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ORIGINAL RESEARCH

Study to assess role of serum albumin levels in abdominal surgical wound healing

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ABSTRACT

In humans, albumin makes up for 4/5th of the normal Colloidal Oncotic Pressure which equates to 25 mmHg (1). The high colloidal osmotic pressure was due to its heavy molecular weight and its increased concentration in plasma. Present at a greater concentration than other plasma proteins and still has the greatest osmotic significance (2). This direct osmotic effect dispenses 60% of the oncotic pressure of albumin. The remaining 40% is a consequence of its negative charge, providing an attractive force for the intravascular retention of positively charged solute particles (3). It is the COP gradient across the capillary membrane which is of greater importance in determining fluid shift into the interstitium rather than the absolute plasma value (4). Excess albumin levels prevent the accumulation of excess colloid primarily through increased albumin degradation and albuminuria, rather than changes in albumin synthesis. The exact site of oncotic regulation in albumin synthesis is not clearly understood, but it has been hypothesized to reside within the hepatic interstitial volume (5). Decreased serum colloid osmotic pressure has been observed in critically ill patients post-operatively (6), and reduced colloid osmotic pressure is associated with higher rates of postoperative complications (morbidity and mortality) in surgical patients. (5).

INTRODUCTION

Wound healing necessitates energy and is a catabolic process. Severely malnourished patients often exhibit impaired wound healing and increased susceptibility to infections. They also suffer deficient immune mechanisms. The catabolic effects of disease or injury can be reversed by adequate nutritional support. The degree of malnutrition is estimated on the basis of weight loss during the past 6 months, physical findings and plasma protein assessment. Malnutrition has been associated with several complications and is considered to be one of the major indicators of poor prognosis. Amongst the various parameters serum albumin has traditionally been used as a significant measure of a patient's nutritional status because of its availability and low cost. Hypoalbuminemia is a deficit of albumin in the blood (adults, defined by an intravascular albumin level of <3.5g/dL). The most concentrated circulating protein in humans is albumin, which provides for around 55–60 per cent of the serum protein. Albumin is composed of 585 amino acids arranged in a lengthy polypeptide chain, with a molecular weight totalling 66,500 Daltons. The polypeptide chain has carbohydrate moiety deficiency and is characterized by a low tryptophan and methionine material. The circulating molecule which is mature in nature; its architecture is held by 17 disulphide bonds which holds sequences of helices of molecule. The folding of molecule and few regions being hydrophilic gives it an excellent property of binding. The tertiary structure heart-shaped human albumin crystal molecule approximates to 80 x 30 Å. The structure is quite different in solution. The three domains are arranged in an ellipsoid pattern, giving the molecule its low viscosity. A strong negative charge of -17 is noted. Due to its inherent flexibility, albumin can adapt to changes in its surrounding environment and conform to ligands when binding. Its resilience allows it to regain its shape easily, facilitated by disulphide bridges that provide strength, particularly under physiological conditions.

AIMS AND OBJECTIVES

Aim

Study to assess role of serum albumin levels in abdominal surgical woundhealing.

Objective

1. To assess serum albumin levels as a potential predictor of like delayed wound healing, organ dysfunction
2. To determine whether albumin levels on

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admission and changes in albumin levels were associated with intensive care unit (ICU)

3. To assess serum albumin levels as a marker for surgical stress

MATERIALS AND METHODS

Patients admitted in surgical wards at C R Gardi Hospital and R D Medical College Hospital for any major abdominal surgeries between Jan-23 – June-24 All patientswere examined clinically and observed for inclusion and exclusion criteria according to our study proforma. All necessary investigations were carried out especially serum albumin levels and patients were planned for surgery electively or in emergency as and when required according to standard protocol.

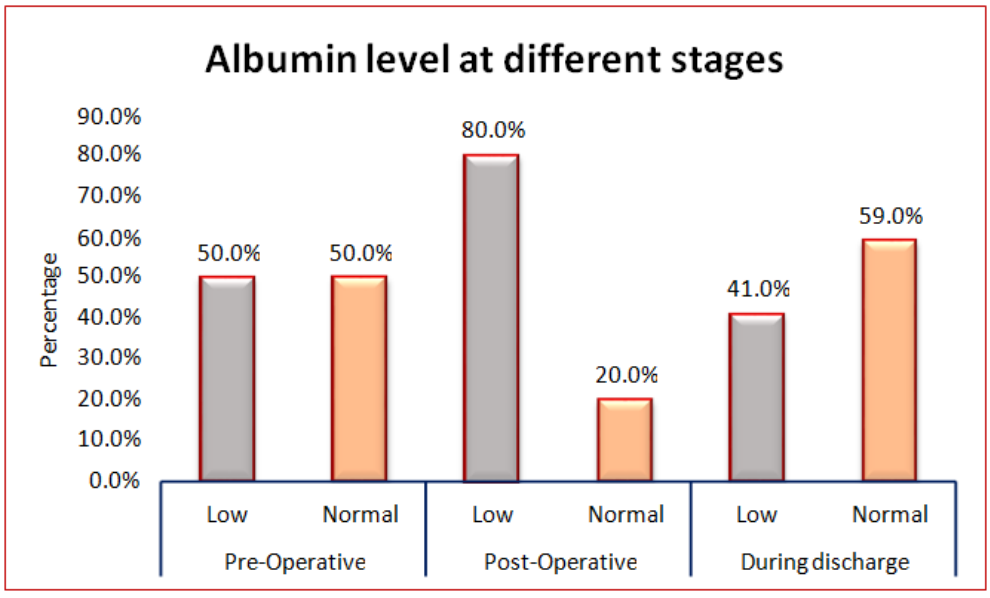
- Details of cases will be recorded including history, clinical examination,investigations done, surgical procedures and post-operative complications.
- Anthropometry – height and weight recorded.
- Follow up till discharge from the hospital.

OBSERVATIONS AND RESULTS

Albumin level at different stages

Albumin		N	%
Pre-Operative	Low	50	50.0%
	Normal	50	50.0%
Post-Operative	Low	80	80.0%
	Normal	20	20.0%
During discharge	Low	41	41.0%
	Normal	59	59.0%

The albumin levels among the cases were monitored pre-operatively, post- operatively, and at the time of discharge. Pre-operatively, the albumin levels were evenly distributed, with 50.0% of cases having low albumin levels and 50.0% having normal levels. However, post-operatively, there was a significant increase in the number of cases with low albumin levels, rising to 80.0%, while only 20.0% maintained normal levels. By the time of discharge, the albumin levels showed some improvement, with 41.0% of cases still having low levels and 59.0% returning to normal levels.



Association between complications and pre-operative albumin

Complication	Pre-Operative Albumin				p
	Low		Normal		
Yes	18	36.0%	19	38.0%	0.000
No	32	64.0%	31	62.0%	
Total	**50**	**100.0%**	**50**	**100.0%**	

In present study, cases with complications showed a distribution where 36.0% hadlow albumin levels, and 38.0% had normal levels. In comparison, among cases without other complications, 64.0% had low albumin levels, and 62.0% had normal levels. The statistical comparison yielded a p-value of 0.000, indicating a significant association between the presence of other complications and lower pre-operative albumin levels.

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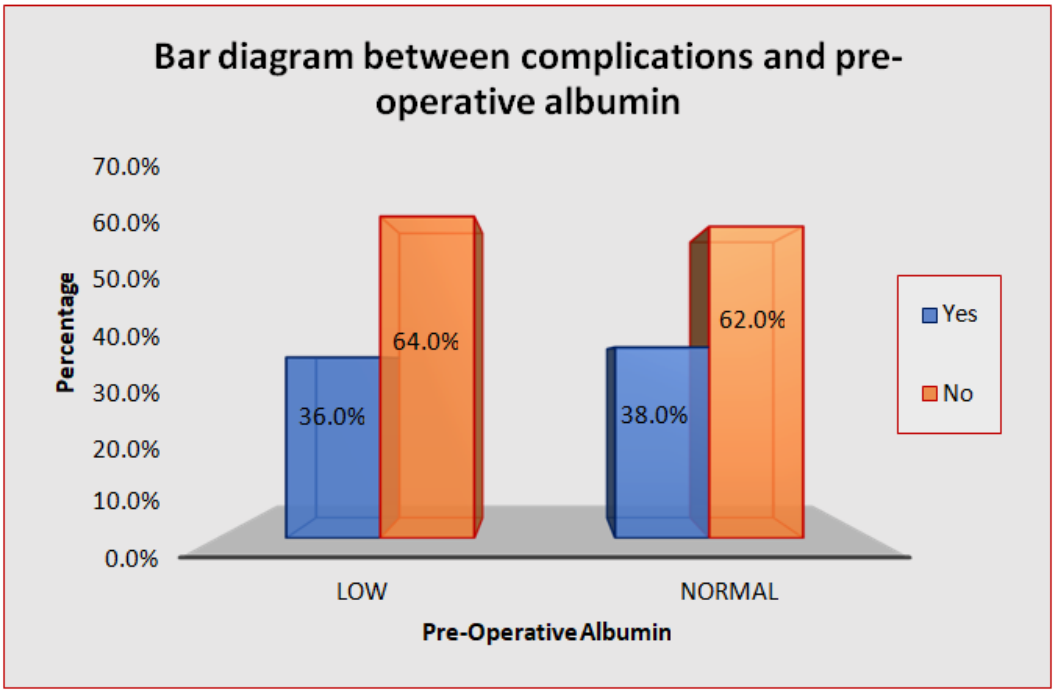
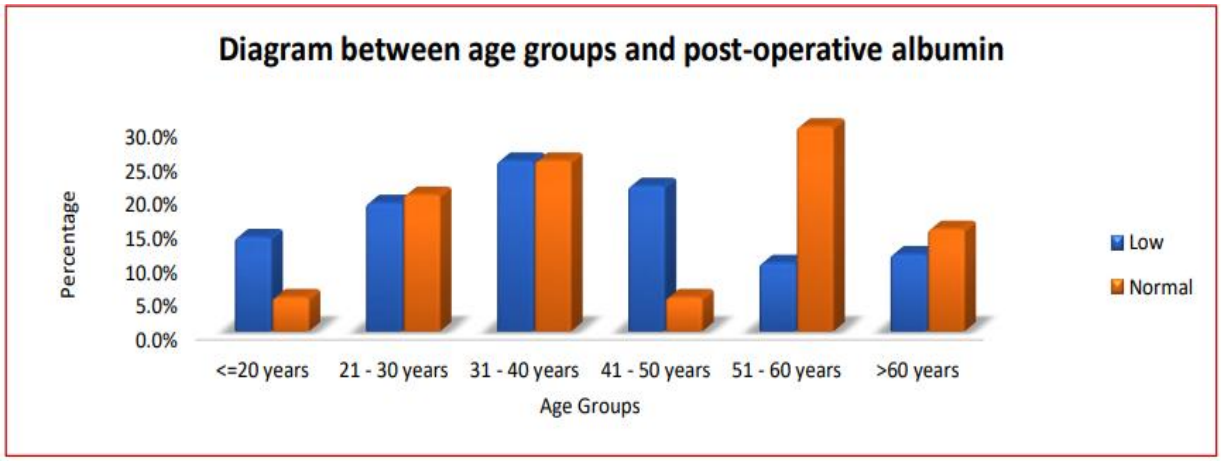


Association between age groups and post-operative albumin

Age Groups	Post-Operative Albumin				p
	Low		Normal		
<=20 years	11	13.8%	1	5.0%	0.149
21 - 30 years	15	18.8%	4	20.0%	
31 - 40 years	20	25.0%	5	25.0%	
41 - 50 years	17	21.3%	1	5.0%	
51 - 60 years	8	10.0%	6	30.0%	
>60 years	9	11.3%	3	15.0%	
Total	**80**	**100.0%**	**20**	**100.0%**	

Table indicate that, among cases aged ≤20 years, 13.8% had low post-operative albumin levels, while 5.0% had normal levels. For those aged 21-30 years, 18.8% had low albumin levels, compared to 20.0% with normal levels. Cases aged 31-40 years exhibited 25.0% with low albumin levels and another 25.0% with normal levels. In the 41-50 years age group, 21.3% had low albumin levels, and 5.0% had normal levels. Those aged 51-60 years showed 10.0% with low albumin levels and 30.0% with normal levels. Lastly, among cases >60 years old, 11.3% had low albumin levels, while 15.0% had normal levels. The statistical comparison yielded a p-value of 0.149, indicating no significant association between age groups and post-operative albumin levels.



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Association between comorbidities and post-operative albumin

		Post-Operative Albumin				p
		Low		Normal		
HTN	Yes	18	22.5%	0	0.0%	0.019
	No	62	77.5%	20	100.0%	
DM	Yes	35	43.8%	0	0.0%	0.000
	No	45	56.3%	20	100.0%	
COPD	Yes	2	2.5%	0	0.0%	0.475
	No	78	97.5%	20	100.0%	
Jaundice	Yes	6	7.5%	0	0.0%	0.207
	No	74	92.5%	20	100.0%	
Anaemia	Yes	32	40.0%	0	0.0%	0.001
	No	48	60.0%	20	100.0%	
CAD	Yes	5	6.3%	0	0.0%	0.251
	No	75	93.8%	20	100.0%	

- Among cases with hypertension (HTN), 22.5% had low post-operative albuminlevels, while none had normal levels. In contrast, 77.5% of cases without HTNhad low albumin levels, and 100.0% had normal levels. The p-value was 0.019, indicating a significant association between HTN and post-operative albumin levels.
- Cases with diabetes mellitus (DM) showed a stark contrast: 43.8% had low post- operative albumin levels, and none had normal levels. Conversely, among caseswithout DM, 56.3% had low albumin levels, and 100.0% had normal levels. Thep-value was 0.000, indicating a significant association between DM and lower post-operative albumin levels.
- Chronic obstructive pulmonary disease (COPD) cases exhibited minimal differences: 2.5% had low albumin levels, while none had normal levels. Among cases without COPD, 97.5% had low albumin levels, and 100.0% had normal levels. The p-value of 0.475 suggested no significant association between COP and post-operative albumin levels.
- Cases with jaundice showed no significant difference: 7.5% had low albumin levels, while none had normal levels. Among cases without jaundice, 92.5% had low albumin levels, and 100.0% had normal levels. The p-value of 0.207 indicated no significant association between jaundice and post-operative albumin levels.
- Among cases with anemia, 40.0% had low albumin levels, while none had normal levels. In contrast, 60.0% of cases without anemia had low albumin levels, and 100.0% had normal levels. The p-value was 0.001, indicating a significant association between anemia and lower post-operative albumin levels.
- Coronary artery disease (CAD) cases showed no significant difference: 6.3% had low albumin levels, while none had normal levels. Among cases without CAD, 93.8% had low albumin levels, and 100.0% had normal levels. The p-value of 0.251 suggested no significant association between CAD and post- operative albumin levels.

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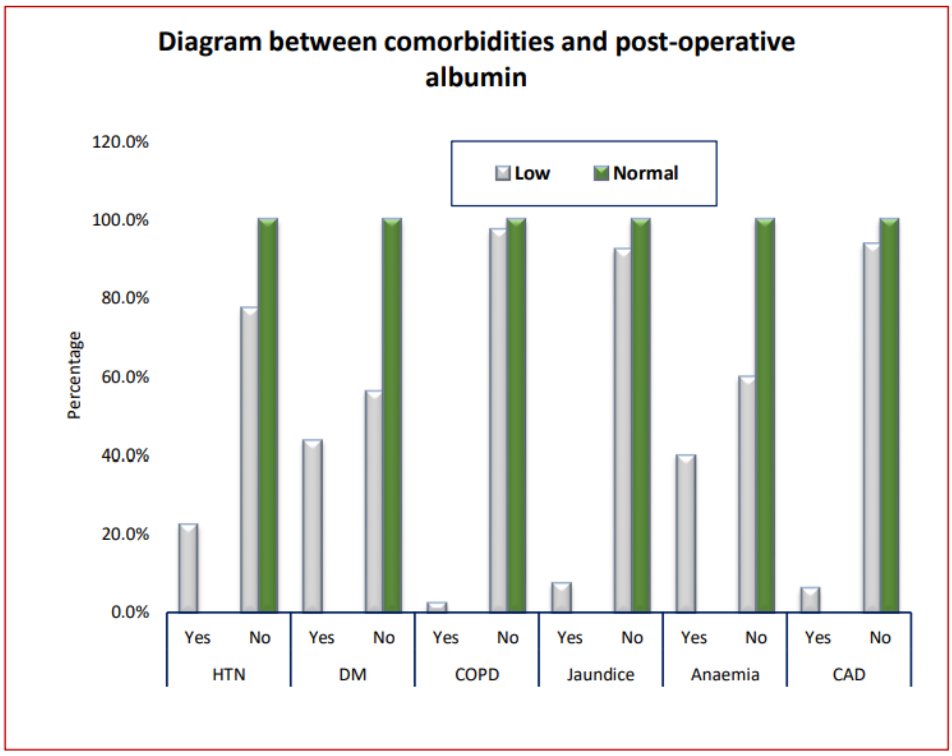
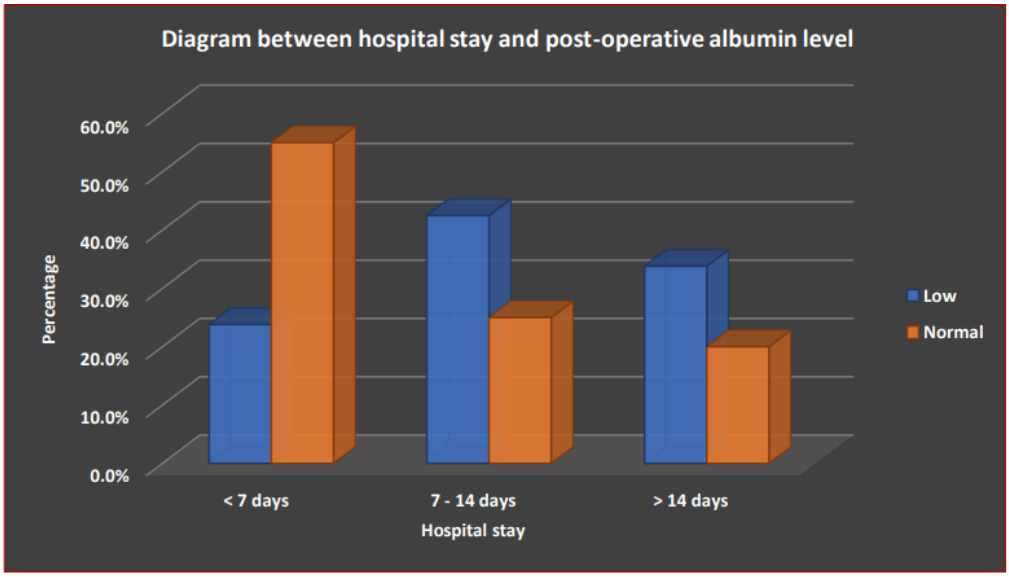


Association between hospital stay and post-operative albumin level

Hospital stay	Post-Operative Albumin				p
	Low		Normal		
< 7 days	19	23.8%	11	55.0%	0.024
7 - 14 days	34	42.5%	5	25.0%	
> 14 days	27	33.8%	4	20.0%	
Total	**80**	**100.0%**	**20**	**100.0%**	

Table indicate that, for hospital stays less than 7 days, 23.8% of cases had low post-operative albumin levels, while 55.0% had normal levels. Stays ranging from 7 to14 days showed 42.5% with low albumin levels and 25.0% with normal levels. Stays exceeding 14 days exhibited 33.8% with low albumin levels and 20.0% withnormal levels.

A p-value of 0.024, indicating a significant association between the duration of hospital stay and post-operative albumin levels. Specifically, shorter hospital stays tended to correlate with higher normal albumin levels, whereas longer stays correlated with higher occurrences of low albumin levels.



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DISCUSSION

This observational study titled **"Study to Assess Role of Serum Albumin Levels in Abdominal Surgical Wound Healing"** was done in department of Surgery at R D Gardi Medical College Ujjain. After obtaining ethical clearance and informed written consent from the participants, data were collected. Keeping in mind objectives of the study, statistical analysis was carried out. Salient results of the study are discussed below **Albumin levels**-Perioperative levels of serum albumin are powerful predictors of morbidity and mortality, with hypoalbuminemia being linked to poor tissue healing, reduced collagen production in surgical wounds or anastomoses, and impaired immunological response. Preoperative serum albumin levels play a critical role in determining a patient's postoperative outcome after major surgery. In the present study, albumin levels among the cases were tracked at three key points: pre-operatively, post-operatively, and at the time of discharge. Initially, pre- operative albumin levels were evenly split, with 50.0% of cases exhibiting low levels and the other 50.0% showing normal levels. However, post-operativemeasurements revealed a notable shift, with 80.0% of cases experiencing low albumin levels and only 20.0% maintaining normal levels. By discharge, there was some improvement: 41.0% of cases still had low albumin levels, while 59.0% had returned to normal levels. Comparatively, **Sindgikar V et al**(85)**.** reported that among their 130 patients, 47 had serum albumin levels above 3.5 g/dL, while 83 had levels below 3.5 g/dL. Similarly, **Sushma P et al**(86)**.** found that mean preoperative serum albumin levels were 3.55±0.47 g/dL, with post-operative levels decreasing from 3.53 to 3.37 g/dL from day 1 to day 5, reflecting a 4.5% drop due to surgical stress. There was a statistically significant difference between pre-operative and post-operative serum albumin levels from POD 1 to POD 5. These findings collectively highlight the dynamic changes in albumin levels during the perioperative period and underscore the significance of maintaining adequate serum albumin levels to improve postoperative outcomes. The consistent drop in albumin levels post-surgery across studies emphasizes the impact of surgical stress on nutritional and metabolic status, which can influence recovery and complicationrates.

Association of preoperative albumin with other parameters

In this study of 100 cases, age, gender, and specific comorbidities were analysed for their impact on pre-operative albumin levels. The distribution of albumin levels did not show significant differences across age groups ($p = 0.120$) or between genders ($p = 0.118$). However, certain conditions demonstrated a notable impact on albumin levels. Diabetes mellitus (DM) was significantly associated with lower pre-operative albumin levels ($p = 0.002$), while jaundice also showed a significant link to low albumin levels ($p = 0.012$). Conversely, hypertension (HTN) and chronic obstructive pulmonary disease (COPD) did not show significant differences in albumin levels ($p = 0.118$ and $p = 0.153$, respectively). Anemia wassignificantly associated with lower pre-operative albumin levels ($p = 0.003$). Additionally, cases with low albumin levels were more likely to experiencecomplications, such as a higher need for fresh frozen plasma or albumin transfusion ($p = 0.014$), and overall complications were more frequent in patients with low albumin levels ($p = 0.004$)

Association of post- operative albumin with other parameters

In this study of 100 cases, post-operative albumin levels were analyzed across different age groups, genders, and comorbidities. Age showed no significant association with post-operative albumin levels ($p = 0.149$). Gender also did not significantly affect post-operative albumin levels ($p = 0.92$). However, certain comorbidities demonstrated significant associations. Hypertension (HTN) was linked to lower post-operative albumin levels ($p = 0.019$), as 22.5% of cases with HTN had low albumin levels compared to none with normal levels. Diabetes mellitus (DM) had an even stronger association ($p = 0.000$), with 43.8% of cases with DM showing low albumin levels and none with normal levels. Chronic obstructive pulmonary disease (COPD) and jaundice showed no significant associations with post-operative albumin levels ($p = 0.475$ and $p = 0.207$, respectively). Anemia was significantly associated with lower post-operative albumin levels ($p = 0.001$), with 40.0% of anemic cases having low albumin levels compared to none with normal levels. Coronary artery disease (CAD) also showedno significant difference in post-operative albumin levels ($p = 0.251$). Overall, while age and gender did not significantly affect post-operative albumin levels, comorbidities like HTN, DM, and anaemia were significantly associated with lower albumin levels after surgery

Association of hospital stays with albumin levels

In the present study, the relationship between hospital stay duration and albumin levels at various stages (pre-operative, post-operative, and during discharge) was investigated. For pre-operative albumin levels, it was found that shorter hospital stays (less than 7 days) were associated with higher normal albumin levels (40.0%), compared to stays of 7-14 days (32.0%) and over 14 days (28.0%) where low albumin levels were more prevalent. This association was statistically significant with a p-value of 0.010. Similarly, for post-operative albumin levels, shorter hospital stays had higher normal albumin levels (55.0% for <7 days), while longer stays correlated with lower albumin levels (33.8% for >14 days), with a significant p-value of 0.024. During discharge, shorter stays also showed higher normal albumin levels (40.7% for <7 days), contrasting with longer stays where low albumin

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levels were more common (43.9% for >14 days), with a significant p-value of 0.001. Additionally, the mean albumin levels varied significantly across different hospital stay durations both pre-operatively (p = 0.040) and post- operatively (p = 0.021). Patients with shorter stays generally exhibited higher mean albumin levels compared to those with longer stays. However, there was no significant association found between the duration of hospital stay and the need for FFP/albumin transfusion (p = 0.217), indicating that transfusion requirements were not influenced by the length of hospitalization in this study. In a study done by Arun et al, mean length of hospital stay in hypoalbumin patients was found to be 10.8 days with a standard deviation of 4.245 and that of norm albumin patients was found to be 9.03 days with a standard deviation of 3.765.16 In hypoalbumin patients, 50% were discharged within 10 days and 50% after 10 days. **Sushma P et al**(86) in their study reported that Mean preoperative serum albumin levels were 3.55+0.47 g/dl. Post-operatively, serum albumin levels decreased from 3.53 to 3.37 from day 1 to day 5. There is albumin drop of 4.5% from POD 1 to POD 5 due to surgical stress. **Ahmed et al**(91) in their study reported that Mean length of hospital stay was found to be higher i.e. 9.73±4.85 days in patients with hypoalbuminemia, compared to 6.45±3.31 days with those having albumin level ≥3.5 g/dl.

CONCLUSION

Based on the comprehensive analysis conducted in the observational study titled "**Study to Assess Role of Serum Albumin Levels in Abdominal Surgical Wound Healing**", several critical conclusions can be drawn regarding the role of serum albumin levels in surgical outcomes and patient management. Firstly, the study revealed that pre-operative serum albumin levels serve as robust predictors of surgical morbidity and mortality. Patients with lower pre-operative albumin levels were significantly more prone to developing post-operative complications such as wound dehiscence and infections. This association underscores the pivotal role of albumin in supporting immune function, collagen synthesis, and overall tissue healing processes critical for recovery post-surgery. Secondly, the presence of comorbidities, notably diabetes mellitus and anemia, was strongly correlated with reduced albumin levels both before and after surgery. This finding highlights the heightened vulnerability of patients with underlying health conditions to hypoalbuminemia, which in turn exacerbates their risks of surgical complications. Managing and optimizing albumin levels in these patient populations could potentially mitigate these risks and improve overall surgical outcomes. Furthermore, while the study noted variations in age and gender distributions among patients, these factors did not independently influence albumin levels significantly. However, they are crucial considerations in understanding patient demographics and may impact surgical management strategies and recovery trajectories. Additionally, the study identified a significant relationship between the duration of hospital stays and albumin levels across different stages of care (pre-operative, post-operative, and during discharge). Patients with shorter hospital stays tended to exhibit higher normal albumin levels, suggesting that effective perioperative management that includes nutritional support could potentially lead to shorter hospitalizations and improved recovery times. Overall, the findings underscore the critical importance of proactive monitoring and management of serum albumin levels in perioperative care. Early identification of hypoalbuminemia and targeted interventions, such as nutritional supplementation, could potentially enhance surgical outcomes by reducing complications, optimizing recovery trajectories, and improving overall patient satisfaction and quality of life post-surgery. These insights are pivotal for informing clinical practices aimed at enhancing patient care and optimizing surgical outcomes in abdominal surgical settings.

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