Section: General Medicine

Original Research Article

SERIAL SERUM ALBUMIN LEVEL MONITORING AS PROGNOSTIC MARKER IN PATIENTS WITH SEPSIS IN ICU

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ABSTRACT

Background: Sepsis is a life-threatening condition characterized by multiorgan dysfunction resulting from a dysregulated host response to infection. Early identification of patients at high risk of adverse outcomes is essential in intensive care settings. Serum albumin, a negative acute-phase reactant, decreases during systemic inflammation and may serve as a simple, cost-effective prognostic marker. The objective is to evaluate the association between serial serum albumin levels and mortality, morbidity, ionotropic requirement, ventilator requirement, and duration of hospital stay in patients with sepsis admitted to the ICU.

Materials and Methods: This prospective longitudinal study included 124 patients aged 18–80 years with sepsis admitted to the ICU of the Department of General Medicine, TDMCH Alappuzha. Serum albumin levels were measured on days 1, 3, 5, and 7 after admission. Clinical outcomes assessed included mortality, duration of hospital stay, need for ionotropic support, and ventilator requirement. Data were analyzed using SPSS version 27.

Results: Among the study participants, 69.4% had normal serum albumin levels (3.5–5.0 g/dl) at admission, while 30.6% had hypoalbuminemia (<3.5 g/dl). Mean serum albumin levels progressively declined from 3.65 g/dl on day 1 to 3.06 g/dl on day 7. Survivors consistently maintained higher albumin levels than non-survivors. Patients requiring ionotropic support, mechanical ventilation, and prolonged hospitalization (>7 days) demonstrated a greater decline in serum albumin levels during ICU stay.

Conclusion: Serial monitoring of serum albumin levels is a simple and useful prognostic tool in septic patients. Declining albumin levels were associated with increased mortality, prolonged hospital stay, and greater need for organ support, highlighting its potential role in risk stratification and clinical decision-making in ICU settings.

Keywords: Sepsis, Serum Albumin, Prognosis, Intensive Care Unit, Mortality.

INTRODUCTION

Sepsis is a prevalent and life-threatening condition. Historically, Hippocrates described sepsis as being associated with festering wounds and decaying flesh. Centuries later, Galen considered sepsis a laudable event necessary for wound healing. In the 19th century, following the germ theory proposed by Semmelweis, Pasteur, and others, sepsis was redefined as "blood poisoning," caused by the spread of pathogens in the bloodstream. However, this theory did not fully explain sepsis, as many patients died despite successful removal of the inciting pathogen. Later, Bone and colleagues defined sepsis as a systemic inflammatory response to infection, broadening the understanding of the disease.[1]

Various scoring systems, such as the Acute Physiology and Chronic Health Evaluation (APACHE) and the Sequential Organ Failure

Assessment (SOFA), have been developed to predict prognosis and outcomes in critically ill patients. These systems incorporate variables like age, vital signs, and assessments of respiratory, renal, and neurological functions, as well as evaluations of chronic medical conditions. However, they can be time-consuming and complex, often requiring numerous clinical and laboratory parameters.[2]

Early identification of patients with poor prognoses and increased risk of complications is crucial for initiating timely intensive management. Therefore, there is a need for an efficient, cost-effective, and straightforward tool to predict mortality in these patients. Serum albumin levels have emerged as a significant marker of clinical condition in critically ill patients. Studies have shown that decreased serum albumin levels are frequently observed in critically ill individuals, which could result from redistribution of albumin between the vascular and interstitial spaces, nutritional deficiency, increased loss of albumin, and impaired hepatic albumin synthesis.[3]

Serum albumin's primary physiological roles include ligand binding and transport, as well as the control of capillary membrane permeability and plasma oncotic pressure. In healthy adults, the normal serum albumin concentration ranges from approximately 3.4 to 5.4 g/dL.[4]

Hypoalbuminemia, which refers to a decreased serum albumin level, is commonly observed in critically ill patients and is linked to increased mortality, prolonged hospital stays, and a higher risk of complications. Albumin is broken down in various organs throughout the body. Serum albumin is frequently measured at admission in critically ill patients as part of the liver function test. The measurement of serum albumin levels is easy, quick, and accessible. A robust, cost-effective indicator to predict mortality and morbidity risk is required in the Indian context, where there are few high-quality intensive care facilities, a low doctor-to-patient ratio, and limited financial resources.

MATERIALS AND METHODS

This prospective longitudinal study was conducted in the Intensive Care Unit (ICU) of the Department of General Medicine, Government T.D. Medical College, Alappuzha, over a period of one year after obtaining Institutional Ethics Committee approval. A total of 124 consecutive patients aged 18–80 years diagnosed with sepsis and admitted to the ICU were enrolled. Patients with chronic malnutrition, chronic liver disease, chronic kidney disease, nephrotic syndrome, protein-losing enteropathy, malignancy, or a history of albumin, fresh frozen plasma, or packed red cell transfusion were excluded.

Demographic and clinical data, including age, sex, smoking status, comorbidities, and relevant clinical findings, were recorded at admission. Sepsis severity was assessed using the Sequential Organ Failure Assessment (SOFA) score. Routine laboratory investigations included complete blood count, renal and liver function tests, coagulation profile, arterial blood gas analysis, blood glucose, microbiological cultures, chest radiography, electrocardiography, and ultrasonography when indicated.

Venous blood samples were collected on days 1, 3, 5, and 7 of ICU admission. Serum albumin levels were measured using the bromocresol green method on an automated analyzer. The primary study variable was serial serum albumin concentration and its association with clinical outcomes in sepsis.

Data were entered into Microsoft Excel and analyzed using SPSS version 27.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation or median (interquartile range), as appropriate. Comparisons between groups were performed using the Chi-square test and Mann–Whitney U test. A p-value <0.05 was considered statistically significant. Written informed consent was obtained from all participants or their legally authorized representatives prior to enrollment.

RESULTS

Table 1: Distribution of DM in study population

DM	Frequency	Percent
NO	42	33.9
YES	82	66.1
Total	124	100.0

The data shows that out of 124 ICU patients with sepsis, 82 (66.1%) had diabetes mellitus (DM), while 42 (33.9%) did not. This indicates that a significant majority of the sepsis patients in study had diabetes, suggesting a possible association between DM and the risk of severe infections requiring ICU admission.

Table 2: Patient Status in Study Population

	Frequency	Percent
Survivor	83	66.9
Non Survivor	41	33.1
Total	124	100.0

83 (66.9%) survived, while 41 (33.1%) did not. This indicates a survival rate of approximately two-thirds of the patients, while one-third succumbed to the illness, highlighting the severity and high mortality risk associated with sepsis.

Table 3: Serial serum albumin monitoring in day 1,3,5,7 in non survivors and survivors

	Patient Status	N	Mean	Std. Deviation	Std. Error Mean
Serum Albumin D1	Survivor	83	3.809639	.3704363	.0406607
	Non Survivor	41	3.341463	.3316441	.0517941
Serum Albumin D3	Survivor	83	3.507229	.3685116	.0404494
	Non Survivor	41	2.985366	.3126987	.0488353
Serum Albumin D5	Survivor	83	3.259036	.3432400	.0376755
	Non Survivor	41	2.792683	.3266422	.0510129
Serum Albumin D7	Survivor	83	3.332530	.4889283	.0536668
	Non Survivor	41	2.502439	.3691123	.0576457

The analysis of serum albumin levels on Days 1, 3, 5, and 7 reveals a consistent difference between survivors and non-survivors. On Day 1, the mean serum albumin level in survivors is 3.81 g/dL (SD = 0.37), which is higher than in non-survivors, who have a mean of 3.34 g/dL (SD = 0.33). This trend continues on Day 3, where survivors maintain a higher mean serum albumin level of 3.51 g/dL (SD = 0.37) compared to 2.99 g/dL (SD = 0.31) in non-survivors. By Day 5, the difference persists, with survivors having a mean of 3.26 g/dL (SD = 0.34) and non-survivors showing a lower mean of 2.79 g/dL (SD = 0.33). On Day 7, the gap becomes most pronounced, as survivors exhibit a mean serum albumin level of 3.33 g/dL (SD = 0.49), while non-survivors have a mean of 2.50 g/dL (SD = 0.37).

Table 4: Serial serum albumin monitoring in population in day 1 to 7

Patient Status And Serum Albumin	Patient Status	N	Mean Rank	Sum of Ranks	P Value
Serum	Survivor	83	75.66	6280.00	<0.001
Albumin D1	Non	41	35.85	1470.00	
	Survivor				
	Total	124			
Serum	Survivor	83	77.56	6437.50	<0.001
Albumin D3	Non	41	32.01	1312.50	
	Survivor				
	Total	124			
Serum	Survivor	83	76.35	6337.00	<0.001
Albumin D5	Non	41	34.46	1413.00	
	Survivor				
	Total	124			
Serum	Survivor	83	79.11	6566.50	<0.001
Albumin D7	Non	41	28.87	1183.50	
	Survivor				
	Total	124			
Diffinalb	Survivor	83	51.25	4253.50	<0.001
Between D1	Non	41	85.28	3496.50	
And D7	Survivor				
	Total	124			

*Mann whitney U test

The data shows a significant decline in serum albumin levels from Day 1 (3.65 g/dL) to Day 7 (3.06 g/dL), with increasing variability over time. The Mann-Whitney U test indicates statistically significant differences ($p < 0.001$) in albumin levels between patient groups (likely survivors vs. non-survivors) at all-time points. The consistently negative Z-scores (-4.987 to -7.359) suggest that lower albumin levels are associated with worse outcomes, reinforcing its potential as a prognostic marker in sepsis.

Table 5: Mean age distribution of study populations

Patient Status					Total
			Survivor	Non Survivor	
Age	18-45	Count	18	0	18
		% within Patient Status	21.7%	0.0%	14.5%
	45-65	Count	46	23	69
		% Within Patient Status	55.4%	56.1%	55.6%
	65-80	Count	19	18	37
		% Within Patient Status	22.9%	43.9%	29.8%
Total		Count	83	41	124
		% Within Patient Status	100.0%	100.0%	100.0%

Chi Square Test-12.9 P Value <0.01

Age is significantly associated with patient survival (p = 0.002). Among survivors, 55.4% were aged 45-65 years, and 22.9% were 65-80 years. In contrast, 43.9% of non-survivors were aged 65-80years, showing that older age is linked to higher mortality risk. Younger patients (18-45 years) had a 100% survival rate, reinforcing age as a critical risk factor for patient outcomes.

Table 6: Association with DM and patient status

Patient Status					Total
			Survivor	Non Survivor	
DM	No	Count	38	4	42
		% Within Patient Status	45.8%	9.8%	33.9%
	Yes	Count	45	37	82
		% Within Patient Status	54.2%	90.2%	66.1%
Total		Count	83	41	124
		% Within Patient Status	100.0%	100.0%	100.0%

Chi Square Test-15.903 P Value Significant

Table 7: Serial albumin monitoring and ionotropic requirement

Ionotrops and Serum Albumin Level					
	IONOTR OPS	N	Mean Rank	Sum of Ranks	P value
Serum Albumin D1	Yes	69	43.22	2982.50	<0.001
	No	55	86.68	4767.50	
	Total	124			
Serum Albumin D3	Yes	69	42.07	2902.50	<0.001
	No	55	88.14	4847.50	
	Total	124			
Serum Albumin D5	Yes	69	41.83	2886.00	<0.001
	No	55	88.44	4864.00	
	Total	124			
Serum Albumin D7	Yes	69	37.50	2587.50	<0.001
	No	55	93.86	5162.50	
	Total	124			

The Mann-Whitney U test was used to compare serum albumin levels between patients requiring inotropic support (YES) and those not requiring inotropes (NO) at different time points (D1, D3, D5, and D7). The results show a statistically significant difference (p < 0.001) at all-time points, indicating that patients requiring inotropic support had significantly lower serum albumin levels compared to those who did not.

Table 8: The need of mechanical ventilator support and serial serum albumin

Ventilator		Mean	Std. Deviation	Std. Error Mean
Serum Albumin D1	YES	3.385714	.3260946	.0435762
	NO	3.876471	.3545515	.0429957
Serum Albumin D3	YES	3.071429	.3355941	.0448456
	NO	3.551471	.3715609	.0450584
Serum Albumin D5	YES	2.848214	.2935619	.0392289
	NO	3.316176	.3547588	.0430208
Serum Albumin D7	YES	2.630357	.3940095	.0526517
	NO	3.410294	.4998924	.0606209

Ventilator	Yes	No
Serum Alb D1	3.385714	3.876471
Serum Alb D3	3.071429	3.551471
Serum Alb D5	2.848214	3.316176
Serum Alb D7	2.630357	3.410294

On Day 1, the mean serum albumin level for ventilated patients is 3.39 g/dL (±0.33), while for non-ventilated patients; it is 3.88 g/dL (±0.35). This shows a difference of0.49 g/dL, indicating that patients requiring ventilation already present with lower serum albumin at the start. By Day 3, serum albumin levels drop further to 3.07 g/dL (±0.34) in ventilated patients, compared to 3.55 g/dL (±0.37) in non-ventilated patients, a difference of 0.48 g/dL. This suggests a persistent disparity between the two groups. On Day 5, the gap widens as serum albumin continues to decline in ventilated patients, with a mean of 2.85 g/dL (±0.29), while non-ventilated patients maintain a higher level of 3.32 g/dL (±0.35), resulting in a 0.47 g/dL difference. By Day 7, this trend is even more pronounced: ventilated patients have a mean serum albumin level of 2.63 g/dL (±0.39), while non-ventilated patients show 3.41 g/dL (±0.50), marking the largest difference of 0.78 g/dL.

Table 9: Serial albumin monitoring and hospital stay

Hospitalstay		N	Mean Rank	Sum of Ranks	P Value
Serum Albumin D1	<7days	56	73.50	4116.00	.002
	>7days	68	53.44	3634.00	
	Total	124			
Serum Albumin D3	<7days	56	79.23	4437.00	<0.001
	>7days	68	48.72	3313.00	
	Total	124			
Serum Albumin D5	<7days	56	84.46	4730.00	<0.001
	>7days	68	44.41	3020.00	
	Total	124			
Serum Albumin D7	<7days	56	87.78	4915.50	<0.001
	>7days	68	41.68	2834.50	
	Total	124			

DISCUSSION

Primary objective of the study was to study the association between serial serum albumin monitoring and mortality in patients with sepsis in icu. In this study 124 patients with sepsis were enrolled based on inclusion criteria. Patients with 18 years or more is included.

The data shows the distribution of patient survival status across three age groups: 18-45 years, 45-65 years, and 65-80 years. Among the 18-45 age groups, all 18 patients (14.5% of the total population) were survivors, resulting in a 100% survival rate and no non-survivors. Dr Saravanakumar. G et al studied 70 sepsis patients admitted in medical intensive care unit and surgical intensive care unit and Mean (SD) age in the survivor group was 37.53 (10.48) and in the nonsurvivor group was 38.85 (10.53). The minimum and maximum age in the survivor group were 21 & 60 respectively, in the non-survivor group it's was 21 & 6.[5]

Out of 124 patients, 89 (71.8%) are male and 35 (28.2%) are female. Among the survivors, 59 (71.1%) are male and 24 (28.9%) are female. Among the non-survivors, 30 (73.2%) are male and 11 (26.8%) are female and more males than females are affected, but the survival rates between sexes do not show a significant difference. There is a strong association between diabetes and non-survival ($p < 0.001$). Among non-survivors, 90.2% had diabetes, compared to 54.2% of survivors. This suggests that individuals with diabetes have a substantially higher risk of mortality than those without diabetes. This finding emphasizes the need for close monitoring and management of diabetic patients to improve survival rates. There is a significant link between alcohol use and non-survival ($p = 0.002$). Alcohol consumption was reported by 75.6% of non-survivors, compared to 45.8% of survivors.[6] The higher prevalence of alcohol use among non-survivors implies that it may negatively impact health outcomes, potentially by worsening existing conditions or increasing vulnerability to severe complications.

The declining serum albumin levels in non-survivors indicate a gradual deterioration in nutritional or physiological status, potentially reflecting disease severity and a poor prognosis. In contrast, survivors exhibit more stable albumin levels, suggesting better metabolic health and a greater likelihood of recovery.[7] As a recognized indicator of inflammation and nutritional condition, consistently low serum albumin levels in non-survivors may be linked to persistent systemic inflammation, fluid imbalance, or insufficient nutritional support. The smaller standard deviations in non-survivors indicate less variation in their albumin levels, possibly reflecting a consistently poor clinical course. The rising standard error over time in both groups, particularly on day 7, may suggest increased variability in patient outcomes or responses to treatment as the illness progresses.[8]

All non-survivors (100%, $n = 41$) required ventilator support, while none survived without it. In contrast, only 18.1% of survivors ($n = 15$) needed ventilation, while 81.9% ($n = 68$) did not. This suggests a strong association between ventilator dependence and mortality. Patients who required mechanical ventilation had a significantly higher likelihood of not surviving, indicating that the need for ventilator support may reflect greater illness severity and a poorer prognosis.[9,10,11] Conversely, the majority of survivors did not require ventilation, suggesting better respiratory function and overall clinical stability. The study few limitations like The sample size of the study was small and was conducted at a single centre, so generalizability of results will be difficult, Need more information about durations of hospital stay, Mechanical ventilator support, ionotropes support.

CONCLUSION

The analysis demonstrates a clear and consistent relationship between serum albumin levels and patient outcomes; including hospital stay duration, ventilator support, and survival status. Patients with normal serum albumin levels (3.5-5 g/dL) were more likely to have shorter hospital stays (<7 days), while those with low albumin levels (<3.5 g/dL) experienced longer hospital stays (>7 days). This suggests that low albumin levels reflect poor nutritional and physiological status, which may contribute to delayed recovery and prolonged

hospitalization. Furthermore, the mean serum albumin level decreased steadily over time, from 3.65 g/dL on Day 1 to 3.06 g/dL on Day 7, with non-survivors showing a more significant decline. This decline indicates that a persistent reduction in albumin levels may serve as a predictive marker for disease severity and higher mortality risk. Statistical tests ($p < 0.001$) confirm that lower albumin levels are significantly associated with longer hospital stays and poor outcomes.The findings highlight that monitoring serum albumin levels is crucial in assessing patient prognosis, as declining levels are associated with worsening clinical status, prolonged hospital stays, and increased likelihood of death. Maintaining adequate serum albumin levels may play a role in improving patient outcomes by supporting better physiological stability and reducing the need for intensive interventions.

REFERENCES

1. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. The ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. Chest. 1992 Jun;101(6): 1644–55.
2. Cheon S, Kwon H, Ryu JA. Evaluating the Prognostic Efficacy of Scoring Systems in Neurocritical and Neurosurgical Care: An Insight into APACHE II, SOFA, and GCS. J Neurointensive Care [Internet]. 2023 Oct 30 [cited 2025 Mar 26];6(2):123–9. Available from: http://e-jnic.org/journal/view.php?number=98&utm_source= chatgpt.com
3. Jin X, Li J, Sun L, Zhang J, Gao Y, Li R, et al. Prognostic Value of Serum Albumin Level in Critically Ill Patients: Observational Data From Large Intensive Care Unit Databases. Front Nutr [Internet]. 2022 Jun 13 [cited 2025 Mar 26];9. Available from:https://www.frontiersin.org/journals/nutrition/articles/10.3389/fnut.2022.770 674/full
4. Akirov A, Masri-Iraqi H, Atamna A, Shimon I. Low Albumin Levels Are Associated with Mortality Risk in Hospitalized Patients. Am J Med [Internet]. 2017 Dec 1 [cited 2025 Mar 26];130(12):1465.e11-1465.e19. Available from: https://www. amjmed.com/article/S0002-9343%2817%2930800-8/fulltext?utm_source=chatgpt.com.
5. Post Graduate, Department of General Medicine, Rajah Muthiah Medical College & Hospital, Annamalai University, Chidambaram, India – 608002, G DSaravanakumar. Estimation of Serial Serum Albumin Level as a Prognostic Marker in Sepsis Patients Admitted in Intensive Care Units. J Med Sci Clin Res [Internet]. 2020 Nov 25 [cited 2025 Mar 25];08(11). Available from: http://jmscr.igmpublication.org/v8-i11/91%20jmscr.pdf
6. Atrash AK, de Vasconcellos K. Low albumin levels are associated with mortality in the critically ill: A retrospective observational study in a multidisciplinary intensive care unit. South Afr J Crit Care [Internet]. 2020 Dec 1 [cited 2025 Mar 26];36(2):10.7196/SAJCC.2020.v36i2.422. Available from: https://www.ncbi.nlm. nih.gov/pmc/articles/PMC9045521/
7. Rudd KE, Kissoon N, Limmathurotsakul D, Bory S, Mutahunga B, Seymour CW, et al. The global burden of sepsis: barriers and potential solutions. Crit Care [Internet]. 2018 Sep 23 [cited 2025 Mar 25];22(1):232. Available from: https://doi.org/10.1186/s13054-018-2157-z.
8. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA [Internet]. 2016 Feb 23 [cited 2025 Mar 19];315(8):801–10. Available from: https://doi.org/10.1001/jama.2016.0287
9. Greenwood D, Slack RCB, Barer MR, Irving WL. Medical Microbiology E-Book: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. With STUDENT CONSULT Online Access. Elsevier Health Sciences; 2012. 795 p.
10. Shahsavarinia K, Moharramzadeh P, Arvanagi RJ, Mahmoodpoor A. qSOFA score for prediction of sepsis outcome in emergency department. Pak J Med Sci [Internet]. 2020 [cited 2025 Mar 20];36(4):668–72. Available from: https://www.ncbi. nlm.nih.gov/pmc/articles/PMC7260919/
11. Salomão R, Ferreira BL, Salomão MC, Santos SS, Azevedo LCP, Brunialti MKC. Sepsis: evolving concepts and challenges. Braz J Med Biol Res [Internet]. 2019 Apr 15 [cited 2025 Mar 20];52:e8595. Available from: https://www.scielo.br/j/bjmbr/a/ 8sBCYxdTk9cySHkNRtjjxVj/?utm_source=chatgpt.com.