e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(2); 706-709

Original Research Article

Serial Serum Albumin Level Estimation as a Prognostic Factor in Sepsis Patients Admitted in Intensive Care Units

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Received: 01-11-2025 / Revised: 15-12-2025 / Accepted: 21-01-2026
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Conflict of interest: Nil

Abstract

Background: The dysregulated host response to infection is the hallmark of the clinical disease known as sepsis. There is a range of severity, from septic shock to sepsis. Mortality rates in shock cases have been shown to range from 10% to 40%, although estimates vary greatly and depend on the group being studied. Finding out whether serum albumin levels and mortality risk are quantitatively connected and examining the impact of serial serum albumin level monitoring as a predictor of mortality and morbidity in sepsis patients admitted to the intensive care unit are the main objectives of the study.

Method: This descriptive study involved 70 sepsis patients hospitalized to the Medicine ICU at Darbhanga Medical College & Hospital in Laheriasarai, Bihar, between September 2020 and February 2021. All of the selected patients received a comprehensive evaluation on the first day following the sepsis diagnosis, and on days three and five, their serum albumin levels were measured. Patients were observed during their hospital stay, and their results—that is, whether they lived or died—were recorded. In order to examine data placed into an MS Excel spreadsheet, statistical product and service solutions (SPSS) version 18 was utilized.

Results: The 70 patients selected for the study were divided into two groups: survivors and non-survivors. On day 1, the survivor group's mean serum albumin level was 3.72 g/dl (±0.278), whereas the non-survivor group's was 3.11 g/dl (±0.247). The non-survivor group's mean serum albumin levels on day three were 2.65 g/dl (±0.172), while the survivor groups were 3.17 g/dl (±0.248). The survivor group's mean blood albumin levels on day five were 2.72 g/dl (±0.25), while the non-survivor groups were 2.32 g/dl (±0.144). The difference in mean blood albumin on days 1, 3, and 5 was shown to be statistically significant using an unpaired t test, with a p value ≤0.001. The decline in mean serum albumin level in survivors from day 1to day 5 was 3.72 g/dl to 2.72 g/dl. In non-survivors it is 3.11 g/dl to 2.32 g/dl.

Conclusion: This study found a direct correlation between a blood albumin level of less than 3.5 gm/dl on all three days and the prognosis of a sepsis patient. Beginning on day 1, serum albumin levels in both the survivor and non-survivor groups gradually dropped; however, a drop below 3.0 gm/dl was associated with a higher death rate. It suggests that the rate at which serum albumin falls below the normal threshold affects the mortality prognosis of the sepsis patient. Even in settings with little resources, patients with sepsis are at risk of a poor prognosis, and serum albumin measurement is less expensive and can help with clinical evaluation.

Keywords: Serum albumin, Sepsis, Intensive care unit.

DOI: 10.25258/ijcpr.18.2.114

Introduction

Albumin is an essential protein that can only be produced by the liver. At a rate of 10–15 g per day (3.5 g/dL to 5 g/dL), albumin, the most abundant protein in plasma, is released into the blood. Albumin serves a few physiological purposes. Human albumin is the most important modulator of plasma's oncotic pressure. As a result, it prevents fluid from leaking into the extravascular spaces. Moreover, albumin influences the movement of specific molecules. Serum albumin carries endogenous materials including fatty acids, ions, and bilirubin as well as external compounds like drugs. Additionally, albumin is a hormone transporter that binds at least 40% of the calcium in the blood and transports thyroxine, testosterone, and cortisol. Among the drugs that albumin carries are furosemide, warfarin, methadone, thiopental, methotrexate, propranolol, and many more. One way that albumin helps maintain acid-base balance is by acting as a plasmatic buffer.[1–3] Albumin levels in plasma can drop as a result of burns, sepsis, nephrotic syndrome, chronic kidney failure, liver failure, and protein-losing enteropathy. Among the many problems that patients with low albumin face is mortality. Hypoalbuminemia is not a physiological effect of aging, despite the fact that the conditions that cause it are increasingly common as people age. As a result, hypoalbuminemia and its effects may be more common in older adults.[4]

Because of increased capillary leakage and vascular permeability, sepsis is linked to a changed albumin distribution between intravascular and extravascular compartments. Additionally, sepsis patients have increased albumin breakdown and decreased albumin production. These pathophysiological pathways make hypoalbuminemia a risk factor for death in patients with sepsis.[5]

The purpose of this study is to determine whether there is a quantitative relationship between serum albumin levels and mortality risk. Additionally, it seeks to determine whether serum albumin level serial monitoring is useful in predicting mortality and morbidity in sepsis patients admitted to the intensive care unit.

Material and Methods

For this descriptive study, 70 sepsis patients were admitted to the medicine intensive care unit (ICU) of Darbhanga Medical College and Hospital in Laheriasarai, Bihar, between September 2020 and February 2021. The selected patients were all older than eighteen, had a confirmed case of sepsis by culture, and had a high suspicion of sepsis with two or more of the following: an abnormal white blood cell count (>12,000/μL or < 4,000/μL), a temperature that was either higher than 380°F (100.40°F) or lower than 360°F (96.80°F), a heart rate that was higher than 90 beats per minute, a respiratory rate, or an arterial carbon dioxide tension (PaC02) of less than thirty-two millimeters of mercury. Patients with chronic liver disease, chronic kidney disease with proteinuria, protein-losing enteropathy, malnutrition, and those who died within five days of admission were not included in this study.

Following a comprehensive evaluation of each selected patient, blood albumin levels were compared by phone on the 28th day after the diagnosis with the clinical result (survivor/non-survivor) at the time of sepsis diagnosis, as well as on days 3 and 5. About two milliliters of blood were venepunctured on the first day of the sepsis diagnosis, and again on days three and five. Antiseptic and a disposable syringe were used. The study comprised intubated patients with sepsis symptoms from all etiologies who were put on mechanical ventilation. The use of mechanical ventilation was decided by the treating physician.

A comprehensive clinical examination was performed along with a meticulous and comprehensive history recording. Serum albumin (SA), serum electrolytes, renal and hepatic functions, total blood counts, and other tests performed at the time of admission were also noted.

Analysis of arterial blood gas, blood culture, and sensitivity were obtained. Every patient had their days on a ventilator, days in the intensive care unit, and days in the hospital noted. SPSS version 18 was used for data analysis after the data was entered into Microsoft Excel. The mean, median, mode, and standard deviation are the representations of all quantitative variables.

Categorical variables expressed as percentages and frequencies. Chi-square tests were used to analyze qualitative data, while the Mann-Whitney test was used to analyze quantitative data if the "normality test" was passed. Otherwise, the unpaired t-test was used. Statistical significance was defined as P values < 0.05.

Results

70 sepsis patients who were admitted to a medical intensive care unit were chosen for this study. Of the 70 admitted patients that were the subject of this investigation, 43 (61.42%) were released from the hospital after being declared survivors, and 27 (38.57%) passed away there (non survivors).

Two groups of patients were created: survivors and non-survivors. The nonsurvivor group's mean age was 38.85 (10.53), while the survivor group's mean age was 37.53 (10.48). The non-survivor group had minimum and maximum ages of 21 and 61, respectively, while the survivor group had lowest and maximum ages of 21 and 60. Within the survivor group, there were 30.2 percent (n=13) females and 69.8% males (n=30). Within the non-survivor group, there were 21 male (77.8%) and 6 female (22.2%).

In the survivor group, 16.3% of patients experienced a stroke, 11.6% snake bites, 9.3% OP poisoning, and 9.3% COPD patients, according to the etiological diagnosis. Of the patients in the non-survivor group, 25.9% had a stroke, 14.8% had COPD, 11.1% had diabetic foot, and 14.8% had OP poisoning. Causative organisms included pseudomonas in 48.57% of patients, E. Coli in 28.58%, MRSA in 10%, streptococci in 8.58%, klebsiella in 3.85%, and anaerobes in 1% of patients. In our study, the proportion of patients with normal blood albumin levels on day 1 (g/dl) in the survivor group was 72.10%, while the non-survivor group had just 3.7% of normal levels. Day 1 mean serum albumin levels were 3.72 g/dl (±0.278) in the survivor group and 3.11 g/dl (±0.247) in the nonsurvivor group. Using an unpaired t test, the difference in mean serum albumin on day 1 was shown to be statistically significant with a t value of 9.28, df of 68, and p value <0.001. Compared to 100% in the non-survivor group, 88.40% of patients in the survivor group had blood albumin levels <3.5 (g/dl) on day 3. Eleven percent of patients in the survivor group and zero percent in the nonsurvivor group had normal blood albumin levels (>3.5 g/dl). Day 3 mean serum albumin levels were 2.65 g/dl (±0.172) in the non-survivor group and 3.17 g/dl (±0.248) in the survivor group. Using an unpaired t test, the difference in mean serum albumin on day three was shown to be statistically significant with a t value of 9.496, df of 68, and p value <0.001. In this current investigation, on day 5, 95.30% of patients in the survivor group had serum albumin levels < 3.5 (g/dl), compared to 100% in the nonsurvivor group. The proportion of patients with normal blood albumin levels (>3.5 g/dl) was identified in 4.70% of the survivor group and 0% of the non-survivor group. Day 5 mean blood albumin levels were 2.72 g/dl (±0.25) in the survivor group and 2.32 g/dl (±0.144) in the non-survivor group. By using an unpaired t test, the difference in mean serum albumin on day 5 was shown to be statistically significant, with a t value of 7.43, df 68, and p value <0.001. The mean blood albumin level of survivors in our study decreased from 3.72 g/dl to 2.72 g/dl between days 1 and 5. It ranges from 3.11 to 2.32 g/dl in nonsurvivors.

Table 1: Serum Albumin Levels in Survivor and non-survivor groups

S.albumin in g/dl	Survivors(n=43)	Non-survivors (n=27)	Total (n=70)
Day 1			
• <3.5	12(27.9%)	26(96.3%)	38(54.28%)
• >3.5	31(72.1%)	1(3.7%)	32(45.71%)
Day 3			
• <3.5	38(88.4%)	27(100%)	65(92.85%)
• >3.5	3(6.9%)	0(0%)	3(4.28%)
Day 5			
• <3.5	41(95.3%)	27(100%)	68(97.14%)
• >3.5	2(4.7%)	0(0%)	2(2.85%)

Table 2: Comparing mean (SD) serum albumin in g/dl

S.albumin in g/dl	Mean (SD)		t-value	df	p-value
	Survivor	Non-survivor			
Day 1	3.72(±0.278)	3.11(±0.247)	9.28	68	<0.001
Day 3	3.17(±0.248)	2.65(±0.172)	9.49	68	<0.001
Day 5	2.72(±0.250)	2.32(±0.144)	7.43	68	<0.001

Discussion

For this study, seventy sepsis patients who were admitted to a medical intensive care unit were selected. Patients were divided into two categories: survivors and non-survivors.

The survivor group had mean serum albumin levels of 3.72 g/dl (± 0.278) on day 1 while the nonsurvivor group had mean levels of 3.11 g/dl (± 0.247). A statistically significant difference in mean blood albumin on day 1 was determined using an unpaired t test, with a t value of 9.28, df of 68, and p value <0.001. However, the difference was not statistically significant. In a study by Nirmala et al., survivors had slightly higher serum albumin on day 1 (3.46 ± 0.25 vs. 3.44 ± 0.30) than nonsurvivors.[6]

A study by Sanket Mahajan et al. found that the study group's mean blood albumin level on Day 1 (of admission) was 3.3 g/dl (± 0.4 g/dl). In survivors, it was 3.4 g/dl (±0.4 g/dl), while in nonsurvivors, it was 3.1 g/dl (± 0.19 g/dl). It was much lower among non-survivors (p = 0.003).[7] On the day of admission, the average blood albumin levels in survivors and non-survivors were 2.45 gm% (±0.50) and 3.06 gm% (+/-0.54), respectively (p< 0.01), according a study by Gosavi et al.[8]

The nonsurvivor group's mean serum albumin levels on day three were 2.65 g/dl (±0.172), whereas the survivor groups were 3.17 g/dl (±0.248). The change in mean serum albumin on day three was shown to be statistically significant using an unpaired t test, with a t value of 9.496, df of 68, and p value <0.001. According to a study by Nirmala et al., death among critically ill patients was significantly correlated with a decrease in serum albumin on day three (S - 3.46 ±0.29/NS - 2.83 ± 0.51). Mahajan et al. state that a patient's serum albumin level on day three (S - 3.04 ± 0.51/NS - 2.75 ± 0.22) is the strongest predictor of their prognosis.[6, 7] Day 5 mean blood albumin levels were 2.72 g/dl (± 0.25) in the survivor group and 2.32 g/dl (± 0.144) in the nonsurvivor group. By using an unpaired t test, the difference in mean serum albumin on day 5 was shown to be statistically significant, with a t value of 7.43, df 68, and p value <0.001. According to a study by Pal. A. et al., there was a greater chance of survival for those who recovered to a higher mean albumin value on day 5. On day 5, no mortality was seen in the participants whose serum albumin value was greater than 3.5 g/dl. If serum albumin was less than 2.5 g/dl, the death rate was 70%. Any serum albumin concentration below 2.5 g/dl on day 5 is therefore indicative of a poor prognosis, whereas individuals who recover to a mean value of >3.0 g/dl have a much better prognosis with respect to death.[9]

The mean blood albumin level of survivors in our study decreased from 3.72 g/dl to 2.72 g/dl between days 1 and 5. It ranges from 3.11 to 2.32 g/dl in non-survivors. The findings indicate that the serum albumin levels of both groups decreased progressively, although the decline in non-survivors was more pronounced than in survivors. It implies that the patient's mortality outlook is influenced by the rate at which serum albumin drops. Serum albumin levels dropping suggest a bad outlook. Similar findings are reported in a research by Mahajan et al., which indicates that the survivors' serum albumin decreased by 0.86 g/dl from the time of admission to day 10. Over a ten-day period, it is 1.09 g/dl in non-survivors.[7]

Conclusion

This study found a direct correlation between a blood albumin level of less than 3.5 gm/dl on all three days and the prognosis of a sepsis patient. Beginning on day 1, serum albumin levels in both the survivor and non-survivor groups gradually dropped; however, a drop below 3.0 gm/dl was associated with a higher death rate. It suggests that the rate at which serum albumin falls below the normal threshold affects the mortality prognosis of the sepsis patient.

Serum albumin measurement is less expensive, and its serial measurement may aid in the clinical evaluation of patients with sepsis, who even in places with few resources are at risk of a bad prognosis. Early implementation of intensive therapy can enhance survival rates in patients with severe sepsis.

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