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Original Research Article

Role of Serial Estimation of Serum Albumin Level as a Prognostic Factor in Sepsis Patients

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Abstract:

Background: The high morbidity and mortality rates of sepsis contribute to a significant global healthcare burden. The mortality rate is still high because of the delay in diagnosis caused by the absence of trustworthy diagnostic procedures, despite the significant advancements in therapeutic choices. Endothelial dysfunction and an increase in systemic capillary permeability are caused by the strong activation of the inflammatory cascade in sepsis. The kidney excretes more albumin in the urine due to capillary leaks in the glomerulus and a lack of barrier integrity. The main aim of this study is to evaluate whether there is a quantitative relationship between serum albumin levels and the risk of mortality, as well as the function of serial monitoring of serum albumin levels as a predictor of mortality and morbidity in sepsis patients admitted to the intensive care unit.

Method: Present study was conducted in ICU Medicine department of Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar from July 2023 to June 2024 on 140 sepsis patients who admitted during this study period. On the first day of sepsis diagnosis, as well as on days three and five, the serum albumin levels of all the enrolled patients were assessed after a thorough evaluation. Throughout their hospital stay, patients were monitored, and their outcome that is, whether they died or survived was noted. SPSS (statistical product and service solutions) software version 24.0 was used to analyze the data after it was entered into an MS Excel sheet.

Results: There were two groups of 140 patients selected for the study: survivors and non-survivors. On the first day, the survivor group's mean serum albumin level was 3.72 g/dl (±0.278), while the non-survivor group's was 3.11 g/dl (±0.247). On day three, the survivor group's mean serum albumin level was 3.17 g/dl (±0.248), while the non-survivor group's was 2.65 g/dl (±0.172). On day five, the survivor group's mean serum albumin level was 2.72 g/dl (±0.25), while the non-survivor group's was 2.32 g/dl (± 0.144). According to the unpaired t test, the difference in mean serum albumin on days 1, 3, and 5 was statistically significant (p value ≤0.001). Survivors' mean blood albumin levels 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.

Conclusion: According to this study, a patient with sepsis who has a serum albumin level below 3.5 gm/dl for all three days has a bad prognosis. Serum albumin levels gradually decreased in both the survivor and non-survivor groups starting on day 1, but a drop below 3.0 gm/dl was linked to a greater death rate. It implies that the prognosis of the sepsis patient in terms of mortality is influenced by the speed at which serum albumin drops below the normal level. The clinical evaluation of sepsis patients, who are at risk of a bad prognosis even in locations with little resources, may benefit from serum albumin testing, which is less expensive and can be measured serially.

Keywords: Serum albumin, Sepsis, Intensive care unit.

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Introduction

Nearly 60% of patients with severe sepsis do not survive past their initial hospitalization, and 57.6% of them die within 28 days, making sepsis a serious hazard in Indian hospitals [1]. Tropical diseases

exacerbate sepsis in Indian intensive care units (ICUs), resulting in multiple organ failure. Common signs and symptoms of these infections include fever and rash, fever and muscle pain (fever-myalgia), fever and joint pain (fever-arthralgia), fever and jaundice (fever-icterus), or acute encephalitis syndrome [2].

The most prevalent plasma protein is albumin, which typically has serum concentrations between ~3.5 and 5 g/dl. Colloid osmotic pressure is maintained mostly by albumin, which is synthesized in the liver [3]. In a prospective cohort analysis, Yin-M et al. found that patients with severe sepsis who had an albumin level of less than 2.92 gm/dl at the time of admission had a higher 28-day mortality rate [4]. The death rate was 46.7% for patients with blood albumin levels below 2.92 g/dl and 14.1% for those with levels over the cut-off.

The 90-day death rate in patients with severe sepsis or septic shock was predicted by the CRP/albumin ratio assessed at admission and discharge, according to study by Ranzani et al. [5].

Serum albumin by itself is unlikely to have been a significant predictor, because elevated CRP/albumin ratios were clearly the result of either low serum albumin, high CRP, or both.

This emphasizes how important serial albumin level measurements are. A poor prognosis is associated with a low serum albumin content in critical illness [6]. In many situations, serum albumin appears to be a reliable prognostic indication [7]. In the majority of critically ill patients and elderly people, albumin concentrations may serve as a marker for subclinical disease. Hypoalbuminemia in hospitalized patients is linked to longer hospital stays, more complications, and higher death rates [8,9]. The measurement of serum albumin levels is easy, quick, and accessible.

Finding out whether there is a quantitative relationship between blood albumin levels and mortality risk is the main aim of this study. It also aims to ascertain the relevance of serial monitoring of serum albumin levels as a predictor of mortality and morbidity in sepsis patients admitted to the intensive care unit.

Material and Methods

Present study was conducted in ICU Medicine department of Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar from July 2023 to June 2024 on 140 sepsis patients who admitted during this study period. Admitted patients aged over 18 years, who have a proven sepsis by culture, and high suspicion of sepsis with following two or more variables

A. Temperature of more than 38^0C (100.4^0F) or less than 36^0C (96.8^0F)
B. Heart rate of more than 90 beats per minute
C. Respiratory rate of more than 20 breaths per minute or arterial carbon dioxide tension ($PaC0_2$) of less than 32mm Hg.
D. Abnormal white blood cell count (>12,000/μL or < 4,000/μL)

Patients who have chronic liver disease, chronic kidney disease with proteinuria, malnutrition, protein losing enteropathy and who died within 5 days of admission were excluded in this study.

Every participant provided written, informed consent. Serum albumin levels were assessed at the time of sepsis diagnosis, on days three and five of the diagnosis, and associated with clinical outcome (survivor/non-survivor) via phone after the 28th day of diagnosis for all of the chosen patients. On the first day of the sepsis diagnosis, approximately 2 ml of blood was extracted by venepuncture; this was followed on days 3 and 5. Disinfectant and a disposable syringe were used. Patients with sepsis-like symptoms from all causes who were intubated and placed on mechanical ventilation were included in the study. The treating physician made the decision to use mechanical ventilation.

A careful and detailed history was recorded and thorough clinical examination was conducted. Total blood counts, serum electrolytes, renal functions, liver functions and serum albumin (SA) done at the time of admission were also recorded.

Blood culture and sensitivity and arterial blood gas analysis were obtained. Days on ventilator, days of ICU stay and days of hospital stay were recorded for all the patients. Data was entered in MS excel and analysed using SPSS software version 18. All quantitative variables are represented in mean, median, mode and standard deviation.

Categorical variables represented in frequencies and percentages. Analysis of qualitative data was done using chi-square tests and quantitative data was done using unpaired t-test if data passes 'normality test' or else by Mann-Whitney Test. P values less than 0.05 were considered statistically significant.

Results

140 sepsis patients who were admitted to a medical intensive care unit were selected for this study. 86 (61.42%) of the 140 admitted patients in this study were released from the hospital (survivors), while 54 (38.57%) of the patients passed away while still in the hospital (non-survivors).

There were two groups of these patients: survivors and non-survivors. Both the survivor and nonsurvivor groups had mean (SD) ages of 37.53 (±10.48) and 38.85 (±10.53), respectively. The

survivor group's minimum and maximum ages were 21 and 60, respectively, whereas the non-survivor groups were 21 and 61. 30.2% (n=26) of the survivors were female, while 69.8% (n=60) were male. There were 22.2% (n=12) females and 77.8% (n=42) males in the non-survivor group. Based on the etiological diagnosis, 16.3% of patients in the survivor group experienced a stroke, 11.6% were bitten by a snake, 9.3% were poisoned by OP, and 9.3% had COPD. In the non-survivor group, stroke affected 25.9% of patients, OP poisoning affected 14.8%, COPD affected 14.8%, and diabetic foot affected 11.1%. In terms of causal organisms, the following were found in 48.57% of patients: pseudomonas, 28.58% E. Coli, 10% MRSA, 8.58% streptococci, 3.85% Klebsiella, and 1% anaerobes.

In our study, 72.10 percent of patients in the survivor group had normal serum albumin levels on day 1 (g/dl), whereas only 3.7% of patients in the non-survivor group did. On the first day, the survivor group's mean serum albumin level was 3.72 g/dl (±0.278), while the nonsurvivor group's was 3.11 g/dl (±0.247). According to the unpaired t test, the difference in the mean serum albumin on day one was statistically significant (t value 9.28, df 68, and p value <0.001). Compared to 100% of patients in the non-survivor group, 88.40% of patients in the survivor group had a blood albumin level of less than 3.5 (g/dl) on day three. 11.6% of patients in the survivor group and 0% of patients in the nonsurvivor group had normal blood albumin levels (>3.5 g/dl). On day three, the survivor group's mean serum albumin level was 3.17 g/dl (±0.248), while the non-survivor group's was 2.65 g/dl (±0.172). According to the unpaired t test, the difference in the mean serum albumin on day three was statistically significant (t value 9.496, df 68, and p value <0.001).

In the current study, 95.30 percent of patients in the survivor group had a blood albumin level below 3.5 (g/dl) on day 5, whereas 100% of patients in the nonsurvivor group did the same. 4. 70% of patients in the survivor group and 0% of patients in the non-survivor group had normal blood albumin levels (>3.5 g/dl). On day five, the survivor group's mean serum albumin level was 2.72 g/dl (±0.25), while the non-survivor group's was 2.32 g/dl (±0.144). According to the unpaired t test, the difference in the mean serum albumin on day five was statistically significant (t value 7.43, df 68, and p value <0.001). The mean blood albumin level among 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=86)	Non-survivors (n=54)	Total (n=140)
Day 1			
• <3.5	24(27.9%)	52(96.3%)	76(54.28%)
• >3.5	62(72.1%)	2(3.7%)	64(45.71%)
Day 3			
• <3.5	76(88.4%)	54(100%)	130(92.85%)
• >3.5	10(11.6%)	0(0%)	14(7.14%)
Day 5			
• <3.5	82(95.3%)	54(100%)	136(97.14%)
• >3.5	4(4.7%)	0(0%)	4(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 2	3.17(±0.248)	2.65(±0.172)	9.49	68	<0.001
Day 3	2.72(±0.250)	2.32(±0.144)	7.43	68	<0.001

Discussion

In this study 140 sepsis patients admitted in medical intensive care unit and surgical intensive care unit were selected. These patients were divided into Survivor and non-survivor groups.

Mean level of serum albumin at day 1 was 3.72 g/dl (±0.278) in survivor group and in nonsurvivors group, it was 3.11 g/dl (±0.247). The difference in mean serum albumin in day 1was statistically significant with t value 9.28, df 68 and p value <0.001 by unpaired t test. In a study by Nirmala et al (2015), slightly higher serum albumin was detected in Survivors versus nonsurvivors on day 1 (3.46 ± 0.25 vs. 3.44 ± 0.30), but the variance was statistically not significant [10]. In a study by Sanket Mahajan et.al, mean serum albumin level on day of admission (Day 1) for the study group was 3.3 g/dl (± 0.4 g/dl). In survivors, it was 3.4 g/dl (± 0.4 g/dl) and in nonsurvivors it was 3.1 g/dl (± 0.19 g/dl). It was significantly lower (p = 0.003) in non-survivors. [11] A study done by gosavi et.al also

shows the mean Serum albumin on day of admission in survivors and non-survivors was 3.06 gm% (±0.54) and 2.45 gm% (±0.50) (p< 0.01). [12] Mean level of serum albumin at day 3 was 3.17 g/dl (±0.248) in survivor group and in nonsurvivors group, it was 2.65 g/dl (±0.172). The difference in mean serum albumin in day 3 was statistically significant with t value 9.496, df 68 and p value <0.001 by unpaired t test. Study by Nirmala et al. (2015) showed a fall in serum Albumin on day 3 was strongly associated with mortality among patients with Critically ill (S - 3.46 ±0.29/NS - 2.83 ± 0.51). Mahajan et al. (2015) also reported strongest predictor of the outcome of patients is serum albumin on day 3 (S - 3.04 ± 0.51/NS - 2.75 ± 0.22) [10].

Mean level of serum albumin at day 5 was 2.72 g/dl (+ 0.25) in survivor group and in nonsurvivors group, it was 2.32 g/dl (+ 0.144). The difference in mean serum albumin in day 5 was statistically significant with t value 7.43, df 68 and p value <0.001 by unpaired t test. In a study done by Pal. A et.al shows those who recovered to higher mean albumin value on day 5 had higher chances of survival. No mortality was seen in subjects who has serum albumin value of >3.5 g/dl on day 5. While Serum albumin <2.5 g/dl had mortality rate of 70%. Thus, serum albumin value of 2.5 g/dl on day 5 can be taken as prognostic marker of poor outcome while those who recovered to mean value of >3.0 g/dl have a far better prognosis in terms of mortality [13].

In our study the decline in mean serum albumin level in survivors from day 1 to 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. This results show that both groups were gradually fall in serum albumin level but the fall in non survivors is steeper than survivors. It suggests that the rapidity with which serum albumin falls has an effect on the prognosis of the patient in terms of mortality. A decline in serum albumin indicates a poor prognosis. A study done by Mahajan et.al also shows the similar results that is a decline in serum albumin in the survivors from admission to day 10 in survivors is 0.86 g/dl. In non-survivors it is 1.09 g/dl over a period of 10 days. [11]

Conclusion

According to this study, a patient with sepsis who has a serum albumin level below 3.5 gm/dl for all three days has a bad prognosis. Serum albumin levels gradually decreased in both the survivor and non-survivor groups starting on day 1, but a drop below 3.0 gm/dl was linked to a greater death rate. It implies that the prognosis of the sepsis patient in terms of mortality is influenced by the speed at which serum albumin drops below the normal level.

The clinical evaluation of sepsis patients, who are at risk of a bad prognosis even in locations with little resources, may benefit from serum albumin testing, which is less expensive and can be measured serially.

Early initiation of intensive care can increase the survival rate of patients with severe sepsis.

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