducted to evaluate the role of preoperative serum albumin levels as a predictor of postoperative morbidity and mortality in patients undergoing major gastrointestinal surgeries at Nepal Medicit Hospital.

2. Methods

This retrospective observational study was conducted at Nepal Medicit Hospital from January 2023 to December 2025. Medical records of patients who underwent major gastrointestinal surgical procedures during the study period were reviewed.

A total of 122 patients undergoing major gastrointestinal surgeries were included in the study. Surgical procedures included gastrectomy, colectomy, pancreaticoduodenectomy (Whipple procedure), hepatectomy, bowel resection, anterior resection, and other major gastrointestinal and hepatopancreatobiliary surgeries. Patients with incomplete records, chronic liver disease, nephrotic syndrome, severe systemic illness significantly affecting serum albumin levels, or those receiving albumin supplementation preoperatively were excluded.

Preoperative serum albumin levels measured within 7 days prior to surgery were recorded. Patients were divided into two groups based on serum albumin levels: hypoalbuminemia group (<3.5 g/dL) and normal albumin group (≥ 3.5 g/dL).

The primary outcomes assessed were postoperative morbidity and 30-day postoperative mortality. Postoperative complications included surgical site infection, anastomotic leak, delayed gastric emptying, pneumonia, urinary tract infection, postoperative bleeding, intraabdominal collections, multiorgan dysfunction, and cardiac complications.

Data were analyzed using SPSS version 23.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Categorical variables were compared using the Chi-square test or Fisher's Exact test where appropriate. A p-value of <0.05 was considered statistically significant. Patient confidentiality was maintained throughout the study.

3. Results

A total of 122 patients undergoing major gastrointestinal surgical procedures were included in the study. The mean age of the study population was 60.71 ± 14.89 years, with a median age of 61.5 years. The age ranged from 20 to 92 years. The study population consisted of 69 males (56.6%) and 53 females (43.4%) (Fig: 1). Based on preoperative serum albumin levels, patients were categorized into two groups: 56 patients with hypoalbuminemia (serum albumin <3.5 g/dL) and 66 patients with serum albumin ≥ 3.5 g/dL.

The surgical spectrum predominantly comprised major upper gastrointestinal and hepatopancreatobiliary procedures. Distal gastrectomy was the most commonly performed surgery ($n=22$, 18.03%), followed by Whipple's pancreaticoduodenectomy ($n=20$, 16.39%) and right/extended right hemicolectomy ($n=18$, 14.75%). Other frequently performed procedures included anterior resection, proximal gastrectomy with double tract reconstruction, and total gastrectomy ($n=5$ each, 4.10%). Additional colorectal, hepatobiliary, pancreatic, and palliative procedures constituted the remaining operative workload (Table: 2).

Gastrointestinal malignancies formed the major disease burden within the study population. Stomach carcinoma was the most common diagnosis ($n=29$), followed by colorectal malignancies involving the colon ($n=24$). Periampullary

carcinoma and rectal carcinoma accounted for 12 cases each. Gastric gastrointestinal stromal tumors (GIST) were observed in 9 patients, while pancreatic head carcinoma and gallbladder carcinoma were present in 5 patients each. Other less frequent diagnoses included esophageal carcinoma, cholangiocarcinoma, cystic pancreatic neoplasms, mesenteric and omental GISTs, neuroendocrine tumors, and benign or premalignant lesions (Table: 1).

Overall postoperative complications occurred in 38 patients (31.15%). Patients with preoperative hypoalbuminemia demonstrated a significantly higher complication rate compared with patients with normal serum albumin levels. In the hypoalbuminemia group, 26 of 56 patients (46.43%) developed postoperative complications, whereas only 12 of 66 patients (18.18%) in the normal albumin group developed complications (Table: 3). This association between hypoalbuminemia and postoperative morbidity was statistically significant (Table: 5).

A total of 47 postoperative complication events were observed. Surgical site infection was the most common complication, occurring in 17 patients, followed by anastomotic leak (n=7) and delayed gastric emptying (n=4). Most complications were more frequently observed among hypoalbuminemic patients. Notably, postoperative pneumonia developed exclusively in the hypoalbuminemia group (n=4) and was absent in patients with normal albumin levels, demonstrating statistical significance (p=0.0418). Other complications predominantly observed in the hypoalbuminemia group included upper gastrointestinal bleeding, urinary tract infection, cardiac failure, multiorgan dysfunction, and intraabdominal hemorrhage (Table: 6).

Postoperative mortality was observed in 10 patients (8.20%) overall. Mortality was significantly higher among patients with low preoperative serum albumin levels, with 8 deaths among 56 patients (14.29%) compared with 2 deaths among 66 patients (3.03%) in the normal albumin group. Statistical analysis confirmed a significant association between preoperative hypoalbuminemia and postoperative mortality (Table: 4).

These findings demonstrate that preoperative hypoalbuminemia is strongly associated with increased postoperative morbidity and mortality following major gastrointestinal surgery and may serve as a reliable predictor of adverse postoperative outcomes.

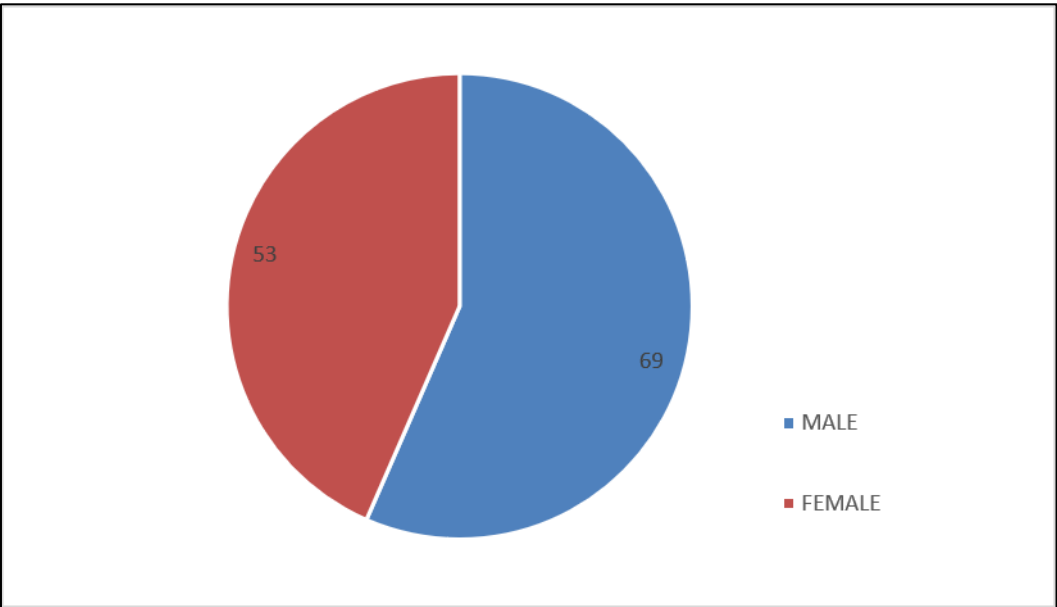


Figure 1 Sex Distribution

Table 1 Distribution of Diagnoses among Study Patients

Diagnosis	Number of Patients
Stomach Carcinoma	29
Colon Carcinoma / Tumors (<i>incl. Right, Left, Sigmoid</i>)	24
Periampullary Carcinoma	12

Rectal Carcinoma	12
Stomach GIST (<i>Gastrointestinal Stromal Tumor</i>)	9
Gallbladder Carcinoma	5
Pancreatic Head Carcinoma	5
Esophageal Carcinoma	4
Duodenal Carcinoma	3
Cystic Pancreatic Neoplasms (IPMN / Mucinous Cystic Neoplasm/SPEN)	3
Distal Cholangiocarcinoma	2
Mesenteric GIST	2
Ampullary Adenoma / Polyp	2
Appendiceal Mucinous Neoplasm	1
Rectal Perforation	1
Rectal Polyp	1
Pancreatic Neuroendocrine Tumor	1
Hilar Cholangiocarcinoma	1
Small Bowel Perforation	1
Omental GIST	1
Focal Nodular Hyperplasia (FNH)	1
Liver Metastasis	1
Liver Angiomyolipoma	1
Total	122

Table 2 Distribution of Surgical Procedures Performed

Operation Performed	Number
Distal Gastrectomy	22
Whipple's Pancreaticoduodenectomy	20
Right / Extended Right Hemicolectomy	18
Anterior Resection (AR)	5
Proximal Gastrectomy (with Double Tract Reconstruction)	5
Total Gastrectomy	5
Gastric Wedge Resection (for GIST)	4
Esophagectomy (Ivor Lewis / McKeown)	4
Left Hemicolectomy	4
Sigmoidectomy	3
Small Bowel Resection / Repair / Tumor Excision	3
Low Anterior Resection (LAR)	3
Hartmann's Procedure	3

Extended Cholecystectomy	3
Liver Resection / Segmentectomy	3
Palliative Bypass Surgery	2
Duodenal Resection	2
Transduodenal Ampullectomy	2
Spleen-Preserving Distal Pancreatectomy	2
Extrahepatic Bile Duct Excision with Roux-en-Y Hepaticojejunostomy	2
Abdominal Perineal Resection (APR)	1
Polypectomy	1
Diverting Loop Colostomy	1
Total Gastrectomy with Distal Pancreatectomy & Splenectomy	1
Pancreatic Cyst Enucleation	1
Omental Mass Excision	1
Palliative Cholecystectomy	1
Total Operations	122

Table 3 Association Between Preoperative Serum Albumin Level and Postoperative Complications

Preoperative Albumin	Total Patients	Patients who developed Complications	Complication Percentage
<3.5	56	26	46.43%
>3.5	66	12	18.18%
TOTAL	122	38	31.15%

Table 4 Association Between Preoperative Serum Albumin Level and Postoperative Mortality

Preoperative Albumin	Total Patients	Mortalities	Mortality Percentage	P Value
<3.5	56	8	14.29%	0.0426
>3.5	66	2	3.03%	
TOTAL	122	10	8.20%	

Table 5 Comparison of Postoperative Outcomes Between Low and Normal Serum Albumin Groups

Parameter	Low Albumin Group (<3.5) (N=56)	Low Albumin Group (≥3.5) (N=66)	P Value
Overall Patient Complication Rate	46.43% (26/56)	18.18% (12/66)	0.0009

Table 6 Postoperative Complications

Complication Category	Number
Surgical Site Infection (SSI) <i>(Includes Superficial, Deep, Organ/Space)</i>	17
Anastomotic Leak	7
Delayed Gastric Emptying	4
Pneumonia	4
Upper GI Bleed <i>(anastomotic site GI bleed)</i>	2
Urinary Tract Infection	2
Intestinal Obstruction	2
Cardiac Failure	1
Multiorgan Dysfunction	1
Intraabdominal Bleed	1
Pulmonary Embolism	1

Table 7 Comparison of Postoperative Complications by Serum Albumin Levels

Outcomes	Low Albumin < 3.5 g/dL	Serum Albumin ≥3.5g/dl	P- Value
Mortality	8	2	0.0426
Postoperative Complications			
Surgical Site Infection (SSI) <i>(Includes Superficial, Deep, Organ/Space)</i>	11	6	0.1180
Anastomotic Leak	5	2	0.2454
Delayed Gastric Emptying	3	1	0.3322
Pneumonia	4	0	0.0418
Upper GI Bleed <i>(anastomotic site GI bleed)</i>	2	0	0.2086
Urinary Tract Infection (UTI)	2	0	0.2086
Intestinal Obstruction	0	2	0.4993
Cardiac Failure	1	0	0.4590
Multiorgan Dysfunction	1	0	0.4590
Intraabdominal Bleed	1	0	0.4590
Pulmonary Embolism	0	1	1.0000

4. Discussion

The present retrospective observational study conducted at Nepal Mediciti Hospital demonstrates a significant association between preoperative hypoalbuminemia and adverse postoperative outcomes following major gastrointestinal surgeries. Among 122 patients included in the study, individuals with serum albumin levels <3.5 g/dL exhibited substantially higher rates of postoperative complications (46.43% vs. 18.18%) and mortality (14.29% vs. 3.03%) compared with patients having normal serum albumin levels. These findings reaffirm the role of serum albumin as an important prognostic marker in gastrointestinal surgical patients.

Serum albumin is widely regarded as a reliable indicator of nutritional status, systemic inflammatory response, and physiological reserve. Hypoalbuminemia reflects impaired protein synthesis, increased catabolism, and chronic inflammatory burden, all of which contribute to delayed wound healing, impaired collagen formation, reduced immune competence, and increased susceptibility to postoperative complications. These pathophysiological mechanisms may explain the higher incidence of surgical site infections, anastomotic leaks, pulmonary complications, and systemic infections observed among hypoalbuminemic patients in the present study.

The findings of this study are consistent with previously published literature demonstrating the prognostic significance of serum albumin in surgical patients. Asif Ali Amir Ali et al. reported that hypoalbuminemia (<3.5 g/dL) was significantly associated with increased postoperative complications, with all 30-day mortalities occurring exclusively in the low albumin group, while surgical site infection remained the most common complication.(9) Similarly, Samuel Lalhruaizela et al. demonstrated significantly higher rates of surgical site infection, wound dehiscence, prolonged hospital stay, and mortality among patients with serum albumin levels <3 g/dL undergoing laparotomy for gastrointestinal diseases.(10)

Comparable observations were made by Arun et al. at Jubilee Mission Medical College, where hypoalbuminemic patients experienced significantly increased surgical site infections, delayed recovery of oral intake, prolonged hospitalization, and higher mortality rates, emphasizing serum albumin as a simple and cost-effective prognostic biomarker.(11) Furthermore, Badia-Tahull et al. confirmed that preoperative hypoalbuminemia was significantly associated with increased morbidity and prolonged hospital stay in patients undergoing elective major gastrointestinal surgery, irrespective of the specific surgical procedure performed.(12)

Earlier landmark studies also support these observations. Kudsk et al. demonstrated that hypoalbuminemia is strongly associated with increased postoperative morbidity and prolonged hospital stay in gastrointestinal surgical patients.(6) Likewise, Gibbs et al. identified even mild hypoalbuminemia as a significant predictor of postoperative mortality and major complications in a large surgical cohort.(4) These studies collectively support the present findings that low preoperative serum albumin significantly increases both postoperative morbidity and mortality.

Kuzu et al. further demonstrated that hypoalbuminemia is associated with increased rates of anastomotic leakage and wound infection following colorectal surgery.(13) These findings closely parallel the present study, where surgical site infection and anastomotic leak were among the most frequent complications in hypoalbuminemic patients.

An important observation in the present study was the occurrence of pneumonia predominantly among patients with hypoalbuminemia. This finding is supported by Waitzberg et al., who reported significantly higher rates of respiratory infections and sepsis among malnourished surgical patients due to impaired immune response and reduced pulmonary defense mechanisms.(14) This highlights the systemic impact of hypoalbuminemia beyond local wound-related complications.

In addition to increased morbidity, the present study demonstrated significantly higher 30-day mortality among patients with low serum albumin levels. Similar findings were reported by Garth et al., who showed that hypoalbuminemia is associated with increased perioperative mortality across surgical populations.(15) The prognostic value of serum albumin likely reflects both nutritional depletion and underlying disease severity.

Although some authors have suggested that hypoalbuminemia may primarily represent an indicator of systemic disease severity rather than a directly modifiable risk factor, its prognostic significance remains clinically valuable. Cabrerizo et al. highlighted that hypoalbuminemia frequently reflects underlying inflammatory burden in addition to nutritional deficiency.(16) Nevertheless, in gastrointestinal surgery where malignancy, obstruction, chronic illness, and malnutrition are common, serum albumin continues to demonstrate strong predictive utility for postoperative outcomes.

The present study contributes important regional evidence from Nepal, where data regarding perioperative risk stratification using serum albumin remain limited. Given its simplicity, low cost, and widespread availability, serum albumin can serve as an effective tool in routine preoperative assessment for identifying high-risk gastrointestinal surgical patients. Early recognition and optimization of hypoalbuminemia may potentially improve postoperative outcomes and reduce perioperative morbidity and mortality.

This study has several limitations. First, its retrospective design makes it dependent on the accuracy and completeness of hospital records, introducing the possibility of information bias. Important variables such as detailed nutritional assessment, inflammatory markers, tumor stage, operative duration, intraoperative blood loss, and perioperative optimization strategies could not be fully evaluated. Second, this was a single-center study with a relatively small sample size, which may limit the generalizability of the findings. In addition, serum albumin may be influenced by systemic inflammation, malignancy, hepatic dysfunction, and chronic illness, and therefore may not exclusively reflect nutritional status. Furthermore, only short-term postoperative outcomes within 30 days were assessed, while long-term outcomes were not evaluated.

5. Conclusion

This retrospective observational study conducted at Nepal Medcity Hospital demonstrated that preoperative hypoalbuminemia is significantly associated with increased postoperative morbidity and mortality in patients undergoing major gastrointestinal surgery. Preoperative serum albumin, being a simple, inexpensive, and widely available biomarker, may serve as a valuable tool for perioperative risk stratification and identification of high-risk surgical patients. Early recognition and optimization of hypoalbuminemia may help improve postoperative outcomes and reduce perioperative morbidity and mortality. Further prospective multicenter studies with larger sample sizes are recommended to validate these findings.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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