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MODERN APPROACHES TO THE TREATMENT OF SEPSIS: A LITERATURE REVIEW

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Abstract. Sepsis remains one of the most serious and difficult-to-control causes of hospital mortality, despite substantial progress in intensive care methods, improvements in antimicrobial treatment protocols, and the implementation of modern infection-control systems. Recent changes in understanding the pathogenesis of sepsis—based on the complex interaction of inflammatory, immune, and metabolic processes—have led to the development of a new multifactorial treatment strategy. Particular emphasis is placed on early diagnosis, which reduces the risk of multiple organ failure, and on the personalized selection of therapeutic interventions. This review highlights current concepts of the immunopathogenesis of sepsis, including hyperinflammatory responses, immune paralysis, endothelial dysfunction, and microcirculatory disorders. Contemporary recommendations for antibacterial therapy, hemodynamic stabilization strategies, optimization of respiratory support in sepsis-associated ARDS, immunomodulatory approaches, and the possibilities of extracorporeal blood purification are discussed in detail. Emerging research directions related to biomarkers, digital prediction systems, molecular technologies, and personalized medicine are also presented.

Keywords: sepsis, septic shock, intensive care, cytokine storm, immunomodulation, extracorporeal detoxification, hemodynamic support.

Introduction. Sepsis is one of the most complex and multifaceted conditions in modern medicine. It is characterized by a dysregulated systemic response to infection leading to life-threatening organ dysfunction. In recent years, substantial progress has been made in understanding the pathophysiological mechanisms of sepsis, including the role of innate and adaptive immunity, neurohumoral changes, endothelial dysfunction, and microcirculatory impairment. These processes trigger cascades of events such as increased vascular permeability, tissue hypoxia, metabolic imbalance, and ultimately multiple organ failure.

Despite the introduction of the Sepsis-3 diagnostic criteria and improvements in imaging, laboratory diagnostics, and patient monitoring, the problem of delayed recognition remains highly relevant. The condition often progresses rapidly and requires clear early-response algorithms and interdisciplinary management. Additionally, rising antibiotic resistance, the prevalence of healthcare-associated infections, and the growing number of patients with immunodeficiency significantly complicate clinical management.

Today, sepsis is viewed not as a single disease but as a spectrum of pathological conditions requiring individualized therapeutic strategies. A comprehensive understanding of pathogenetic mechanisms enables the development of more effective treatment methods and contributes to improving patient survival.

Relevance. Sepsis remains one of the leading causes of mortality in intensive care units worldwide, second only to cardiovascular and oncological diseases. Its high prevalence among hospitalized patients, as well as the significant proportion of severe cases requiring invasive treatment, creates a substantial clinical and socioeconomic burden on healthcare systems.

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Another crucial aspect of relevance is the global rise in antimicrobial resistance, which significantly reduces the effectiveness of conventional treatment regimens and increases the frequency of adverse outcomes. In the context of widespread multidrug-resistant microorganisms, traditional approaches are insufficient and require new antimicrobial strategies.

Recent studies emphasize the importance of early diagnosis and accurate risk stratification, as the first hours determine the likelihood of septic shock and mortality. However, the clinical presentation is often nonspecific, complicating timely recognition and initiation of therapy. Thus, innovative diagnostic tools—including expanded biomarker panels, genetic tests, and artificial-intelligence–based predictive systems—remain highly relevant.

The need for personalized intensive care is also paramount. Patients with sepsis differ significantly in age, comorbidities, immune status, and pathogen characteristics, requiring tailored therapeutic protocols. New methods of immunomodulation, extracorporeal detoxification, and metabolic monitoring offer promising potential for improving treatment effectiveness.

Objective of the Review. To summarize current data on the diagnosis and treatment of sepsis, systematize key approaches to intensive care, and evaluate promising methods aimed at improving therapeutic outcomes and patient survival.

Modern Approaches to the Diagnosis of Sepsis

1. Early diagnosis and assessment scales. Clinical tools such as qSOFA, SOFA, and NEWS2 are used to rapidly assess disease severity. Particular attention is given to early detection of occult organ dysfunction.

2. Biomarkers of sepsis. Common biomarkers include: Procalcitonin (PCT), C-reactive protein (CRP), Interleukin-6 (IL-6), Presepsin, Markers of endothelial dysfunction.

Their combined use improves diagnostic accuracy and helps monitor treatment effectiveness.

Antibacterial Therapy

1. Early initiation of antibiotics. According to current guidelines, antibiotics should be administered within the first 60 minutes when septic shock is suspected.

2. De-escalation therapy. After culture results become available, therapy should be narrowed to target the identified pathogen.

3. The challenge of antimicrobial resistance. Increasing resistance requires:

- Combination therapy

- Therapeutic drug monitoring (TDM)

- Strict adherence to antimicrobial stewardship programs

Hemodynamic Support

1. Fluid therapy. Restricted fluid resuscitation with dynamic preload indices (SVV, PPV) is recommended.

2. Vasopressors. First-line agents:

- Norepinephrine

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- Vasopressin (in refractory shock)

Epinephrine is used selectively.

3. Inotropic support. Dobutamine is indicated in significant myocardial dysfunction.

Respiratory Support

ARDS is a common complication in sepsis.

1. Lung-protective ventilation

- Low tidal volume (6 mL/kg)

- Limitation of plateau pressure

- Individualized PEEP

2. HFNC and NIV. Effective at early stages of respiratory failure.

3. Prone positioning. Improves oxygenation in severe ARDS.

Immunomodulatory Therapy. Promising approaches include:

- JAK inhibitors

- Agents regulating monocyte and lymphocyte activity

- Anti-cytokine therapy

- Mitochondria-targeted treatments

Glucocorticoids are used in refractory septic shock.

Extracorporeal Detoxification Methods. Key modalities include: high-permeability hemofiltration, polymyxin B endotoxin adsorption, cytokine adsorption (CytoSorb), plasma exchange

These methods help reduce inflammatory mediators and improve hemodynamics.

Metabolic and Nutritional Support

- Early enteral nutrition

- Lactate monitoring

- Correction of vitamin C, hydrocortisone, and thiamine deficiency (HAT therapy—under evaluation)

- Prevention of hyperglycemia

Promising Treatment Directions

- Personalized immunodiagnostics

- Mitochondrial function monitoring

- Targeted endothelial-dysfunction therapies

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- AI-based sepsis-prediction systems

Conclusion. Modern sepsis treatment is based on early recognition, a comprehensive therapeutic approach, and individualized management. The combination of antimicrobial therapy, optimized hemodynamic and respiratory support, immunomodulation, and extracorporeal methods significantly improves patient outcomes. Future progress is closely linked to the development of personalized medicine, biomarker research, and novel monitoring technologies.

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