ADVANCED LABORATORY TECHNOLOGIES IN THE ETIOLOGICAL DIAGNOSIS OF SEPSIS

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Annotation. *Sepsis is currently considered to be the result of an uncontrolled systemic inflammatory response to the presence of an infection. Diagnosis of sepsis includes the identification of an etiological infectious factor - the identification of the pathogen and the study of its sensitivity to antibacterial drugs, since it is the use of appropriate antibiotics that, ceteris paribus, is the key to the final cure of the patient.*

Key words*: sepsis, bacteriological research, serological method, Mass spectrometry, polymerase chain reaction, identification.*

Sepsis remains one of the most pressing global health challenges and a leading cause of mortality in intensive care units worldwide. Despite advances in antimicrobial therapy, intensive care technologies, and laboratory diagnostics, sepsis continues to be associated with high morbidity, mortality, and significant economic burden. The urgency of this problem is обусловлена the rapid progression of the disease, difficulties in early diagnosis, and delays in initiating adequate etiological treatment [1].

According to the World Health Organization (WHO), sepsis affects approximately 49 million people annually worldwide, accounting for nearly 11 million deaths each year, which corresponds to about 19-20% of all global deaths. Particularly high incidence and mortality rates are observed in low- and middle-income countries, where limitations in early diagnosis and access to modern diagnostic technologies persist. At the same time, sepsis remains a major cause of death even in high-income countries, especially among elderly patients, newborns, and individuals with immunodeficiency or chronic comorbid conditions [2,6].

The etiological structure of sepsis is predominantly represented by bacterial pathogens, including Gram-negative microorganisms- Escherichia coli, Klebsiella spp., Pseudomonas aeruginosa and Gram-positive bacteria- Staphylococcus aureus, Streptococcus spp., Enterococcus spp. Fungal pathogens, primarily Candida species, account for up to 10-15% of sepsis cases, particularly in immunocompromised patients and those undergoing prolonged intensive care. The growing prevalence of multidrug-resistant microorganisms, according to WHO estimates, significantly complicates the selection of effective antimicrobial therapy and contributes to increased mortality rates [4].

Clinically, sepsis is defined as a life-threatening organ dysfunction caused by a dysregulated host response to infection. The disease is characterized by a wide spectrum of clinical manifestations, including fever or hypothermia, tachycardia, tachypnea, hypotension, altered consciousness, and progressive dysfunction of vital organs. According to epidemiological data, up to 40-50% of patients with sepsis develop multiple organ dysfunction syndrome, while progression to septic shock is associated with mortality rates exceeding 40%, despite modern therapeutic approaches [5].

The nonspecific and heterogeneous nature of early clinical symptoms often leads to delayed diagnosis. From the standpoint of evidence-based medicine, it has been demonstrated that each hour of delay in the initiation of

adequate antimicrobial therapy increases mortality by approximately 7-8% in patients with septic shock. Therefore, rapid and accurate etiological diagnosis, including identification of the causative pathogen and determination of its antimicrobial susceptibility, is a key factor in improving survival and clinical outcomes in patients with sepsis. In this regard, the development and implementation of modern technological methods for the etiological diagnosis of sepsis represent a priority direction in contemporary clinical laboratory diagnostics, enabling a significant reduction in diagnostic time and optimization of individualized antimicrobial therapy.

Traditional methods for the etiological diagnosis of sepsis include: bacteriological research, serological method, mass spectrometry, polymerase chain reaction (PCR) and gas chromatography [1,2].

For clinical practice, the most important information regarding the choice of effective antibiotic therapy is the bacteriological method. Despite significant technological progress in relation to bacteriological studies (use of selective media, automation, accelerated diagnostic panels), the time to establish the type of pathogen and determine its sensitivity to antibacterial drugs takes at best 24- 48 hours. At the same time, from the standpoint of evidence-based medicine, it has been established that every hour of delay in adequate antibiotic therapy in patients with septic shock reduces survival by 7.6% [4].

Modern technologies make it possible to reduce the time of etiological diagnosis and selection of effective antibacterial drugs for the treatment of patients with sepsis to several hours. New technological approaches in the diagnosis of sepsis can be divided into 3 groups:

- Accelerated determination of sensitivity to antibacterial drugs and an individual approach to treatment;

- Accelerated identification of microorganisms and empirical therapy;

- Combination of the optimal possibilities of 2 approaches (rapid identification and rapid determination of sensitivity to antibacterial drugs) and an individual approach to treatment.

Technologies belonging to the first group make it possible to monitor the growth of bacteria in broths designed specifically for human urine and biological fluids, starting from the moment of inoculation. Mathematical processing of the results of bacterial growth in real time makes it possible to obtain not only a qualitative assessment of the presence / absence of microorganisms in the sample, but also a quantitative assessment of the initial bacterial content in CFU / ml. The result of the study can be obtained within 3-6 hours, and sensitivity to antibacterial drugs can be established within the next 3 hours [6].

The second group of approaches is based on the use of modifications of the mass spectrometry method. The most actively used matrix-assisted laser desorption / ionization (MALDI). The colony material is mixed with an ionizing matrix, then the sample is irradiated with an ultraviolet laser, which ionizes the soluble proteins of microorganisms, which are distributed by mass / charge. Analysis of the mass spectrum of proteins from colonies with a database of spectra collected from known microorganisms using a database program allows you to identify the type of bacteria. Based on the established type of bacteria and analysis of the literature, the most effective antibacterial therapy is determined. Identification of the type of microorganism is carried out within a few minutes. The disadvantage of the method is that it takes time (at least 24 hours) to obtain a pure culture. The combination of 2 approaches allows you to establish the type of microorganism in patients with sepsis for a maximum of 6 hours and determine the sensitivity to antibacterial drugs for the next 3 hours [3].

Thus, modern technologies make it possible to reduce the time for the etiological diagnosis of sepsis, the determination of sensitivity to antibacterial

drugs, and the choice of an individual approach to treatment to one working day of bacteriological laboratory specialists.

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