Association of Early Postoperative Fall in Albumin with Morbidity after Colorectal Resections

Niroj Banepali[1], Subodh Kumar Adhikari[2]

[1]MCh resident, [2]Professor and Co-ordinator;

Department of Surgical Gastroenterology, Bir Hospital, National Academy of Medical Sciences, Kathmandu, Nepal
Corresponding Author: Dr. Niroj Banepali; Email: niroj993@gmail.com

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ABSTRACT

Introduction: Severity of systemic inflammatory response to surgical trauma may predict those at increased risk of postoperative complications. Serum albumin level falls early postoperatively and its measurement is cheap and widely available. This study evaluates the role of postoperative fall in albumin to predict postoperative complications of colorectal resections.
Methods: This is a prospective observational study of 56 consecutive patients undergoing colorectal resections in the department of Surgical Gastroenterolgy of Bir Hospital, NAMS from 2020 December to 2022 May. Postoperative albumin drop (Δ Albumin) was defined as 'Preoperative albumin – Albumin on Postoperative Day 1'. The primary outcome was 30-day postoperative complications. Multivariate analysis was performed to identify factors associated with postoperative complications. Receiver operating characteristic (ROC) curve analysis was done for determining the value of postoperative albumin drop in identifying patients with complications.
Results: Postoperative albumin drop > 0.5 g/dl (OR 4.26, CI 3.6-39.99, p = 0.018) and emergency surgery (OR 3.25, CI 1.06-95.79, p = 0.046) were independent predictors of postoperative complications. Patients with complications had higher 'Δ Albumin' (0.6 g/dl vs. 0.27 g/dl, p =0.001) compared to those without complications. The ROC curve Area under the curve of Δ Albumin to discriminate patients with complications was 0.865. Cut-off value of 'Δ Albumin' ≥ 0.35 g/dl resulted in highest accuracy of 80.36%, sensitivity of 95.2% and specificity of 71.4%. Patients with postoperative albumin drop > 0.5 g/dl had significantly higher rate of surgery specific complications (61.9% vs. 11.4%, p = 0.001) compared to those with albumin drop ≤ 0.5 g/dl.
Conclusion: Early postoperative fall in albumin level may identify patients at risk for overall as well as surgery specific complications after colorectal resections.
Keywords: Colorectal resections, morbidity, postoperative albumin drop, predictor.

INTRODUCTION

Colorectal resections are associated with very high morbidity with up to one-third patients having at least one complication[1]. Surgical site infections, anastomotic leaks, postoperative ileus and haemorrhage are among frequently reported complications after colorectal surgery[2]. Occurrence of severe complications increase the length of hospital-stay and costs and may result in poor outcomes[3,4].

As with any injury, surgery also elicits metabolic stress response and the magnitude of this response may dictate post-operative course including complication rates[5]. Exaggerated systemic inflammatory response after surgical trauma has been shown to be associated with poor outcomes[6]. Several inflammatory markers have been suggested as predictors of increased morbidity after colorectal surgery. These include C-reactive protein (CRP), Neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein to albumin ratio (CAR)[3,7,8]. However, CRP kinetics do not favour its use as an early marker since maximal CRP increases are observed only around third postoperative day[6,9].

Postoperative drop in serum albumin levels may result from increased vascular permeability associated with inflammatory response[10]. Systemic inflammatory response also decreases albumin synthesis as albumin is a negative acute phase reactant[11].

Postoperative albumin drop has recently been shown to be a biomarker for surgical stress and has been shown to correlate with intraoperative blood loss and operative duration[6]. A European study reported that magnitude of postoperative albumin drop correlated to overall complications after major abdominal surgery[12].

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Postoperative albumin drop has also been shown to be an independent predictor of postoperative complications after oesophageal and gastric resections[11,13].

However, specific value of postoperative albumin drop in early prediction of complications after colorectal resections is largely unknown. Recently few studies have studied the role of postoperative albumin drop in this regard[14–16]. A retrospective study reported that among patients undergoing major colorectal surgery, those with albumin drop > 15% within first 2 postoperative days had increased overall complications as well as surgical site infections[14]. Another study concluded that postoperative albumin drop was the only independent predictor of severe postoperative complications after laparoscopic colorectal cancer resections[15]. Similarly, a prospective study of 105 consecutive patients with laparoscopic colorectal cancer surgery found that patients with postoperative infectious complications had significantly greater fall in their postoperative albumin levels compared to those without[16].

Measurement of serum albumin is routinely done in most laboratories. Unlike CRP, studies have shown that albumin levels dropped within 4-6 hours post-operatively and remained so for 2-3 days[6,9]. Therefore, measurement of fall in albumin postoperatively might be used as an early predictor of complications. Early identification of patients at risk can lead to more rigorous monitoring and prompt interventions to minimize the impact of these complications. We could not find similar studies in our setup on search of database like Pubmed, Medline and Cochrane Library. Hence, current study was done to evaluate the role of fall in albumin postoperatively in predicting morbidity after colorectal resections in our population.

METHODS

This is a prospective observational study of fifty-six consecutive patients undergoing colorectal resections in the department of Surgical Gastroenterolgy of Bir Hospital, NAMS from 2020 December to 2022 May. Bir hospital, NAMS is a tertiary referral centre of Nepal which receives patients from all over the country. Similarly, our department is one of the few high-volume centres for gastrointestinal surgeries in Nepal, including colorectal surgery.

All the patients undergoing colorectal resections in the department of Surgical Gastroenterology, Bir Hospital, NAMS were eligible for enrollment in this study, provided Informed consent was given. Patients under 18 years of age and those who denied consent were excluded. Consecutive sampling method, a type of non-random sampling, was adopted for case selection.

Sample size was calculated 50.58 (~ 51) cases by using prevalence formula [N = z^2 p q/d^2]; Where, N = sample size; z = 1.96 (for 95% confidence interval); p = prevalence of morbidity after colorectal resections = 0.156 (15.6%)[4]; q = 1-p = 1-0.156 = 0.844; d = 0.1 (for 10% margin of error).

Approval was obtained from the Institutional Review Board (IRB) of NAMS (Ref: 1218/207879) and Informed consent was obtained from the participants of the study. For each patient, preoperative variables including demography, body mass index (BMI), co-morbidities, ASA status and ECOG performance status were recorded. Reports of preoperative investigations, including preoperative serum albumin level, were noted. In those undergoing elective surgery, preoperative serum albumin was measured within 3 days prior to surgery. Serum albumin was measured in our laboratory by Bromocresol Green (BCG) colorimetric method with the help of Erba XL-300 fully random-access clinical chemistry analyzer. When albumin binds with Bromocresol Green, albumin-BCG complex is formed which is yellowish green in color. The intensity of color change is proportional to albumin concentration and can be measured sphectro-photometrically to determine the albumin concentration. To ensure validity of the test results, daily control test runs and calibration checks are performed in our laboratory and any discrepancies are addressed on regular basis.

At surgery, location and extent of pathology, nature of pathology (benign vs. malignant), operative procedure, surgical approach (open vs. laparoscopic), type of anastomosis and operative duration were recorded. Diversion stoma was created in patients undergoing low anterior resections (LAR). Intravenous antibiotics were commenced at the time of induction of anesthesia and continued for 5 days. Additional antibiotic therapy was given as per requirements and according to culture and sensitivity reports.

Serum albumin level was measured on the first post-operative day (POD1) and repeated as necessary. Post-operative albumin drop (Δ Albumin) was calculated by subtracting POD1 albumin from patient's preoperative albumin level (Δ Albumin = Preoperative albumin – POD1 albumin). Postoperative albumin drops % (Δ Albumin %) was expressed as a percentage drop from baseline preoperative level [Δ Albumin % = {(preoperative albumin-POD1 albumin)/preoperative albumin} x 100%].

All patients were followed up for at least 30 days post-operatively and complications that occurred were recorded and graded as per Clavien Dindo classification[17] and appropriate management was instituted. Histopathology report of the resected specimen was recorded as well.

Outcomes and definitions

The primary outcome was occurrence of any complications within 30 days of surgery. Morbidity was defined as any deviation from normal post-operative course and graded as per Clavien Dindo classification[17]. Major complications included Clavien Dindo grade III or higher complications. Surgical site infections were defined as per CDC guidelines 2017[18]. Anastomotic leakage was defined and graded as per International Study Group of Rectal Cancer (ISGRC)[19]. Mortality was defined as death within 30th post-operative day from any cause

.Statistical Analysis

Data were analysed with SPSS version 20.0. Patients were divided into 2 groups; 'Group with postoperative complications' and 'Group without postoperative complications. Continuous data were presented as mean ± SD. Categorical data were expressed as ratios and proportions. Univariate and multivariate analysis were performed to identify factors associated with postoperative complications after colorectal resections. A P-value of less than 0.05 was considered as statistically significant and confidence interval was set at 95%.

Chi square test was done to evaluate the association of fall in albumin postoperatively with complications after colorectal resections. Student's t test was performed to compare the mean postoperative albumin drop in those with and without complications. Receiver operating characteristic (ROC) curve analysis was carried out for determining the appropriate cut-off level of postoperative albumin drop for discriminating between patients with or without complications. Area under the curve and sensitivity, specificity and accuracy were also determined for predicting complications. Odds ratio were also calculated for various factors associated with postoperative complications after colorectal resections. Multinomial logistic regression analysis was used to derive the odds ratio. All factors with p value ≤ 0.5 in univariate analysis were entered as independent variables in multiple regression analysis.

RESULTS

Altogether 56 patients were included in this study. The baseline characteristics of the study patients are shown in Table 1. Mean age of the patients was 54.02 ± 15.64 years and their mean preoperative albumin level was 3.70 ± 0.56 g/dl. Forty-seven patients (83.9%) underwent elective surgery. Laparoscopic surgery was performed in 18 (32.1%) patients. Most of the patients (32.14%) had malignancy of the right colon followed by malignancy of the rectum (30.36%). Ten (17.9%) patients had surgeries for benign indications.

Twenty-one patients (37.5%) had at least one postoperative complication. Major complications (Clavien Dindo Grade 3 or higher) were observed in 11 (19.6%) patients (Table 2). Surgery specific complications (SSI, Wound dehiscence and anastomotic leaks) were seen in 15 (26.8%) patients. Surgical site infections (SSI) were the commonest complication after colorectal resections. Anastomotic leak was observed in five (8.9%) patients. Two (3.6%) patients had reoperation; both surgeries were for burst abdomen.

Table 1: Baseline characteristics of study patients

Characteristics		N (%)
Age (Years)	> 60 years	23 (41.1%)
	≤ 60 years	33 (58.9%)
Gender	Male	35 (62.5%)
	Female	21 (37.5%)
BMI category	High (≥ 25)	15 (26.8%)
	Normal (18.5 – 24.9)	36 (64.3%)
	Low (< 18.5)	5 (8.9%)
Preoperative Albumin (g/dl)	≥ 3.5	41 (73.2%)
	< 3.5	15 (26.8%)
Location of lesion	Rectum	22 (39.3%)
	Colon	34 (60.7%)
Nature of lesion	Malignant	46 (82.1%)
	Benign	10 (17.9%)

Table 2: Complications of colorectal resections

Complications	N (%)
Overall complications	21 (37.5%)*
Major complications (Clavien Dindo III-V)	11 (19.6%)
General complications	
Chest infection	3 (5.4%)
Urinary tract infection	3 (5.4%)
Deep venous thrombosis	1 (1/8%)
Surgery Specific complications	15 (26.8%) **
SSI	14 (25%)
Anastomotic leak	5 (8.9%)
Burst abdomen	3 (5.4%)
Reoperation	2 (3.6%)
Mortality	1 (1.8%)

* This is the total number of patients developing any complications. If a single patient had more than one complication, it is counted as one only.

** Includes patients who developed surgical complications.

Factors associated with complications after colorectal resections

On univariate analysis (Table 3), low postoperative albumin (< 3.5 g/dl), presence of rectal pathology and postoperative albumin drop > 0.5 g/dl were significantly associated with complications after colorectal resections (Fisher's exact test was used to assess the association). Although there were more postoperative complications in those with low preoperative albumin level as compared to those with normal preoperative albumin levels (60% vs. 29.3%), the association did not reach statistical significance (p = 0.06).Similarly, there were more complications in those undergoing emergency surgery compared to elective cases, but the association was not statistically significant (p=0.066). Age, gender, BMI, malignant pathology and surgical approach were not significantly associated with postoperative complications.

Emergency surgery (OR 3.25, CI 1.06-95.79) and postoperative albumin drop > 0.5 g/dl (OR 4.26, CI 3.6-39.99) were the only independent predictors of postoperative complications after colorectal surgery as shown by multivariate analysis (Table 4). For multivariate analysis, multinomial logistic regression was used and stepwise forward entry method was selected to derive the best model. All factors with p value ≤ 0.5 on univariate analysis were entered as independent variables and 'occurrence of any postoperative complications (Yes vs. No)' was the dependent variable. Continuous independent variables were dichotomised for analysis. The independent variables were age category, gender, BMI category (high vs. low), location of pathology (colon vs. rectum), nature of pathology (benign vs. malignant), stoma (yes vs. no), surgical approach (open vs. laparoscopic), timing of surgery (emergency vs. elective) and postoperative albumin drop (≥ 0.5 g/dl vs. < 0.5 g/dl). Patients who had postoperative albumin drop (Δ Albumin) more than 0.5 g/dl were four times more likely to have postoperative complications (OR = 4.26).

Forty-nine (87.5%) patients had fall in the serum albumin levels postoperatively. Among those with postoperative albumin drop, 40.8% had postoperative complications compared to only 14.3% having complications in those without postoperative albumin drop (p=0.237).

Mean preoperative and postoperative serum albumin

Table 3: Factors associated with postoperative complications after colorectal resections (Univariate analysis)

Characteristics		Postoperative Complications		*p* value
		No (35) N (%)	Yes (21) N (%)	
Age in years	> 60	22 (66.7%)	11 (33.3%)	0.576
≤ 60	13 (56.5%)	10 (43.5%)		
Gender	Female	15 (71.4%)	6 (28.6%)	0.395
	Male	20 (57.1%)	15 (42.9%)	
Mean BMI (Kg/m²)		22.77	23.75	0.281
Low Preoperative Serum Albumin (g/dl)	No	29 (70.7%)	12 (29.3%)	0.060
	Yes	6 (40.0%)	9 (60.0%)	
Low Postoperative Serum Albumin (g/dl)	No	23 (79.3%)	6 (20.7%)	*0.012*
	Yes	12 (44.4%)	15 (55.6%)	
Postoperative albumin drop > 0.5 g/dl	No	30 (85.7%)	5 (14.3%)	*0.001*
	Yes	5 (23.8%)	16 (76.2%)	
Rectal pathology	No	26 (76.5%)	8 (23.5%)	*0.011*
	Yes	9 (40.9%)	13 (59.1%)	
Malignant pathology	No	5 (50%)	5 (50%)	0.476
	Yes	30 (65.2%)	16 (34.8%)	
Laparoscopic surgery	No	23 (60.5%)	15 (39.5%)	0.772
	Yes	12 (66.7%)	6 (33.3%)	
Emergency surgery	No	32 (68.1%)	15 (31.9%)	0.066
	Yes	3 (33.3%)	6 (66.7%)	

levels were 3.70 g/dl and 3.33 g/dl respectively. Patients with complications had lower mean preoperative (3.52 g/dl vs. 3.81 g/dl, p = 0.057) as well as lower mean postoperative albumin levels (2.92 g/dl vs. 3.57 g/dl, p = 0.001) compared to those without complications.

The mean postoperative albumin drop was 0.39 g/dl (10.71%). Patients with complications had a significantly higher postoperative albumin drop (Δ Albumin) as compared to those without complications (0.6 g/dl vs. 0.27 g/dl, p =0.001). Fractional postoperative albumin drop (Δ Albumin %) was also significantly higher in those with complications compared to those without (17.3% vs. 6.76%, p = 0.001). Table 5 shows the different albumin values in patients with or without complications.

The association between postoperative albumin drop and increased morbidity was observed even in those patients who had their postoperative albumin levels in the normal range (> 3.5g/dl). Postoperative albumin drop was also significantly associated with occurrence of severe postoperative complications.

Postoperative albumin drop (Δ Albumin) had better ability to predict postoperative complications compared to preoperative or postoperative albumin levels as shown by its higher AUC value (0.865 vs. 0.625 vs. 0.806) on ROC analysis (not shown here).

Receiver operating characteristic curve analysis was also performed to compare the role of postoperative albumin drop (Δ Albumin) with fractional postoperative albumin drop (Δ Albumin %) in predicting postoperative complications (Fig. 1)

Based on ROC curve, suggested cut-off values for prediction of complications were determined and sensitivity, specificity and accuracy were calculated at these cut-off values (Table 6). Fractional Postoperative albumin drop (Δ Albumin %) was shown to be a better predictor of postoperative complications compared to absolute postoperative albumin drop (Δ Albumin) as demonstrated by a higher AUC value as well as higher accuracy rate. A cut-off value of postoperative

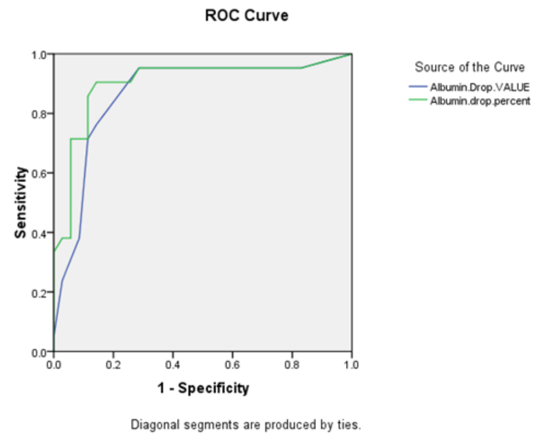

Fig 1. ROC analysis of different albumin parameters for predicting complications

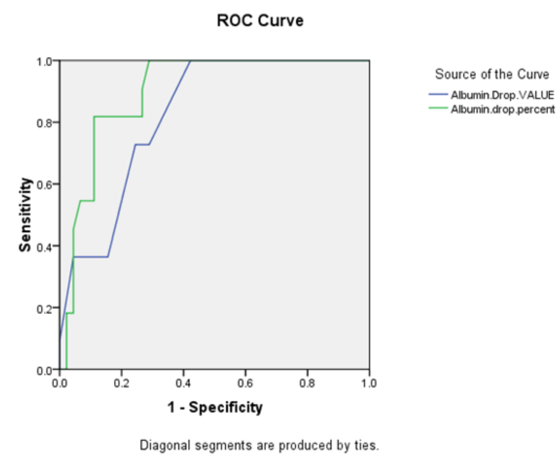

Fig 2. ROC analysis of different albumin parameters for predicting major complications

Table 4: Factors associated with postoperative complications after colorectal resections (Multivariate analysis)

Variable	Reference category	Odds ratio	95% CI	P value
Old Age (> 60 years)	≤ 60 yrs	2.23	0.32-15.58	0.420
Male Gender	Female	4.13	0.4-42.86	0.234
BMI	Normal	6.49 (High BMI)	.016-10.48	0.267
		3.77 (Low BMI)	0.07-10.52	0.105
Rectal pathology	Colon	6.62	0.14-31.74	0.337
Malignant pathology	Benign	1.26	0.54-29.87	0.884
Open surgery	Laparoscopic	1.1	0.3-2.52	0.253
Emergency surgery	Elective	3.25	1.06-95.79	0.046
Postoperative Albumin drop > 0.5 g/dl	Drop ≤ 0.5	4.26	3.6-39.99	0.0018

Table 5: Different albumin parameters and postoperative complications

Albumin parameters	Patients with complications N=21)	Patients without complications (N = 35)	P value
Mean preoperative albumin	3.52 ± 0.71 g/dl	3.81 ± 0.43 g/dl	0.057
Mean postoperative albumin	2.92 ± 0.65 g/dl	3.57 ± 0.37 g/dl	0.001
Mean postoperative albumin drop (Δ Albumin)	0.60 ± 0.22 g/dl	0.27 ± 0.21 g/dl	0.001
Mean postoperative albumin drop % (Δ Albumin %)	17.31 ± 6.42 %	6.76 ± 5.12 %	0.001

Table 6: AUCs, cut-off values and accuracy of different albumin parameters for predicting postoperative complications

Parameter	AUC	Cut-off	Sensitivity	Specificity	PPV	NPV	Accuracy
Δ Albumin (gm/dl)	0.865	0.35	95.2%	71.4%	66.7%	96.1%	80.36%
Δ Albumin %	0.901	11.265	90.5%	85.7%	79.2%	93.8%	87.5%

Table 7: AUCs, cut-off values and accuracy of different albumin parameters for predicting major postoperative complications

Parameter	AUC	Cut-off	Sensitivity	Specificity	PPV	NPV	Accuracy
Δ Albumin (gm/dl)	0.824	0.35	100%	57.8%	36.7%	100%	66.07%
Δ Albumin %	0.899	11.265	100%	71.1%	45.8%	100%	76.79%

Table 8: Association of early postoperative albumin fall with surgery specific complications

Characteristics		Albumin drop > 0.5 g/dl Yes N (%)	No N (%)	*p* value
Overall surgery specific complications	Yes	11 (52.4%)	4 (11.4%)	*0.001*
	No	10 (47.6%)	31 (88.6%)	
SSI	Yes	10 (47.6%)	4 (11.4%)	*0.004*
	No	11 (52.4%)	31 (88.6%)	
Anastomotic leaks	Yes	4 (19%)	1 (2.9%)	0.06
	No	17 (81%)	34 (97.1%)	

albumin drop ≥ 0.35 g/dl was derived for prediction of postoperative complications. Whereas, a cut-off value of fractional postoperative albumin drop ≥ 11.27% resulted in highest accuracy for prediction of postoperative complications.

For predicting major complications too, fractional Postoperative albumin drop (Δ Albumin %) was a better predictor compared to absolute postoperative albumin drop (Δ Albumin) (Fig 2 and Table 7).

Table 8 shows the association of early postoperative fall in serum albumin levels (Δ Albumin) > 0.5 g/dl with surgery specific complications. Overall rate of surgery specific complications was significantly higher in those with Δ Albumin > 0.5 g/dl. SSI was also observed significantly more in those with Δ Albumin > 0.5 g/dl.

On ROC curve analysis, Δ Albumin was shown to have good ability to discriminate between patients with and without surgery specific complications too as shown by AUC of 0.842. Best cut-off point to predict patients with surgery specific complications was 'Δ Albumin ≥ 0.35 g/dl' with sensitivity and specificity of 94.1% and 64.1% respectively.

DISCUSSION

Several previous studies have already demonstrated the adverse effects of preoperative hypoalbuminemia on postoperative outcomes after colorectal surgery[20–22]. The adverse impact of low preoperative albumin on surgical outcomes is understandable given the important role of albumin as a nutritional marker and its role in wound healing. However, whether postoperative hypoalbuminemia or perioperative alterations in albumin levels have some prognostic value is still investigational. Some recent studies have elucidated the role of albumin as a marker of systemic inflammatory response and shown that its levels fall postoperatively as part of the metabolic response and also that magnitude of postoperative albumin drop parallels the degree of surgical insult[6,12].

Measurement of serum albumin is cheap, easy and widely available. Thus measurement of postoperative albumin drop as a marker of perioperative stress and hence poor surgical outcomes seems attractive. Therefore, the current study focused on the role of postoperative albumin drop (Δ Albumin) in predicting postoperative complications after colorectal resections.

Our results confirm that serum albumin levels decrease in the early postoperative period, even in those patients who had uncomplicated postoperative course. Moreover, those patients with postoperative albumin drop had a higher risk of developing complications compared to those who had no postoperative albumin drop. Furthermore, patients with postoperative complications had a significantly larger decrease in postoperative albumin levels (Δ Albumin) compared to those without complications. This suggests that 'Δ Albumin' could be a useful marker to identify patients at increased risk for complications after colorectal surgery.

Our results are in concurrence with other published studies evaluating the association of 'Δ Albumin' and morbidity after colorectal resections. A retrospective study of 626 patients undergoing major colorectal surgery also found that postoperative albumin drop on POD2 was an independent risk factor for overall complications. In that study, patients with 'Δ Albumin' ≥15% had more postoperative major complications, longer postoperative stay, and increased surgical site infections compared to those with 'Δ Albumin' <15%. There was no significant differences in preoperative or postoperative serum albumin levels[14]. Another study from China found postoperative albumin drop to be the only independent risk factor for severe postoperative complications after laparoscopic colorectal resections. In their study, 'Δ Albumin' had a very strong accuracy in predicting severe complications with an ROC curve AUC of 0.916. A cut-off value of postoperative albumin drop of 17.3% resulted in sensitivity and specificity of 0.842 and 0.858 respectively[15]. Significant drops in postoperative albumin levels through POD3 were observed in patients with at least one infectious complication after colorectal surgery[16]. The delta albumin (Δ Albumin) was an independent risk factor for severe complications in colorectal cancer patients after curative laparoscopic surgery as well[23].

Several reasons have been provided to explain the fall in serum albumin level in the early postoperative period[12,14,15]. Redistribution of albumin between intravascular and tissue compartments subsequent to increased vascular permeability appears to be the predominant mechanism and the change in albumin levels is proportionate to the magnitude of systemic inflammatory response[6]. A study found that trans-capillary leakage of albumin increases by as much as 100% after major surgery and up to 300% in patients in with septic shock[10]. Moreover, albumin is a negative acute phase reactant and its hepatic synthesis is down-regulated in response to metabolic stress so as to allow increased production of positive acute phase reactants like CRP, fibrinogen and macroglobulins[5]. Thirdly, increased energy requirements also lead to increased albumin consumption to allow gluconeogenesis[24]. It may be argued that excessive intravenous fluid administration in the postoperative period may lead to an apparent fall in postoperative albumin levels. However, a study by Hubner et al has shown that haemodilution plays only a relatively minor role in postoperative albumin drop. In their study, the fall in hematocrit levels was only 7% compared to a 20% fall in albumin during the same time period[6].

Tissue trauma due to surgical procedures elicits a metabolic stress response which leads to increase in the serum levels of positive acute phase reactants like C-reactive protein (CRP) and procalcitonin while levels of negative acute phase reactants like albumin decrease[25]. Hence, measurement of these acute phase reactants can quantify metabolic stress response after surgery[26]. For such a marker to be clinically useful as a predictor of postoperative course, it should be measurable early in the postoperative period. Besides, it should be readily measurable, widely available, and inexpensive. CRP levels increase slowly in the postoperative period reaching maximal values only on POD2/ POD3. Meanwhile, measurement of procalcitonin is expensive and not widely available. On the other hand, albumin measurement is cheap, easily done and its values dropped within 6 hours of surgery[6].

Studies have shown that there is a significant correlation between maximal CRP increase and maximal albumin decrease, thus suggesting that decrease in postoperative albumin levels parallels the extent of systemic inflammatory response. Moreover, albumin decrease also showed linear correlation to duration of surgery further corroborating that extent of albumin drop is a measure of the magnitude of surgery[6]. Another study also found that postoperative albumin decrease on POD1 strongly correlated to surgical stress as measured by mEPASS score as well as to duration of surgery and blood loss[12].

CRP and procalcitonin are currently used as measures of systemic inflammatory response but their value as early postoperative marker is limited by their slow kinetics. On the other hand post-operative albumin drop was observed within 6 hours of surgery followed by a plateau phase till POD3[6]. So, using postoperative albumin drop as a marker helps in earlier prediction and allows more time for interventions.

We also compared the value of different albumin parameters (viz. preoperative albumin, postoperative albumin, Δ Albumin and Δ Albumin %) in discriminating between patients with and without complications. Our results showed that there were significantly lower postoperative albumin levels and higher Δ Albumin and Δ Albumin % in those with postoperative complications. However, there was no significant difference in the preoperative albumin levels. A Japanese study also found that there was no significant difference in preoperative serum albumin level between patients with or without anastomotic leakage in colorectal cancer patients but significantly lower postoperative serum albumin levels in those with leak[27]. Another study also reported significantly lower postoperative albumin levels in patients with infectious complications but no significant difference in preoperative albumin levels between patients with or without infectious complications after colorectal surgery[16].

In our study, ROC curve analysis suggested 'Δ Albumin %' to be the best predictor with an AUC of 0.901 compared to 0.865 for Δ Albumin and 0.806 for absolute value of postoperative albumin. This further suggests that serial measurement of albumin level might be better than single measurements, either preoperatively or postoperatively.

Another interesting finding of this study was that Δ Albumin was a significant predictor of postoperative complications even in those patients whose postoperative serum albumin was still above 3.5 g/dl. Moreover, this study showed that early postoperative fall in serum albumin levels was also significantly associated with rate of surgery specific complications. Thus, besides being a nutritional marker, albumin also has important role as a measure of systemic inflammatory response to surgery.

This study has some limitations. Firstly, there is some heterogeneity in the study population. Since our study includes patients with benign as well as malignant colorectal diseases, we cannot conclude with certainty whether 'Δ Albumin' is able to predict postoperative complications in both subsets of our patients with same accuracy. A longer duration of study could have been performed to accrue sufficient sample of a homogenous nature. Secondly, it is a single centre study. A multi-centre study is more ideal as there is also external validation of the results. However this could also introduce other confounding factors like surgeon experiences and different management protocols according to institutions. On the other hand, prospective nature of the study is a significant strength of this study. In addition, there are few studies from our region reporting on the role of postoperative drop in prediction of postoperative complications.

CONCLUSION

Postoperative albumin drop > 0.5 g/dl and emergency surgery were independent predictors of overall postoperative complications after colorectal resections. Patients with postoperative complications had higher 'Δ Albumin' as well as higher 'Δ Albumin %' compared to those without. Early postoperative fall in albumin could also predict those at risk for surgery specific complications. Thus, measurement of fall in albumin postoperatively may identify patients at increased risk for complications. A larger, multi-center study is required to clarify its role further.

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