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Original Research Article

COMPARATIVE EVALUATION OF PROCALCITONIN AND SERUM LACTATE AS PROGNOSTIC BIOMARKERS IN SEPSIS

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Abstract: ***Background:*** Sepsis represents a critical medical emergency characterized by significant rates of morbidity and death within intensive care settings. While clinical scores like SIRS, qSOFA, SOFA and APACHE II aid in risk assessment, their feasibility is limited in some settings. Serum lactate reflects tissue hypoxia, and procalcitonin indicates infection severity, but their prognostic superiority remains unclear. Hence, this study aimed to compare serum lactate and procalcitonin to identify the better prognostic biomarker in ICU patients with sepsis. ***Methods:*** A retrospective record-based cross-sectional study was conducted in patients diagnosed with sepsis by SIRS criteria. We measured serum procalcitonin and serum lactate levels to investigate their association with disease prognosis, as determined by the qSOFA score. ***Results:*** A total of 118 patients were screened, of whom 21 were excluded based on predefined exclusion criteria, and 97 patients were included in the final analysis. The study population consisted of 58 men (59.8%) and 39 women (40.2%), with a mean age of 52.4 ± 14.8 years. Serial measurements demonstrated a significant decline in both procalcitonin (PCT) and serum lactate levels over time ($p < 0.001$). PCT showed a progressively strengthening correlation with qSOFA scores, reaching statistical significance from day 3 onward (day 3: $r = 0.263$, $p = 0.010$; day 5: $r = 0.261$, $p = 0.010$; day 7: $r = 0.276$, $p = 0.007$), while no significant correlation was observed at admission. The strongest correlation was noted between PCT on day 5 and qSOFA on day 7 ($r = 0.342$, $p = 0.001$). A modest association was also observed between PCT, and total leukocyte count at admission ($r = 0.209$, $p = 0.041$). In contrast, serum lactate demonstrated weak and inconsistent correlations. ROC analysis showed improving prognostic performance of PCT, with AUC increasing from 0.543 to 0.662 ($p < 0.001$), whereas serum lactate showed poor discrimination (AUC 0.458– 0.518; $p > 0.05$). Higher qSOFA scores were consistently associated with elevated PCT levels. ***Conclusion:*** Procalcitonin demonstrated relatively better prognostic performance than serum lactate and may aid in severity assessment and clinical judgement in sepsis.

Keywords: Sepsis, Serum lactate, Procalcitonin, SIRS criteria, qSOFA score

INTRODUCTION

Sepsis is characterized as a dangerous failure of organ systems resulting from a patient's irregular immune reaction to an infection. This medical condition encompasses a range of severity, from initial sepsis to septic shock, and continues to be a primary driver of Intensive Care Unit (ICU) admissions and global mortality. Pathophysiologically, a disruption in the equilibrium between pro-inflammatory and anti-inflammatory pathways triggers widespread cytokine release and the activation of coagulation and complement cascades, resulting in microcirculatory impairment and eventual multiorgan failure (1,2). During septic shock, impaired oxygen delivery relative to cellular demand forces tissues to switch from oxidative phosphorylation to anaerobic glycolysis and subsequent lactate production. (3,4)

Historically, sepsis diagnosis relied on the Systemic Inflammatory Response Syndrome (SIRS) framework, which required ≥2 of the following abnormalities: temperature >38 °C or <36 °C, heart rate >90 beats/min, respiratory rate >20 breaths/min or $PaCO_2$ <32 mmHg, and deranged white blood cell count (>12,000/mm³, <4,000/mm³, or >10% immature forms). Despite its clinical utility, SIRS has limited specificity for outcome prediction. Subsequently, the Sepsis-3 consensus shifted focus to organ dysfunction, operationalized through a Sequential Organ Failure Assessment (SOFA) score increase of ≥2 points as the diagnostic threshold for sepsis. As a practical bedside adjunct, the quick SOFA (qSOFA) tool was introduced, comprising three parameters — reduced level of consciousness (GCS below 15), elevated respiratory rate (≥22/min), and low systolic blood pressure (≤100 mmHg) — with a score of ≥2 signalling heightened risk of adverse outcomes.(5)

Risk stratification systems such as the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation II (APACHE II) are commonly employed to estimate disease severity and assess mortality risk. However, these scoring systems require multiple clinical and laboratory parameters and may not always be feasible in emergencies or resource- limited settings. (6)

Serum lactate functions as a sensitive, though non-specific, marker of tissue oxygen insufficiency and cellular metabolic disturbance. Elevated lactate levels typically arise from impaired oxygen consumption, enhanced anaerobic metabolic activity, and reduced hepatic and renal clearance.(3) Given that rising lactate concentrations correlate with increased mortality, repeated lactate monitoring has been incorporated into sepsis resuscitation bundles as a means of tracking treatment response.(3,4,6)

Additionally, procalcitonin (PCT), the biochemical precursor to calcitonin, rises during systemic bacterial infections and serves as a reflection of the severity of organ dysfunction and the inflammatory response (2,7,8). Furthermore, serial assessment of procalcitonin (PCT) levels during intensive care unit stay may offer valuable prognostic insights into patient outcomes. (9,10,11)

Notwithstanding their routine clinical application, the question of which biomarker holds superior prognostic value in sepsis remains unresolved. The present study was therefore designed to directly compare the prognostic utility of serum lactate and PCT, examining their temporal kinetics throughout the ICU stay, with the aim of identifying the more reliable marker for outcome prediction in critically ill sepsis patients.

OBJECTIVE

To compare the prognostic utility of serum lactate and procalcitonin levels in predicting disease severity in patients with sepsis

MATERIALS AND METHODS

This retrospective, record-based cross-sectional study was conducted in the medical and surgical ICUs of Apollo General Hospital, Hyderabad, India. The study was initiated after approval by the Institutional Research Committee of AIMSR. As this was a record-based study, previously documented clinical and laboratory data were analyzed.

Study eligibility was assessed for 118 individuals aged ≥18 years who were hospitalized in medical or surgical ICUs with sepsis during the period from June 2024 to June 2025. Patients were categorized as having sepsis if they met the SIRS criteria in addition to having a presumed or documented infection.

Inclusion criteria for the study comprised adults aged 18 years or above, of any sex, admitted to the ICU with sepsis fulfilling SIRS parameters. To be eligible, patients also required documented assessments of specific serum biomarkers, namely lactate and procalcitonin, both at the point of ICU admission and throughout the duration of their hospitalization.

Exclusion criteria for the study comprises of patients with incomplete or missing clinical or laboratory data, those who had undergone recent major surgery, those with severe trauma, extensive burns, severe hepatic dysfunction, metabolic disorders, or seizures and those with conditions that could independently influence serum lactate and procalcitonin levels.

Of the 118 patients initially screened, 21 were subsequently excluded based on the predefined criteria. Thus, the final analysis comprised 97 patients.

At the point of admission, baseline clinical were recorded for each patient, encompassing vital signs (including blood pressure, heart rate, respiratory rate, and body temperature), total leukocyte count, and Glasgow Coma Scale (GCS) values. Initial qSOFA scores were also determined at this stage. Laboratory evaluations for serum procalcitonin and lactate were completed within the first 24 hours of admission,

followed by periodic reassessments of all clinical variables on hospital days 3, 5, and 7. All statistical computations were performed using IBM SSPS Statistics, version 24.0.

DATA ANALYSIS

Continuous variables are reported as mean ± standard deviation accompanied by 95% confidence intervals (CI), while categorical variables are presented as frequencies and percentages. To evaluate the relationships between PCT, serum lactate, qSOFA scores, and total leukocyte count (TLC), the Pearson correlation coefficient was utilized. The prognostic accuracy of these biomarkers was measured through receiver operating characteristic (ROC) curve analysis. Furthermore, area under the curve (AUC) values were calculated, and the Youden index was applied to establish optimal diagnostic cut-off thresholds. Statistical significance was set at a two-tailed p-value of less than 0.05.

RESULTS

Of 118 patients screened, 97 met the eligibility criteria and were included in the analysis after 21 patients were omitted by established exclusion criteria. The baseline demographic and clinical data are presented in Table 1. The study group had a mean age of 52.4 ± 14.8 years and was predominantly male (59.8%). At admission, the mean systolic blood pressure was 124.6 ± 18.2 mmHg, respiratory rate was 22.4 ± 4.1 breaths/min, and Glasgow Coma Scale score was 14.1 ± 1.2. The mean qSOFA score was 1.64 ± 0.72. The baseline biomarker levels were as follows: procalcitonin (PCT) 17.8 ± 9.4 ng/mL, serum lactate 2.8 ± 1.1 mmol/L, and total leukocyte count (TLC) 16.84 ± 7.21 $\times 10^3$/L.

Table 1. Distribution of Demographic Variables and Admission Vitals in Sepsis Patients (N = 97)

Variable	Mean ± SD / Frequency (%)
Age (Years)	52.4 ± 14.8
Gender (Male/Female)	58 (59.8%) / 39 (40.2%)
Systolic BP (mmHg)	124.6 ± 18.2
Respiratory Rate (breaths/min)	22.4 ± 4.1
GCS Score	14.1 ± 1.2v
Admission PCT (ng/mL)	17.8 ± 9.4
Admission Serum Lactate (mmol/L)	2.8 ± 1.1
Admission TLC (10^3/L)	16.84 ± 7.21
Mean qSOFA (Admission)	1.64 ± 0.72

Serial measurements showed a significant decline in both PCT and serum lactate levels over 7 days (Table 2). PCT decreased from 17.82 ± 9.45 ng/mL at admission to 6.42 ± 3.24 ng/mL on day 7, and serum lactate declined from 2.84 ± 1.12 mmol/L to 1.43 ± 0.51 mmol/L (both $p < 0.001$), indicating a consistent temporal reduction.

Table 2. Longitudinal Analysis of Serum Procalcitonin and Serum Lactate Levels Over Seven Days

Time Point	Procalcitonin (ng/mL)	Serum Lactate (mmol/L)
Admission	17.82 ± 9.45	2.84 ± 1.12
Day 3	11.41 ± 6.82	2.12 ± 0.94
Day 5	8.25 ± 4.51	1.81 ± 0.72
Day 7	6.42 ± 3.24	1.43 ± 0.51
P-value (Trend)	< 0.001	< 0.001

Table 3. Correlation between PCT and qSOFA on Day 0, Day 3, Day 5 and Day 7 of Hospitalisation

PCT Measurement	Statistic	qSOFA (Day 0)	qSOFA (Day 3)	qSOFA (Day 5)	qSOFA (Day 7)
PCT (Day 0)	r	0.165	0.219*	0.215*	0.184
	p	0.106	0.031	0.034	0.074
	N	97	97	97	97
PCT (Day 3)	r	0.149	0.263**	0.236*	0.215*
	p	0.147	0.010	0.020	0.037
	N	97	97	97	97
PCT (Day 5)	r	0.020	0.207*	0.261**	0.342**
	p	0.848	0.042	0.010	0.001
	N	97	97	97	97
PCT (Day 7)	r	-0.035	0.175	0.185	0.276**
	p	0.732	0.087	0.070	0.007
	N	97	97	97	97

PCT demonstrated a progressively stronger, though weak-to-moderate, correlation with the qSOFA score over time. (Table 3). Although the association at admission was not significant ($r = 0.165$, $p = 0.106$), significant correlations emerged on day 3 ($r = 0.263$, $p = 0.010$) and day 5 ($r = 0.261$, $p = 0.010$), with the strongest correlations observed on PCT on day 5 and qSOFA on day 7($r=0.334$, $p=0.001$).Additionally, a significant correlation was maintained between PCT and qSOFA both on day 7($r=0.276$, $p=0.007$).

In contrast, serum lactate levels showed no consistent correlation with qSOFA scores (table 4), with only an isolated weak association observed between serum lactate measured on day 7 and the qSOFA on day 3($r= 0.206$, $p = 0.043$), while all other comparisons were non-significant. ($p>0.05$).

Table 4. Correlation between Serum Lactate and qSOFA on Day 0, Day 3, Day 5 and Day 7 of Hospitalization

Serum Lactate Measurement	Statistic	qSOFA (Day 0)	qSOFA (Day 3)	qSOFA (Day 5)	qSOFA (Day 7)
Serum Lactate (Day 0)	r	0.103	0.107	0.129	0.018
	p	0.315	0.298	0.209	0.866
	N	97	97	97	97
Serum Lactate (Day 3)	r	0.061	0.198	0.125	0.036
	p	0.556	0.052	0.221	0.730
	N	97	97	97	97
Serum Lactate (Day 5)	r	0.087	0.149	0.135	0.054
	p	0.399	0.145	0.186	0.604
	N	97	97	97	97
Serum Lactate (Day 7)	r	0.136	0.206*	0.161	0.037
	p	0.183	0.043	0.116	0.721
	N	97	97	97	97

Table 5. Correlation between PCT and TLC on Day 0, Day 3, Day 5 and Day 7 of Hospitalisation

PCT Measurement	Statistic	TLC (Day 0)	TLC (Day 3)	TLC (Day 5)	TLC (Day 7)
PCT (Day 0)	r	0.209*	0.177	0.023	0.112
	p	0.041	0.085	0.824	0.278
	N	97	97	97	97
PCT (Day 3)	r	0.166	0.170	0.048	0.182
	p	0.108	0.099	0.643	0.080
	N	97	97	97	97
PCT (Day 5)	r	0.040	0.118	0.088	0.169
	p	0.699	0.252	0.393	0.101
	N	97	97	97	97
PCT (Day 7)	r	-0.033	0.002	0.038	0.083
	p	0.747	0.982	0.714	0.424
	N	97	97	97	97

TLC demonstrated weak and inconsistent correlations with PTC (Table 5), reaching statistical significance only upon admission ($r = 0.209$, $p = 0.041$). No significant association was observed between serum lactate levels and TLC at any time point (Table 6; all $p > 0.05$).

Patients with abnormal qSOFA scores consistently had higher mean PCT levels than those with normal scores across all time points (table 7), with differences evident at admission (22.61 vs. 17.44 ng/ml) a persisting through day 7(6.56 vs. 5.40ng/ml).

Table 6. Correlation between Serum Lactate and TLC on Day 0, Day 3, Day 5 and Day 7 of Hospitalization

Serum Lactate Measurement	Statistic	TLC (Day 0)	TLC (Day 3)	TLC (Day 5)	TLC (Day 7)
Serum Lactate (Day 0)	r	0.005	0.074	0.073	0.033
	p	0.962	0.472	0.478	0.751
	N	97	97	97	97
Serum Lactate (Day 3)	r	-0.105	-0.088	0.024	-0.018
	p	0.307	0.393	0.817	0.865
	N	97	97	97	97
Serum Lactate (Day 5)	r	-0.053	0.014	0.051	-0.002
	p	0.605	0.889	0.623	0.986
	N	97	97	97	97
Serum Lactate (Day 7)	r	0.015	0.112	0.196	0.121
	p	0.882	0.275	0.055	0.241
	N	97	97	97	97

Table 7. Comparison of Mean Serum Procalcitonin Levels Across qSOFA Score Categories on Day 0, Day 3, Day 5, and Day 7 of Hospitalization

Time Point	qSOFA Category	N	Mean	Standard Deviation	Standard Error
PCT (Day 0)	Normal	55	17.4382	13.96511	1.88306
	Abnormal	42	22.6060	16.76998	2.58766
	Total	97	19.6758	15.37646	1.56124
PCT (Day 3)	Normal	55	13.1620	9.83469	1.33833
	Abnormal	42	17.9762	14.02604	2.16426
	Total	97	15.2682	12.02614	1.22741
PCT (Day 5)	Normal	55	10.5640	8.74457	1.17912
	Abnormal	42	12.9167	11.35573	1.75223
	Total	97	11.5827	9.97294	1.01260
PCT (Day 7)	Normal	55	5.4013	4.56177	0.61511
	Abnormal	42	6.5633	5.77162	0.89058
	Total	97	5.9044	5.12516	0.52038

Receiver operating characteristic analysis demonstrated an improvement in the prognostic performance of PCT over time (Table 8). The area under the curve increased from 0.543 at admission ($p = 0.296$) to 0.662 on day 7 ($p < 0.001$), with a sensitivity of 100% and specificity of 32.6% on day 7(Figure. 1).

In contrast, serum lactate showed poor discriminative ability at all time points (Table 9), with AUC values ranging from 0.458 to 0.518 and no statistically significant results.

Table 8. Receiver Operating Characteristic (ROC) Analysis of Serial PCT Levels for Prediction of Sepsis Severity Defined by qSOFA Scores

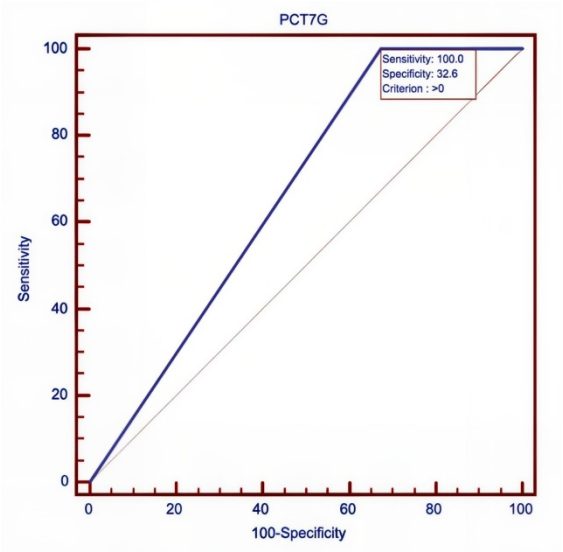
Test Variable	Area Under Curve (AUC)	95 % CI	p-value	Sensitivity (%)	Specificity (%)	Youden Index
PCT (Day 0)	0.543	0.46 – 0.62	0.296	87.5	21.2	0.087
PCT (Day 3)	0.563	0.49 – 0.63	0.083	90.5	22.2	0.127
PCT (Day 5)	0.572	0.49 – 0.65	0.055	90.3	24.2	0.146
PCT (Day 7)	0.662	0.61 – 0.71	<0.001	100	32.6	0.326

Table 9. Receiver Operating Characteristic (ROC) Analysis of Serial Serum Lactate Levels for Prediction of Sepsis Severity Defined by qSOFA Scores

Test Variable	Area Under Curve (AUC)	95 % CI	p-value	Sensitivity (%)	Specificity (%)	Youden Index
Serum Lactate (Day 0)	0.458	0.36 – 0.55	0.412	58.3	49.3	0.076
Serum Lactate (Day 3)	0.516	0.43 – 0.60	0.781	91.7	24.7	0.163
Serum Lactate (Day 5)	0.518	0.42 – 0.61	0.752	16.7	94.5	0.112
Serum Lactate (Day 7)	0.490	0.39 – 0.58	0.903	87.5	27.4	0.149

Overall, although both biomarkers declined over time, PCT demonstrated a stronger association with qSOFA scores and relatively better prognostic performance than serum lactate.

Figure 1 Receiver Operating Characteristic (ROC) curve of procalcitonin (day 7) for predicting clinical outcomes in sepsis patients



DISCUSSION

Sepsis is defined as a multifaceted pathological state where an aberrant host immune response to an infectious agent triggers widespread inflammation, reduced blood flow to tissues, and the failure of various organ systems. The early identification of reliable biomarkers capable of predicting disease severity and clinical outcomes is necessary for optimizing management strategies and improving survival. (1)

In the present study, both PCT and serum lactate were evaluated as prognostic tools in individuals requiring intensive care due to sepsis. The findings demonstrated that PCT levels were significantly correlated with qSOFA scores during hospitalization, indicating that increasing PCT levels were associated with worsening clinical severity. However, the strength of this association was weak-to-moderate, suggesting a modest relationship between PCT levels and disease severity. The strongest correlation observed between PCT on day 5 and qSOFA score on day 7 suggests that procalcitonin levels may reflect impending clinical deterioration. Furthermore, serial measurements revealed a progressive decline in procalcitonin levels among patients who demonstrated clinical improvement, highlighting its utility in monitoring therapeutic response. These observations agree with prior studies reporting the rise in procalcitonin levels during systemic bacterial infection owing to the upregulation of the CALC-1 gene in response to microbial toxins and inflammatory cytokines. (2,7)

In contrast, although serum lactate levels showed a statistically significant overall decline over time, they failed to demonstrate clinically meaningful correlations with qSOFA

scores or inflammatory markers across the study period. Only a weak and isolated association was observed, while most correlations remained non-significant. Furthermore, receiver operating characteristic (ROC) analysis revealed poor discriminative ability of serum lactate, with no statistically significant predictive performance, whereas procalcitonin showed a progressive improvement in diagnostic accuracy over time. Although sensitivity was high, specificity remained low, limiting procalcitonin's standalone clinical utility. These findings indicate that, despite its established role as a marker of tissue hypoxia and metabolic stress, serum lactate may have limited prognostic reliability when used in isolation. Similar variability in serum lactate performance has been reported in previous studies, where its prognostic value was influenced by factors such as hepatic clearance, comorbid conditions, and heterogeneity in patient populations (4). Conversely, other investigators have reported serum lactate clearance as a useful predictor of mortality, suggesting that differences in study design, patient severity, and endpoints may account for the observed discrepancies (12).

An additional observation was the presence of a weak but statistically significant correlation between PCT and total leukocyte count at admission, suggesting a relationship with the early inflammatory response. However, this association was not sustained over time, reflecting the dynamic and heterogeneous nature of the immune response in sepsis. The absence of a consistent relationship between serum lactate and leukocyte count further supports the limited role of lactate as an inflammatory biomarker.

Overall, the results of the present study support the hypothesis that procalcitonin demonstrates comparatively better, though modest performance, than serum lactate as a biomarker for predicting outcomes in sepsis. The ability of PCT to demonstrate significant correlations with clinical severity, its dynamic decline with clinical improvement, and its relatively better performance in ROC analysis collectively establish its clinical relevance in risk stratification and monitoring. However, certain unexpected findings, such as the lack of strong correlation between serum lactate and qSOFA, may be attributed to factors such as early clinical intervention, variability in tissue perfusion states, and differences in serum lactate metabolism among individuals.

CONCLUSION

Serum procalcitonin and serum lactate levels measured during the ICU stay were evaluated for their clinical prognostic relevance in patients with sepsis in correlation with the qSOFA score and total leukocyte count. The findings suggest that procalcitonin demonstrates relatively better, though modest, prognostic performance than serum lactate; however, expanded multicenter trials are essential to corroborate the current observations.

LIMITATIONS

This study is subject to several constraints. As it was executed in a single institution, which may have introduced population bias and the findings may not be fully generalizable to other patient populations. The follow-up window was confined to seven days, which may be insufficient to capture the complete clinical evolution of sepsis over a longer observation period. Additionally, mortality outcomes were not analyzed due to incomplete longitudinal data on biomarker levels and qSOFA scores for all patients, which may have introduced attrition bias and limited the validity of outcome analysis. Furthermore, qSOFA was used as a surrogate marker of disease severity rather than a definitive clinical outcome such as mortality, which may limit the interpretation of prognostic accuracy. Therefore, further large-scale multicenter studies with longer follow-up durations are required to minimize potential confounding factors and better establish the prognostic significance of PCT and serum lactate levels in patients with sepsis.

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REFERENCES

1. Kim MH, Choi JH. An update on sepsis biomarkers. Infect Chemother. 2020;52(1):1–18. doi:10.3947/ic.2020.52.1.1
2. Vijayan AL, Vanimaya, Ravindran S, Saikant R, Lakshmi S, Kartik R, et al. Procalcitonin: a promising diagnostic marker for sepsis and antibiotic therapy. J Intensive Care. 2017;5:51. doi:10.1186/s40560-017-0246-8
3. Shetty BS, Balookar R, Biradar DS, Patil MB. Serum lactate as a prognostic marker in patients with sepsis: a prospective study. Int Surg J. 2020;7(5):1530–1534
4. Bakker J. Lactate is the target for early resuscitation in sepsis. Rev Bras Ter Intensiva. 2017;29(2):124–127. doi:10.5935/0103-507X.20170021
5. Liu Z, Meng Z, Li Y, Zhao J, Wu S, Gou S, et al. Prognostic accuracy of the lactate level, SOFA score and qSOFA score for mortality among adults with sepsis. Scand J Trauma Resusc Emerg Med. 2019;27(1):51. doi:10.1186/s13049-019-0609-3
6. Tejaswini P, Singhai A, Pawar A, Joshi R, Saigal S, Pakhare AP. Study on assessing serum lactate as an early prognostic determinant in sepsis outcome. Cureus. 2024;16(1):e52186. doi:10.7759/cureus.52186
7. Schuetz P, Albrich W, Mueller B. Procalcitonin for diagnosis of infection and guide to antibiotic decisions:

present and future. BMC Med. 2011;9:107. doi:10.1186/1741-7015-9-107

8. Muller B, Becker KL, Schachinger H, Rickenbacher PR, Huber PR, Zimmerli W, et al. Calcitonin precursors are reliable markers of sepsis in a medical intensive care unit. Crit Care Med. 2000;28(4):977–983
9. Liu D, Su L, Han G, Yan P, Xie L. Prognostic value of procalcitonin in adult patients with sepsis: a systematic review and meta-analysis. PLoS One. 2015;10(6):e0129450. doi:10.1371/journal.pone.0129450
10. Yu H, Nie L, Liu A, Wu K, Hseen YC, Yen DW, et al. Combining procalcitonin with the qSOFA score for sepsis mortality prediction. Medicine (Baltimore). 2019;98(23):e15981. doi:10.1097/MD.0000000000015981
11. Hu Z, Zhou Y, Liu C, Kang Y, Pertrankin Z. Procalcitonin and lactate as prognostic markers in patients with sepsis and septic shock. Oncotarget. 2018;9(4):5125–5136. doi:10.18632/oncotarget.23701
12. Braun N, Schuetz P, Baruti R, Amin D. Procalcitonin or lactate clearance, or both, for risk assessment in patients with sepsis? Results from a prospective US ICU patient cohort. Crit Care. 2015;19(Suppl 1):P59. doi:10.1186/cc14139

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