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**PROGNOSTIC SIGNIFICANCE OF PREOPERATIVE SERUM ALBUMIN LEVEL IN
PATIENTS UNDERGOING EMERGENCY LAPAROTOMY IN UNIVERSITY OF BENIN
TEACHING HOSPITAL, BENIN, NIGERIA**

PROGNOSTIC SIGNIFICANCE OF PREOPERATIVE SERUM ALBUMIN LEVEL IN PATIENTS UNDERGOING EMERGENCY LAPAROTOMY IN UNIVERSITY OF BENIN TEACHING HOSPITAL, BENIN, NIGERIA

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ABSTRACT

Introduction: Preoperative serum albumin level has prognostic value which may aid appropriate risk stratification and planning of the perioperative and postoperative care of patients that undergo emergency laparotomy. This study is aimed at evaluating the prognostic value of preoperative serum albumin level in predicting 30-day postoperative mortality and morbidity in patients that had laparotomy for acute abdomen.

Methods: An observational study was conducted over 12 months at University of Benin Teaching Hospital. Eighty-seven patients that had emergency laparotomy were recruited. Preoperative serum albumin levels were measured. Patients were followed up for 30 days postoperatively, taking note of complications, mortality and duration of admission. Data was analysed using SPSS version 22.0. Fischer's exact test and multivariate analysis were used to determine association between variables. Statistical significance was set at p-values less than 0.05.

Results: Eighty-seven adults were studied, 61 (70.1%) males and 26 (29.9%) females. Thirty-one (35.6%) patients developed at least one complication. The most common complication was surgical site infection. Hypoalbuminemic patients had more complications, higher mortality and had more prolonged admission than patients that had normal preoperative albumin levels: (40% vs 17%, 18.8% vs 5.9%, and 31.4% vs 17.6%

respectively). Hypoalbuminemia was associated with development of surgical site infection ($p=0.006$) and burst abdomen ($p=0.032$).

Conclusion: This study demonstrated that preoperative serum albumin level can be used to prognosticate 30 days postoperative outcome of emergency laparotomies.

Keywords: Preoperative serum albumin, hypoalbuminemia, emergency laparotomy, surgical site infection, burst abdomen.

INTRODUCTION

Acute abdomen is the rapid evolution of severe abdominal symptoms that may be a pointer to life threatening intra-abdominal pathology requiring urgent surgical intervention.¹ Acute abdomen accounts for approximately 10% of patients presenting to the emergency room.¹ Common causes of acute abdomen requiring emergency laparotomy include acute intestinal obstruction, acute appendicitis and its complications (including perforation), perforated peptic ulcer, incarcerated ventral hernia, small intestinal perforations, blunt and penetrating abdominal injuries. The preoperative risk factors and delay in presentation and treatment account for the morbidity and mortality in patients undergoing emergency laparotomy.² The physiological insult of acute abdominal pathology, when combined with chronic ill

health, complicates the post-operative course.³

Several parameters exist that may be used to predict the outcome of emergency surgeries. These parameters are used in various preoperative risk assessment scoring systems. Examples of these scoring systems are Acute Physiology and Chronic Health Evaluation II (APACHE II), American Society of Anaesthesiologists (ASA) score, Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity (POSSUM), Surgical APGAR, and National Emergency Laparotomy Audit risk calculator.⁴

Acute phase proteins are also used preoperatively to predict the outcome of surgical intervention.⁵ Acute phase proteins are markers that demonstrate significant changes in their serum concentrations during inflammation. The serum concentration of these markers during inflammatory processes forms the basis of their classification as positive or negative acute phase proteins. Negative acute phase proteins are down regulated with decreased serum concentrations during inflammation.⁶

Albumin is the most reliable, and commonly used indicator of a patient's nutritional status and it is designated as a negative acute phase protein.⁷ Evidence has shown that patients with signs of malnutrition are at a higher risk of postoperative complications and an increased risk of death in comparison with well-nourished patients.⁸

Albumin is the most predominant serum-binding protein in the human body.⁸ It constitutes 50% of the total body's protein and maintains the oncotic pressure of plasma. Albumin transports bilirubin, fatty acids, trace vitamins and minerals, hormones and drugs. Serum level of albumin also affects platelet function. Normal albumin levels indicate adequate liver, kidney and immune functions.⁹ Hence, serum albumin has multiple functions: immune-modulatory, detoxification and antioxidant functions, aside being the main determinant of plasma oncotic pressure.¹⁰

Hypoalbuminemia is associated with poor prognosis in surgical patients but remains unclear whether this is due to it being a marker of severe malnutrition with its attendant increased morbidity and mortality or an independent risk factor.⁹ Knowledge of the prognostic impact of serum albumin will enable appropriate risk stratification, maximizing the utilization of intensive preoperative and postoperative care facility for patients and better understanding of the need to inform patients about postoperative risks.¹¹

Laparotomy for acute abdomen is a common emergency surgery performed in UBTH, a premier tertiary health institution located in South-South Nigeria. Therefore, there is the need to be able to predict the outcome and develop a simple tool that can be useful in prognosticating outcome of patients who have laparotomy for acute abdomen. There is paucity of data on this subject matter in our sub-region and this study will contribute to the literature on the use of albumin for prognosticating the outcomes of patients who have laparotomy for acute abdomen.

Therefore, this study aimed to evaluate the prognostic significance of preoperative serum albumin level in prediction of 30-day postoperative morbidity and mortality in patients undergoing laparotomy for an acute abdomen at the University of Benin Teaching Hospital (UBTH).

METHODS

This study was conducted in the surgery department of University of Benin Teaching Hospital; a premier federal tertiary hospital located in South-south Nigeria. It was an observational study done over a period of 12 months February 2021 to January 2022.

The study included all consenting adult patients who presented in the emergency room with acute abdomen and subsequently had emergency exploratory laparotomy. Patients excluded from the study were those with gynaecological and urological pathologies, re-laparotomies done within a month of the initial laparotomy, established

chronic kidney disease, chronic liver disease, diabetes mellitus, protein losing enteropathy, long term steroid use, histologic diagnosis of cancer, acquired immunodeficiency syndrome (AIDS) and those on chemotherapy.

The Ethics and Research Committee of the University of Benin Teaching Hospital granted approval for the study (protocol number: ADM/E22/A/VOL.VII/14830971). All information obtained was treated with confidentiality and privacy.

Patients were classified into three groups based on their preoperative serum albumin levels:¹² Group1: Normal serum albumin - > 3.5gm/dl, Group2: Moderate hypoalbuminemia - 2.5-3.5gm/dl and Group 3: Severe hypoalbuminemia - < 2.5gm/dl.

Outcome measures included postoperative complications (surgical site infection, wound dehiscence, anastomotic leak, burst abdomen, etc.) occurring within 30days of surgery, death occurring within 30 days of surgery and length of hospital stay: Hospitalization longer than 15 days was defined as prolonged hospital stay.¹³

Data collected were patients' socio-demographics, symptoms and signs, preoperative diagnosis, preoperative serum albumin level, intraoperative findings, and postoperative outcomes. All these were entered into a proforma. Data were analysed using International Business Machines Statistical Package for Social Sciences (IBM SPSS) statistics for windows, version 22.0. Association between variables were determined using Fischer's exact test and multivariate analysis. Statistical significance was set at p-values less than 0.05.

RESULTS

Eighty-seven patients (87) patients that had emergency exploratory laparotomy for acute abdomen were recruited into this study. The age range of the patients was 18-86 years and

mean age was 44.8±16.9 years. A large proportion of the patients were found to be aged 30-59 years, representing 58.5% of the participants. Majority, 61(70.1%) were males, with a male to female ratio of 2.3:1. About half, 44(50.6%) were skilled labourers. Most, 52(59.8%) were married while at least three-fifths had at least secondary school education (Table 1).

Table 1: Socio-demographics of recruited patients.

Variables	Frequency (n = 87)	Percentage
Age (years)		
Below 20	6	6.9
20-29	13	14.9
30-39	17	19.5
40-49	17	19.5
50-59	17	19.5
60-69	9	10.3
70 and above	8	9.2
Mean age ± SD (44.8 ± 16.9)		
Sex		
Male	61	70.1
Female	26	29.9
Occupation		
Unemployed/Students/Housewives	10	11.5
Unskilled Labourers	19	21.8
Skilled Labourers	44	50.6
Working class	11	12.6
Professionals and management	3	3.4
Marital Status		
Single	29	33.3
Married	52	59.8
Divorced	4	4.6
Co-habiting	1	1.1
Educational Status		
None	5	5.7
Primary	18	20.7
Secondary	27	31
Tertiary	26	29.9
Religion		
Christian	79	90.8
Muslim	6	6.9
ATR	2	2.3

Table 2: Indications for emergency laparotomy

Indications	Frequency (n = 87)	Percentage
Intestinal Obstruction	28	32.2
Perforated Appendix	22	25.3
Perforated Peptic Ulcer	19	21.8
Abdominal Trauma	9	10.3
Others*	9	10.3

*Others- acute mesenteric ischemia, typhoid ileal perforation, splenic abscess, acute pancreatitis, sub-phrenic abscess, perforated rectum, intra-abdominal abscess

Intestinal obstruction was found to be the most common cause of acute abdomen requiring emergency laparotomy, occurring in 28 (32.2%) of the patients. Twenty-two (25.3%) patients had perforated appendix, 19 (21.8%) perforated peptic ulcer, 9 (10.3%) had abdominal trauma. Other less common causes of acute abdomen were mesenteric ischemia, splenic abscess, sub-phrenic abscess etc (Table 2).

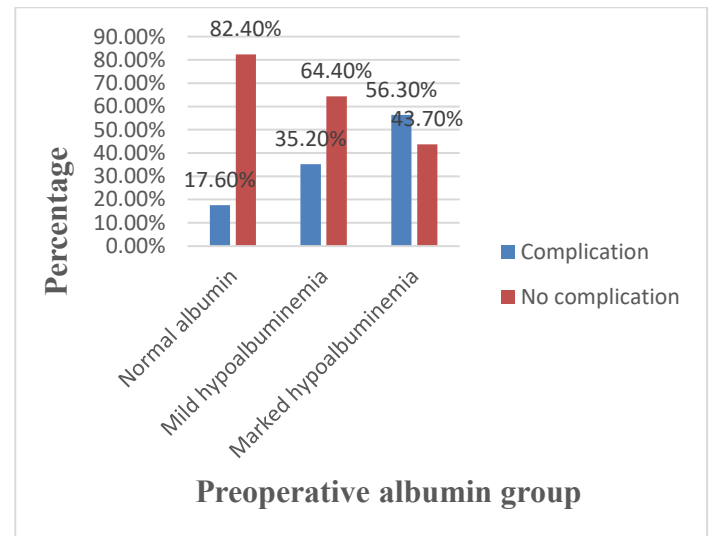
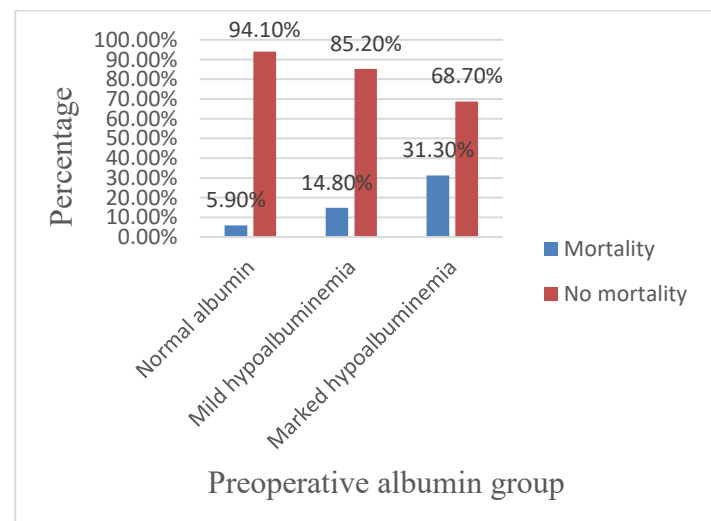
Table 3: Postoperative outcomes

Variable	Frequency (n = 87)	Percentage
Post-op Complications		
No	56	64.4
Yes	31	35.6
When Yes, type*		
Surgical Site infection	27	31
Sepsis	9	10.3
Wound Dehiscence	8	9.2
Anastomotic Leak	6	6.9
Burst Abdomen	4	4.6
Deep vein thrombosis	1	1.1
Death		
No	73	83.9
Yes	14	16.1
Days on Admission		
1-14days	62	71.3
15days and above	25	28.7

*Multiple response question

About two-third, 31(35.6%) of the respondents developed post-operative complications with surgical site infection, sepsis and wound dehiscence being the most frequent in the order listed. Fourteen (16.1%) of the patients died, while about three-quarters, 25 (28.7%) spent less than 15 days in the facility (Table 3).

When comparing the postoperative complication rates between the patients in the various preoperative albumin groups, it was observed that complications occurred more in the group of patients with hypoalbuminemia. (Fig1). Patients that had hypoalbuminemia had higher mortality rates. It was noted that the more marked the hypoalbuminemia, the higher the rate of mortality. (Fig2).

**Figure 1: Comparison of complication rates****Figure 2: Comparison of mortality rates**

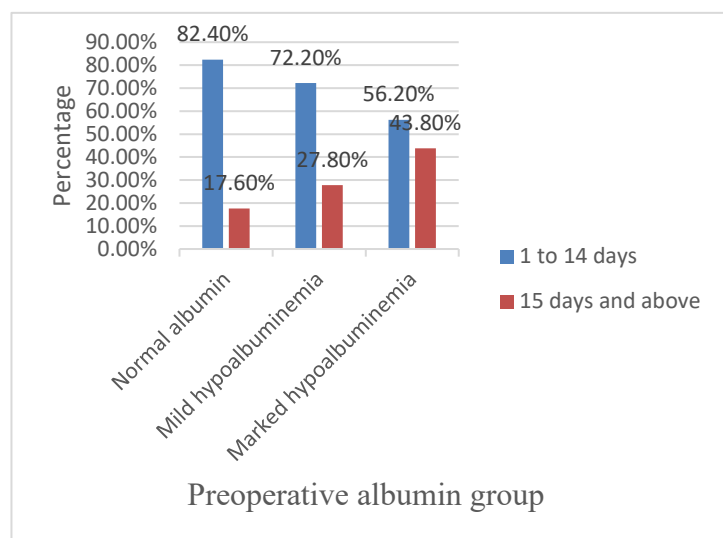


Figure 3: Comparison of length of admission

It was found that 17.6% of patients who had normal albumin had prolonged hospital stay, compared to 27.8% and 43.8% of patients that had mild and severe hypoalbuminemia respectively (Fig3). Seventy patients (80.5%) had hypoalbuminemia (54 moderate, 16 severe), while 17 patients had normal preoperative serum albumin. Twenty-eight (40%) that had hypoalbuminemia developed at least one complication. Twenty-six (37.1%) of the patients had surgical site infection, 8 (11.4%) had wound dehiscence, 5 (7.1%) had anastomotic leak while 4 (5.7%) patients had burst abdomen. Among those who developed complications, surgical site infection was found to occur more among those with moderate, 17 (63.0%) and severe, 9 (33.0%) hypoalbuminemia and this association was statistically significant.

Table 4: Comparison of postoperative outcome among the different albumin groups

Total Population						
Variables		Normal Albumin n = 17 Freq(%)	Moderate Hypoalbuminemia n = 54 Freq(%)	Severe Hypoalbuminemia n = 16 Freq(%)	Fischers Exact	p value
Post-op Complications						
No		14 (25.0)	35 (62.5)	7 (12.5)	5.368	0.068
Yes		3 (9.7)	19 (61.3)	9 (29.0)		
Type of Complication*						
Surgical infection	Site	1 (3.7)	17 (63.0)	9 (33.0)	9.956	0.006
Sepsis		1 (11.10)	6 (66.7)	2 (22.2)	0.503	0.890
Wound Dehiscence		0 (0.0)	7 (87.5)	1 (12.5)	2.214	0.288
Anastomotic Leak		1 (16.7)	4 (66.7)	1 (16.7)	0.226	1.000
Burst Abdomen		0 (0.0)	1 (25.0)	3 (75.0)	6.046	0.032
Others		0 (0.0)	1 (100.0)	0 (0.0)	1.104	1.000
Death						
No		16 (21.9)	46 (63.0)	11 (15.1)	3.697	0.163
Yes		1 (7.1)	8 (57.1)	5 (35.7)		
Days on Admission						
1-14days		14 (22.6)	39 (62.9)	9 (14.5)	2.689	0.260
15days and above		3 (12.0)	15 (60.0)	7 (28.0)		

*Multiple response question.

Table 5: Multivariate analysis- predictors of postoperative complications.

Predictor	β (Regression coefficient)	Odds ratio	95% CI for OR		p value
			Lower	Upper	
Serum Albumin					
Normal		1			
Moderate	2.557	0.078	0.006	0.933	0.044*
Marked	0.669	0.512	0.089	2.950	0.454
ASA Score					
1					
2	-2.421	0.089	0.013	0.621	0.015
3	-22.086	0	0	0	0.998
4	-1.497	0.224	0.072	0.697	0.010
Comorbidities					
No		1			
Yes	0.914	2.495	0.64	9.721	0.188
Alcohol Consumption					
No		1			
Yes	-0.14	0.869	0.238	3.178	0.832
Tobacco Use					
No		1			
Yes	-0.635	0.53	0.113	2.479	0.42
Duration of Symptoms before presentation					
1-5days		1			
6-10days	0.8	2.224	0.363	13.614	0.387
11-15days	0.963	2.621	0.363	18.933	0.34
16 and above	0.009	1.009	0.083	12.303	0.995
Time to Surgery from presentation					
Within 6 Hours		1			
7 to 24 hours	0.289	1.335	0.194	9.173	0.769
Above 24 Hours	0.268	1.308	0.407	4.203	0.653

*Statistically Significant

All four patients who had burst abdomen had hypoalbuminemia, 3 (75.0%) had severe hypoalbuminemia and this association was statistically significant. There was a higher mortality rate among patients who had hypoalbuminemia compared with patients who had normal albumin (18.6 vs 5.9%, $p = 0.163$). Although patients who had hypoalbuminemia had longer hospital stay compared to patients who had normal albumin, the association was not statistically significant (31.4% vs. 17.6%, $P = 0.26$) (Tables 4, 5 and 6).

The development of post-op complications occurred at least two times more in those with moderate hypoalbuminemia than those with

normal albumin. This finding was statistically significant.

DISCUSSION

This study was an observational study conducted in the University of Benin Teaching Hospital over 12months period. Eighty-seven patients, categorized into three groups, were recruited based on their serum albumin levels. Hypoalbuminemia was found to be associated with post-operative complications.

The high incidence of hypoalbuminemia noted in this study gives credence to the documented fact that, being a negative acute phase protein, the level of albumin in serum falls rapidly following acute illness such as

Table 6: Multivariate analysis- Predictors of death

Table 3: Multivariate analysis: Predictors of death					
Predictor	β (Regression coefficient)	Odds ratio	95% CI for OR		p value
			Lower	Upper	
Serum Albumin					
Normal		1			
Moderate	0.853	2.346	0.089	61.806	0.609
Marked	0.238	0.512	0.089	2.950	0.823
ASA Score					
1		1			
2	-19.765	0	0	0	0.999
3	-20.856	0	0	0	0.998
4	-0.597	0.55	0.135	2.248	0.405
Comorbidities					
No		1			
Yes	-1.01	0.364	0.086	1.548	0.171
Alcohol Consumption					
No		1			
Yes	-1.267	0.282	0.057	1.396	0.121
Tobacco Use					
No		1			
Yes	20.636	9.17	0	0	0.998
Duration of Symptoms before presentation					
1-5days		1			
6-10days	0.529	1.697	0.139	20.728	0.679
11-15days	0.069	1.071	0.069	16.524	0.961
16 and above	1.75	5.754	0.129	257.235	0.367
Time to Surgery from presentation					
Within 6 Hours		1			
7 to 24 hours	-0.38	0.684	0.062	7.548	0.757
Above 24 Hours	-0.623	0.536	0.113	2.535	0.432

NB: None of the factor examined was a significant predictor of death among the participants.

occurs during acute abdomen. The finding of higher complication rate in patients with preoperative hypoalbuminemia compared to those that had normal level of albumin is similar to findings from studies done in other parts of the world by Kumar et al., Warriar et al., Sindgikar et al., Garg et al., Bhuyan et al., and Nagesh et al.¹⁴⁻¹⁹ Although all the observed complications occurred more in the patients that had hypoalbuminemia, the association between serum albumin level

before surgery and occurrence of complications after surgery was statistically significant only with SSI and burst abdomen.

The observed higher rate of mortality among patients that had hypoalbuminemia when compared with those that had normal preoperative serum albumin levels is comparable to studies done by Kumar et al.,¹⁴ and Bhuyan et al.¹⁸ Higher rate of mortality has also been reported in patients with

Table 7: Multivariate analysis- Predictors of days on admission

Predictor	β (Regression coefficient)	Odds ratio	95% CI for OR		p value
			Lower	Upper	
Serum Albumin					
Normal		1			
Moderate	0.853	2.346	0.089	61.806	0.609
Marked	0.238	0.512	0.089	2.950	0.823
ASA Score					
1		1			
2	-1.771	0.17	0.025	1.135	0.067
3	-21.627	0	0	.	0.998
4	-1.876	0.153	0.045	0.526	0.003
Comorbidities					
No		1			
Yes	1.02	2.774	0.608	12.667	0.188
Alcohol Consumption					
No		1			
Yes	-0.379	0.684	0.172	2.731	0.591
Tobacco Use					
No		1			
Yes	-0.358	0.699	0.143	3.431	0.659
Duration of Symptoms before presentation					
1-5days		1			
6-10days	-0.549	0.578	0.098	3.39	0.543
11-15days	0.085	1.089	0.16	7.416	0.931
16 and above	-0.657	0.519	0.037	7.25	0.626
Time to Surgery from presentation					
Within 6 Hours		1			
7 to 24 hours	-0.717	0.488	0.061	3.891	0.498
Above 24 Hours	-0.492	0.611	0.176	2.126	0.439

Preoperative serum albumin level did not significantly predict length of hospital stay.

hypoalbuminemia undergoing other types of surgeries.^{20,21} Among the patients who died, 5.9%, 14.8% and 31.3% had normal albumin, mild and severe hypoalbuminemia respectively. This suggests that as the serum albumin reduces, mortality increases. This observation is similar to that of Kumar et al.¹⁴ The correlation between preoperative serum albumin level and death in this study, was however, not statistically significant. Nagesh et al. in a retrospective study on 136 patients who had major gastrointestinal surgery also did not find statistically significant relationship between preoperative albumin level and mortality.¹⁹

Patients that had low preoperative serum albumin level had longer hospital stay compared to those that had normal albumin levels (31.4% vs 17.6%). Though not statistically significant in this study, this finding is in tandem with several other studies which showed that patients that had preoperative hypoalbuminemia had a significantly prolonged hospital stay.²²⁻²⁵ Most of these studies involved larger patient populations. The observed effect of hypoalbuminemia on hospital stay may be because patients with hypoalbuminemia have more complications which will ultimately require a longer hospital stay for resolution of

complications. These findings of higher complications, increased mortality rate and prolonged hospital stay may be because patients with hypoalbuminemia may subsequently have defective drug binding, fluid balance, oxidation, and microvascular integrity, which will in turn lead to altered wound healing, organ function and recovery.²⁶

Patients that had low preoperative serum albumin levels had more postoperative complications, higher mortality rate and prolonged hospital stay compared to those that had normal preoperative serum albumin levels. This association is significant with occurrence of surgical site infection and burst abdomen.

CONCLUSION

This study showed that serum albumin level before surgery has prognostic significance in predicting the occurrence of post-operative complications within 30 days of an emergency laparotomy. We, therefore, advocate that appropriate measures should be instituted to mitigate the occurrence of post-operative complications in persons that have hypoalbuminemia in order to have good surgical outcome.

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