Correlation of Post-operative Albumin Level to the Clinical Outcome in Patients Undergoing Abdominal (Intra-Peritoneal) Surgery

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Abstract
Surgical intervention has become an integral aspect of an individual's life. A study conducted in the United States indicates that the average number of surgeries a person undergoes in their lifetime is 9.2. Surgical complications, such as surgical site infections, persist as significant concerns despite advancements in asepsis, antimicrobial therapies, sanitation, and surgical techniques. Various clinical, biochemical, and radiological methods are available to assist clinicians in the prompt diagnosis of postoperative complications. Acute-phase proteins (APPs) are proteins whose plasma concentrations increase (positive acute-phase proteins) or decrease (negative acute-phase proteins) in response to inflammation. This study aims to evaluate the relationship between postoperative serum albumin levels and clinical outcomes in patients undergoing abdominal (intraperitoneal) surgery. This prospective, time-bound study was conducted on 110 patients in the Department of General Surgery at the PES Institute of Medical Sciences and Research, Andhra Pradesh, from November 2022 to August 2024. The study population included patients above the pediatric age group of both sexes who underwent abdominal (intraperitoneal) surgery in the General Surgery Department of PES IMS. All participants were admitted and initially subjected to a comprehensive history-taking process, which included an assessment of symptoms, disease duration, and general physical and systemic examinations. Patients undergoing pancreatic surgery exhibited the lowest albumin values (34.7-5.3 g/l), followed by those undergoing gastroesophageal (36.4-5.4 g/l), colorectal (37.8-5.1 g/l), and hepatic surgery (38.4-5.8 g/l). The association between albumin levels and the type of surgery approached statistical significance. Our study found that a greater postoperative decrease in serum albumin was associated with complications; thus, serum albumin may serve as a predictive marker for clinical outcomes in patients undergoing surgery.

INTRODUCTION

Surgical interventions have become part and parcel of an individual's life. One United States study says that average number of surgeries that a person undergoes in his/her lifetime is 9.2[1]. Surgical complications such as surgical site infections continue to be a serious problem, despite developments in asepsis, antimicrobial medications, sanitation, and operating methods. They are to blame for the rising expense, morbidity, and mortality associated with surgical procedures, and they remain a big issue even in hospitals with the most sophisticated equipment and proper preoperative preparation and antibiotic prophylaxis policies[2].

There are several clinical, bio-chemical, and radiological methods available to help clinicians quickly diagnose postoperative problems[3]. Acute-phase proteins (APPs) are a type of protein whose plasma levels rise (positive acute-phase proteins) or fall (negative acute-phase proteins) in response to inflammation. When an injury occurs, inflammatory cells release cytokines such as IL-1, IL-6, and TNF-ALPHA, which cause alterations in acute phase protein secretions in the liver[4-6]. CRP, hepcidin, ferritin, ceruloplasmin, haptoglobulin, fibrinogen, prothrombin, and platelet activating factor are examples of positive acute phase reactants. Albumin, transferrin, transthyretin, retinol binding protein, anticortin, and transcortin are the negative acute phase proteins. In the acute phase reaction to trauma, stress, inflammation, or sepsis, the rate of transcription of albumin mRNA and synthesis of albumin decreases, whereas the rate of gene transcription for positive acute phase proteins like CRP increases[7].

Albumin is a protein and a biochemical marker that has an instantaneous reaction to surgical stress and is commonly utilised as a nutritional marker and outcome predictor. In the majority of major abdominal procedures, a drop in albumin level can be seen during the first few hours after surgery. Despite well-established pathophysiological fundamentals of albumin kinetics, albumin is rarely employed as a marker of problems in the early postoperative period. There is also a link between albumin levels and surgical trauma and postoperative stress response[8]. Decreased plasma albumin concentration (P-alb) associated with surgical trauma is known and the mechanism is likely to be multifactorial, but increased capillary leakage is believed to be a major factor. This altered capillary leak can result from an inflammatory response evoked by surgical trauma[9].

Since albumin is a negative phase protein, its synthesis and blood levels decrease after injury. Surgery is also a kind of man-made injury for the benefit of a person. Albumin levels decrease postoperatively and can be used as a predictor for finding clinical results[5,10,11]. There is a plethora of studies in the literature looking at the level of albumin as a predictor of postoperative complications in abdominal surgeries. The present study was aimed to examine the level of albumin pre and post operatively in the context of predicting complications of surgeries in patients undergoing abdominal surgeries.

Aims and Objectives: To evaluate the relationship between post-operative serum albumin levels and the clinical outcomes in patients undergoing abdominal (intra-peritoneal) surgery.

- To measure the post-operative serum albumin levels in patients undergoing abdominal surgery at defined time intervals.
- To assess the clinical outcomes including length of hospital stay, incidence of post-operative complications, wound healing status, and morbidity/mortality rates

MATERIALS AND METHODS

This is a prospective time bound study conducted on 110 patients in the department of General surgery, PES institute of medical sciences and research at Andhra Pradesh. Nov 2022 to Aug 2024. The sampling technique was convenience sampling. A specially designed proforma was filled for each patient. These proforma have general information about the patients, pre and post-operative albumin and other variables. Inclusion criteria are People undergoing abdominal (intra-peritoneal) surgeries between and those with age group of 18-70 years were included. Exclusion criteria are People with underlying liver disease were excluded. The study group comprised of patients above pediatric age group and both genders that undergo abdominal (intra- peritoneal) surgery at General surgery department of PES IMS.

All included patients were admitted, initially subjected for detailed history taking which included symptoms and duration of the disease; general physical and systemic examination. A specially designed proforma was filled for each patient. These proforma have general information about the patients, pre and post-operative albumin and other variables. The data was then analyzed for correlation of the post-operative albumin drop with the clinical outcome of the abdominal (intra-peritoneal) surgeries using Clavien-Dindo scoring system.

The study group comprised of patients above pediatric age group and both genders that undergo abdominal (intra- peritoneal) surgery at General surgery department of PES IMS .

Statistical analysis was done using the statistical package for social sciences (SPSS). Different statistical methods were used as appropriate. Mean ± SD was determined for quantitative data and frequency for

categorical variables. The independent t- test was performed on all continuous variables. The normal distribution data was checked before any t-test. The Chi-Square test was used to analyze group difference for categorical variables A p- value < 0.05 was considered significant.

RESULTS AND DISCUSSIONS

The present study was done to study the correlation of postoperative changes in albumin to the clinical outcome in patients undergoing abdominal (intra-peritoneal) surgery. Total 110 patients (Table 1 shows age distribution) were included in the present study who underwent intra-peritoneal surgeries. The albumin levels were measured before and 6-hour after surgery, the percentage difference change in the albumin level after 6-hour of surgery was calculated. The change was more than or equal to 10% among 36 patients, while it was <10% among 74 patients. The albumin levels were measured before and 24-hour after surgery, the percentage difference change in the albumin level after 24-hour of surgery was calculated. The change was more than or equal to 15% among 20 patients, while it was <15% among 90 patients. The patients were evaluated for the development of post-surgical complications. The distribution of complications is shown in Table 2. Grade 1 complications were the most prevalent, while 67 patients developed no any complications. The complications among patients in study population divided on the basis of percentage albumin change 6-hour after surgery. The distribution of patients was compared by means of chi-square test, there was a significantly high number of patients developed complications who had =10% of albumin change (Table 3). Similarly, the complications among patients in study population divided on the basis of percentage albumin change 24-hour after surgery. The distribution of patients was compared by means of Chi square test, there was a significantly high number (18 out of 20) of patients developed complications who had =15% of albumin change (Table 4). No any significant association between the complications

In the realm of elective surgeries, abdominal surgeries are among the most frequently done procedures. In spite of the fact that there has been a decrease in postoperative mortality as a result of advancements in surgical and perioperative procedures, the postoperative morbidity rate has remained high over the past few decades. In addition to the risks associated with morbidity, the postoperative issues that patients experience result in a large financial burden. In order to accomplish this goal, significant initiatives are currently being made in order to minimise the costs of healthcare[12]. Increased vascular permeability for cells and plasma solutes is a

reaction that occurs in every single instance of trauma, acute sickness, chronic disease, life events, numerous or solitary organ failure, and cancer. This response is present in situations such as oedema that occurs during the healing process of wounds and the requirement to maintain intravascular volume by "overhydrating" individuals who have been traumatised or who have recently undergone surgery[13].

A quick decrease in the quantity of albumin, which is a protein that is responsible for maintenance, is observed as a result of inflammatory signals[14]. It is possible to predict the fate of first-hit acute inflammatory disorders, such as initial trauma, burns, or acute infections, by analysing the serum levels of albumin. The acute phase reaction is characterised by changes in albumin and other markers of inflammation, including CRP, which increases within hours of major surgery. This reaction is triggered by acute inflammation[15].

In this particular study, the objective was to investigate the level of albumin in patients who were due to have abdominal procedures and to see whether or not it might be used as a signal for problems. The purpose of this study was to investigate the relationship between postoperative changes in albumin levels and the clinical outcome of patients who had undergone abdominal (intraperitoneal) surgery. There were a total of 47.63±17.45 years of age among all of the patients that were studied, with 53.6% of them being female and 46.4% being male. Similar to present study Issangya et al studied 61 participants; with the mean age of 51.6±16.3, but in contrast to our finding 28 (45.9%) participants were experienced postoperative adverse outcomes and the majorities were males 40 (65.6%)[16].

Zhou *et al* tried to identify peri-operative variables associated with operative duration and determined their influence on clinical outcomes in pediatric patients[17]. The operative time was often increased by excision difficulty caused by a larger choledochal cyst size, a greater BMI, and older age in the multivariate analysis. A long surgical duration was associated with delayed gastrointestinal functional recovery, as measured using the time to first defecation and first bowel movement. Significantly lower levels of serum albumin were found in the long operative time group than in the short operative time group. The total length of postoperative hospital stay was longer in patients in the long operative time group than in those in the short operative time group. In the present study the duration of surgery was recorded, among 6.4% patients it was =150 minutes, in 76.4% patients it was between 150-300 minutes and in 17.3% it was >300 minutes. For perioperative morbidity and even in patients with normal preoperative levels, a negative acute-phase protein, albumin, is important[18].

Table 1 :Age distribution

Age group	NN	Percentage
<30	20	18.2
>50	49	44.5
30-50	41	37.3
Total	110	100.0

Table 2: Distribution of post-surgery complications among the study population according to Clavien- Dindo classification (n=110)

Grade	N	Percentage
Grade 1	28	25.5
Grade 2	6	5.5
Grade 3a	2	1.8
Grade 3b	2	1.8
Grade 5	5	4.5
No complications	67	60.9
Total	110	100.0

Table 3: Association Of The Type Of Complications With Percentage Change In Albumin At 6-Hour Post-Surgery

	<10 (%)	=10 (%)	
Grade 1	11 (15)	17 (47)	28
Grade 2	2 (2)	4 (11)	6
Grade 3a	1 (1)	1 (3)	2
Grade 3b	0	2 (5)	2
Grade 5	0	5 (14)	5
No complications	60 (81)	7 (19)	67

Table 4: Association of the type of complications with percentage change in albumin at POD-1

Type of complication	% of albumin difference		Total
Grade 1	21 (23)	7 (35)	28
Grade 2	2 (2)	4 (20)	6
Grade 3a	1 (1)	1 (5)	2
Grade 3b	1 (1)	1 (5)	2
Grade 5	0	5 (20)	5
No complications	65 (72)	2 (10)	67
Total	90 (100)	20 (100)	110

Labgaa *et al* reported the sudden drop in the levels of serum albumin after surgery[17]. Serum albumin drop (ΔAlb) was found to be correlated with the mEPASS score and to CRP increase. ΔAlb was also correlated to overall complications, CCI and length of hospital stay. The efficacy of ΔAlb with sensitivity of 77.1% and a specificity of 67.2% to predict complications gave the value of =10 g/l. A threefold increased risk showed after overall post-operative complications in patients with ΔAlb=10 g/l on POD-1.

The albumin levels pre and post-operatively were recorded by Issangya *et al.* among the patients undergoing abdominal surgeries[16]. In pre-operative serum albumin values, 67.8% patients had albumin level of lower than 3.4 g/l while similar to present study, lower than 3.4 g/l post-operative albumin values had in 91% patients. A high albumin had in 27.3% patients with median percentage value of 14.77%. Also, an independent significant factor, ΔAlb, associated with adverse outcomes was reported in this study. The percentage difference in the albumin level after 6-hour of surgery was <10% among 67.3% of patients and =10% among 32.7% of patients. The percentage difference change in the albumin level after 24-hours of surgery was <15% among 81.8% of patients and =15% among 18.2% of patients.

Similar to present study Hübner *et al* studied albumin level drop as marker of surgical stress, a significant immediate decline by 10 g/l after surgery. 10 Operation length, maximum CRP and estimated blood loss was correlated with maximal Albumin decrease. Pre-operative and post-operative hypoalbuminemia were identified in 15.4% and 51.2% of subjects, respectively. The decrease in plasma albumin concentration in association with surgical trauma is well known, and the mechanisms are probably multifactorial, but an increase in capillary leakage is thought to be a major component. This altered capillary leakage may be attributed to the inflammatory reaction elicited by the surgical trauma[9].

The most prevalent types of complications recorded among the study population were grade I (25.5%), followed by grade 2 (5.5%), grade 5 (4.5%), grade 3a (wound gaping and 2 suturing) and grade 3b each present among 1.8% of patients. In a correlation analysis demonstrated positively correlation of postoperative exogenous albumin infusion with complication grade among the patients undergoing pancreaticoduodenectomy[19].

The factors including, a high CRP on POD 3 or 4, the presence of Charcot's triad and a longer operating time predicted a high ΔAlb level which was explained by Liu Q *et al* in determining the perioperative factors related with the post-operative reduction in serum albumin. The high occurrence of postoperative complications with gastrointestinal functional recovery delay, reflected by the postoperative defecation and bowel movement delay was also related to a high ΔAlb level. Patients undergoing pancreatic surgery showed the lowest albumin values (34.7-5.3 g/l), followed by gastroesophageal (36.4-5.4 g/l), colorectal (37.8-5.1 g/l), and hepatic surgery (38.4-5.8 g/l) patients. The

association between albumin levels and the type of surgery approached significance[19].

When the association of percent difference change in albumin level after 6-hours of surgery was studied with type of complications, we found a significant association indicating if more the percent difference in albumin level, the number of complications also increases. Similar, results were obtained when the results were compared after 24-hours of surgery. While the comparison of type of complication with duration of surgery did not yield any significant association among these parameters.

In patients having complications and a longer hospital stay had significantly higher maximal decreased Albumin levels reported by Hübner *et al*[10]. They concluded that a drop in albumin in early post-operative condition was correlated with adverse clinical outcomes and also reflect the magnitude of surgical trauma.

After gastric cancer resection short-term complications developed by 27.8% patients were reported in a study by Liu *et al*[11]. The serum albumin decline postoperatively was found to be an independent risk factor for complications. The cutoff value was reported to be 14.0%. After gastrectomy the likelihood of short-term complications were more in patients with postoperative decrease in serum albumin if =14.0%. The results of study by Nakano *et al* for predicting the prognosis of patients with curatively resected PDAC reported potential markers being postoperative level and recovery rate of serum albumin[20].

Surgery in the abdominal cavity is followed by a larger decrease in serum albumin concentrations, as in other surgical procedures. Enhanced capillary permeability causes escape of fluid and albumins from the vessels, and returns to normal in 12-24 h after surgery; however, after extensive surgery, albumin was found in the extravascular compartment 7-10 days after surgery[21]. Altered metabolism combines with the mechanisms of decrease at early postoperative phase, blood loss/dilution and most importantly due to capillary leakage redistribution into the third space. In the early postoperative phase, the latter accounts for >75% decrease in the level of albumin and appears to be related to the magnitude of systemic inflammatory response. Therefore, perioperative fluid management may affect decrease in albumin level, but it mainly reflects the extent of postsurgical stress response[12].

Serum albumin is widely used as reliable indicator for nutritional status and as predictor for clinical outcomes. Protein metabolism is significantly disturbed after any kind of traumatic event, for example, surgery, sepsis, and burn injuries; albumin has been identified as a reliable indicator of this process. Plasma concentrations of albumin reveal an important decrease as early as a few hours after the hit.

The underlying pathophysiological mechanisms include: 1) the impairment in the albumin synthesis is seen during the early postoperative phase as an importance of acute phase proteins, in the host defense process these acute phase proteins are needed to facilitate the production of these acute phase molecules. However, the decrease observed at initial period is found to be transitory. In the early postoperative period the increase in the fractional albumin synthesis is proportionally to the degree of inflammation is seen; perioperative nutrition can further stimulate the production; 2) in the early postoperative phase, nearly 10 times basal energy expenditure increases, and within 10 days to favor gluconeogenesis up to 20% of protein from body store can be consumed; 3) however, sequestration into the third space is the most important postoperative losses of albumin. In the context of sepsis and (surgical) trauma, a well-known phenomenon is capillary leak[10].

Even though our study shows the efficacy of post-operative albumin drop in abdominal (intra-peritoneal) surgeries in predicting the complications it had been done in small sample size and includes all types of intra- peritoneal surgeries. Our study had not brought out the association between the comorbidity (diabetes, hypertension) and the outcome. Our study had not discussed about the association of laparoscopic versus open surgery with post-operative albumin drop. In the near future a study with large sample size, including only selective intra-peritoneal surgery could validate the efficacy of post-operative albumin drop in predicting outcome.

CONCLUSION

As per literature early perioperative decreases in serum albumin levels may be a good, simple and cost-effective tool to predict adverse outcomes in major abdominal surgeries. =10% and =15% decrease in albumin level after 6 hrs and 24 hrs of surgery respectively than before surgery in patients undergoing abdominal surgeries, has a better predictive value for prediction of surgical complications. Therefore, the estimation of albumin level after 6 hours of surgery can be recommended for the prediction of any adverse outcomes of surgery.

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