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Original Research Article

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

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Abstract:

Background: The clinical condition known as sepsis is defined by a dysregulated host response to infection. A spectrum of severity exists, spanning from sepsis to septic shock. While estimates of mortality vary widely and depend on the population under study, they have been shown to be between 10% and 40% in cases of shock. The study's primary goals are to ascertain if serum albumin levels and mortality risk are quantitatively correlated and to investigate the effect of serial monitoring of serum albumin levels as a predictor of mortality and morbidity in sepsis patients admitted to the intensive care unit.

Method: From July 2023 to December 2023, 140 sepsis patients were admitted to the Medicine ICU at Sri Krishna Medical College & Hospital in Muzaffarpur, Bihar, for this descriptive study. On the first day after the diagnosis of sepsis, all of the chosen patients underwent a thorough evaluation, and their serum albumin levels were examined on days three and five. Throughout their hospital stay, patients were monitored, and their outcome that is, whether they survived or died was documented. Version 18 of the statistical product and service solutions (SPSS) program was used to analyze data that had been entered into an MS Excel spreadsheet.

Results: There were two groups of the 140 patients that were chosen for the study: survivors and non-survivors. The mean level of serum albumin at day 1 was 3.72 g/dl (±0.278) in survivor group while in non-survivors group; it was 3.11 g/dl (±0.247). 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. 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 days 1, 3, and 5 was found to be statistically significant, 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: According to this study, a sepsis patient's prognosis is directly correlated with a serum albumin level that is less than 3.5 gm/dl on all three days. Serum albumin levels gradually decreased in both the survivor and non-survivor groups starting on day 1, but a decline below 3.0 gm/dl was linked to a greater death rate. It implies that the sepsis patient's mortality prognosis is influenced by how quickly serum albumin drops below the normal threshold. Serum albumin measurement is less expensive, and its serial measurement may aid in the clinical evaluation of patients with sepsis, which even in places with few resources are at risk of a bad prognosis.

Keywords: Serum albumin, Sepsis, Intensive care unit.

Introduction

The liver is the only organ in the body that can produce albumin, a necessary protein. The most prevalent protein in plasma, albumin is discharged in the blood at a rate of 10–15 g per day (3.5 g/dL to 5 g/dL). A few physiological functions of albumin exist. The most significant modifier of plasma's oncotic pressure is human albumin. Thus, it stops fluids from seeping into the extravascular areas. Additionally, albumin affects how certain chemicals are transported. Serum albumin transports both foreign chemicals like medications and endogenous substances like fatty acids, ions, and bilirubin. Moreover, albumin is a hormone transporter that carries cortisol, testosterone, and

thyroxine, and it binds at least 40% of the calcium in circulation. Furosemide, warfarin, methadone, thiopental, methotrexate, propranolol, and numerous other medications are among those carried by albumin. Albumin functions as a plasmatic buffer, which contributes to its role in preserving acid-base balance. [1-3]

Liver failure, starvation, nephrotic syndrome, chronic kidney failure, protein-losing enteropathy, burns, and sepsis can all cause a decrease in the amount of albumin in the plasma. Patients with low albumin have numerous issues, including mortality. Although disorders that lead to hypoalbuminemia become more prevalent as people age, hypoalbuminemia itself is not a physiological consequence of aging. Because of this, older people may have hypoalbuminemia and its consequences more frequently [4].

Sepsis is associated with altered albumin distribution between intravascular and extravascular compartments due to increased vascular permeability and capillary leakage. In addition, there is a decreased synthesis and an enhanced degradation of albumin in sepsis patients. Hypoalbuminemia is a risk factor for mortality in sepsis patients due to these pathophysiological mechanisms. [5]

This study aims to ascertain if serum albumin levels and mortality risk are quantitatively correlated, as well as the relevance of serum albumin level serial monitoring in predicting mortality and morbidity in sepsis patients admitted to the intensive care unit.

Material and Methods

From July 2023 to December 2023, 140 sepsis patients were admitted to the medicine ICU of Sri Krishna Medical College and Hospital in Muzaffarpur, Bihar, for this descriptive study. All of the patients who were chosen were older than eighteen years, had a confirmed case of sepsis by culture, and had a high suspicion of sepsis with two or more of the following factors: 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 ninety beats per minute, a respiratory rate that was higher than twenty breaths per minute, or an arterial carbon dioxide tension (PaC02) of less than thirty-two millimeters of mercury, and an abnormal white blood cell count (>12,000/µL or < 4,000/µL).

This study excluded patients with malnutrition, protein-losing enteropathy, chronic liver disease, chronic kidney disease with proteinuria, and patients who passed away within five days of admission.

Before the study began, each participant provided informed written consent. Every patient who was chosen was given a thorough evaluation, and on the 28th day following the diagnosis, their serum albumin levels were compared by phone with the clinical outcome (survivor/non-survivor) at the time of sepsis diagnosis, as well as on days 3 and 5. On the first day of the sepsis diagnosis, about 2 ml of blood was venepunctured, and then on days 3 and 5. Disposable syringe and antiseptic were utilized. Patients with sepsis symptoms from all etiologies who were intubated and placed on mechanical ventilation were included in the study. The treating physician made the decision to use mechanical ventilation.

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

140 sepsis patients who were admitted to a medical intensive care unit were chosen for this study. Of the 140 admitted patients that were the subject of this investigation, 86 (61.42%) were released from the hospital after being declared survivors, and 54 (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=26) females and 69.8% males (n=60). Within the non-survivor group, there were 42 male (77.8%) and 12 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=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%)	10(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 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

140 sepsis patients who were admitted to a medical intensive care unit were chosen for this study. Two groups of patients were created: survivors and non-survivors.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. In a research by Nirmala et al., survivors were shown to have slightly greater serum albumin on day 1 (3.46 ± 0.25 vs. 3.44 ± 0.30) than nonsurvivors, although the difference was not statistically significant. [6] The study group's mean blood albumin level on Day 1 (of admission) was 3.3 g/dl (± 0.4 g/dl) according to a study by Sanket Mahajan et al. It was 3.4 g/dl (±0.4 g/dl) in survivors and 3.1 g/dl (± 0.19 g/dl) in nonsurvivors. In non-survivors, it was considerably lower (p = 0.003). [7] According to a Gosavi et al. study, the average serum albumin levels in survivors and non-survivors on the day of admission were 2.45 gm% (±0.50) and 3.06 gm% (+/-0.54), respectively (p< 0.01). [8] Day 3 mean serum albumin levels were 2.65 g/dl (±0.172) in the nonsurvivor 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. A study by Nirmala et al. revealed that among critically sick patients, a drop in serum albumin on day three was substantially linked to mortality (S - 3.46 ±0.29/NS - 2.83 ± 0.51). According to Mahajan et al., the best indicator of a patient's prognosis is their serum albumin level on day three (S - 3.04 ± 0.51/NS - 2.75 ± 0.22). [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

According to this study, a sepsis patient's prognosis is directly correlated with a serum albumin level that is less than 3.5 gm/dl on all three days. Serum albumin levels gradually decreased in both the survivor and non-survivor groups starting on day 1, but a decline below 3.0 gm/dl was linked to a greater death rate. It implies that the sepsis patient's mortality prognosis is influenced by how quickly serum albumin drops below the normal threshold. Serum albumin measurement is less expensive, and its serial measurement may aid in the clinical evaluation of patients with sepsis, which 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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