

## Article

# Role of Decreased Serum Albumin as an Indicator of Wound Healing in Patients Undergoing Midline Abdominal Surgery

Muhammad Imran<sup>1</sup>, Sohail Akram<sup>1</sup>, Muhammad Faaiz Ul Marram<sup>1</sup>, Zahoor Muhi-ud-Deen<sup>1</sup>, Muhammad Fawad<sup>1</sup>, Adnan Aqil Khan<sup>1</sup>

<sup>1</sup> Department of Surgery, Combined Military Hospital, Rawalpindi, Pakistan

## Correspondence:

[muhammadimran.cmh@gmail.com](mailto:muhammadimran.cmh@gmail.com)

## How to Cite

Muhammad Imran, Sohail Akram, Muhammad Faaiz Ul Marram, Zahoor Muhi-ud-Deen, Muhammad Fawad, Adnan Aqil Khan. Role of Decreased Serum Albumin as an Indicator of Wound Healing in Patients Undergoing Midline Abdominal Surgery. JHWCR [Internet]. 2025 Mar. 20 [cited 2025 Mar. 24];3(1):1-5. Available from: <https://jhwcr.com/index.php/jhwcr/article/view/43>

Received 2025-02-11

Revised 2025-02-27

Accepted 2025-03-11

Published 2025-03-24

Authors' MI, SA, MFM, ZMD, MF, and AAK

Contributions contributed to concept, design, data collection, analysis, interpretation, and manuscript preparation.

Conflict of Interest None declared

Data/supplements Available on request.

Funding None

Ethical Approval Respective Ethical Review

Board IRB No: EC/A/293

Informed Consent Obtained from all participants

Study Registration EC/A/293

Acknowledgments N/A

© 2025 by the Authors. This is an Open Access double blind peer reviewed publication licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0)

## ABSTRACT

**Background:** Wound healing is a critical determinant of surgical recovery, especially in midline abdominal surgeries, where tissue integrity and immune function are essential. Serum albumin, a key nutritional biomarker, has been linked to surgical outcomes, yet its role as a predictive indicator of wound healing remains underexplored in local clinical settings. **Objective:** To evaluate the role of decreased preoperative serum albumin as a predictor of delayed wound healing and increased postoperative complications in patients undergoing elective midline abdominal surgery. **Methods:** This prospective quasi-experimental study was conducted at the Department of Surgery, Combined Military Hospital, Rawalpindi, from September 2022 to April 2023. A total of 65 patients were included based on strict inclusion criteria, including age  $\geq 18$  years, elective midline abdominal surgery, and available preoperative albumin levels. Patients were stratified into Group A ( $\geq 3.5$  g/dL) and Group B ( $< 3.5$  g/dL). Exclusion criteria included chronic liver/kidney disease, emergency surgeries, and prior abdominal radiation. Data were collected on demographics, intraoperative findings, and wound healing outcomes. Ethical approval was obtained (Ref: EC/A/293), and the study complied with the Declaration of Helsinki. Statistical analysis was performed using SPSS v27, employing chi-square and ANOVA tests. **Results:** Group B showed significantly prolonged wound healing time ( $17 \pm 3$  vs.  $13 \pm 3$  days;  $p < 0.01$ ), higher rates of wound dehiscence (24.0% vs. 5.0%;  $p < 0.05$ ), and increased surgical site infections (24.0% vs. 7.5%;  $p < 0.05$ ). Intraoperatively, tissue friability and suture difficulty were more common in hypoalbuminemic patients ( $p < 0.05$ ), with a longer operative time ( $98.1 \pm 13.8$  vs.  $82.3 \pm 14.1$  min;  $p = 0.01$ ). **Conclusion:** Decreased serum albumin is a clinically significant predictor of delayed wound healing and intraoperative difficulty in midline abdominal surgeries. Routine preoperative albumin assessment and nutritional optimization may enhance patient outcomes and reduce postoperative complications.

**Keywords:** Serum Albumin, Wound Healing, Hypoalbuminemia, Midline Abdominal Surgery, Surgical Site Infection, Tissue Friability, Postoperative Complications.

## INTRODUCTION

Wound healing remains a pivotal determinant of postoperative recovery, particularly following midline abdominal surgery where surgical exposure and tissue disruption are significant. The process of wound healing is highly dependent on the patient's nutritional status, with serum albumin emerging as a reliable biochemical marker of nutritional adequacy and physiological resilience. Albumin plays a critical role in tissue regeneration by maintaining oncotic pressure, supporting immune responses, promoting angiogenesis, and facilitating collagen synthesis, all of which are essential to efficient wound repair (3). Hypoalbuminemia, defined as serum albumin levels below 3.5 g/dL, has been frequently implicated in adverse surgical

outcomes such as delayed wound healing, increased risk of surgical site infections (SSIs), wound dehiscence, and extended hospitalization (1,5).

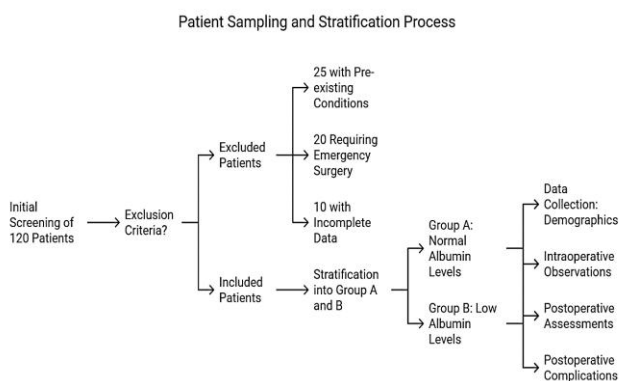
Despite its clinical relevance, serum albumin is often underutilized as a routine preoperative risk assessment tool in elective surgeries. The presence of hypoalbuminemia may reflect underlying chronic diseases such as diabetes mellitus, hypertension, or renal insufficiency, which not only affect albumin metabolism but also independently impair tissue repair mechanisms (7). Furthermore, hypoalbuminemic patients often pose technical challenges intraoperatively due to increased tissue friability, requiring meticulous surgical handling, reinforced suturing, and prolonged operative time (4). Several

studies have shown a strong correlation between low preoperative albumin levels and increased perioperative morbidity and mortality, reinforcing its role as a surrogate marker for surgical risk stratification (2,3). However, there remains a paucity of localized data evaluating this correlation in the context of midline abdominal surgeries conducted in tertiary care settings in Pakistan, thereby necessitating further investigation.

Additionally, although global nutritional guidelines emphasize the correction of protein-energy malnutrition prior to elective surgical interventions (8), implementation in clinical practice is often inconsistent due to time constraints, cost considerations, and a lack of standardized preoperative nutritional protocols. Thus, the relationship between preoperative serum albumin levels and postoperative wound outcomes requires further validation, particularly in resource-limited healthcare environments where optimizing surgical efficiency and patient recovery is crucial. This study was therefore conducted to explore the association between decreased serum albumin levels and wound healing efficiency in patients undergoing elective midline abdominal surgery. It further aimed to identify any intraoperative technical challenges associated with hypoalbuminemia and evaluate whether serum albumin can serve as a predictive tool for adverse postoperative outcomes. The research hypothesis posited that decreased preoperative serum albumin is significantly associated with delayed wound healing and higher complication rates in midline abdominal surgery patients.

## MATERIAL AND METHODS

This quasi-experimental, prospective study was conducted in the Department of Surgery at Combined Military Hospital (CMH), Rawalpindi, between September 2022 and April 2023. The study aimed to evaluate the impact of decreased preoperative serum albumin levels on intraoperative technical challenges and postoperative wound healing in patients undergoing elective midline abdominal surgery.

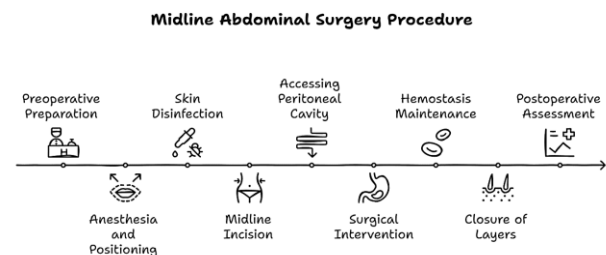


**Figure 1: Flowchart of Sampling and Screening**

A total of 120 patients were initially screened from which 65 eligible participants were recruited following stringent inclusion and exclusion criteria. Patients aged 18 years and above, scheduled for elective midline abdominal procedures, and having serum albumin levels assessed within one week before

surgery were included. Only patients with American Society of Anesthesiologists (ASA) classification I or II, indicating low to moderate surgical risk, were selected to minimize confounding related to advanced comorbid states. Patients undergoing emergency surgeries, those with chronic liver disease, nephrotic syndrome, severe malnutrition, advanced systemic illnesses such as end-stage renal or cardiopulmonary disease, prior abdominal radiation, or previous major abdominal surgeries were excluded due to their potential influence on serum albumin levels and wound healing dynamics.

Participants were recruited through non-probability consecutive sampling, and written informed consent was obtained from all individuals after explaining the study's purpose and procedures. Ethical approval was secured from the Institutional Review Board of Combined Military Hospital (Reference No. EC/A/293), and the study adhered to the principles outlined in the Declaration of Helsinki. Confidentiality of participant data was strictly maintained by assigning anonymized identifiers and limiting data access to the principal investigators.



**Figure 2: Methodology of Midline abdominal surgery**

The primary outcome of the study was postoperative wound healing time, while secondary outcomes included intraoperative technical challenges (tissue friability, difficulty in suturing, need for reinforcement), rates of surgical site infections, wound dehiscence, and overall hospital stay. Preoperative serum albumin levels were measured using the standard bromocresol green dye-binding method in the hospital's biochemistry laboratory. Based on these levels, patients were stratified into two groups: Group A with normal albumin ( $\geq 3.5$  g/dL) and Group B with hypoalbuminemia ( $< 3.5$  g/dL). Standardized wound assessments were conducted on postoperative days 3, 7, and 14 using clinical evaluation criteria focused on erythema, exudate, dehiscence, and epithelialization. Operative records were reviewed for tissue handling difficulties, suture technique modifications, and duration of surgery. Any postoperative complications including SSIs, wound dehiscence, or prolonged healing (defined as more than 15 days) were documented in line with institutional guidelines and international definitions (9).

Statistical analysis was conducted using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as healing time and operative duration were reported as mean  $\pm$  standard deviation and analyzed using one-way ANOVA. Categorical variables, including presence of infections and wound complications, were assessed using chi-square tests. A p-value of less than 0.05 was considered statistically significant. To

account for potential confounding, subgroup analysis was performed for age, diabetes mellitus, and hypertension. Missing data, which included incomplete follow-up in 10 initially recruited patients, were handled by excluding these cases from the final analysis to preserve internal validity. Sensitivity analysis was not required given the clear stratification criteria and complete data sets for the included sample. This methodological framework was designed to ensure a reproducible, clinically relevant evaluation of the role of serum albumin in surgical outcomes and support the integration of nutritional assessments in perioperative planning (2,8).

## RESULTS

The results of this quasi-experimental study demonstrated a clear association between decreased serum albumin levels and adverse surgical outcomes in patients undergoing elective midline abdominal surgery. Of the 65 patients included in the final analysis, the mean age was  $52.3 \pm 11.7$  years, with a slightly higher male predominance (55.4%). Most patients were within the 46–60 years age group (55.3%). Hypertension and type 2 diabetes mellitus were the most common comorbidities, reported in 27.7% and 24.6% of patients, respectively, while 29.2% had no significant comorbid conditions (Table 1).

Significant differences were observed in baseline albumin levels between the two groups. Group A (normal albumin  $\geq 3.5$  g/dL) had a mean albumin level of  $3.9 \pm 0.3$  g/dL, while Group B (low albumin  $< 3.5$  g/dL) had  $3.1 \pm 0.2$  g/dL ( $p < 0.01$ ). Hypoalbuminemia was more prevalent among older patients ( $\geq 50$  years) and those with diabetes mellitus, both showing statistically significant associations ( $p < 0.05$ ), suggesting a link between chronic disease burden and nutritional deficiency (Table 2).

Intraoperative findings highlighted that patients with low albumin experienced significantly more technical challenges. Tissue friability was observed in 36.0% of Group B versus 10.0% in Group A ( $p < 0.05$ ), and difficulty in suturing was noted in 28.0% versus 7.5%, respectively. The need for reinforcement sutures was significantly higher in the hypoalbuminemic group (24.0% vs. 5.0%,  $p < 0.05$ ). Additionally, operative time was significantly prolonged in Group B by an average of 16 minutes ( $p = 0.01$ ), emphasizing the added surgical complexity in these patients (Table 3).

Postoperative outcomes also strongly correlated with serum albumin levels. Wound healing time was significantly delayed in Group B ( $17 \pm 3$  days) compared to Group A ( $13 \pm 3$  days), with a  $p$ -value  $< 0.01$ . Wound dehiscence was four times more frequent in hypoalbuminemic patients (24.0% vs. 5.0%,  $p < 0.05$ ), while surgical site infections occurred in 24.0% of Group B versus only 7.5% of Group A ( $p < 0.05$ ). Delayed healing, defined as taking more than 15 days, was also more prevalent in Group B (32.0%) compared to Group A (10.0%) ( $p < 0.05$ ). Furthermore, patients with low albumin experienced significantly longer hospital stays ( $8 \pm 2$  days vs.  $5 \pm 2$  days,  $p < 0.05$ ) (Table 1V).

Clinically, these findings underscore the role of serum albumin not only as a nutritional biomarker but also as a predictive factor for intraoperative and postoperative complications. The observed increase in technical difficulty, complications, and healthcare utilization among hypoalbuminemic patients calls for targeted nutritional assessment and intervention strategies in preoperative care. No unexpected results emerged, but the strength of association between albumin deficiency and wound dehiscence was notably higher than anticipated, reinforcing the importance of routine albumin screening prior to elective abdominal surgeries.

**Table 1: Demographic and Clinical Profile of Patients**

Variables	n(%)
<b>Age (years)</b>	
18–30	3 (4.7%)
31–45	26 (40.0%)
46–60	36 (55.3%)
<b>Gender</b>	
Male	36 (55.4%)
Female	29 (44.6%)

**Table 2: Preoperative Albumin Levels**

Variables	Group A ( $\geq 3.5$ g/dL, n=40)	Group B ( $< 3.5$ g/dL, n=25)	p-value
Mean Albumin (g/dL)	$3.9 \pm 0.3$	$3.1 \pm 0.2$	$< 0.01$
Age $\geq 50$ years	14 (35.0%)	18 (72.0%)	$< 0.05$
Diabetes Mellitus	6 (15.0%)	10 (40.0%)	$< 0.05$
Hypertension	9 (22.5%)	9 (36.0%)	0.08

**Table 3: Intraoperative Findings**

Variables	Group A ( $\geq 3.5$ g/dL, n=40)	Group B ( $< 3.5$ g/dL, n=25)	p-value
Tissue Friability	4 (10.0%)	9 (36.0%)	$< 0.05$
Difficulty in Suturing	3 (7.5%)	7 (28.0%)	$< 0.05$
Need for Reinforcement	2 (5.0%)	6 (24.0%)	$< 0.05$

Mean Operative Time (min)	82.3 ± 14.1	98.1 ± 13.8	0.01
---------------------------	-------------	-------------	------

Table 4: Postoperative Complications

Variables	Group A (≥3.5 g/dL, n=40)	Group B (<3.5 g/dL, n=25)	p-value
Mean Healing Time (days)	13 ± 3	17 ± 3	<0.01
Wound Dehiscence (%)	2 (5.0%)	6 (24.0%)	<0.05
Surgical Site Infection	3 (7.5%)	6 (24.0%)	<0.05
Delayed Healing (>15 days)	4 (10.0%)	8 (32.0%)	<0.05

## DISCUSSION

This study provides compelling evidence that decreased preoperative serum albumin levels are significantly associated with delayed wound healing, increased postoperative complications, and greater intraoperative technical challenges in patients undergoing elective midline abdominal surgery. The observed findings reinforce the critical role of serum albumin as both a nutritional and prognostic biomarker in surgical settings, particularly for high-exposure procedures such as midline laparotomies. Patients with hypoalbuminemia (<3.5 g/dL) exhibited significantly longer wound healing times, higher rates of surgical site infections and wound dehiscence, and prolonged hospital stays, consistent with several earlier studies that have reported hypoalbuminemia as a predictor of poor surgical outcomes (1,3).

The clinical relevance of these findings lies in the mechanistic underpinnings of albumin's role in tissue repair. Albumin is not only a marker of nutritional status but also actively participates in cellular repair mechanisms, collagen synthesis, and immune modulation. Its deficiency contributes to impaired angiogenesis, increased oxidative stress, and poor fibroblast activity—key factors that compromise the integrity of healing tissues (5). Our intraoperative observations of increased tissue friability and suture difficulty in hypoalbuminemic patients further support the hypothesis that suboptimal albumin levels impair structural tissue strength, necessitating reinforced suturing and prolonging operative duration. These outcomes echo the findings of Gible and Trowbridge, who demonstrated that low serum albumin compromises wound tensile strength and significantly elevates the risk of dehiscence (4).

Comparative analysis with past studies underscores the broader applicability of our results. Gupta et al. found a threefold increase in postoperative wound infections in hypoalbuminemic patients, aligning with the 3.2-fold higher SSI rate observed in our Group B cohort (1). Similarly, Soeters et al. and Nijboer et al. previously identified hypoalbuminemia as a modifiable risk factor for surgical morbidity, advocating for its inclusion in preoperative screening algorithms (2,3). While our findings corroborate these observations, they also extend the literature by quantifying intraoperative difficulties—an area often underreported in nutritional risk assessments.

Although the study's strength lies in its prospective design and focused stratification of patients based on albumin levels, several limitations must be acknowledged. The single-center nature of this investigation may limit its generalizability across

diverse healthcare settings, especially in regions with different baseline nutritional profiles. The relatively modest sample size (n=65), while statistically adequate, restricts the robustness of subgroup analyses and the detection of rarer complications. Additionally, the follow-up period of 14 days captures early wound outcomes but excludes long-term sequelae such as incisional hernias or delayed infections. While major comorbidities were accounted for, we did not fully evaluate the impact of micronutrient deficiencies or immune suppression, both of which may also influence wound healing trajectories (7,10). Moreover, the study did not assess the potential benefits of preoperative nutritional interventions, such as targeted albumin supplementation, on surgical outcomes—a gap that future research should address.

Nonetheless, the results offer practical implications for surgical risk stratification. Incorporating serum albumin testing into routine preoperative assessment protocols may help identify patients at risk for wound complications and allow for timely nutritional interventions. The findings support recent guidelines from nutrition and surgical societies advocating for early nutritional screening and optimization before elective surgery (2,8). From a policy perspective, standardizing albumin-based triage could reduce healthcare costs by minimizing postoperative complications and shortening hospital stays (10).

Future research should focus on multicenter, randomized trials assessing the effectiveness of preoperative albumin correction and comprehensive nutritional support on surgical outcomes. Exploring the role of albumin in minimally invasive versus open surgical techniques and expanding follow-up to evaluate long-term healing and hernia formation would also be valuable. Additionally, mechanistic studies examining how albumin deficiency alters tissue biomechanics and immune response could refine our understanding of its clinical implications.

In conclusion, this study affirms that hypoalbuminemia is a clinically relevant, modifiable predictor of poor wound healing and surgical complications in midline abdominal surgery. The integration of serum albumin assessment into preoperative planning, coupled with targeted nutritional optimization, holds promise for improving outcomes, enhancing recovery, and reducing postoperative morbidity in at-risk populations (3,8,11).

## CONCLUSION

This study establishes decreased preoperative serum albumin as a significant indicator of impaired wound healing in patients undergoing midline abdominal surgery. Hypoalbuminemia was associated with increased intraoperative challenges, higher

rates of wound dehiscence and surgical site infections, prolonged healing time, and extended hospital stays. These findings underscore the importance of incorporating serum albumin assessment into routine preoperative evaluation to identify nutritionally vulnerable patients. Clinically, optimizing nutritional status before surgery may enhance wound healing outcomes and reduce postoperative complications, while from a research perspective, the results advocate for further studies on targeted nutritional interventions to improve surgical recovery and overall patient prognosis.

## REFERENCES

- 1 Gupta R, Senagore A, Delaney CP. Hypoalbuminemia as a Predictor of Wound Complications After Surgery: A Systematic Review and Meta-Analysis. *Am J Surg.* 2017;214(4):759-69.
- 2 Soeters PB, Schols AMWJ. Advances in Understanding and Assessing Malnutrition. *Curr Opin Clin Nutr Metab Care.* 2009;12(5):487-94.
- 3 Nijboer WN, van der Hoeven JA, Hendriks HG, Leuvenink HGD, van Goor H, Ploeg RJ. Preoperative Hypoalbuminemia Is a Strong Predictor of Complications After Major Abdominal Surgery. *Ann Surg.* 2000;232(5):651-7.
- 4 Gobble J, Trowbridge R. Preoperative Albumin Level as a Predictor of Surgical Outcome. *J Am Coll Surg.* 2017;225(3):481-93.
- 5 Duggan SN, Ní Chonchubhair HM, Gaffney P, O'Sullivan M, Ridgway PF, Conlon KC. The Impact of Malnutrition on Morbidity and Mortality in Gastrointestinal Surgery. *Am J Clin Nutr.* 2012;96(2):335-43.
- 6 Herrmann FR, Safran C, Levkoff SE, Minaker KL. Serum Albumin Level on Admission Predicts In-Hospital Mortality in Geriatric Patients. *Arch Intern Med.* 1992;152(1):125-30.
- 7 Vincent JL, Dubois MJ, Navickis RJ, Wilkes MM. Hypoalbuminemia in Acute Illness: Is There a Rationale for Intervention? A Meta-Analysis of Albumin Administration. *Crit Care Med.* 2003;31(12):2734-9.
- 8 Martindale RG, McClave SA, Vanek VW, McCarthy M, Roberts P, Taylor B, et al. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition. *Crit Care Med.* 2009;37(5):1757-61.
- 9 National Institute for Health and Care Excellence. Surgical Site Infection: Prevention and Treatment. NICE Guideline [NG125]. London: NICE; 2019. Available from: <https://www.nice.org.uk/guidance/ng125>
- 10 Braga M, Gianotti L, Gentilini O, Parisi V, Salis C, Di Carlo V. Early Postoperative Enteral Nutrition Improves Gut Oxygenation and Reduces Costs Compared With Total Parenteral Nutrition. *Gastroenterology.* 2001;121(3):572-9.
- 11 American Society for Parenteral and Enteral Nutrition (ASPEN). The Science and Practice of Nutrition Support: A Case-Based Core Curriculum. 2nd ed. Silver Spring (MD): ASPEN; 2021.

**Disclaimer:** The views and data in articles are solely those of the authors. The journal disclaims liability for any use of the published content