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Emergency Laparotomy and Serum Albumin: A Promising Predictive Marker

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Abstract

Background: Emergency laparotomy, a critical surgery for acute abdominal emergencies, presents significant risks of complications and mortality. Accurately predicting outcomes remains challenging, impacting resource allocation and tailored post-operative care. This study investigates serum albumin, a key blood protein, as a potential predictive marker in emergency laparotomy patients.

Methods: This prospective observational study enrolled 62 emergency laparotomy patients at IGOT hospital Bengaluru between May and August 2023. Data on demographics, surgical indications, procedures, pre-operative, post operative albumin levels, and post-operative complications were collected. Complications were categorized using the Clavien-Dindo classification. Statistical analysis assessed the relationship between albumin levels and outcomes.

Results: Patients averaged 46.67 years old, predominantly male (64%). Gastric perforation was the most common surgical indication (24%), followed by ileal perforation and intestinal obstruction (16% each). Pre-operative hypoalbuminemia (albumin < 3.5 g/dL) was associated with a higher complication rate (58%) compared to normal levels (38%). Severity of complications correlated with post-surgery albumin decrease. Pre-operative albumin inversely correlated with hospital stay duration, while post-operative albumin drop positively correlated with stay length.

Discussion: This study underscores serum albumin's potential as a predictor of post-operative outcomes in emergency laparotomy. High hypoalbuminemia prevalence (62%) and its complication association emphasize nutritional status's critical role. Lower pre-operative albumin and greater post-operative decrease were linked to increased complication risk and severity, suggesting albumin's value in risk stratification and targeted post-operative care for potentially improved outcomes.

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Conclusion: This study provides compelling evidence for serum albumin's potential as a predictor of post-operative complications in emergency laparotomy. Optimizing pre-operative albumin levels may be crucial for reducing complications and enhancing patient recovery. Further research is warranted to explore albumin level monitoring's clinical utility and interventions to improve albumin status for better surgical outcomes.

Introduction

Emergency laparotomy, a crucial surgical intervention for acute abdominal emergencies, saves lives by addressing conditions like bowel obstructions and perforations. Despite advances, accurately predicting outcomes remains challenging.

Predicting outcomes is vital. Mortality rates range from 10% to 25% [1], and complications like infections and organ dysfunction further impact patients [2]. Accurate prediction helps anticipate hospital stays, allocate resources, and tailor post-operative care. This improves overall well-being and quality of care.

Current methods include physiological parameters, lab markers, imaging, and scoring systems. While parameters like heart rate and white blood cell count are used, they may lack accuracy [3]. Scoring systems like APACHE and POSSUM help with risk stratification but may be complex for emergency situations [4,5,6]. There's a need for more reliable predictors.

Serum albumin, a key blood component, plays roles in maintaining pressure, transporting substances, and immune response [7]. Low albumin has been linked to increased complications and mortality in surgical patients [8]. Studies by Dindo et al. (2003) and Vaid et al. (2014) suggest a link between low albumin and worse outcomes [8, 9]. These findings highlight the need to explore serum albumin's role in emergency laparotomy.

Limited research exists on the specific relationship between serum albumin levels and outcomes in emergency laparotomy patients [9]. Further studies are needed to understand this link better.

Identifying albumin as a reliable marker could significantly impact clinical care by refining risk stratification, optimizing preoperative management, and prompting proactive interventions for patients with low albumin levels.

Exploring the role of serum albumin in predicting outcomes of emergency laparotomy is crucial. This research can improve patient care by refining risk stratification, optimizing preoperative management, and ultimately, enhancing patient outcomes. Understanding the link between albumin levels and outcomes has the potential to revolutionize surgical practice and patient care.

Method

Study Design

This study was a prospective observational investigation conducted at Institute of Gastroenterology Sciences & Organ Transplant (IGOT Hospital), Bengaluru between May and August 2023. It involved a group of 62 patients who underwent emergency exploratory laparotomy for various abdominal conditions.

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Inclusion and Exclusion Criteria

Patients included in the study were those who underwent emergency exploratory laparotomy at IGOT Hospital, Bengaluru during the specified timeframe. Individuals under 18 years of age were excluded.

Participants and Data Collection

A total of 62 patients were enrolled in the study. Data was collected on their demographics, surgical reasons (indications), procedures performed, and pre-operative albumin levels. Low albumin (hypoalbuminemia) was defined as a level below 3.5 g/dL.

Post-operative Monitoring

Albumin levels were reassessed 4-6 hours after surgery. The change in albumin levels was calculated as a percentage of the initial value.

Outcomes and Follow-up

Patients were monitored throughout their hospital stay until discharge or death for the development of complications. These complications included superficial surgical site infections (SSIs), wound separation (dehiscence), burst abdomen, acute respiratory distress syndrome (ARDS), acute kidney injury (AKI), multiple organ dysfunction syndrome (MODS), sepsis, leaks, and prolonged ileus. The severity of complications was categorized using the Clavien-Dindo classification system. Additionally, the type of treatment received for complications was documented (conservative management, interventional procedures, or intensive care unit (ICU) admission). The length of hospital stay was also recorded.

Data Analysis

Statistical analysis was performed using SPSS software version 23. Descriptive statistics (mean and standard deviation) were used to summarize the data. Pearson's correlation coefficient was used to evaluate relationships between variables. For analysis involving multiple variables, Analysis of Variance (ANOVA) was employed. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Data from 62 patients who underwent emergency exploratory laparotomy at Institute of Gastroenterology Sciences & Organ Transplant (IGOT Hospital), Bengaluru were collected and analysed. The ages of the patients ranged from 18 to 82 years, with an average age of 46.67±18.03 years. The majority of patients (the largest age group) were between 41-50 years old. Among the 62 patients, 40 (64%) were male and 22 (36%) were female.

The most frequent reason for laparotomy was gastric perforation, affecting 15 patients (24%). This was followed by ileal perforation and intestinal obstruction, each affecting 10 patients (16%) (see Table 1).

Table 1: Indications for Laparotomy

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Indication	Number of Patients	Percentage (%)
Appendicular abscess and perforation	6	10
Carcinoma colon	4	6
Gastric perforation	15	24
Ileal perforation	10	16
Obstruction	10	16
Sigmoid volvulus	2	4
Splenic injury	5	8
Stab injury	4	6
TB abdomen	6	10

The most common surgical procedure performed was resection anastomosis, which was done in 20 patients (32%). The next most common procedure was modified Graham's omental patch repair, performed in 15 patients (24%) (see Table 2).

Table 2: Procedures Performed

Procedure Performed	Number of Patients	Percentage (%)
Resection anastomosis	20	32
Modified Graham's omental patch repair	15	24
Appendicectomy	6	10
Right hemicolectomy	5	8
Splenectomy	5	8
Primary closure of perforation	4	6
Peritoneal lavage	2	4
Negative laparotomy	2	4
Stoma creation	1	2

Pre-operative albumin levels among patients ranged from 1.8 to 4.5 g/dl, with a mean value of 3.23±0.74 g/dl. Of these patients, 38 (62%) had hypoalbuminemia, while 24 (38%) had normal albumin levels. Post-operative albumin levels measured 4-6 hours after surgery ranged from 1.4 to 4.1 g/dl, with a mean value of 2.75±0.79 g/dl. The average reduction in absolute albumin levels was 0.48 g/dl. The percentage change in albumin levels ranged from 4.76% to 26.67%, with an average of 15.71±6.54%.

Complications occurred in 36 of the 62 patients (58%). The most frequent complications were wound dehiscence and sepsis, each seen in 9 patients (14%), followed by anastomotic leak in 7 patients (12%). Other complications are listed in Table 3. Twelve patients experienced more than one complication. There were 6 deaths (10%).

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Table 3: List of Complications Observed

Complications	Number of Patients	Percentage (%)
Seroma formation	6	10
Wound dehiscence	9	14
Burst abdomen	1	2
ARDS	6	10
AKI	5	8
MODS	4	6
Sepsis	7	12
Leak	9	14
Prolonged ileus	4	6

Patients without complications had a mean pre-operative albumin level of 3.83 g/dl, while those with complications had a mean level of 2.78 g/dl, a statistically significant difference ($p<0.05$). Complications were categorized according to the Clavien-Dindo classification.

The mean pre-operative albumin levels for these patients are shown in Table 4. This data was statistically significant ($p=0.047$).

Table 4: Distribution of Mean Values of Pre-operative Albumin

Complications	Number of Patients	Mean Level of Pre-op Albumin	Standard Deviation
No complications	26	3.83	0.53
Clavien-Dindo 1	8	3.25	0.70
Clavien-Dindo 2	9	2.77	0.50
Clavien-Dindo 3	5	2.8	0.69
Clavien-Dindo 4	9	2.68	0.24
Clavien-Dindo 5	6	2.4	0.37

The mean percentage drop in albumin levels for these patients is shown in Table 5. This data was also statistically significant ($p=0.047$).

Table 5: Distribution of Mean Percentage Drop in Albumin Levels

Complications	Number of Patients	Mean Percentage Drop in Albumin	Standard Deviation
No complications	26	9.66	2.68
Clavien-Dindo 1	8	14.79	6.4
Clavien-Dindo 2	9	20.68	4.2
Clavien-Dindo 3	5	20.78	2.2
Clavien-Dindo 4	9	20.67	3.2

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Complications	Number of Patients	Mean Percentage Drop in Albumin	Standard Deviation
Clavien-Dindo 5	6	24.27	1.7

A negative correlation was found between preoperative albumin levels and the duration of hospital stay (Pearson coefficient = -0.452) (p=0.001). Conversely, a positive correlation was noted between the percentage drop in albumin levels and the duration of hospital stay (Pearson coefficient = 0.612) (p=0.00).

DISCUSSION

The analysis of 62 patients who underwent emergency exploratory laparotomy at Institute of Gastroenterology Sciences & Organ Transplant (IGOT Hospital), Bengaluru revealed several significant findings. The mean age of 46.67 years and the predominance of male patients (64%) align with existing literature on the demographics of patients undergoing emergency laparotomy [10,11]. This study highlights gastric perforation as the most common indication for surgery, followed by ileal perforation and intestinal obstruction. This distribution is consistent with previous studies, which have similarly reported a high incidence of gastrointestinal perforations as a primary cause for emergency laparotomy [12].

The high rate of gastric perforation (24%) may be attributed to factors such as widespread Helicobacter pylori infection and the use of nonsteroidal anti-inflammatory drugs (NSAIDs), both of which are known to increase the risk of peptic ulcer disease and subsequent perforation [13,14]. The relatively high incidence of ileal perforation (16%) and intestinal obstruction (16%) also reflects known patterns in emergency abdominal surgeries, often related to infectious diseases, including tuberculosis, which is endemic in many regions, and postoperative adhesions from previous surgeries [15,16].

Our findings regarding the most frequently performed procedures, namely resection anastomosis (32%) and modified Graham's omental patch repair (24%), are in line with the common surgical interventions reported in similar patient populations [17,18]. The choice of resection anastomosis can be attributed to its effectiveness in managing bowel perforations and obstructions, providing definitive treatment and restoring gastrointestinal continuity [19].

The study also sheds light on the critical role of nutritional status, as evidenced by preoperative albumin levels, in influencing patient outcomes. The mean preoperative albumin level was 3.23±0.74 g/dl, with a significant proportion of patients (62%) exhibiting hypoalbuminemia. This is a well-documented risk factor for postoperative complications and prolonged recovery [20]. Hypoalbuminemia is indicative of poor nutritional status, which can impair wound healing and immune response, thereby increasing susceptibility to complications such as sepsis and wound dehiscence, both of which were notably prevalent in our study (14% each) [21,22].

Preoperative hypoalbuminemia increases the risk of postoperative complications through several mechanisms. Firstly, albumin plays a crucial role in maintaining oncotic pressure and intravascular volume, which are essential for tissue perfusion and oxygen delivery.

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Hypoalbuminemia can lead to tissue hypoperfusion, impaired wound healing, and an increased risk of surgical site infections [23]. Secondly, albumin serves as a carrier for many substances, including drugs and hormones, and contributes to the transport of essential nutrients. Low albumin levels can impair the delivery of nutrients to tissues, further compromising wound healing and immune function [24].

Furthermore, preoperative hypoalbuminemia has been associated with an increased risk of intra-abdominal septic complications, including anastomotic leakage and intra-abdominal abscess formation [25]. The hypoalbuminemic state compromises the body's ability to mount an effective immune response, leading to impaired tissue repair and increased susceptibility to infections [26]. This underscores the importance of preoperative optimization of nutritional status to mitigate the risk of postoperative complications.

The high percentage fall in albumin levels seen in patients who had postoperative complications reflects the severity of the inflammatory response and the extent of tissue injury. Surgical stress and inflammation lead to increased capillary permeability and the extravasation of albumin into the interstitial space. Additionally, cytokine-mediated downregulation of albumin synthesis by the liver contributes to decreased albumin levels [27]. The magnitude of the decrease in albumin levels correlates with the degree of systemic inflammation and tissue damage, making it a potential marker for the severity of postoperative complications.

To use albumin as a prognostic factor, clinicians can monitor preoperative albumin levels and the percentage fall in albumin levels postoperatively. Patients with preoperative hypoalbuminemia and a significant decrease in albumin levels postoperatively may benefit from closer postoperative monitoring and early intervention to mitigate the development of complications. Furthermore, interventions aimed at optimizing albumin levels perioperatively, such as nutritional supplementation and albumin infusions, may improve patient outcomes and reduce the incidence of postoperative complications [28].

Future research should focus on validating the prognostic value of albumin in larger patient cohorts and investigating the effectiveness of interventions targeting albumin levels in improving surgical outcomes. Additionally, studies exploring the relationship between albumin kinetics and specific postoperative complications may provide insights into the underlying mechanisms and identify novel therapeutic targets.

Conclusion

This study investigated the potential of serum albumin as a predictor of outcomes in emergency laparotomy patients. The findings suggest a significant correlation between pre-operative albumin levels and post-operative complications. Here's a breakdown of the key takeaways:

- Low albumin levels (hypoalbuminemia) were prevalent in a substantial portion of patients (62%).
- Patients with hypoalbuminemia experienced a higher rate of complications compared to those with normal albumin levels.

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- The extent of decrease in albumin levels post-surgery also correlated with the severity of complications.
- These findings suggest that albumin could be a valuable marker for predicting post-operative outcomes.

The study highlights the importance of nutritional status in surgical outcomes. Optimizing albumin levels before surgery might be crucial for reducing complications and improving patient recovery. Future research should focus on validating these results in larger studies and exploring interventions to improve albumin levels for better surgical outcomes.

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