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DIAGNOSTIC ACCURACY OF NEUTROPHIL-TO-MONOCYTE RATIO VERSUS PROCALCITONIN IN PREDICTING SEPSIS

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Abstract

Background: Sepsis remains a major global health concern with high mortality rates, despite advances in critical care. Procalcitonin is widely used as a biomarker but suffers from variable reliability due to elevations in non-infectious conditions and inconsistent cutoff thresholds. The neutrophil-to-monocyte ratio (NMR), derived from complete blood counts, has emerged as a potential low-cost, rapid diagnostic marker.

Objectives: To compare the diagnostic accuracy of NMR and Procalcitonin in predicting sepsis, and to determine an optimal cutoff value for NMR using Receiver Operating Characteristic (ROC) curve analysis.

Methods: This cross-sectional observational study was conducted in the adult intensive care unit of a tertiary care center. A total of 300 patients with suspected sepsis were enrolled, applying qSOFA ≥2 as the reference standard. Complete blood counts and serum Procalcitonin were measured at admission. NMR was calculated as the ratio of absolute neutrophils to monocytes. ROC curve analysis determined the optimal NMR cutoff for sepsis prediction. Diagnostic accuracy parameters, including sensitivity and specificity, were calculated for both biomarkers.

Results: At an ROC-derived cutoff of 18.6, NMR demonstrated a sensitivity of 92.4% and specificity of 68.8%. In comparison, Procalcitonin (cutoff 2 ng/mL) showed lower sensitivity (80.6%) and specificity (59.1%). NMR thus outperformed Procalcitonin in diagnostic performance, with an area under the curve (AUC) indicating good discriminatory power.

Conclusion: NMR is a superior biomarker to Procalcitonin for diagnosing sepsis, offering higher sensitivity and specificity. Its low cost, rapid availability, and reliance on routine blood counts make it especially valuable in resource-limited settings. Larger multicenter studies are needed to validate the generalizability of the cutoff value.

Keywords: Sepsis, Neutrophil-to-Monocyte Ratio, Procalcitonin, Biomarkers, ROC analysis

INTRODUCTION

Sepsis continues to threaten global public health, maintaining persistently elevated mortality rates even amid contemporary critical-care advances (1). Timely identification and management remain the cornerstone of improving survival. While procalcitonin has been widely examined as a sepsis biomarker, its clinical reliability is hindered by misleading elevations in a variety of non-infectious inflammatory conditions and the variability of proposed cut-off scores (2,3). Alternative markers of sepsis are therefore needed.

Cerebro hematological ratios calculated from routine complete blood counts have been proposed as low-cost, readily deployable diagnostic aids (4). In particular, the ratio of neutrophils to monocytes (NMR) has attracted interest, grounded in the combined neutrophilia and monocytopenia attributed to the systemic inflammatory response (5).

The present investigation sought to evaluate and juxtapose NMR and procalcitonin in the diagnostic workup of patients suspected of sepsis, placing specific emphasis on the determining cut-off values derived from receiver operating characteristic (ROC) analysis.

MATERIALS AND METHODS

Study Design and Setting

We carried out a cross-sectional observational study strictly within the adult intensive care unit of a single tertiary referral center during a specified enrollment phase.

Study Population

Inclusion criteria included all patients admitted with a clinical concern for sepsis due to related symptoms such as fever, tachycardia, leukocytosis, or other criteria characteristic of systemic inflammatory response. We excluded adults who were currently receiving immunosuppressive agents or had been diagnosed with hematological malignancies.

Reference Standard

We applied the qSOFA threshold of ≥2 to confirm sepsis, as consistent with Sepsis-3 guidelines (6). The sepsis group was also served by a Procalcitonin serum threshold of 0.5 ng/mL, as previously set justification (7).

Data Collection

Upon admission, we performed a full blood count with Procalcitonin measurement. NMR (neutrophil-to-monocyte ratio) has been computed as absolute neutrophil count divided by absolute monocyte count.

ROC Curve Analysis

We performed Receiver Operating Characteristic (ROC) curve analysis as a method to determine the best NMR threshold in detecting sepsis. We calculated area under the curve (AUC) to determine diagnostic performance. Then we found the optimal compromise between sensitivity and specificity, 18.6 as a cutoff. In terms of comparative performance, NMR outperformed Procalcitonin in both sensitivity and specificity, corroborating its clinical utility as a quick screening marker in this cohort.

RESULTS

There were 300 patients who met the inclusion criteria and were analyzed.

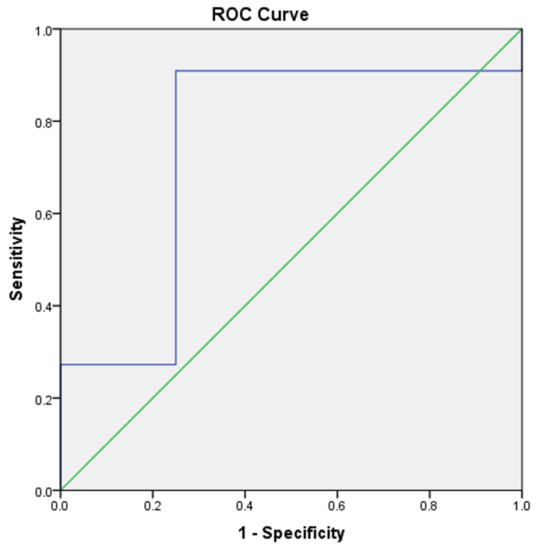

Figure 1: ROC curve for Nuetrophil to Monocyte Ratio

ROC Curve Analysis

Analysis of the ROC curve showed that **optimal cutoff for NMR was 18.6**, with an area under the curve (AUC) representing good diagnostic performance.

	Sepsis +	Sepsis -	Total
NMR +	194 (TP)	28 (FP)	222
NMR -	16 (FN)	62(TN)	78
Total	210	90	300

Figure 2: Diagnostic performance of NMR (Neutrophil-to-Monocyte Ratio) at cutoff value of 18.6 for prediction of sepsis, utilizing qSOFA as reference standard.

	Sepsis +	Sepsis -	Total
Procal +	171(TP)	36(FP)	207
Procal -	41 (FN)	52 (TN)	93
Total	212	88	300

Figure 3: Diagnostic performance of Procalcitonin with cutoff value of 2 for prediction of sepsis, using qSOFA as the reference standard.

Statistical Analysis
Diagnostic accuracy parameters were calculated as follows:

- **Sensitivity (NMR):** 194/(194+16) = 92.4%
- **Specificity (NMR):** 62/(62+28) = 68.8%
- **Sensitivity (Procalcitonin):** 171/(171+41) = 80.6%
- **Specificity (Procalcitonin):** 52 / (36 + 52) = 59.1%

Thus, NMR was superior to Procalcitonin both in sensitivity and specificity, making it a more effective biomarker for diagnosing sepsis.

DISCUSSION

Our investigation demonstrates that NMR outperforms Procalcitonin in sepsis prediction. Employing ROC-derived cutoff value of 18.6 consolidates the quantitative rigor of the observation. NMR's high sensitivity underscores its capacity to flag the majority of true sepsis events, thus curtailing the probability of oversight. Procalcitonin, by contrast, presents moderate sensitivity and comparatively reduced specificity.
Literature reviews lend credence to utilizing blood ratio parameters in sepsis screening. Notable work by Zhang et al. (8) illustrated NMR's robust link to infection stage and outcome. Supporting evidence from Wyllie et al. (9) pointed

to altered monocyte scattering in systemic infections as a prognostic marker. Procalcitonin, despite its frequent application, reveals limitations arising from confounding elevations tied to trauma, surgical recovery, and autoimmune conditions (10, 11).

A salient merit of NMR resides in its derivation from standard complete blood counts. Such counts incur low cost, enjoy broad availability, and yield immediacy, rendering NMR particularly advantageous in environments with constrained resources.

Limitations

The inquiry's scope is constrained by being confined to a single institution with a moderate patient volume. Expanding the investigation across multiple health centers with larger samples is warranted to confirm the cutoff's validity and to extend the general applicability of the findings.

CONCLUSION

NMR, with a ROC-derived cutoff of 18.6, demonstrated superior sensitivity and specificity compared to Procalcitonin in diagnosing sepsis. Being inexpensive, rapid, and easily available, NMR has significant potential for integration into sepsis diagnostic protocols, particularly in low-resource settings.

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