Section: General Surgery

Original Research Article

STUDY ON ROLE OF ALBUMIN LEVEL AS A PREDICTIVE FACTOR FOR ACUTE PANCREATITIS PROGNOSIS IN A TERTIARY CARE CENTER IN TIRUPPUR-OBSERVATIONAL STUDY

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Abstract

Background: Acute pancreatitis (AP) is a common inflammatory condition with a variable clinical course ranging from mild self-limiting disease to severe forms associated with significant morbidity and mortality. Identifying reliable, cost-effective biomarkers for predicting outcomes in AP is crucial for effective management. Serum albumin, a key plasma protein, plays a vital role in inflammation modulation and has been associated with poor outcomes in critically ill patients, including those with AP. This study aims to evaluate the prognostic value of serum albumin levels in acute pancreatitis, focusing on its association with disease severity and mortality. **Materials and Methods:** This prospective observational study was conducted in the Department of General Surgery, Government Medical College Hospital, Tiruppur, over six months (April–September 2024). Ninety patients diagnosed with acute pancreatitis were enrolled based on inclusion criteria, excluding those with comorbidities. Data were collected using a structured proforma, including demographic details, serum albumin levels, and radiological findings. Patients were followed until discharge or death. Statistical analyses, including chi-square tests, t-tests, ANOVA, and ROC curve analysis, were performed using SPSS version 25, with p-values <0.05 considered statistically significant. **Result:** The mean serum albumin levels were significantly lower in deceased patients (2.63 ± 0.11 g/dL) compared to discharged patients (3.37 ± 0.39 g/dL, p = 0.001). Serum albumin levels decreased with increasing severity of the Modified CT Severity Score (p = 0.001). ROC analysis identified a cutoff value of <2.8 g/dL for predicting mortality, with an AUC of 0.974, sensitivity of 91.56%, and specificity of 84.22%. **Conclusion:** Serum albumin levels serve as a significant predictive marker for disease severity and mortality in acute pancreatitis. Low serum albumin levels correlate with poorer outcomes, emphasizing the need for routine albumin monitoring and potential therapeutic interventions. Further research is needed to validate these findings and establish evidence-based guidelines.

INTRODUCTION

Acute pancreatitis (AP) is a common inflammatory condition of the pancreas, characterized by a wide clinical spectrum ranging from mild, self-limiting disease to severe forms associated with organ failure, systemic inflammation and significant mortality.[1] The management and prognosis of acute pancreatitis remain challenging due to the unpredictable disease course and the lack of universally accepted predictive markers for severity and outcomes. Identifying reliable, cost-effective biomarkers for disease prognosis is crucial to improving clinical decision-making and patient outcomes.[2,3]

Serum albumin, a major plasma protein synthesized by the liver, plays a critical role in maintaining oncotic pressure, modulating immune responses, and acting as a carrier for various substances.[4] Hypoalbuminemia is commonly observed in critically ill patients and has been associated with poor outcomes in a variety of conditions, including sepsis, liver disease, and acute pancreatitis. In the context of acute pancreatitis, albumin levels are often affected by systemic inflammation, increased capillary permeability, and the catabolic state induced by the disease.[5-7]

Several studies have investigated the role of serum albumin as a prognostic marker in acute pancreatitis.

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Evidence suggests that lower albumin levels are associated with higher rates of persistent organ failure, local complications, and mortality.[8] Moreover, albumin infusions have been explored as a therapeutic intervention in hypoalbuminemic patients, with some studies showing improved outcomes. However, the optimal threshold and timing for albumin administration in the management of acute pancreatitis remain unclear.[9-11]

In recent years, albumin has been evaluated not only as a standalone marker but also in combination with other parameters to enhance predictive accuracy for disease severity and mortality.[12] Tools such as the Modified CT Severity Index, APACHE II score, and Ranson's criteria have been used to stratify the severity of acute pancreatitis. Incorporating serum albumin into these scoring systems could potentially improve their utility in clinical practice by providing a more comprehensive assessment of the patient's condition.[13-16]

This observational study aims to assess the role of serum albumin levels as a predictive factor for the prognosis of acute pancreatitis in a tertiary care setting. Specifically, it seeks to determine the association between serum albumin levels and clinical outcomes, including disease severity and mortality, and to establish a threshold for albumin levels that predicts poor outcomes. By addressing these objectives, this study aims to provide insights into the utility of serum albumin as a prognostic biomarker and its potential therapeutic implications.

The findings of this study could have significant clinical implications, particularly in resource-limited settings where advanced diagnostic tools are not readily available. Serum albumin is an inexpensive, widely available laboratory parameter that could serve as a practical marker for risk stratification and guiding treatment strategies in acute pancreatitis.

Objectives

- To study the predictive value of serum albumin for mortality among patients with acute pancreatitis.
- To find out the association of serum albumin levels with outcome of acute pancreatitis.

MATERIALS AND METHODS

This prospective observational study was conducted to evaluate the role of serum albumin as a predictive factor for acute pancreatitis prognosis. The study was carried out in the Department of General Surgery at Government Medical College Hospital, Tiruppur, over a six-month period from April 2024 to September 2024.

The study population included patients diagnosed with acute pancreatitis who were admitted to the hospital during the study period. Patients were selected based on predefined inclusion and exclusion criteria. The inclusion criteria consisted of patients aged 18 years and above, irrespective of gender, with a confirmed diagnosis of acute pancreatitis and no comorbidities. Additionally, only patients who provided informed written consent were included in the study. Patients with any comorbid conditions were excluded from participation.

The sample size was calculated based on the study by Ni et al1 which reported a standard deviation of serum albumin levels of 6.72 among patients with acute pancreatitis. Using the absolute precision (1.5%), the sample size was estimated to be 77. To account for a 10% non-response rate, the final sample size was rounded to 90 patients. 100 patients were included in the study. A convenient sampling method was used for participant selection.

Data collection involved the use of a structured proforma, where personal details, disease condition, and comorbidities of the patients were documented. Blood investigations, including serum albumin were recorded. Patients were followed until discharge or death and serial investigations performed during the hospital stay were documented.

All collected data were entered into Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were used to summarize the data. Associations among categorical variables were tested using the chi-square test, while the independent t-test was used to compare the means between two groups. ANOVA was used to test association of means of more than two groups. Pearson correlation coefficient was calculated among continuous varibales. Receiver Operating Characteristic (ROC) curve was used to determine the cut off value for albumin in predicting mortality. A p-value of less than 0.05 was considered statistically significant.

The study ensured confidentiality of participant information and adhered to ethical research practices. There were no conflicts of interest, and no external sponsorships or funding were involved.

RESULTS

The demographic and clinical characteristics of the study participants are summarized in [Table 1]. The age distribution was as follows: 28 participants (28.0%) were aged 21 to 30 years, 29 (29.0%) were aged 31 to 40 years, 26 (26.0%) were aged 41 to 50 years, 13 (13.0%) were aged 51 to 60 years, and 4 (4.0%) were aged 61 to 70 years. The mean age of the participants was 40.10 ± 10.87 years, and their mean BMI was 23.85 ± 3.18 kg/m². In terms of BMI categories, 3 participants (3.0%) were underweight, 62 (62.0%) had normal BMI, 33 (33.0%) were overweight, and 2 (2.0%) were obese. Regarding sex, the majority of participants were male (99.0%), with only 1 (1.0%) female participant. Most participants were married (91.0%), while 9 (9.0%) were unmarried. Alcohol use was reported in 94 participants (94.0%), with 6 (6.0%) reporting no alcohol use. Smoking was observed in 54 participants (54.0%), whereas 46 (46.0%) were non-smokers. Regarding dietary habits, the majority (93.0%)

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consumed a non-vegetarian diet, while 7 (7.0%) were vegetarians. Participants reported an average of 11.15 ± 9.58 years of alcohol use and 7.25 ± 10.43 years of smoking. The Modified CT Severity Score distribution was as follows: 15 participants (15.0%) had a score of 2, 36 (36.0%) had a score of 4, 37 (37.0%) had a score of 6, 9 (9.0%) had a score of 8, and 3 (3.0%) had a score of 10. When categorized, 15 participants (15.0%) were classified as mild, 73 (73.0%) as moderate, and 12 (12.0%) as severe. Regarding outcomes, 8 participants (8.0%) died, while 92 (92.0%) were discharged. [Figure 1]

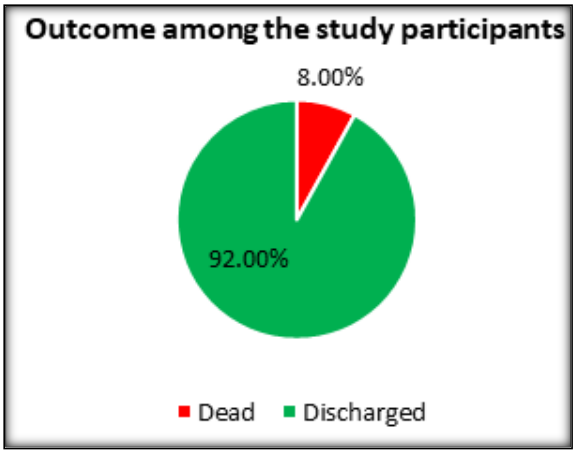

Figure 1: Outcome among the study participants

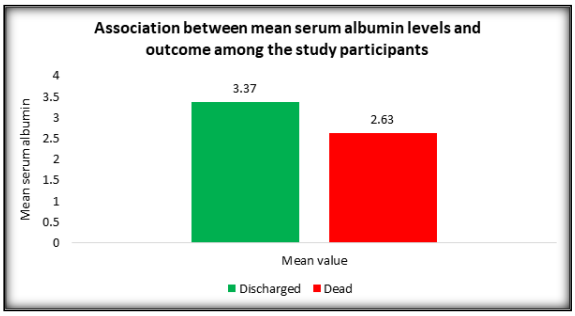

Figure 2: Association between mean serum albumin levels and outcome among the study participants

The mean serum albumin value among the study participants was 3.32 ± 0.43 g/dL. Biochemical parameters showed that serum lipase levels were 240.16 ± 125.74 U/L at 24 hours, 211.91 ± 112.60 U/L at 48 hours, and 178.83 ± 98.88 U/L at 72 hours. Similarly, serum amylase levels were 229.05 ± 157.83 U/L at 24 hours, 195.88 ± 126.88 U/L at 48 hours, and 162.19 ± 105.68 U/L at 72 hours. Total leukocyte counts were 10.23 ± 4.26 (10^3/µL) at 24 hours, 10.08 ± 4.00 (10^3/µL) at 48 hours, and 10.08 ± 3.88 (10^3/µL) at 72 hours. Hemoglobin levels were 14.06 ± 2.20 g/dL at 24 hours, 13.90 ± 2.06 g/dL at 48 hours, and 13.89 ± 1.84 g/dL at 72 hours. Platelet counts were 246.18 ± 78.08 (10^3/µL) at 24 hours, 247.66 ± 77.66 (10^3/µL) at 48 hours, and 248.60 ± 74.67 (10^3/µL) at 72 hours. The mean prothrombin time/INR was 1.28 ± 0.20 seconds at 24 hours.

The mean serum albumin level was significantly higher in the discharged group (3.37 ± 0.39 g/dL) compared to the deceased group (2.63 ± 0.11 g/dL). A t-test yielded a value of 5.28 with a statistically significant p-value of 0.001 ($p < 0.05$), indicating a significant difference in serum albumin levels between the two groups. [Table 3 & Figure 2]

The mean serum albumin levels decreased significantly with increasing severity of the Modified CT Severity Score. Participants with mild scores had the highest mean serum albumin level (3.58 ± 0.31 g/dL), followed by those with moderate scores (3.35 ± 0.38 g/dL), and severe scores (2.77 ± 0.33 g/dL). The ANOVA test yielded an F-value of 16.80 and a statistically significant p-value of 0.001 ($p < 0.05$), indicating a significant association between serum albumin levels and the severity of the Modified CT Severity Score. [Table 4]

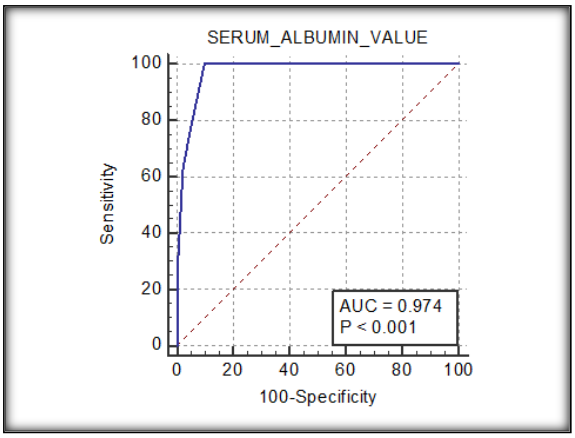

Figure 3: ROC curve for albumin for detecting mortality among the study participants

Serum albumin levels showed no significant correlation with age (r = 0.014, p = 0.88), BMI (r = -0.014, p = 0.89), or years of alcohol habit (r = 0.168, p = 0.09). A weak positive correlation was observed with years of smoking habit (r = 0.201, p = 0.04), which was statistically significant. Serum albumin levels demonstrated moderate negative correlations with serum lipase levels at 24 hours (r = -0.405, p = 0.001), 48 hours (r = -0.351, p = 0.001), and 72 hours (r = -0.334, p = 0.001), all of which were statistically significant. Weak negative correlations were also observed with serum amylase levels at 24 hours (r = -0.206, p = 0.04), 48 hours (r = -0.224, p = 0.02), and 72 hours (r = -0.237, p = 0.01), all statistically significant. No significant correlations were found between serum albumin levels and total leukocyte count at 24 hours (r = -0.072, p = 0.47), 48 hours (r = -0.038, p = 0.71), or 72 hours (r = -0.026, p = 0.79). Similarly, no significant correlations were observed with hemoglobin levels at 24 hours (r = 0.051, p = 0.61), 48 hours (r = 0.065, p = 0.52), or 72 hours (r = 0.012, p = 0.90), as well as platelet counts at 24 hours (r = 0.076, p = 0.45), 48 hours (r = 0.055, p = 0.58), or 72 hours (r = 0.034, p = 0.73). PT/INR levels at 24 hours also showed no significant correlation with serum albumin levels (r = -0.084, p = 0.40). [Table 5]

The ROC curve analysis for serum albumin levels in detecting mortality among study participants

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revealed a cutoff value of < 2.8 g/dL (range: 2.7 to 2.8 g/dL). The area under the curve (AUC) was 0.974 (95% CI: 0.921–0.996), indicating good discriminatory ability ($p < 0.001$). The Youden index was 0.90, with a sensitivity of 91.56% (95% CI: 82.2–95.4%) and specificity of 84.22% (95% CI: 63.1–91.5%). The positive likelihood ratio (LR) was 5.08, while the negative likelihood ratio (LR) was 0.38.

Table 1: Demographic, clinical characteristics and outcome among the study participants.

Variable	Category	Frequency	Percent (%)
Age	21 to 30	28	28.0
	31 to 40	29	29.0
	41 to 50	26	26.0
	51 to 60	13	13.0
	61 to 70	4	4.0
Sex	Female	1	1.0
	Male	99	99.0
BMI Category	Underweight	3	3.0
	Normal	62	62.0
	Overweight	33	33.0
	Obese	2	2.0
Marital status	Married	91	91.0
	Unmarried	9	9.0
Alcohol Use	No	6	6.0
	Yes	94	94.0
Smoking	No	46	46.0
	Yes	54	54.0
Diet	Non-Veg	93	93.0
	Veg	7	7.0
Modified CT Severity Score	2	15	15.0
	4	36	36.0
	6	37	37.0
	8	9	9.0
	10	3	3.0
Modified CT Severity Score Category	Mild	15	15.0
	Moderate	73	73.0
	Severe	12	12.0
Outcome	Dead	8	8.0
	Discharged	92	92.0

Table 2: Mean blood values among the study participants

Parameter	Mean ± SD
Serum Albumin Value (g/dL)	3.32 ± 0.43
Serum Lipase (U/L) - 24 hours	240.16 ± 125.74
Serum Lipase (U/L) - 48 hours	211.91 ± 112.60
Serum Lipase (U/L) - 72 hours	178.83 ± 98.88
Serum Amylase (U/L) - 24 hours	229.05 ± 157.83
Serum Amylase (U/L) - 48 hours	195.88 ± 126.88
Serum Amylase (U/L) - 72 hours	162.19 ± 105.68
Total Count ($10^3/\mu L$) - 24 hours	10.23 ± 4.26
Total Count ($10^3/\mu L$) - 48 hours	10.08 ± 4.00
Total Count ($10^3/\mu L$) - 72 hours	10.08 ± 3.88
Hemoglobin (g/dL) - 24 hours	14.06 ± 2.20
Hemoglobin (g/dL) - 48 hours	13.90 ± 2.06
Hemoglobin (g/dL) - 72 hours	13.89 ± 1.84
Platelet Count ($10^3/\mu L$) - 24 hours	246.18 ± 78.08
Platelet Count ($10^3/\mu L$) - 48 hours	247.66 ± 77.66
Platelet Count ($10^3/\mu L$) - 72 hours	248.60 ± 74.67
PT/INR (seconds) - 24 hours	1.28 ± 0.20

Table 3: Association between serum albumin levels and outcome among the study participants

	Discharged (Mean ± SD)	Dead (Mean ± SD)	T test value	P value
Serum albumin	3.37 ± 0.39	2.63 ± 0.11	5.28	0.001*

*- statistically significant by independent t test

Table 4: Association between serum albumin levels and modified CT severity score among the study participants

Modified CT severity score	Serum albumin level (Mean ± SD)	F value	P value
Mild	3.58 ± 0.31	16.80	0.001*
Moderate	3.35 ± 0.38		
Severe	2.77 ± 0.33		

*- statistically significant by ANOVA test

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Table 5: Correlation between Albumin and blood parameters

Variable	Pearson Correlation Coefficient	P-value	Interpretation
Age	0.014	0.88	No significant correlation
BMI (kg/m²)	-0.014	0.89	No significant correlation
Years of Alcohol Habit	0.168	0.09	Weak positive correlation, not statistically significant
Years of Smoking Habit	0.201	0.04*	Weak positive correlation, statistically significant
Serum Lipase (U/L) - 24 hours	-0.405	0.001*	Moderate negative correlation, statistically significant
Serum Lipase (U/L) - 48 hours	-0.351	0.001*	Moderate negative correlation, statistically significant
Serum Lipase (U/L) - 72 hours	-0.334	0.001*	Moderate negative correlation, statistically significant
Serum Amylase (U/L) - 24 hours	-0.206	0.04*	Weak negative correlation, statistically significant
Serum Amylase (U/L) - 48 hours	-0.224	0.02*	Weak negative correlation, statistically significant
Serum Amylase (U/L) - 72 hours	-0.237	0.01*	Weak negative correlation, statistically significant
Total Count (10^3/μL) - 24 hours	-0.072	0.47	No significant correlation
Total Count (10^3/μL) - 48 hours	-0.038	0.71	No significant correlation
Total Count (10^3/μL) - 72 hours	-0.026	0.79	No significant correlation
Hemoglobin (g/dL) - 24 hours	0.051	0.61	No significant correlation
Hemoglobin (g/dL) - 48 hours	0.065	0.52	No significant correlation
Hemoglobin (g/dL) - 72 hours	0.012	0.90	No significant correlation
Platelet (10^3/μL) - 24 hours	0.076	0.45	No significant correlation
Platelet (10^3/μL) - 48 hours	0.055	0.58	No significant correlation
Platelet (10^3/μL) - 72 hours	0.034	0.73	No significant correlation
PT/INR (seconds) - 24 hours	-0.084	0.40	No significant correlation

Table 6: ROC curve for albumin for detecting mortality among the study participants

Serum albumin level cut off	Area under the curve (AUC)	Younden index	Sensitivity	Specificity	Positive LR	Negative LR
< 2.8 (2.7 to 2.8)	0.974 (0.921 to 0.996)	0.90	91.56% (82.2-95.4%)	84.22% (63.1-91.5%)	5.08	0.38

DISCUSSION

The role of serum albumin as a prognostic marker in acute pancreatitis (AP) has garnered significant attention in recent years due to its association with various clinical outcomes, including disease severity, mortality, and complications. Albumin, a critical plasma protein, plays a vital role in maintaining oncotic pressure, modulating inflammation, and transporting essential molecules. Hypoalbuminemia, commonly observed in patients with acute pancreatitis, has been linked to adverse outcomes such as persistent organ failure and increased mortality.

The current study demonstrated that serum albumin levels were significantly lower in deceased patients (2.63 ± 0.11 g/dL) compared to discharged patients (3.37 ± 0.39 g/dL), with a statistically significant difference ($p < 0.001$). This aligns with the findings of Ni et al1 who reported that higher serum albumin levels in the early stages of severe acute pancreatitis (SAP) were associated with better survival outcomes. Similarly, Xu et al6 demonstrated that hypoalbuminemia (≤30 g/L) was significantly related to higher mortality, and albumin infusion improved survival in hypoalbuminemic SAP patients. Hong et al2 also found that decreased albumin was independently associated with an increased risk of death, with the area under the ROC curve (AUC) of albumin for predicting mortality at 0.87, comparable to the AUC of 0.974 observed in this study. Zhang et al5 identified a cut-off value of albumin ≤34.95 g/L for predicting mortality, further supporting the prognostic value of serum albumin in AP.

The mean serum albumin levels in this study decreased significantly with increasing severity of the Modified CT Severity Score ($p < 0.001$). Participants with mild severity had the highest albumin levels, while those with severe scores had the lowest levels. This finding is consistent with Ocksay et al4 who reported a dose-dependent relationship between hypoalbuminemia and the severity of AP, with severe hypoalbuminemia (<25 g/L) being an independent risk factor for severe outcomes. Similarly, Li et al3 demonstrated that albumin on admission was lower in patients with persistent organ failure (POF) than those without POF, identifying hypoalbuminemia as an independent predictor of severity. Hong et al2 also observed a significant association between albumin levels and the severity of AP, with hypoalbuminemia being a key predictor of organ failure. Yao et al,[7] reported that early albumin variation within 24 hours was associated with poor outcomes, further emphasizing the role of albumin in assessing AP severity.

Serum albumin levels in this study showed a moderate negative correlation with serum lipase levels at 24, 48, and 72 hours ($r = -0.405, -0.351, -0.334$, respectively; $p < 0.001$) and weak negative correlations with serum amylase levels during the same time points. These findings suggest an inverse relationship between albumin levels and markers of pancreatic injury. Ni et al,[1] highlighted that maintaining higher albumin levels through infusion could ameliorate outcomes in SAP, likely by reducing systemic inflammation and pancreatic damage. Similarly, Xu et al,[6] and Zhang et al,[5] found that low albumin levels correlated with

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elevated inflammatory markers and higher APACHE II scores, reinforcing the role of albumin as an indicator of systemic inflammation. Yao et al,[7] identified that early albumin variation was significantly associated with organ dysfunction and poor prognosis, likely mediated by inflammation and pancreatic injury.

The ROC curve analysis in this study identified a cutoff value of <2.8 g/dL for predicting mortality, with an AUC of 0.974. This result aligns with Li et al,[3] who reported an AUC of 0.873 for serum albumin as a predictor of POF and mortality in AP. Xu et al6 demonstrated that the lowest albumin level within one week of admission (OR: 0.93, p = 0.002) was independently associated with mortality, with albumin infusion showing a protective effect. Zhang et al5 reported a cutoff of 34.95 g/L for albumin, emphasizing its utility as a prognostic marker. Hong et al,[2] reported similar predictive values for albumin with an AUC of 0.87, further corroborating the findings of this study.

This study was conducted in a single tertiary care center, which may limit the generalizability of the findings to other settings. The study did not account for potential confounding factors such as pre-existing liver disease, or albumin supplementation, which could influence serum albumin levels and patient outcomes.

CONCLUSION

This study highlights the significant role of serum albumin levels as a predictive factor for the prognosis of acute pancreatitis. Low serum albumin levels were associated with increased disease severity, higher mortality, and poorer outcomes, emphasizing its value as a simple, cost-effective biomarker in clinical practice. Incorporating albumin level monitoring into routine management and exploring therapeutic interventions, such as early albumin supplementation, could potentially improve outcomes in patients with acute pancreatitis. Further multicenter studies with larger sample sizes are needed to validate these findings and develop evidence-based guidelines for albumin management in acute pancreatitis.

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