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Association between preoperative serum albumin level and postoperative wound complications in emergency laparotomy

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ABSTRACT

Introduction: Serum albumin level is a standard, readily available parameter that predicts preoperative mortality and morbidity. Levels above 3.5 g/dL indicate sufficient protein reserves to support biological processes. Patients with levels below 3.2 g/dL are more likely to have poor outcomes.

Methods: This was a cross-sectional study from April to October 2023 at Bir Hospital's Department of General Surgery, using convenience sampling of patients undergoing emergency laparotomy. Eligible participants were adults 20+ who consented. Exclusions included icterus, hemoglobin <7 g/dL, recent transfusion or trauma, diabetes, chronic renal or liver disease, or steroid use. Participants had standardized closure, were monitored daily for postoperative complications, including SSI (per CDC definitions), and were followed for up to 1 month. Data were analyzed in SPSS (mean ± SD for continuous, frequencies/percentages for categorical, Chi-square test, $p<0.05$).

Results: Our study involved 95 patients, 31% female and 69% male, aged 20 to 82. Forty percent had hypoalbuminemia (serum albumin <3.2 gm/dL). Postoperative wound complications occurred in 36.8% (n=35). Surgical Site Infection was seen in 10 patients with albumin >3.2 g/dL and 19 with <3.2 g/dL ($p < 0.001$). Wound dehiscence occurred in 6 cases with albumin <3.2 ($p < 0.002$). Lower albumin levels significantly increase the risk of complications ($p < 0.001$).

Conclusion: Our study showed that serum albumin < 3.2 g/dL was associated with higher rates of wound complications, notably Surgical Site Infection. Preoperative serum albumin testing is cost-effective, predicts postoperative risks, and aids surgeons in nutritional decisions.

Keywords: Emergency laparotomy, Postoperative complications, Serum albumin

INTRODUCTION

It is essential to understand the fundamental metabolic alterations resulting from injury and how poor nutritional status increases the likelihood of postoperative complications, to properly plan the nutritional support for patients undergoing surgery.[1] A metabolic response is necessary for healing and functional recovery, but it requires nutritional therapy. Recent studies have shown a correlation between the adverse effects of long-term protein deficits and outcomes in critically ill surgical patients. Surgery, like any injury, elicits a series of reactions, including the release of stress hormones and inflammatory mediators, such as cytokines, leading to a protein-catabolic state.[2]

Gastrointestinal surgery patients are at higher risk of nutritional depletion due to inadequate dietary intake, surgical stress, and an increased metabolic rate. The prevalence of protein-energy malnutrition ranges from 10% to 54% among surgical patients. Nutrition is essential in the management of all surgical patients. Poor nutritional status is associated with increased morbidity (surgical site infection, chest infection, length of hospital stay, etc. and mortality. The significance of pre-operative malnutrition was first recognized in the 1930s. Studley observed a direct association between preoperative weight loss and operative mortality rate.[3] It has been reported that poor nutritional status is associated with impaired wound healing,[4] higher post-operative infection,[5,6] and adverse effects on the functioning of the gastrointestinal tract, immune, cardiovascular, and respiratory systems. These adverse effects can result in a more extended hospital stay.[7] Serum albumin concentration is a better predictor of surgical outcome than many other preoperative patient characteristics. It is a comparatively low-cost test that should be used more frequently as a prognostic tool to detect malnutrition and risk of adverse surgical outcomes.[8]

The underlying condition for which the exploratory laparotomy is being done can vary from emergencies like blunt or penetrating abdominal trauma, peritonitis secondary to hollow viscus perforation, acute intestinal obstruction, and other pathologies like inflammatory bowel disease, to name a few.[1,2]

Factors that influence the choice of incision for abdominal surgery include the organ of interest and anticipated procedure, the patient's body habitus and degree of obesity, the urgency of the operation, the presence of previous abdominal incisions, and the operating surgeon's preference and experience.[9,10] Most surgeons prefer a midline or paramedian approach to the abdominal viscera. The midline incision is the fastest approach and provides adequate exposure to almost every region of the abdominal cavity and retroperitoneum. It is nearly bloodless and does not require dividing muscle fibers or sectioning nerves.

The center where the study is being undertaken is a referral center for those who need emergency surgical intervention. Patients in this part are not nutritionally balanced because of poverty, hence patients undergoing emergency surgery are at a greater risk of developing postoperative complications like surgical site infection and wound dehiscence.

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This study has therefore been planned to assess the relationship between preoperative serum albumin and the above-mentioned surgical site complications, so that appropriate measures can be taken for primary or secondary prevention of such complications.

METHODS

This was a prospective cross-sectional study conducted among patients undergoing Emergency laparotomy. This study was conducted from April to October 2023 in the Department of General Surgery at Bir Hospital, Kathmandu, Nepal. This institution is a medical college and a tertiary-level hospital that provides treatment to patients from across Nepal. Non-probability (convenience sampling) was used as the sampling method.

Eligible participants were cases presenting to the Emergency Department of Bir Hospital who underwent emergency laparotomy, were aged 20 years or older, and were willing to participate in the study. Patients were excluded if they had icterus, hemoglobin level less than 7 g/dL, a history of blood transfusion or trauma, comorbidities such as diabetes mellitus, chronic renal disease or chronic liver disease, or if they were receiving steroid therapy.

Sample size was calculated as $n = t^2 \times p(1 - p)/ m2$, Where, N = required sample size, t = confidence level at 95 % (standard value of 1.96), p = proportion of population, m = margin of error at 10% (standard value of 0.1), p = 0.455% (patient with preoperative serum albumin) (taken from a similar study).11 So the total sample size calculated was 95.

After enrollment, informed consent was obtained from the patient or guardian, and demographic information (e.g., age, sex, address, admission and discharge dates) along with detailed history and clinical examination findings were recorded in a structured proforma. Baseline investigations (complete hemogram, electrolytes, renal function tests, blood grouping, and urine tests) were sent to the laboratory, and imaging (chest X-ray, abdominal X-ray, and/or abdominal ultrasonography) was performed as clinically indicated. Serum albumin was measured in all participants and documented, using 3.2 g/dL as the reference cut-off.

Following diagnosis and adequate resuscitation, patients underwent emergency laparotomy via a midline vertical incision as required, and operative findings were recorded; the abdominal wall was closed using No. 1 polydioxanone (PDS) with sutures placed approximately 1 cm from the wound margin and 1 cm apart. Patients were assessed daily during the postoperative period, and wounds were examined at regular intervals for surgical site infection using CDC definitions. Postoperative outcomes, including SSI, wound dehiscence, pulmonary complications (e.g., LRTI), and mortality, were documented, and the relationship between serum albumin level and postoperative complications was assessed; participants were followed up for up to 1 month after surgery.

Data were entered in Microsoft Excel 2013 and analyzed using SPSS version 25.0. Continuous variables were summarized as mean ± SD, while categorical variables were presented as frequencies and percentages. Associations were assessed using the Chi-square test at the 95% confidence level, and $p < 0.05$ was considered statistically significant.

Ethical approval was obtained from the Institutional Review Board of Bir Hospital (ref no: 209/2080/81) prior to the commencement of the study. At enrollment, the study aims, procedures, potential risks and benefits, and issues of confidentiality were explained to the patient and the nearest relative in Nepali or English. Participation was voluntary, and participants could refuse or withdraw at any time without any consequences. Written informed consent was obtained from the nearest relative, with the patient's assent, and confidentiality was maintained throughout.

RESULTS

The study was conducted on 95 patients aged 20-90 years who underwent emergency surgery at Bir Hospital, Kathmandu, Nepal. Of the 95 patients, the largest number were aged 31-40 years, with 26. The youngest patient was 20 years old, and the eldest one was 82 years old. The mean and standard deviation of the age included in the study were 43.09±15.047 years. Among the 95 patients included in the study, 35 (36.84%) developed complications, and 60 (63.15%) had uneventful recovery. The sociodemographic profile is shown in Table 1.

Table 1: Sociodemographic profile of patients included in the study(n=95)

Demographics	Complication	
	Present	Absent
Gender		
Male	29(30.52%)	37(38.94%)
Female	6(6.32%)	23(24.21%)
Age Group		
20-30	3(3.15%)	20(21.05%)
31-40	4(4.21%)	22(23.15%)
41-50	9(9.47%)	9(9.47%)
51-60	11(11.58%)	3(3.16%)
61-70	5(5.26%)	6(6.31%)
71-80	2(2.10%)	0
81-90	1(1.05%)	0

Hypoalbuminaemia (<3.2 g/dl) was seen in 38(40%) cases. Almost half of the subjects had serum albumin levels below 3.2 g/dL. The mean serum albumin was 3.46 gm/dl.

The most common pathology for surgery was a Perforated Duodenal ulcer. The second most common condition was Acute Intestinal Obstruction, as shown in Table 2.

Table 2: Distribution of the study based on the final diagnosis

Final Diagnosis	Frequency	Percent
Perforated Duodenal Ulcer	42	44.2
Acute Intestinal Obstruction	30	31.6
Appendicular Perforation	19	20
Ileal / Jejunal Perforation	4	4.2
Total	95	100

Thirty-five patients had postoperative complications, of which surgical site infection accounted for a total of 29(30.5%). It was the most typical complication observed. Among the patients who underwent emergency laparotomy, the association between surgical site infection and wound dehiscence with serum albumin was statistically significant. (Table 3)

Table 3: Patterns of complications among the patients undergoing emergency laparotomy(n=95)

Complications	S. Albumin		P-value
	<3.2gm/dl (n = 38)	≥3.2gm/dl (n = 57)	
Surgical Site Infection	19 (50%)	10 (17.5%)	0.001
Wound Dehiscence	6 (15.8%)	0 (0%)	0.002

The study showed that with serum albumin in the normal range (>3.2 g/dl), complications were less frequent, with 51 (53.68%) patients not having complications. The maximum number of complications was observed in patients with serum albumin 2.5-3.1 g/dl (22, 23.16%); however, all patients with serum albumin less than 2.5g/dl developed complications (Table 4)

Table 4: Relation between serum albumin (in the normal and low range) and complications

Albumin (gm./dl)	< 3.2gm/dl	≥ 3.2gm/dl	Chi square	P value
Complications	29 (30.52%)	6 (6.32%)	38.110	< 0.001
No Complications	9 (9.47%)	51 (53.69 %)		

When patients were grouped by serum albumin in the standard and low ranges, and complications were compared, 30.52% of complications occurred in the group with serum albumin <3.2 g/dL. There were only

6.32% complications in the group with serum albumin ≥ 3.2 g/dL. This showed that patients with low serum albumin had more complications, which was statistically significant ($p < 0.001$).

Table 5: Results of Logistic Regression for Predicting Complications in Terms of Albumin Level

Variable	Wald $\chi 2$	p- Value	OR	95% CI
Serum Albumin (gm./dl)	29.127	< 0.001	0.032	0.009-0.112

Odds ratio 0.032 suggests that as albumin level decreases, there is an increased risk of postoperative complications, and the association is also statistically significant with a p value <0.001.

DISCUSSION

This study was conducted in Bir Hospital, Kathmandu, Nepal. Nutritional assessment is essential for identifying patients at increased risk of postoperative complications. Hypoalbuminemia results from a decrease in albumin production or an increase in loss. Albumin is mainly lost through the epidermis, the renal, or the gastrointestinal route. Correction of the patient's nutritional status is required, as malnutrition increases the risk of morbidity and mortality.

This study includes 95 patients who underwent emergency laparotomy with midline incision; out of 95 patients, 35 patients developed postoperative complications. The incidence of postoperative complications was 36.8%. This is similar to studies done by Bhuyan K et al,[11] Kumar S et al,[12] Sharma L et al,[13] with the rates 45.5%, 45.8%, 68.75%, respectively. These studies were done in developing countries. Most of the patients in developing countries have poor nutritional status, so there is a high incidence of postoperative complications.

Out of 57 patients with normal serum albumin levels, postoperative complication rate was seen only in 6 cases. The incidence of postoperative complications was 10.52% as similar to a study done by Bhuyan K et al.[11]

In this study, the mean age of patients was 43.09 years with a SD of 15.047. The maximum age was 82 years, and the minimum age was 20 years. Most postoperative complications were observed in patients aged 41 and above, which was similar to a study conducted by Sharma et al.[13] Lalhruaizela et al. [16] The explanation for this is that, as age increases, there may be deterioration of the tissue repair mechanism.

In this study, out of 95 patients, 29 were female, and the remaining were male. Among 66 male patients, 29 (44%) patients developed postoperative complications, which was similar to a study done by Sharma L et al. 15 male patients (47.62%) were found to be more affected than females (37.48%). This study revealed male dominance. There is no well-explained cause for it, but it may be due to smoking and a higher incidence of peptic ulcer perforation and intestinal obstruction in males sex.[14]

In this study, out of 95 patients, hypoalbuminaemia (< 3.2 g/dl) was seen in 38 cases (40%), out of which 19 developed SSI. The incidence of SSI was 50%. An association between low albumin level and the development of SSI was found to be statistically significant. This present study is comparable with other studies, Bhuyan et. al.,[11] Sindgikar et al,15 Warrie VM et al,[16] Hennessey et al,[17] Lalhruaizela et al,[18] shows that the incidence of SSI was 36%, 72.7%, 31.9%, 46.4%, and 24.09%, respectively, and those studies revealed that hypoalbuminemia was a significant risk factor associated with surgical site infection.

In the present study, the incidence of SSI in patients with normal serum albumin level (≥ 3.2 g/dl) was 17.5%, which was low, similar to a survey by Bhuyan K et al.[11]

In this study, six patients with serum albumin levels <3.2g/dl (15.8%) developed wound dehiscence, which is similar to a survey done by Tulukdar et al,[19] revealed hypoalbuminemia had a significant impact, leading to wound dehiscence. Other studies Warrie VM et. al,[16] Grahman GR Batal,[20] Sindgikae et al,[15] also revealed that hypoalbuminaemia is a risk factor associated with abdominal dehiscence.

This was a single institutional study. If future studies take into consideration other parameters, such as BMI and the Prognostic Nutritional Index (which includes triceps skinfold thickness, transferrin, delayed cutaneous hypersensitivity, and albumin), the outcome of the study will be more beneficial.

CONCLUSION

Preoperative serum albumin is a good indicator of predicting postoperative outcome. Patients with low serum albumin (<3.2 g/dL) had a higher complication rate, which was statistically significant ($p < 0.001$). Patients with serum albumin ≥ 3.2 g/dL had fewer complications. SSI was the most typical postoperative complication noted, which was followed by wound dehiscence. Thus, serum albumin is a good prognostic indicator because it detects PEM, which is not necessarily accompanied by lower body weight and may not be clinically recognizable, yet is associated with a significant risk of morbidity and mortality.

DECLARATION

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Author Contributions

SP and RKA reviewed the literature, conceptualized and designed the research; SP and RKA did data collection, analysis, and prepared the results; NT drafted the manuscript; and all authors reviewed the manuscript and approved the final version of the manuscript. All authors agreed to be accountable for all aspects of the research work.

Conflict of interest

None

Ethical Approval

This research was approved by the IRB of Bir Hospital with the reference number of 209/2080/81 on 16 February 2080/5/21

Consent/Assent

All participants provided written informed consent before data collection.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request

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