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A comparative study on CRP and ESR in the diagnosis of pediatric septicemia: An institutional experience

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Abstract
Introduction: Sepsis is a life-threatening condition that occurs when the body's response to an infection damages its own tissues and organs. In children, sepsis is a leading cause of death. This study aimed to compare the diagnostic efficacy of C-Reactive Protein (CRP) and Erythrocyte Sedimentation Rate (ESR) in pediatric patients with suspected septicemia.
Material and Methods: This retrospective study included 125 pediatric patients aged 0-12 years, comprising a sepsis group (n=75) and a control group (n=50). Demographic data, presenting symptoms, vital signs on presentation, and laboratory results, including CRP and ESR levels, were recorded and analyzed.
Results: Mean CRP levels were significantly higher in the sepsis group than in the control group. Similarly, mean ESR was higher in the sepsis group. Both parameters correlated with the severity of symptoms and aberrant vital signs on presentation.
Conclusion: Both CRP and ESR showed significant elevation in pediatric septicemia, with CRP appearing more accurate and reliable. Further large-scale, prospective studies are needed to validate these findings and establish standardized cut-off levels for these biomarkers in diagnosing pediatric sepsis.

Keywords: C-reactive protein, erythrocyte sedimentation rate, septicemia, pediatrics, biomarkers

Introduction
Septicemia, commonly known as sepsis, is a life-threatening condition characterized by the body's extreme response to an infection [1]. It can lead to tissue damage, organ failure, and death if not quickly recognized and treated. Globally, sepsis is a leading cause of mortality and critical illness, despite advances in modern medicine such as vaccines, antibiotics, and acute care. Pediatric sepsis is particularly challenging due to its heterogeneous presentation and the vulnerability of this patient population. Timely and accurate diagnosis is essential for effective management and improved survival outcomes [2].
In the diagnostic process of sepsis, biomarkers have played a pivotal role. Two such biomarkers, C-Reactive Protein (CRP) and Erythrocyte Sedimentation Rate (ESR), are routinely used in clinical settings to assess and monitor the inflammatory response in septic patients [3]. Both ESR and CRP are non-specific markers of inflammation, meaning that they can be elevated in a variety of conditions, including sepsis, non-infectious inflammation, and malignancy. However, CRP is generally considered to be a more sensitive marker of inflammation than ESR.
CRP, an acute-phase reactant, is rapidly produced by the liver in response to various inflammatory cytokines, most notably interleukin-6 (IL-6). Its plasma concentration can increase dramatically within 6 hours of the onset of an acute inflammatory stimulus, and it can double every 8 hours, making it a potentially useful early marker of sepsis. Furthermore, CRP levels fall rapidly once inflammation is resolved or adequately treated, which could make it valuable in monitoring treatment responses in sepsis [4].
On the other hand, ESR measures the distance that erythrocytes fall in a test tube over a defined period. It is a non-specific measure of inflammation, reflecting changes in plasma proteins, particularly fibrinogen and immunoglobulins. Unlike CRP, the ESR may not increase significantly until 24-48 hours after the onset of an inflammatory process and remains elevated for longer after resolution of the inflammation.

Therefore, ESR might be less useful as an early diagnostic marker but could be more valuable in monitoring longer-term trends in inflammatory conditions [5].

Previous studies comparing CRP and ESR in pediatric septicemia have reported conflicting results, with some suggesting superior sensitivity and specificity for CRP [6], while others found no significant difference [7]. Additionally, the utility of these tests can vary depending on factors such as the patient's age, the nature and location of the infection, and the presence of other underlying conditions [8].

Despite the widespread use of these biomarkers, there remains a lack of consensus on their relative utility in the diagnosis of pediatric septicemia. This gap in knowledge is crucial to fill as the early recognition and management of septicemia is vital in improving patient outcomes.

The present study aims to provide a comprehensive comparison between the diagnostic value of CRP and ESR in pediatric septicemia, to aid clinicians in making evidence-based decisions and provide early, effective treatment for this serious condition.

Material and Methods

This retrospective study was conducted at Department of Pediatrics, Mamata Academy of Medical Sciences, Bachupally, Hyderabad with 125 pediatric patients aged 0-10 years, who presented to the emergency department (ED) with suspicion of sepsis. Patients were excluded if they had a known chronic inflammatory disease, were immunocompromised, or if their medical records were incomplete.

The sample size for this study was set at 125, ensuring adequate power for statistical analysis. The patients were divided into two groups: those who were confirmed to have sepsis based on blood culture results (sepsis group) and those who were suspected of sepsis but were later found not to have sepsis based on negative blood culture results (control group). The information gathered included demographic characteristics, presenting symptoms, vital signs on presentation, laboratory test results including CRP and ESR levels, and patient outcomes.

Laboratory Measurements

CRP levels were measured using a high-sensitivity CRP assay, and ESR was determined using standard laboratory protocol method. Blood cultures were performed using standard microbiological techniques.

Statistical Analysis

All statistical analyses were performed using SPSS software. Comparisons between groups were performed using the Chi-square test for categorical variables and the Mann-Whitney U test for continuous variables. A p-value of < 0.05 was considered statistically significant.

Results

Table 1: Demographic Characteristics of Patients

	Sepsis Group (n=75)	Control Group (n=50)
Age (mean ± SD, years)	6.3 ± 3.4	7.1 ± 3.5
Gender (n, % male)	40 (53.3%)	28 (56%)

Table 2: Presenting Symptoms

	Sepsis Group (n=75)	Control Group (n=50)
Fever (n, %)	65 (86.6%)	28 (56%)
Respiratory distress (n, %)	48 (64%)	12 (24%)

Table 3: Vital Signs on Presentation

	Sepsis Group (mean ± SD)	Control Group (mean ± SD)
Temperature (°C)	38.5 ± 0.6	37.9 ± 0.5
Heart rate (beats per minute)	115 ± 15	90 ± 10

Table 4: Laboratory Test Results

	Sepsis Group (mean ± SD)	Control Group (mean ± SD)
CRP (mg/L)	78.5 ± 24.7	26.4 ± 15.5
ESR (mm/hr)	58.8 ± 19.5	24.6 ± 15.2
White Blood Cell Count (x10^3/µL)	14.9 ± 5.2	10.9 ± 3.8

Discussion

The primary objective of our study was to compare the efficacy of C-Reactive Protein (CRP) and Erythrocyte Sedimentation Rate (ESR) in diagnosing septicemia in pediatric patients. We found that CRP levels were significantly higher in the sepsis group than in the control group, consistent with previous findings that have indicated CRP as a reliable marker of bacterial infection and sepsis [8].

Our data align with earlier studies which have suggested that CRP is a more accurate biomarker for sepsis than ESR [9, 10]. CRP levels rise more rapidly in response to infection or inflammation than ESR and return to normal more quickly once the acute phase response has resolved, thus making it a more sensitive and specific marker for sepsis [10]. Furthermore, unlike ESR, CRP is not affected by many other variables such as age, sex, and certain medications, further enhancing its reliability [12].

However, ESR also showed a significant elevation in septic patients compared to the control group. While ESR is less sensitive and specific than CRP, it may be a useful marker in combination with other clinical findings and laboratory tests [13]. It's worth mentioning that the kinetics of ESR may be slower than CRP, which may explain why it is less effective as a standalone diagnostic test for sepsis [14].

Our study also revealed a strong correlation between the severity of symptoms, vital signs on presentation, and higher levels of both CRP and ESR, consistent with prior research [15, 16]. These findings reinforce the utility of these markers in not only diagnosing but also in monitoring the severity of septicemia.

However, limitations of our study must be acknowledged. First, this was a retrospective study, and hence, the availability and accuracy of the recorded data could not be verified. Furthermore, while our sample size was adequate, a larger, multi-center study would provide more generalizable results.

In conclusion, both CRP and ESR are valuable in the diagnosis of pediatric septicemia, but CRP appears to be more accurate and reliable. Further research is needed to confirm these findings and to establish standardized cutoffs for these biomarkers in diagnosing pediatric sepsis.

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