CONTEMPORARY APPROACHES TO SEPSIS DIAGNOSIS: THE ROLE OF PRESEPSIN AS AN EARLY BIOMARKER

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Abstract: *Sepsis continues to pose a major challenge in clinical medicine due to its rapid progression and high mortality. Timely diagnosis remains critical for improving survival rates, yet conventional biomarkers often fail to provide sufficient sensitivity in the early stages of infection. Presepsin, a soluble fragment of the CD14 receptor, has recently emerged as a promising biomarker associated with innate immune activation. This paper summarizes current knowledge on the biological origin of presepsin, evaluates its diagnostic and prognostic performance, and discusses its clinical relevance in both adult and pediatric populations.*

Keywords: *presepsin, sepsis, biomarkers, early detection, infection, intensive care.*

Introduction

Sepsis is defined as a dysregulated systemic response to infection that can lead to organ dysfunction and death. Despite advancements in critical care, early recognition of sepsis remains problematic due to the lack of highly specific and rapidly responsive diagnostic tools. Commonly used laboratory indicators, including C-reactive protein (CRP) and procalcitonin (PCT), provide useful information but have notable limitations. These markers may increase in non-infectious inflammatory conditions and often demonstrate delayed kinetics. Consequently, the search for more precise biomarkers has intensified.

Presepsin has gained attention as a novel indicator directly associated with immune system activation in response to pathogens. Its diagnostic

performance has been evaluated in various clinical settings, showing promising results.

Presepsin in Pediatrics

The role of presepsin (PSP) in neonatal and pediatric practice has been actively investigated, particularly in preterm infants. In a study involving 26 critically ill premature neonates (gestational age 26–36 weeks) admitted to a neonatal intensive care unit on the first day of life with severe non-infectious conditions, the mean presepsin level was reported at 643.1 pg/mL, with a median value of 578 pg/mL. No significant correlation was identified between gestational age and presepsin concentration within this range. Based on these findings, the authors suggested that these values may serve as reference levels for preterm neonates born at 26–36 weeks of gestation.

In another investigation analyzing umbilical cord blood from 64 healthy newborns, the average presepsin concentration was 953 ± 419 pg/mL, with an interquartile range of 661–1114 pg/mL. By the third day of life, mean presepsin levels decreased to 741 ± 316 pg/mL (interquartile range: 490–937 pg/mL), indicating a dynamic postnatal adjustment.

Further research compared presepsin levels in neonates with and without sepsis. In a cohort of 27 newborns diagnosed with sepsis and 18 infants without confirmed infection but presenting perinatal risk factors or clinical signs suggestive of infection, mean presepsin concentrations were significantly higher in the septic group (1772 ± 1009 pg/mL) compared to the non-septic group (556 ± 158 pg/mL). These findings support the potential utility of whole blood presepsin measurement as a reliable biomarker for the early diagnosis of neonatal sepsis.

Biological Basis of Presepsin

Presepsin is a fragment of the CD14 receptor, which plays a key role in the innate immune response. CD14 is expressed on monocytes and

macrophages and is involved in recognizing bacterial components such as lipopolysaccharides.

During infection, activation of phagocytosis leads to cleavage of CD14 and release of presepsin into the bloodstream. This mechanism distinguishes presepsin from conventional inflammatory markers, as it directly reflects immune activation in response to pathogens. As a result, presepsin levels increase rapidly in bacterial and fungal infections, while remaining relatively stable in non-infectious inflammatory conditions.

Diagnostic Value in Pediatric Sepsis

Presepsin has demonstrated high sensitivity in the early diagnosis of sepsis in neonates and children. Its levels rise earlier than those of CRP and procalcitonin, allowing clinicians to identify infection before the onset of clear clinical symptoms.

Studies have shown that presepsin concentrations are significantly higher in neonates with sepsis compared to those without infection. This difference makes presepsin a valuable tool for distinguishing between infectious and non-infectious conditions in pediatric patients. Additionally, presepsin has been shown to have high diagnostic accuracy, with strong sensitivity and specificity in identifying neonatal sepsis. Its use may reduce diagnostic uncertainty in critical care settings.

Table 1. Clinical Significance of Presepsin Levels in Pediatric Sepsis

Presepsin Level (pg/mL)	Clinical Interpretation	Pediatric Relevance
< 200	Sepsis unlikely	Normal range in healthy children
200–300	Low probability of infection	Requires observation, possible early stage

300–500	Possible systemic infection	Early inflammatory response, monitoring needed
500–1000	Moderate risk of sepsis	Suggestive of developing infection
> 1000	High risk of severe sepsis or septic shock	Strong indication for urgent intervention
> 2000	Very high risk, poor prognosis	Associated with severe disease and possible mortality

Role in Monitoring and Prognosis

Beyond diagnosis, presepsin is useful for monitoring disease progression and evaluating treatment effectiveness. Its levels decrease rapidly in response to appropriate antimicrobial therapy, reflecting clinical improvement.

Persistent elevation or increase in presepsin levels may indicate treatment failure or progression of infection. This makes presepsin a dynamic biomarker that can guide therapeutic decision-making. Furthermore, presepsin levels have been associated with disease severity. Higher concentrations are typically observed in severe sepsis and septic shock, suggesting its value as a prognostic indicator.

Clinical Applications in Pediatrics

In neonatal intensive care units, presepsin has proven particularly valuable for early detection of sepsis. It can be measured quickly and provides results within a short time, which is essential in emergency situations.

Presepsin is also useful in differentiating bacterial infections from non-infectious inflammatory conditions. Unlike traditional markers, it does not

significantly increase in the absence of infection, such as in cases of trauma or surgical stress. In pediatric practice, presepsin may also be used to assess the effectiveness of therapy and to monitor recovery, making it a versatile tool in clinical management.

Table 2. Comparison of Presepsin with Traditional Biomarkers

Parameter	Presepsin	Procalcitonin (PCT)	C-reactive Protein (CRP)
Time of increase	Very early (1–2 hours)	Moderate (3–6 hours)	Late (12–24 hours)
Specificity for infection	High	Moderate–high	Low
Sensitivity in neonates	Very high	High	Moderate
Response to therapy	Rapid decrease	Moderate	Slow
Prognostic value	High	Moderate	Low

Comparison with Traditional Biomarkers

Compared to CRP and procalcitonin, presepsin offers several advantages. It rises earlier during infection, has greater specificity for bacterial processes, and better reflects disease severity. While CRP is a general marker of inflammation and procalcitonin is more specific to bacterial infections, presepsin provides a more direct indication of immune system activation.

Combining presepsin with other biomarkers may further improve diagnostic accuracy.

Limitations and Future Perspectives

Despite its promising characteristics, presepsin is not yet widely implemented in clinical practice. Variability in reference values, especially in pediatric populations, remains a challenge.Further large-scale studies are needed to establish standardized cutoff values and to validate its clinical utility across different age groups. Additionally, cost and availability may limit its use in some healthcare settings.

Future research should focus on integrating presepsin into clinical protocols and exploring its combined use with other biomarkers.

Conclusion

Presepsin is a promising biomarker for the diagnosis and management of pediatric sepsis. Its rapid response, high specificity, and strong correlation with disease severity make it a valuable tool in clinical practice. The use of presepsin may improve early detection, guide treatment decisions, and enhance patient outcomes. Continued research will further define its role in pediatric critical care.

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