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CORRELATION OF SERUM ALBUMIN, ABSOLUTE EOSINOPHIL COUNT, AND qSOFA SCORE IN ASSESSING MORBIDITY AND MORTALITY IN PATIENTS WITH SEPSIS: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Sepsis remains a leading cause of morbidity and mortality in intensive care units. Serum albumin, absolute eosinophil count (AEC), and the qSOFA score are simple, low-cost parameters proposed for risk stratification, but their comparative and serial prognostic value remains incompletely defined. The objective in to assess serum albumin, AEC, and qSOFA score in patients with sepsis, and to correlate these parameters with morbidity and mortality.

Materials and Methods: This prospective observational study enrolled 105 adults with sepsis (qSOFA ≥2) admitted to the medical intensive care unit over 18 months. Serum albumin, AEC, and qSOFA score were measured serially on Days 0, 3, 5, and 7. Patients were followed for mechanical ventilation, inotropic support, hospital stay, and in-hospital mortality. Chi-square test and Student's independent t-test were used, with $p<0.05$ considered significant.

Results: Of 105 patients, 53 (50.5%) required mechanical ventilation, 77 (73.3%) required inotropic support, and 44 (41.9%) died in hospital. Serum albumin declined progressively from 2.95 g/dL (Day 0) to 2.51 g/dL (Day 7), and was significantly lower among patients requiring mechanical ventilation and non-survivors by Day 5-7 ($p<0.05$). qSOFA score showed consistent, significant divergence from Day 3 onward between patients requiring mechanical ventilation or inotropic support and those who did not, and between survivors and non-survivors ($p<0.001$ by Day 5-7). Absolute eosinophil count did not differ significantly by any outcome at any time point ($p>0.05$).

Conclusion: Serial serum albumin and qSOFA score, rather than single admission values, correlate significantly with morbidity and mortality in sepsis, while absolute eosinophil count does not reliably predict outcome in this cohort. Serial qSOFA monitoring combined with serum albumin trend offers a practical, low-cost prognostic strategy in resource-limited critical care settings.

Keywords: Sepsis; serum albumin; absolute eosinophil count; qSOFA; mortality; intensive care.

INTRODUCTION

Sepsis is defined by a dysregulated host response to infection that results in life-threatening organ dysfunction, and remains a major contributor to mortality worldwide.[1] The World Health Organization estimates that sepsis affects around 49 million people annually and accounts for nearly 20% of all deaths globally; despite advances in antimicrobial therapy and critical care support, early diagnosis and risk stratification remain significant challenges because of its complex and heterogeneous clinical presentation.

Sepsis incidence varies with geography, healthcare infrastructure, and population demographics, with low- and middle-income countries reporting higher rates due to delayed diagnosis and limited healthcare access, while sepsis remains among the leading causes of ICU admission and hospital death even in high-income settings.[2] A wide range of pathogens can cause sepsis, and the clinical spectrum extends from fever and tachycardia to multiorgan failure; progression to septic shock, characterized by refractory hypotension requiring vasopressors to maintain mean arterial pressure ≥65 mmHg together with serum lactate >2 mmol/L despite adequate fluid resuscitation, carries a substantially higher risk of death.[3]

Among biomarkers investigated for sepsis, absolute eosinophil count (AEC) has drawn particular attention: eosinopenia, driven by stress-induced corticosteroid release during systemic infection, has been reported to correlate inversely with the quick Sequential Organ Failure Assessment (qSOFA) score, with AEC below 50 cells/cu.mm associated with a greater risk of death in septic patients, underlining its potential as a rapid, inexpensive prognostic indicator.[4]

Serum albumin, the major plasma protein responsible for oncotic pressure regulation and modulation of inflammation, is frequently reduced in sepsis, and hypoalbuminemia has been linked to poor clinical outcomes, including reduced survival, across a range of patient populations.[5] The qSOFA score, comprising altered mentation, systolic blood pressure, and respiratory rate, is a simple bedside tool for rapid identification of high-risk sepsis patients as part of the Sepsis-3 framework, though used alone its sensitivity may be limited, prompting interest in combining it with biomarkers such as serum albumin and AEC to improve risk stratification.[6]

Conventional approaches to assessing sepsis severity often rely on single measurements at admission, but sepsis is increasingly recognized as a dynamic, time-dependent process. This study was therefore conducted to identify predictors of morbidity and mortality among patients admitted to the medical intensive care unit for sepsis, focusing on serial rather than single-point assessment of serum albumin, AEC, and qSOFA score.

Aims and Objectives

1. To assess the levels of serum albumin, absolute eosinophil count, and qSOFA score in patients with sepsis.
2. To correlate serum albumin, absolute eosinophil count, and qSOFA score in predicting prognosis of patients with sepsis.

MATERIALS AND METHODS

Study design and setting: This prospective observational study was conducted in the Department of General Medicine, Medical Intensive Care Unit (MICU), PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh, over a period of 18 months (April 2024 to October 2025).

Study population and eligibility: All patients aged more than 18 years admitted to the emergency ward or medical intensive care unit with suspected or documented bacterial sepsis and a qSOFA score ≥2 were screened. Patients with alcoholic liver disease, malabsorption syndromes, protein-losing enteropathy, chronic malnutrition, chronic liver disease, nephrotic syndrome, parasitic infections, asthma, atopic dermatitis, advanced malignancy, long-term steroid therapy, or AIDS were excluded, as these conditions independently affect serum albumin or eosinophil count.

Sample size and sampling: The sample size of 105 was calculated based on a previous study evaluating absolute eosinophil count as a diagnostic and prognostic marker for sepsis in relation to SOFA and qSOFA scores.4 A purposive sampling technique was used, with eligible patients consecutively screened and enrolled after written informed consent until the target sample size was reached.

Study procedure: After Institutional Human Ethics Committee approval, eligible patients were screened and enrolled, with bacterial sepsis confirmed by microbiological testing where applicable. Baseline demographic, clinical, and laboratory details were recorded at admission. Severity was assessed using the qSOFA score (altered mental status, systolic blood pressure ≤100 mmHg, respiratory rate ≥22/min) on Day 0, and repeated on Days 3, 5, and 7. Serum albumin and absolute eosinophil count were measured on the same four occasions. Patients were followed throughout hospitalization until discharge, death, discharge against medical advice, or referral to a higher centre.

Data collection: Data were recorded using a structured proforma capturing sociodemographic details, comorbidities, vital signs, and comprehensive laboratory investigations including complete blood picture, liver and renal function tests, electrolytes, C-reactive protein, procalcitonin, arterial blood gas analysis, prothrombin time, and microbiological cultures. Outcome variables recorded included duration of hospital stay,

requirement for mechanical ventilation and inotropic support, and in-hospital mortality.

Statistical analysis: Data were entered in Microsoft Excel and analysed using STATA version 14. Continuous variables were expressed as mean ± standard deviation and compared using Student's independent t-test; categorical variables were expressed as frequencies and percentages and compared using the chi-square test. Correlation analysis was performed to evaluate the relationship of serum albumin, AEC, and qSOFA score with morbidity and mortality. A two-sided p value <0.05 was considered statistically significant.

RESULTS

A total of 105 patients admitted with sepsis were enrolled and followed through their hospital course. The baseline demographic, clinical, and comorbidity profile of the cohort is summarized in [Table 1]. The 45-64 year age group was the largest (40.00%), followed by patients aged ≥65 years (37.14%); males predominated overall (64.76%). Diabetes mellitus (38.10%) and hypertension (31.43%) were the most common comorbidities. Mean pulse rate was 108.15 ± 22.36 bpm and mean respiratory rate 26.12 ± 7.95 cpm, consistent with a systemically unwell cohort. Pneumonia was the leading primary diagnosis (44.76%), followed by urinary tract infection (14.29%) and acute gastroenteritis (11.43%), with a long tail of less common sources of infection.

Baseline laboratory parameters across haematological, renal, hepatic, electrolyte, inflammatory, and arterial blood gas domains are summarized in [Table 2]. The cohort showed evidence of systemic inflammation and organ stress at presentation, with an elevated mean total leukocyte count (14.98 ± 9.18 ×10³/µL), markedly elevated inflammatory markers (CRP 171.58 ± 147.02 mg/L; procalcitonin 36.95 ± 51.67 ng/mL), impaired renal function (urea 70.13 ± 49.73 mg/dL; creatinine 2.07 ± 1.41 mg/dL), low serum albumin (2.25 ± 2.01 g/dL), and evidence of metabolic derangement on arterial blood gas analysis (mean pH 7.29 ± 0.15; lactate 35.44 ± 29.53 mmol/L).

Table 1: Baseline demographic, clinical and comorbidity profile (N=105)

Parameter	Frequency (n)	Percentage (%)
Age category (years)		
18–29	3	2.86
30–44	21	20.00
45–64	42	40.00
≥65	39	37.14
Gender		
Female	37	35.24
Male	68	64.76
Comorbidities		
Diabetes mellitus	40	38.10
Hypertension	33	31.43
Ischemic heart disease	12	11.43
Cerebrovascular accident	4	3.81
Vital signs (Mean ± SD)		
Pulse rate (bpm)	108.15 ± 22.36	
Systolic BP (mmHg)	114.71 ± 72.64	
Diastolic BP (mmHg)	67.39 ± 15.04	
Respiratory rate (cpm)	26.12 ± 7.95	
Temperature (°F)	98.74 ± 1.34	
Primary diagnosis		
Pneumonia	47	44.76
Urinary tract infection	15	14.29
Acute gastroenteritis	12	11.43
Cellulitis	9	8.57
Intra-abdominal sepsis	3	2.86
Scrub typhus	3	2.86
Viral fever	3	2.86
Urosepsis	2	1.90
Other (acute pancreatitis, cerebral malaria, cholecystitis, diabetic foot, liver abscess, meningoencephalitis, necrotising fasciitis, otitis externa, perianal abscess, pyrexia of unknown origin — 1 each)	10	9.52

Table 2: Baseline laboratory parameters (Mean ± SD)

Parameter	Mean	SD
Complete blood count		
Total leukocyte count (×10³/µL)	14.98	9.18
Absolute eosinophil count (×10³/µL)	0.29	0.29
Hemoglobin (g/dL)	11.88	2.84
Platelet count (/µL)	209009.50	98144.96
Renal parameters		
Urea (mg/dL)	70.13	49.73
Creatinine (mg/dL)	2.07	1.41

Liver function parameters		
Total bilirubin (mg/dL)	1.91	2.52
Conjugated bilirubin (mg/dL)	0.60	1.72
Unconjugated bilirubin (mg/dL)	1.53	0.43
Serum albumin (g/dL)	2.25	2.01
Electrolytes		
Sodium (mEq/L)	132.30	6.90
Potassium (mEq/L)	5.33	10.07
Chloride (mEq/L)	109.07	104.05
Inflammatory / coagulation markers		
C-reactive protein (mg/L)	171.58	147.02
Procalcitonin (ng/mL)	36.95	51.67
Prothrombin time (sec)	25.32	53.64
Arterial blood gas parameters		
pH	7.29	0.15
PCO2 (mmHg)	32.60	16.06
PO2 (mmHg)	96.77	57.15
HCO3 (mEq/L)	16.42	7.74
Lactate (mmol/L)	35.44	29.53

The serial trend of serum albumin, AEC, and qSOFA score, together with key clinical course indicators, is presented in [Table 3]. Mean serum albumin declined progressively from 2.95 g/dL on Day 0 to 2.51 g/dL by Day 7, whereas AEC fluctuated narrowly around 0.27–0.32 ×10³/µL across all four time points without a consistent directional trend. Mean qSOFA score rose from 1.50 on Day 0 to a peak of 1.81 on Day 3 before declining to 1.26 by Day 7, reflecting a mixed cohort trajectory as some patients improved and others deteriorated. Over the course of hospitalization, 53 patients (50.48%) required mechanical ventilation, 77 (73.33%) required inotropic support, 79 (75.24%) had a hospital stay exceeding 7 days, and 44 (41.90%) died in hospital.

Table 3: Serial trend of serum albumin, absolute eosinophil count and qSOFA score, and clinical course

Parameter	**Day 0**	**Day 3**	**Day 5**	**Day 7**
Serial serum albumin (g/dL), Mean (SD)				
Mean (SD)	2.95 (0.77)	2.58 (0.62)	2.55 (0.59)	2.51 (0.63)
Serial absolute eosinophil count (×10³/µL), Mean (SD)				
Mean (SD)	0.28 (0.29)	0.31 (0.34)	0.27 (0.27)	0.32 (0.41)
Serial qSOFA score, Mean (SD)				
Mean (SD)	1.50 (0.92)	1.81 (0.82)	1.63 (1.00)	1.26 (1.28)

Clinical course parameter	Frequency (n)	Percentage (%)
Mechanical ventilation required	53	50.48
Inotropic support required	77	73.33
Hospital stay > 7 days	79	75.24
In-hospital mortality	44	41.90

The association of serum albumin, AEC, and qSOFA score with mechanical ventilation, inotropic support, mortality, and duration of hospital stay across Day 0, 3, 5, and 7 is detailed in [Table 4]. Serum albumin did not differ significantly between outcome groups at Day 0 for any comparison, but became significantly lower among patients requiring mechanical ventilation by Day 7 (2.38 vs 2.64 g/dL, p=0.04) and among non-survivors from Day 5 onward (Day 5: 2.39 vs 2.66 g/dL, p=0.02; Day 7: 2.26 vs 2.68 g/dL, p<0.001), while albumin did not differ significantly by inotropic support or duration of stay at any time point. AEC showed no statistically significant association with any outcome at any time point (all p>0.05). In contrast, qSOFA score diverged sharply and consistently from Day 3 onward: patients requiring mechanical ventilation or inotropic support, and non-survivors, all had significantly higher qSOFA scores than their comparators from Day 3 through Day 7 (p<0.001 by Day 5 and Day 7 for all three comparisons), while qSOFA also differed significantly by duration of stay on Day 5 and Day 7 (p=0.03 and p=0.02 respectively).

Table 4: Association of serum albumin, absolute eosinophil count (AEC), and qSOFA score with clinical outcomes across Day 0, 3, 5 and 7

Marker	**Day 0**	**Day 3**	**Day 5**	**Day 7**
Mechanical ventilation (No vs Yes)				
Serum albumin (g/dL)	2.86 vs 3.04 p=0.22	2.64 vs 2.53 p=0.39	2.62 vs 2.48 p=0.23	2.64 vs 2.38 p=0.04
AEC (×10³/µL)	0.32 vs 0.25 p=0.23	0.31 vs 0.32 p=0.87	0.28 vs 0.27 p=0.74	0.30 vs 0.33 p=0.71
qSOFA score	1.40 vs 1.58 p=0.32	1.50 vs 2.11 p<0.001	0.98 vs 2.26 p<0.001	0.48 vs 2.02 p<0.001
Inotropic support (No vs Yes)				
Serum albumin (g/dL)	2.84 vs 2.99 p=0.39	2.58 vs 2.58 p=1.00	2.54 vs 2.55 p=0.98	2.62 vs 2.46 p=0.26
AEC (×10³/µL)	0.35 vs 0.26 p=0.13	0.29 vs 0.32 p=0.74	0.26 vs 0.28 p=0.78	0.29 vs 0.33 p=0.70
qSOFA score	1.46 vs 1.51 p=0.84	1.54 vs 1.91 p=0.04	0.89 vs 1.90 p<0.001	0.39 vs 1.57 p<0.001
Mortality (Survived vs Died)				

Serum albumin (g/dL)	2.95 vs 2.95 p=0.99	2.67 vs 2.47 p=0.10	2.66 vs 2.39 p=0.02	2.68 vs 2.26 p<0.001
AEC (×10³/µL)	0.31 vs 0.25 p=0.24	0.31 vs 0.32 p=0.92	0.27 vs 0.28 p=0.74	0.29 vs 0.36 p=0.39
qSOFA score	1.43 vs 1.59 p=0.37	1.66 vs 2.02 p=0.02	1.10 vs 2.36 p<0.001	0.57 vs 2.20 p<0.001
Duration of hospital stay (≤7 days vs >7 days)				
Serum albumin (g/dL)	2.77 vs 3.01 p=0.16	2.57 vs 2.59 p=0.89	2.47 vs 2.57 p=0.46	2.45 vs 2.52 p=0.63
AEC (×10³/µL)	0.28 vs 0.28 p=0.98	0.25 vs 0.33 p=0.29	0.29 vs 0.27 p=0.77	0.27 vs 0.34 p=0.45
qSOFA score	1.38 vs 1.53 p=0.48	1.85 vs 1.80 p=0.79	2.00 vs 1.51 p=0.03	1.77 vs 1.09 p=0.02

Values shown as Group A vs Group B mean, with p value from independent-samples t-test at each time point.

DISCUSSION

This prospective study of 105 patients with sepsis demonstrates that dynamic, serial changes in serum albumin and qSOFA score-rather than single admission values-provide meaningful prognostic information regarding mechanical ventilation requirement, inotropic support, and mortality, whereas absolute eosinophil count did not reliably discriminate outcome in this cohort. This pattern is consistent with the evolving view of sepsis as a time-dependent, heterogeneous syndrome of progressive immune dysregulation and organ dysfunction.[1]

The predominance of elderly and middle-aged patients in our cohort is consistent with previous reports highlighting increased sepsis susceptibility with advancing age due to immunosenescence, reduced physiological reserve, and altered inflammatory responses; Fleischmann et al. similarly demonstrated that elderly populations account for a substantial proportion of ICU-treated sepsis cases globally.[7] The prevalence of diabetes mellitus, hypertension, and ischemic heart disease observed here further supports the established association between chronic comorbidity and compromised host defence, a relationship also emphasized by Martin et al., who reported that underlying chronic disease significantly contributes to adverse sepsis outcomes.[8]

Approximately half of our cohort required mechanical ventilation, reflecting the severity of sepsis-associated respiratory dysfunction; this is consistent with Keegan and Wira's observation that progression to severe respiratory compromise frequently necessitates ventilatory support in the emergency and critical care setting.[9]

Serial monitoring revealed a progressive decline in serum albumin, with significantly lower levels among patients who required mechanical ventilation and among non-survivors emerging only at later time points (Day 5-7) rather than at admission. This is in keeping with Ali et al., who reported a significant correlation between reduced serum albumin and sepsis severity among ICU patients,[5] and with Arnau-Barrés et al., who found serum albumin to be a strong predictor of outcome specifically in serial or later assessments among elderly septic patients.[10] The findings support the interpretation that albumin depletion, reflecting capillary leakage and ongoing systemic inflammation, becomes a more informative marker as illness evolves rather than at the point of admission.

The association between lower serum albumin and mortality observed here, most evident from Day 5 onward, parallels Yin et al.'s finding that reduced serum albumin independently predicts mortality risk in severe sepsis,[11] and Kumar et al.'s report that lower admission albumin is associated with subsequent progression to severe sepsis and septic shock.[12] Taken together, these findings reinforce serum albumin as a simple, inexpensive, and serially informative biomarker for risk stratification in resource-limited critical care settings.

In contrast, absolute eosinophil count did not differ significantly between outcome groups at any time point in our cohort, a finding that contrasts with reports linking eosinopenia to higher SOFA scores4 and to adverse outcomes in critically ill patients more broadly.[13] This discrepancy may reflect differences in study population, sample size, timing of blood sampling relative to physiological and circadian variation, and the specific outcome definitions used across studies, and highlights the need for further work to clarify the role of eosinophil dynamics as an independent prognostic marker in sepsis.

The qSOFA score, developed as a simplified bedside tool for early identification of patients at risk of poor outcomes as part of the Sepsis-3 framework,[6] showed the most consistent and robust prognostic performance of the three parameters studied. Our findings that qSOFA differed significantly between outcome groups from Day 3 onward align with Sterling et al.'s work on the prognostic implications of Sepsis-3-defined septic shock criteria,[14] and support the continued use of qSOFA as a practical tool where advanced scoring systems are not readily available.

The progressively widening divergence in qSOFA scores among patients requiring mechanical ventilation or inotropic support is consistent with the concept that sepsis progression is dynamic and requires continuous reassessment for timely intervention, as emphasized by Font et al. in their review of septic shock pathophysiology and clinical decision-making.[15] Similarly, the significantly higher qSOFA scores among non-survivors from Day 3 onward mirror Diwan et al.'s findings that higher clinical severity scores are associated with increased mortality risk among ICU patients with sepsis.[16]

The absence of a significant association between serum albumin and inotropic support requirement in our study may reflect the complex interplay between nutritional status, hepatic synthetic capacity, capillary permeability, and fluid resuscitation

strategy, as suggested by Tsao et al. in their analysis of albumin and phospholipase A2 in sepsis.[17] This contrasts with other reports, such as Nugroho et al., who found reduced albumin to be associated with increased 28-day mortality and illness severity in septic shock,[18] underscoring the variability in albumin's performance across different sepsis phenotypes and the need for standardized measurement protocols.

Overall, our findings support a clinical strategy of serial, rather than single-point, assessment of serum albumin and qSOFA score to guide early identification of high-risk septic patients, particularly in resource-limited settings where advanced biomarkers or continuous monitoring technology may not be readily available. Incorporating routine serial measurement of these low-cost, widely available parameters into ICU protocols may aid timely escalation of care and improve outcomes in critically ill patients with sepsis.

Strengths and Limitations

- The study was conducted at a single tertiary care centre, which may limit the generalizability of the findings to other settings.
- The sample size, while adequate for the primary comparisons, was moderate and may have limited statistical power to detect smaller associations, particularly for absolute eosinophil count.
- Potential confounding factors related to comorbidities, baseline nutritional status, and variations in treatment protocols (including fluid resuscitation and antibiotic timing) were not fully controlled for in the analysis.
- Serum albumin and eosinophil count can be influenced by factors such as hepatic synthetic function, corticosteroid use, and circadian variation, which were not independently adjusted for in this study.

CONCLUSION

This study demonstrates that dynamic, serial changes in serum albumin and qSOFA score, rather than isolated admission values, correlate significantly with morbidity and mortality among critically ill patients with sepsis. Serum albumin became a significant discriminator of mechanical ventilation requirement and mortality from Day 5 onward, while qSOFA score showed consistent and robust divergence between outcome groups from Day 3 onward, reinforcing its utility as a practical bedside prognostic tool. Absolute eosinophil count, in contrast, did not demonstrate significant association with any outcome at any time point, suggesting limited value as an independent severity marker in this cohort. These findings support the incorporation of serial serum albumin and qSOFA monitoring into routine ICU protocols for sepsis, offering a low-cost, readily available strategy for early risk stratification, particularly in resource-limited critical care settings.

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