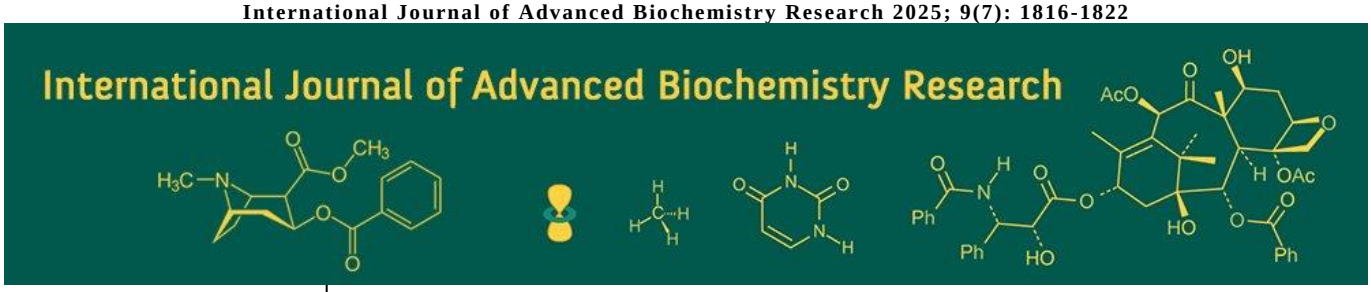

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; 9(7): 1816-1822
www.biochemjournal.com
Received: 02-05-2025
Accepted: 06-06-2025

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Precision prognosis in sepsis: Role of serum lactate-to-albumin ratio as a biochemical marker

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7w.5054

Abstract
Aim: To evaluate the prognostic utility of the Lactate/Albumin (L/A) ratio in predicting mortality among sepsis patients and to assess its applicability in an Indian tertiary care setting.
Methods: This prospective observational research was performed in the ICU of Krishna Hospital, Karad, spanning 18 months (March 2023-September 2024), enrolling 100 adult patients with sepsis according to Sepsis-3 criteria. Inclusion necessitated ICU admission within 24 hours of sepsis start, along with serum lactate and albumin levels assessed within 6 hours. Individuals with chronic liver or renal illness, cancer, pregnancy, trauma, surgery-related sepsis, or a history of albumin treatment were excluded. The L/A ratio was evaluated at admission, and patients were monitored until release or demise.
Results: The findings indicated that among 100 sepsis patients, the majority were over 40 years of age, with widespread comorbidities including hypertension (34%) and diabetes (28%). Respiratory infections constituted the primary source at 33%. Laboratory results revealed anemia, borderline thrombocytopenia, and increased creatinine levels. Patients with SOFA scores of 10 or above demonstrated a significant death rate of 84.6%. A significant association was identified between the SOFA score and the lactate-to-albumin (L/A) ratio ($r = 0.76$, $p<0.0001$). ROC analysis demonstrated that the L/A ratio exhibited greater predictive accuracy (AUC = 0.70) than lactate, albumin, or the SOFA score individually.
Conclusion: In conclusion, the lactate-to-albumin ratio shows promise as a rapid prognostic tool for sepsis mortality prediction. Future multicenter studies with larger cohorts and serial monitoring are needed to validate its clinical utility. Integration into dynamic risk models may enhance early decision-making in sepsis management.

Keywords: Albumin, biochemical marker, lactate, prognostic utility, serum lactate-to-albumin ratio

1. Introduction

Sepsis has become a critical condition that occurs when the body's response to an infection becomes dysregulated, resulting in organ dysfunction [1]. It could come from any infectious source and can rapidly progress to septic shock, potentially resulting in multiple organ failure and death if not promptly addressed [2]. Sepsis could affect individuals across all age groups; however, infants, young children, the elderly, and those with weakened immune systems are most susceptible [3]. The World Health Organization (WHO) indicates around 49 million sepsis cases and 11 million fatalities per year. This accounts for more than 20% of worldwide deaths [4]. Low-and middle-income countries (LMICs) disproportionately experience almost 85% of these deaths. Each year, about 2.9 million children under five perish to death, highlighting the imperative for enhanced diagnostic and treatment approaches for this condition [5].

Despite the progress of significant care and antimicrobial treatments, the prognosis for sepsis is problematic. Early symptoms are often nonspecific, which prevents early diagnosis and action [6]. Prognostic scoring methods such as sofa and qsofa are widely used, although variables show sensitivity and uniqueness. In addition, the absence of reliable and generally applied biomarks inhibits the initial risk classification. In the resource absorption environment, such difficulties in infrastructure insufficiency, delay in treatment and antibiotic resistance are increased [7].

These obstacles highlight the requirement required for effective, available immunity tools to increase sepsis results, especially in lower and medium or countries (LMICS) [8].

Biomarkers such as C-reactive protein (CRP) and Procalcitonin (ProCT) are commonly utilized for assistance in the clinical diagnosis of sepsis. While CRP functions as a general biomarker for inflammation, it lacks specificity and could rise in several non-infectious conditions [9]. Procalcitonin (ProCT) offers improved specificity for bacterial infections and has been employed to guide antibiotic treatment [10]. Both indications possess limitations—CRP levels rise late and stay consistently raised, whereas ProCT may remain low in early-stage sepsis or increase in non-infectious circumstances [11]. Furthermore, individual heterogeneity and the lack of clear cut-off criteria reduce their predictive value, limiting their efficacy as independent indicators [12].

Serum lactate is widely recognized as a surrogate marker of tissue hypoperfusion. In sepsis, compromised circulatory function leads to anaerobic metabolism and elevated lactate levels. Lactate concentrations >2 mmol/L, especially when associated with hypotension, are indicative of septic shock and correlate strongly with mortality risk [13]. Albumin, a key negative acute-phase reactant, typically decreases in systemic inflammation due to reduced synthesis and increased capillary leakage [14]. Hypoalbuminemia in sepsis is associated with poor outcomes, though its non-specificity limits its standalone prognostic value [15].

The Lactate/Albumin (L/A) ratio has emerged as a promising composite biomarker that combines indicators of tissue hypoxia and systemic inflammation. This ratio provides a more integrative assessment of disease severity compared to lactate or albumin alone [16]. Elevated L/A ratios have been linked to increased risks of organ failure, septic shock, and mortality, and may help identify high-risk patients requiring early, aggressive intervention [17]. It should be utilized to augment, rather than substitute for clinical judgment and other diagnostic instruments [18].

Recent research from high-income countries has demonstrated that the L/A ratio possesses a prognostic advantage over lactate or albumin individually. Shadvar *et al*. (2019) demonstrated that an L/A ratio beyond 0.15 correlates significantly with 28-day mortality [19], whereas Zhu *et al*. (2022) highlighted its superior risk classification capability [20]. Although these encouraging results, the majority of data originates from well-funded hospital settings, with less validation in low-and middle-income countries (LMICs) such as India, where factors including malnutrition and inadequate access to intensive care units may affect biomarker reliability [21]. Consequently, localized investigations are necessary to assess the prognostic utility of the L/A ratio and determine region-specific cut-off levels [22]. This study intends to evaluate the effectiveness of the Lactate/Albumin (L/A) ratio as a predictor of death in patients with sepsis. It proposes to examine the marker's relevance and predictive value inside the Indian healthcare system, hence offering region-specific insights to enhance its broader clinical utility in LMICs.

2. Materials and Methods

2.1 Study Design

This study was a prospective, hospital-based observational analysis performed over an 18-month period (March 2023 to September 2024) in the Intensive Care Unit (ICU) of Krishna Hospital, Karad, a tertiary care center equipped to manage critically ill patients. The purpose of this study sought to evaluate the predictive significance of the Lactate/Albumin (L/A) ratio in forecasting in-hospital mortality in patients with sepsis. The study sought to assess whether the L/A ratio provided enhanced risk classification relative to individual biomarkers, including blood lactate and serum albumin.

2.2 Study Participants

The study included 100 adult patients diagnosed with sepsis and admitted to the ICU of Krishna Hospital, Karad. A purposive sampling strategy was used, and participants were selected based on eligibility criteria. Inclusion criteria were age ≥18 years, diagnosis of sepsis as per Sepsis-3 criteria, ICU admission within 24 hours of onset, and availability of lactate and albumin values within 6 hours. Patients were enrolled after obtaining informed consent. Exclusion criteria included chronic liver disease, end-stage renal disease on hemodialysis, prior albumin therapy, malnutrition, immunocompromised status, malignancy, pregnancy, trauma, post-surgical sepsis, or refusal to participate.

2.3 Data Collection and Laboratory Analysis

Upon ICU admission, demographic data, comorbidities, and baseline clinical characteristics were recorded. Blood samples were collected at 0 hours for complete blood count, serum lactate, serum albumin, urea, and creatinine. The L/A ratio was calculated from the measured values, with reference ranges of 0.7-2.1 mmol/L for lactate and 3.5-5.0 g/dL for albumin. Clinical evaluation also included detailed history-taking and physical examination to establish baseline health status.

2.4 Organ Dysfunction Assessment

The severity of organ dysfunction was assessed using the Sequential Organ Failure Assessment (SOFA) score, which evaluates six physiological systems: respiratory (PaO_2/FiO_2), coagulation (platelet count), liver function (bilirubin), cardiovascular function (mean arterial pressure or vasopressor use), central nervous system (Glasgow Coma Scale), and renal function (creatinine or urine output). Each organ system was scored from 0 to 4, and a cumulative SOFA score was computed.

2.5 Outcome Measures

Patients were observed during their hospital admission, and metrics including ICU stay length, overall hospital time, and in-hospital mortality were documented for statistical evaluation. The L/A ratio were subsequently evaluated concerning these outcomes to ascertain its predictive relevance in the clinical course of sepsis.

2.6 Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were summarized as Mean ± SD or median (IQR) and compared using Student's t-test or Mann-Whitney U test. Categorical data were expressed as frequencies (%) and analyzed using Chi-square or Fisher's exact test. ROC curve analysis was used to assess the predictive accuracy of the L/A ratio, lactate, and albumin for mortality, with AUC and optimal cut-offs determined via Youden's Index. A p-value<0.05 was considered statistically significant.

3. Results

3.1 Demographic characteristics

This study evaluating the demographic and clinical characteristics of sepsis patients revealed significant patterns indicative of illness severity and associated risk factors. Among the 100 patients, the majority were over 40 years of age (61%), with slightly male predominance (56%). Hypertension (34%) and diabetes (28%) were the predominant comorbidities, signifying increased susceptibility. Respiratory infections were the predominant cause (33%), whereas changed mental state (33%) emerged as the most prevalent presenting symptom. ICU admission required hospitalization in 61% of instances, and 41% had extended hospitalizations, underscoring the significant clinical and resource burden linked to sepsis.

Table 1: Demographic Characteristics of Study Participants

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	20-30	17	17.0
	31-40	22	22.0
	41-50	30	30.0
	>50	31	31.0
Gender	Male	56	56.0
	Female	44	44.0
Comorbidities	Diabetes Mellitus	28	28.0
	Hypertension	34	34.0
	Chronic Kidney Disease	19	19.0
	Chronic Liver Disease	11	11.0
	None	27	27.0
Source of Infection	Respiratory	33	33.0
	Urinary Tract	22	22.0
	Abdominal (GIT)	18	18.0
	Skin/Soft tissue	9	9.0
	Unknown	18	18.0
Presenting Symptoms	Fever	15	15.0
	Oliguria	16	16.0
	Cold clammy skin	24	24.0
	Altered mental status	33	33.0
	Nausea/Vomiting	21	21.0
ICU Admission Required	Yes	61	61.0
	No	39	39.0
Length of stay	≤ 14 days	59	59.00
	> 14 days	41	41.00

3.2 Hematological and Biochemical Profile of Sepsis Patients

In sepsis, laboratory examinations are essential for evaluating physiological and organ functionality. A mean hemoglobin level of 10.2 g/dL signifies mild to severe anemia, presumably resulting from inflammation or prolonged blood loss. A platelet counts of around 158,000 cells/mm³ indicates borderline thrombocytopenia, which raises concerns regarding coagulopathy. Increased mean creatinine (1.9 mg/dL) indicates compromised renal function and initial organ failure. These results highlight the pervasive effects of sepsis and the necessity for rigorous biochemical surveillance.

Table 2: Distribution of Laboratory Parameters Among Patients with Sepsis

Laboratory Parameter	Mean±Standard Deviation (SD)
Hemoglobin (g/dL)	10.2±2.1
Platelet Count (cells/mm³)	158,000±72,000
Serum Creatinine (mg/dL)	1.9±1.1

3.3 Clinical Symptoms among Participants

The clinical characteristics of ICU patients with sepsis demonstrated an elevated mean body temperature (38.56 ±1.23 °C), tachycardia (heart rate: 108.45 ±18.77 bpm), increased respiratory rate (22.09±4.16 breaths/min), and hypotension (systolic BP: 90.34±12.35 mmHg), in addition to mild to moderate neurological impairment (mean mental status score: 13±2). These findings align with the systemic inflammatory response and hemodynamic instability typical of sepsis, signifying considerable physiological stress and initial indications of organ malfunction in the afflicted population.

Table 3: Distribution of Clinical Signs Among ICU Patients Diagnosed with Sepsis

Clinical Sign	Mean ± SD
Temperature (°C)	38.56±1.23
Heart Rate (beats per minute)	108.45±18.77
Respiratory Rate (breaths/min)	22.09±4.16
Systolic Blood Pressure (mmHg)	90.34±12.35
Altered Mental Status (Score)	13±2

3.4 Laboratory Distribution of Patients Based on Serum Lactate and Albumin Levels

Table 4 displays statistically significant differences in serum lactate and albumin levels across the examined groups. Patients with lactate levels beyond 2.1 mmol/L demonstrated a markedly elevated mean lactate concentration (2.20 ±0.31 mmol/L) in contrast to those with levels ≤2.1 mmol/L (1.95 ±0.15 mmol/L; t=14.30, $p<0.0001$), indicating increased metabolic disturbance and possible tissue hypoperfusion. Individuals with hypoalbuminemia (<3.5 g/dL) exhibited a markedly reduced mean albumin level (3.01 ±0.23 g/dL) compared to those with norm albuminemia (≥3.5 g/dL: 3.80 ±0.17 g/dL; t=15.86, p<0.0001), suggesting potential malnutrition, hepatic impairment, or a systemic inflammatory response. These findings emphasize the prognostic significance of erroneous lactate and albumin levels, illustrating their correlation with detrimental physiological abnormalities in critically sick patients.

Table 4: Distribution of Patients According to Lactate and Albumin Levels

Parameter	Group	Mean ± SD	t-stat	p-value
Lactate	≤ 2.1 mmol/L	1.95±0.15	14.30	<0.0001
	> 2.1 mmol/L	2.20±0.31		
Albumin	<3.5 g/dL	3.01±0.23	15.86	<0.0001
	≥ 3.5 g/dL	3.80±0.17		

3.5 Assessment of Organ Dysfunction Using the SOFA Score

The Sequential Organ Failure Assessment (SOFA) score is an essential clinical instrument for quantifying organ failure and predicting prognosis in patients with sepsis. Table 5 demonstrates that sepsis patients with elevated SOFA scores have an increased likelihood of mortality. Patients with SOFA scores of 10 or above had a mortality rate of 84.6%, far exceeding the 26.8% mortality rate observed in patients with scores ranging from 7 to 9, and the 15.2% mortality rate in those with scores between 0 and 6. The observed pattern indicates that the mortality risk increases when the SOFA score reflects declining organ function. These findings corroborate the application of the SOFA score for

forecasting in-hospital outcomes and assessing the severity of sepsis. The average mortality risk significantly increases with a SOFA score in addition to 9.

Table 5: Distribution of SOFA Scores and Associated Mortality in Sepsis Patients

SOFA Score Range	No. of Patients	Survivors (n)	Non-survivors (n)	Mortality Rate (%)
0-6	33	28	5	15.2%
7-9	41	30	11	26.8%
≥10	26	4	22	84.6%

3.6 Correlation Analysis of SOFA Score with Lactate-to-Albumin Ratio

The correlation study revealed a significant positive association between the SOFA (Sequential Organ Failure Assessment) score and the serum lactate-to-albumin (L/A) ratio (r = 0.76, p<0.0001), indicating that higher L/A ratios are closely linked to increased severity of organ failure. This study underscores the L/A ratio's potential as a reliable prognostic biomarker in severely sick septic patients, signifying systemic hypoperfusion and hypoalbuminemia, which are significant factors in multiorgan failure.

Table 6: Correlation Analysis of SOFA Score with Serum Lactate-to-Albumin Ratio

Variable	Correlation Coefficient (r)	p-value
SOFA Score	0.76	<0.0001

3.7 Assessment of lactate, albumin, lactate/albumin and SOFA score ratio in forecasting 28-day outcome in sepsis patients.

The ROC curve evaluating the predictive capacity of serum lactate for 28-day outcomes in sepsis patients demonstrates inadequate effectiveness, since the curve closely aligns with the reference line. The area under the ROC curve (AUC) for lactate is around 0.62, signifying minimal discriminative capacity. An AUC of 0.5 signifies inadequate discrimination, whereas values approaching 1.0 reflect strong predictive capability of the model. An AUC of 0.62 indicates that lactate possesses a moderate, however superior-to-chance, ability to predict 28-day mortality in patients with sepsis. This highlights the significance of utilizing integrated markers such as the lactate/albumin ratio or the SOFA score to better determine an individual's mortality risk

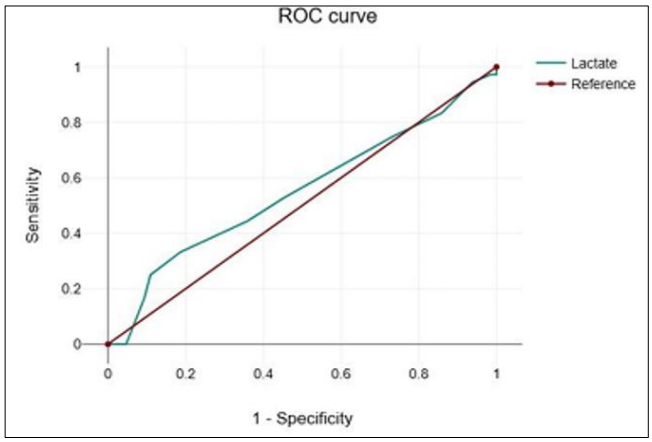

Fig 1 (a): ROC curve for predicting 28-day mortality in sepsis patients based on lactate.

The ROC curve for serum albumin in predicting 28-day outcomes in sepsis patients showed slight deviation from the reference line, indicating limited discriminative capacity. The determined area under the curve (AUC) measures approximately 0.58, signifying insufficient predictive power. An AUC of 0.5 signifies insufficient diagnostic usefulness, whereas an AUC of 0.7 or above is deemed adequate. An AUC of 0.58 indicates that albumin alone is insufficiently accurate for predicting short-term mortality in sepsis and should be interpreted with caution or utilized alongside additional indicators such as lactate, lactate/albumin ratio, or SOFA score to enhance prognostic efficacy.

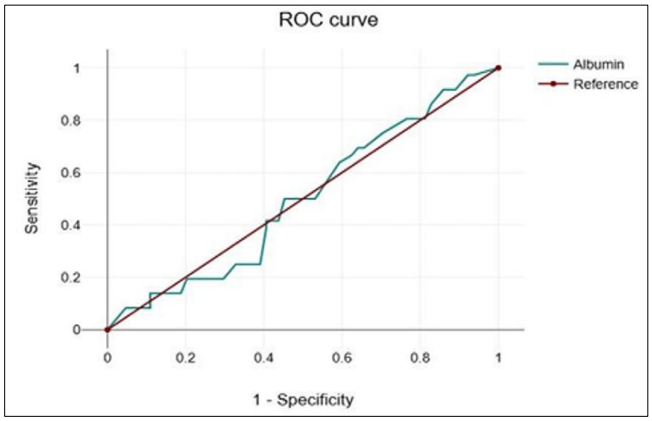

Fig 1 (b): ROC curve for predicting 28-day mortality in sepsis patients based on Albumin

The ROC (Receiver Operating Characteristic) curve illustrated in the image assesses the diagnostic efficacy of the lactate-to-albumin (L/A) ratio in forecasting 28-day death in sepsis patients. The graph illustrates sensitivity (true positive rate) relative to 1-specificity (false positive rate). The L/A ratio curve (in blue) is situated above the reference line (red diagonal), signifying improved discrimination compared to random chance. The nearer the curve approaches the left and higher boundaries of the ROC space, the greater the accuracy of the test. The graph does not specify the precise area under the curve (AUC), although its form indicates considerable diagnostic use of the L/A ratio, potentially with an AUC approaching 0.70. This indicates that the L/A ratio has sufficient accuracy in predicting negative outcomes in sepsis, with acceptable trade-offs in sensitivity and specificity.

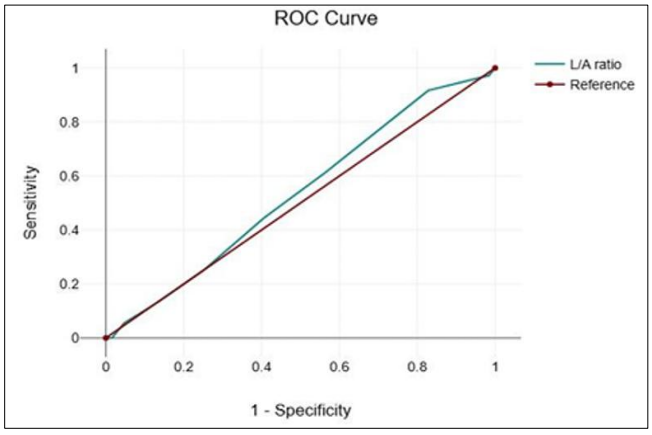

Fig 1 (c): ROC curve for predicting 28-day mortality in sepsis patients based on L/A ratio.

The shown ROC (Receiver Operating Characteristic) curve illustrates the diagnostic effectiveness of the SOFA (Sequential Organ Failure Assessment) score in predicting 28-day mortality in patients with sepsis. The curve depicts sensitivity vs 1-specificity, with the blue line representing the SOFA score and the red diagonal signifying the reference line (random chance). The SOFA score curve is somewhat over the reference line, indicating limited discriminative ability. The proximity of the SOFA curve to the reference line signifies inadequate predictive capability, generally correlated with an Area Under the Curve (AUC) value of about 0.60-0.65. The SOFA score has little efficacy in accurately identifying patients at increased risk of mortality within 28 days of ICU admission due to sepsis.

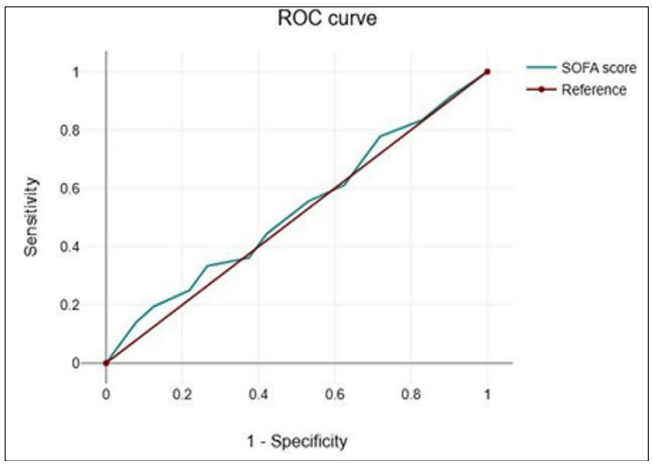

Fig 1 (d): ROC curve for predicting 28-day mortality in sepsis patients based on SOFA score.

4. Discussion

Sepsis significantly affects illness and mortality worldwide, requiring reliable and accurate anti-immunity markers to determine the treatment method [23]. Lactate-to-albumin (L/A) ratio has become an important biochemical metric that combines two important factors: lactate, reflecting tissue hypoxia, and albumin, indicating systemic inflammation and nutritional conditions [24]. The L/A ratio could provide a more accurate evaluation of the disease by incorporating interconnected pathophysiological procedures [25]. The study evaluates the efficiency of the L/A ratio as a future marker for 28-day mortality in sepsis patients and emphasizes its significance in risk stratification and improvement in personal medicine.

The findings of the present study, which revealed that sepsis predominantly affected individuals over 40 years with a slight male predominance and high prevalence of comorbidities such as hypertension and diabetes, are consistent with previous literature. However, a study by Mayr *et al*. (2014) reported that older adults, particularly those with chronic illnesses, are more susceptible to developing sepsis due to compromised immune responses and underlying organ dysfunction [26]. Similarly, Kalantar *et al*. (2022) found that respiratory tract infections were the leading cause of sepsis, aligning with our observation that 33% of cases originated from respiratory sources [27]. The predominance of altered mental status and signs of hypoperfusion, such as clammy skin, in our cohort also mirrors the clinical patterns reported by Shankar-Hari *et al*. (2020), who emphasized these as early indicators of organ dysfunction in sepsis patients [28].

Furthermore, the elevated ICU admission rate (61%) and extended hospitalization duration (>14 days in 41% of cases) identified in our study align with the findings of Vincent *et al*. (2009), which indicated that sepsis markedly escalates ICU demand and length of stay, especially in patients with multiple organ dysfunction [29]. These comparisons collectively highlight the gravity, intricacy, and resource-demanding characteristics of sepsis, especially in elderly populations with pre-existing comorbidities.

This study reveals that serum lactate alone has little discriminative ability in forecasting 28-day mortality, evidenced by an AUC of 0.62. This corresponds with earlier research that identified comparable limits of lactate as an independent prognostic instrument. Gan *et al*. (2024) revealed that the AUC of lactate in predicting death among ICU sepsis patients was 0.64, indicating its low predictive ability unless used in conjunction with other indications [30]. Similarly, Hernandez *et al*. (2016) emphasized that although elevated lactate reflects tissue hypoxia and impaired perfusion, its specificity in predicting outcome is compromised due to its elevation in several non-lethal conditions such as seizures or hepatic dysfunction [31]. In contrast, serum albumin, with an AUC of 0.58 in the present study, showed even weaker predictive ability, corroborating the findings of Li *et al*. (2019), who observed that albumin levels<3.5 g/dL were associated with increased in-hospital mortality but lacked independent prognostic strength when adjusted for severity scores [32].

The integration of these markers into the L/A ratio significantly enhanced prognostic efficacy, with an estimated AUC near 0.70 in this study, reflecting a superior balance between sensitivity and specificity. This observation is well-supported by Shin *et al*. (2018), who found that the L/A ratio outperformed either lactate or albumin alone in predicting 28-and 90-day mortality, with AUC values ranging between 0.72-0.76 [33]. Similarly, Ji *et al*. (2025), in a multicentric study involving over 1,000 sepsis patients, reported that an L/A ratio >1.5 was an independent predictor of mortality, particularly in elderly and hypoalbuminemic patients [34].

The present data reveal a robust positive connection between the SOFA score and the lactate-to-albumin (L/A) ratio ($r = 0.76$, $p<0.0001$), consistent with Karim *et al*. (2025), who documented a comparable link ($r = 0.72$) [35]. The SOFA score, a validated metric for organ failure, demonstrated use in risk classification; patients with scores ≥10 showed an 84.6% 28-day death rate, aligning with Zhang *et al*. (2024), who recognized elevated SOFA thresholds as significant mortality predictors [36].

However, the current ROC analysis indicated only modest predictive accuracy for the SOFA score (AUC 0.60-0.65), highlighting its limits at a singular time point. Loyrion *et al*. (2021) showed identical findings, highlighting the enhanced predictive significance of dynamic SOFA trends over 48-72 hours compared to admission scores alone [37].

The laboratory findings indicate anemia (mean hemoglobin 10.2 g/dL), thrombocytopenia (platelet count about 158,000/mm³), and high creatinine levels (mean 1.9 mg/dL), which are indicative of the systemic dysfunction characteristic of sepsis-related hematological and renal impairment. This aligns with the findings of Ito *et al*. (2019), which indicated that abnormal hematological parameters at admission predicted the exacerbation of multiorgan dysfunction and unfavorable outcomes [38].

Bagshaw *et al*. (2008) revealed renal impairment as a significant factor in sepsis-related mortality, underscoring the clinical importance of these results [39].

In terms of clinical presentation, disturbed mental state (33%) and chilly, clammy skin (24%) were significant characteristics in our population, indicating systemic hypoperfusion. However, Hotchkiss *et al*. (2016) showed that the hallmark characteristics of advanced sepsis and shock are correlated with worse outcomes [40]. Hypotension, tachycardia, and increased respiratory rate seen in our group are fundamental elements of the SIRS and QSOFA criteria, underscoring the necessity for prompt detection and management.

Moreover, the present investigation verifies that although lactate and albumin by itself have minimal predictive value, their ratio—the L/A ratio—significantly enhances the assessment of short-term mortality in sepsis, especially when associated with organ failure as shown by SOFA scores. These findings advocate for the use of the L/A ratio as an adjunctive instrument in the preliminary risk assessment of septic patients and promote more extensive, long-term investigations to authenticate and enhance its predictive value across various clinical contexts.

5. Conclusion

In conclusion, the study highlights the considerable predictive value of the blood lactate-to-albumin (L/A) ratio as a sensitive and easily obtainable biochemical measure for predicting 28-day death in sepsis patients. The significant link noted between increased L/A ratios and SOFA scores illustrates the combined impact of metabolic dysfunction and hypoalbuminemia in critically sick patients, underscoring its function as a proxy measure of organ failure severity. Notwithstanding its therapeutic potential, this study is constrained by its single-center design, restricted sample size, and absence of longitudinal L/A monitoring beyond the first ICU hospitalization. Moreover, possible confounding variables, including nutritional status, hepatic dysfunction, and albumin delivery, were not adequately controlled, potentially affecting albumin levels independently of illness severity. Future multicentric, prospective studies with larger cohorts and serial measurements are necessary to validate the predictive reliability of the L/A ratio, refine threshold values, and investigate its incorporation into dynamic risk stratification models and clinical decision-making algorithms for sepsis management.

6. Acknowledgments

We would like to express our sincere gratitude to all those who contributed to the successful completion of this research. We are particularly thankful for the guidance, support, and resources that were made available throughout the course of this work. The insights and encouragement we received played a vital role in shaping this study, and we truly appreciate the assistance provided at every stage.

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