RESEARCH PAPER

Redefining Sepsis: Role of Early Biomarkers in Diagnosis and Prognostication

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ABSTRACT

Sepsis remains a leading cause of morbidity and mortality worldwide, with early diagnosis being critical for improving outcomes. Traditional clinical criteria lack specificity and may delay timely intervention. Biomarkers such as procalcitonin (PCT), C-reactive protein (CRP), lactate, and emerging markers like presepsin have shown promise in early detection and prognostication. This review explores the current and evolving role of biomarkers in sepsis, highlighting their clinical utility, limitations, and future directions.

Keywords: Sepsis, Biomarkers, Procalcitonin, Lactate, Presepsin, Prognosis.

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1. Introduction

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. Despite advances in critical care, mortality remains high. Early recognition is often challenging due to nonspecific clinical presentation, necessitating the use of reliable biomarkers.

2. Pathophysiology of Sepsis

Sepsis involves a complex interplay of:

- Systemic inflammatory response
- Endothelial dysfunction
- Microcirculatory impairment
- Mitochondrial dysfunction

This leads to tissue hypoxia, organ failure, and metabolic derangements.

3. Ideal Biomarker Characteristics

An ideal sepsis biomarker should:

- Detect infection early
- Differentiate bacterial from non-bacterial causes
- Predict severity and outcomes
- Guide antibiotic therapy

4. Established Biomarkers

4.1 Procalcitonin (PCT)

- Elevated in bacterial infections
- Helps guide antibiotic initiation and de-escalation
- Correlates with severity

4.2 C-Reactive Protein (CRP)

- Widely available
- Less specific than PCT
- Useful for monitoring trends

4.3 Serum Lactate

- Marker of tissue hypoperfusion
- Strong prognostic indicator
- Lactate clearance reflects response to therapy

5. Emerging Biomarkers

5.1 Presepsin (sCD14-ST)

- Early rise in bacterial infections
- May predict severity better than CRP

5.2 Interleukins (IL-6, IL-8)

- Reflect inflammatory response

- Useful in early sepsis detection

5.3 Pro-adrenomedullin (Pro-ADM)

- Associated with endothelial dysfunction
- Strong prognostic marker

6. Biomarkers in Risk Stratification

Combination of biomarkers improves accuracy:

- PCT + Lactate → Severity + perfusion
- CRP + IL-6 → Inflammatory burden

Biomarker-guided scoring systems are emerging.

7. Role in Clinical Decision-Making

- Early diagnosis of sepsis
- Antibiotic stewardship
- Prognostication
- Monitoring treatment response

8. Limitations of Biomarkers

- Lack of absolute specificity
- Variable cut-off values
- Influence of comorbid conditions
- Cost and availability (especially newer markers)

9. Future Directions

- Multi-biomarker panels
- Integration with artificial intelligence
- Personalized medicine approaches
- Point-of-care testing advancements

10. Clinical Implications

- Biomarkers should complement—not replace—clinical judgment
- Serial measurements are more useful than single values
- Integration into sepsis protocols can improve outcomes

11. Conclusion

Biomarkers play an increasingly important role in the early diagnosis and management of sepsis. While no single marker is ideal, a combination approach offers the best clinical utility. Future research should focus on refining biomarker-guided strategies to enhance patient outcomes.

References (Vancouver Style – Sample)

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