"Evaluating Absolute Eosinophil Count as a Diagnostic and Prognostic Marker in Sepsis: Correlation with SOFA and qSOFA Scores"

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Abstract

Introduction : Sepsis is a dysregulated host response to an infection that causes organ failure that poses a serious risk to life. Although culture results are not always available right away and the majority of patients continue to test culture negative, microbial culture is still the gold standard for diagnosing sepsis. Therefore, the objective of the current study was to assess absolute eosinophil count as a new marker for diagnosing sepsis and also to assess the prognosis of the patient in relation to Sequential Organ Failure Assessment (SOFA)/quick Sequential Organ Failure Assessment (qSOFA) score.

Methodology : In this study, 100 patients with sepsis were enrolled. The other 100 patients without any evidence of sepsis were taken as controls. Absolute eosinophil count (AEC), SOFA/qSOFA scores of all the patients were measured on the 1st, 3rd, and 7th day and data was analyzed statistically.

Results: The mean AEC on admission day in sepsis patients was 49.5. The mean AEC among survivors was >50 and nonsurvivors was <50. AEC and SOFA/qSOFA scores exhibit a statistically significant and inverse correlation on the 1st, 3rd, and 7th day of illness.

Conclusion: Absolute eosinophil count (AEC) is a simple and cost-effective marker that may be helpful in diagnosis as well as in predicting the prognosis of sepsis as evidenced by its linear inverse correlation with SOFA/qSOFA score.

Keywords: Absolute eosinophil count, Sepsis, SOFA, qSOFA

IntroductIon

Sepsis is described as life-threatening organ dysfunction induced by an abnormal host response to infection.1 Following the publication of the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3), the definition of sepsis was modified in 2016.1 "Sepsis-3" clinical criteria for sepsis diagnosis include: (1) a suspected/
documented infection and (2) acute organ dysfunction, defined as an increase by two or more points from baseline (if known) on the Sequential (or sepsis-related) Organ Failure Assessment (SOFA) score.1,2 The SOFA score is a 24-point scale that assesses organ dysfunction across six organ systems (renal, cardiovascular, pulmonary, hepatic,
neurologic, and hematologic), with 0–4 points awarded to each organ system.1,3,4

In Sepsis-3 clinical criteria, a new criterion, quick Sequential Organ Failure Assessment (qSOFA), was also established with range 0–3. If the following criteria are met, they will each receive one point—systolic hypotension (≤ 100 mm Hg), tachypnea (>22) or altered mental status. A qSOFA score of ≥2 points has a predictive value for sepsis similar to that of more complicated measures of organ dysfunction.1

Microbial culture is still the gold standard for diagnosing sepsis, although findings are not always available correctly. Furthermore, a considerable proportion of sepsis patients are culture-negative. As a result, the diagnosis of this group of sepsis patients is mainly on clinical criteria and subjective clinical opinion. Eosinophil production is
regulated by interleukin-3 (IL-3), IL-5, and GM-CSF, which are not considerably activated in sepsis, resulting in relative eosinopenia. Absolute eosinophil count (AEC) is a low-
cost, easily accessible test in both rural and urban institutions. In addition to its predictive significance, eosinopenia may be a useful tool in counseling physicians as a swift and affordable indicator of sepsis on admission. As a result, the current study sought to ascertain the role of absolute eosinophil count as a diagnostic and prognostic marker for sepsis, as well as its relationship with SOFA/qSOFA.

Methodology

A cross-sectional study was conducted in the Saraswathi institute of medical sciences, Hapur, with consent from the Internal Ethical Committee. Before joining the trial, all patients provided informed written consent. The study comprised 100 adult patients of both sexes who were diagnosed with sepsis using the Sepsis-3 criteria and were hospitalized in the emergency, general, and intensive care units. The study comprised patients over the age of 18 who were admitted. Patients excluded from the study were aged <18 years, patients with hematological malignancy, patients diagnosed with
tropical diseases such as malaria, dengue, Leptospira, and Rickettsiae, systemic acute or chronic inflammatory or autoimmune or connective tissue diseases or myocardial infarction, patients receiving corticosteroids, patient refusing to give informed consent.

Absolute eosinophil count (AEC) and SOFA/qSOFA score was assessed in all patients at the time of admission, 3rd day, and 7th day of admission then data were analyzed
statistically. Statistical Software for Social Sciences was used to conduct the statistical analysis. Data on categorical factors of patients, such as age, gender, and so on, were expressed as frequencies and percentages. After validating the normality of the data with the Kolmogorov–Smirnov test, the data is displayed as mean standard deviation.
The Chi-squared test was used to compare categorical variables between the clinical outcomes. Statistical significance was defined as a p-value of < 0.05.

Observations and Results

The maximum number of cases in our study belonged to the age group 45–55 years (25%). The mean age of the cases was 51.72 ± 18.75 years. Maximum number of controls in our study belonged to the age group >65 (23%). The mean age of the control was 48.42 ± 16 years .

In our study population, 54% of cases were males and 46% were females, while 53% of controls were males and 47% were females. In our study, the mortality rate was 31 and 69% of patients survived. In our control group, the mortality rate was 7 and 93% of patients survived. Around 50% of our study group were intensive care unit (ICU) patients, 30% were from emergency medicine wards and 20% were from general wards.

In our study group, 70% of sepsis cases were due to pneumonia, 21% were due to urinary tract infection, 5% were due to cellulitis, 2% was due to liver abscess, 1% was due to meningitis, and the remaining 1% was due to surgical site infection. It is found
that in 67 out of 100 patients with sepsis (67%), absolute eosinophil count was <50, and 33 out of 100 sepsis patients (33%) absolute eosinophil count was >50.4 out of 100
controls (4%), absolute eosinophil count was <50, and 96 out of 100 controls (96%)
absolute eosinophil count was >50. The mean AEC on admission day in sepsis patients was 49.58 ± 20.62. The mean AEC on admission day among controls was 89.95 ± 20.62.

In our study, it was found that among survivors 56.52% of patients had 1st day AEC <50, while 43.47% of patients had it >50. Among 90% of expired had 1st day AEC <50, while only 10% of expired had it >50. Our study found that among survivors 7.24% of patients had 3rd day AEC <50, while 92.75% of survivors had it >50. Among 97% of expired had 3rd day AEC <50, while only 3% of expired it had >50.

In our study, it was found that among survivors 2.8% of survivors had 7th day AEC <50, while 97.1% of survivors had it >50. Among expired 97% had 7th day AEC <50, while only
3% of expired had it >50. The mean AEC on admission day among survivors was 56.44 ± 18.55, whereas the mean AEC among nonsurvivors was 34.29 ± 16.56. The mean AEC on day 3 among survivors was 71.02 ± 15.20, whereas the mean AEC among

nonsurvivors was 28.32 ± 16.69. The mean AEC on day 7 among survivors was 75.57 ± 13.29, whereas the mean AEC among nonsurvivors was 23.77 ± 16.15. When day 1 AEC is plotted on the X-axis and day 1 SOFA score is plotted on the Y-axis, a statistically significant and strong inverse correlation is obtained with a correlation coefficient of −0.79. When day 3 AEC is plotted on the X-axis and day 3 SOFA score is plotted on the Y-axis, a statistically significant and very strong inverse correlation is obtained with a correlation coefficient of −0.9. When day 7 AEC is plotted on the X-axis and day 7 SOFA score is plotted on the Y-axis, a statistically significant and very strong inverse correlation is obtained with a correlation coefficient of −0.94. Similarly, we assessed the relation between AEC and qSOFA scores on the 1st, 3rd, and 7th day and obtained a statistically significant and inverse correlation with correlation coefficients −0.37, −0.44, and −0.60, respectively.

DiscussIon

The mean age of the cases in our study was 51.72 ± 18.75 years, with the greatest number of cases falling between the ages of 45 and 55. Similarly, the average age of the study group in Tinoco-Sánchez et al.'s paper "usefulness of eosinopenia as a prognostic marker of severity in sepsis" was 51 years.7 In contrast, in a study conducted in India by Joy et al., the mean age of the population was 61 ± 18.15 years,8 this is because most of the patients were above the age of 60 in their study.

In our study percentage of males was 54% and females was 46%. Similarly in the study "eosinophil count and neutrophil–lymphocyte count ratio as prognostic markers in patients with bacteremia" conducted by Terradas et al.9 percentage of males was 56% and females was 44%.10

In our study mortality was 31% and the survival rate was 69%. In our study, maximum mortality was seen in patients with age more than 65 (71%). The elderly group was the most affected. The average age of the survivors was 46.50 ± 15.87, while the average age group of patients who died was 63.32 ± 19.96.

In our investigation, the death rate appears to be high. This could be owing to the lack of a dedicated infectious disease unit, limited healthcare resources, or the delayed presentation of critically ill patients. In our study, we discovered that absolute eosinophil count was <50 in 67% of patients with sepsis and >50 in 33% of patients with sepsis. Around 4% of controls had absolute eosinophil count <50 and 96% of controls (96%) had absolute eosinophil count >50.

In our study mean, AEC on admission day in sepsis patients was 49.58 ± 20.62. The mean AEC on admission day among controls was 89.95 ± 20.62. The mean AEC on admission day among survivors was 56.44 ± 18.55, whereas the mean AEC among

nonsurvivors was 34.29 ± 16.56. The mean AEC on day 3 among survivors was 71.02 ± 15.20, whereas the mean AEC among nonsurvivors was 28.32 ± 16.69. The mean AEC on day 7 among survivors was 75.57 ± 13.29, whereas the mean AEC among nonsurvivors was 23.77 ± 16.15.

This shows that AEC has a strong correlation with mortality in sepsis patients, as the disease process worsens AEC decreases and the severity of the patient increases.The most likely explanation for this was that the retrospective nature of their study resulted in methodological limitations, such as some data not being available for all patients and they did not describe how the infection was defined and confirmed, which could lead to the exclusion of sepsis patients.

Eosinopenia in sepsis occurs due to immune dysregulation in sepsis leading to reduced activation of eosinophils and due to reduced production of IL-3, IL-5, and granulocyte- macrophage colony-stimulating factor causing a relative eosinopenia. Secondly due to the rapid sequestration of eosinophils into the inflammatory site.6

Our study assessed the correlation between AEC and SOFA scores in sepsis patients on day 1st, 3rd, and 7th and found that AEC and SOFA score exhibits a statistically significant and inverse correlation with correlation coefficients −0.79, −0.9, and −0.94, respectively. Wilson et al.'s work "Low Absolute Eosinophil Count Predicts In-Hospital Mortality in Cirrhosis with Systemic Inflammatory Response Syndrome" supports our findings. They assessed the correlation of AEC with mortality and found the following (hazard ratio: 0.993, 95% confidence interval (CI), correlation coefficient 0.987, p = 0.016). The correlation coefficient of their study matches that of the AEC and SOFA scores on the 3rd day.

We assessed the relation between AEC and qSOFA scores on the 1st, 3rd, and 7th day and obtained a statistically significant and inverse correlation with correlation coefficients −0.37, −0.44, and −0.60, respectively.

ConclusIon

Absolute eosinophil count is a quick, simple, cost-effective, and easily obtainable marker that may be helpful in diagnosis as well as in predicting the prognosis of sepsis as evidenced by its linear inverse correlation with SOFA/qSOFA score. Though more studies are needed to validate our result, our study supports the routine calculation of AEC in sepsis patients.

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