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# BACTERIOLOGICAL METHODS FOR EXAMINING PURULENT INFLAMMATORY DISEASES

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**Abstract**

This article examines the etiology of purulent inflammatory diseases and the classical and modern bacteriological methods used for their detection. During the study, clinical samples were analyzed using microscopic, bacteriological, and molecular techniques. The results showed that, alongside traditional culture methods, molecular diagnostics provide high accuracy and improve treatment efficacy.

**Keywords**

purulent inflammation, bacteriological examination, *Staphylococcus aureus*, MRSA, antibiotic susceptibility, PCR diagnostics, Gram staining.

**Introduction.** Purulent inflammatory diseases are among the most common infectious pathologies in modern medicine. These diseases develop due to various etiological factors, particularly bacterial infections, and can lead to severe complications in the body, including sepsis, tissue necrosis, and functional disorders. Therefore, their early detection and effective treatment are considered urgent issues.

In recent years, the widespread occurrence of antibiotic-resistant microorganisms, especially methicillin-resistant *Staphylococcus aureus* (MRSA) strains, has further complicated the treatment of purulent diseases. This increases the importance of bacteriological diagnostic methods aimed at the accurate and rapid identification of pathogens. Delayed diagnosis leads to inappropriate treatment and contributes to the progression of the disease.

Moreover, bacteriological diagnostics play a significant role in the global monitoring and control of infectious diseases. Particularly in developing countries, improving laboratory diagnostic capacities is of great scientific and practical importance for early disease detection and reducing their spread.

According to scientific sources, *Staphylococcus aureus* plays a major role in the etiology of purulent inflammatory diseases and is considered the most common causative agent of skin and soft tissue infections. International clinical studies have reported its high invasiveness and rapid adaptability to antibiotics (Suresh K Malhotra, 2012).

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Other studies evaluate classical bacteriological methods—culturing microorganisms on nutrient media, studying colony morphology, and performing biochemical tests—as the main and reliable diagnostic approach. In particular, it has been emphasized that pathogen identification through inoculation on blood agar and MacConkey media is widely used (Sunilkumar Biradar, 2021).

Modern scientific research highlights the importance of molecular diagnostic methods. Specifically, it has been noted that accurate diagnosis can be achieved in a short time by detecting the genetic material of bacteria using PCR technology. This method is especially effective in identifying antibiotic-resistant strains, including MRSA (O.E. Khokhlova, 2017).

In addition, many scientific studies emphasize the importance of antibiotic susceptibility testing methods. Through the Kirby–Bauer disk diffusion method, the sensitivity of bacteria to various antibiotics is determined, enabling the selection of an individual treatment strategy. According to studies, this method is considered one of the most widely used and effective approaches in clinical practice (M. Mohamadiya Rizwana, 2025).

**Research Methods:** This study was conducted under experimental conditions to identify bacterial pathogens involved in purulent inflammatory diseases and to assess their antibiotic susceptibility. During the research, both classical and modern bacteriological methods were applied in a comprehensive manner based on clinical samples. The following biological samples obtained from patients presenting with purulent inflammation were used in the study:

- purulent wound exudate,
- samples from skin and soft tissue infections,
- in some severe cases, blood samples.

All samples were collected under sterile conditions with strict adherence to aseptic and antiseptic rules and were promptly delivered to the laboratory.

The obtained samples were initially examined under a microscope using the Gram staining method. The preparations were dried, fixed, and stained according to the Gram method. As a result of microscopy, the morphology, arrangement, and Gram-positive or Gram-negative characteristics of the bacteria were determined. This method enabled rapid diagnosis. The samples were inoculated onto nutrient media under sterile conditions. The main nutrient media used were:

- blood agar,
- MacConkey agar.

The inoculated samples were incubated at 37°C for 24–48 hours. After incubation, the formed colonies were analyzed based on their macroscopic (color, shape, hemolysis zone) and microscopic characteristics.

To identify the isolated pure culture, a series of biochemical tests were performed, including the catalase test, coagulase test, and oxidase test.These tests were used to determine the type of bacteria and to carry out their differential diagnosis.

The antibiotic susceptibility of the isolated bacterial strains was determined using the Kirby–Bauer disk diffusion method. In this method, standard antibiotic disks were placed on Müller-Hinton agar and incubated for 24 hours. The results were evaluated by measuring the diameter of the inhibition zones, and the bacteria were classified as sensitive, moderately sensitive, or resistant.At the modern stage of the study, some samples were examined using the PCR (polymerase chain reaction) method. Through this method, DNA fragments of bacteria were identified, and the presence of antibiotic-resistant strains, especially MRSA, was confirmed.

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The PCR method was distinguished by its high sensitivity and accuracy. The obtained results were summarized and comparatively analyzed. The results of classical and molecular methods were compared to evaluate their effectiveness.

**Research Results.** During the study, a total of 30 clinical samples (purulent wound, skin infection, and blood samples) were subjected to bacteriological examination.

Table 1

**Identified microorganisms and their proportion**

| № | Microorganisms | Number (n) | Proportion (%) |
|---|---|---|---|
| 1 | *Staphylococcus aureus* | 18 | 60% |
| 2 | *Streptococcus* spp. | 5 | 16.7% |
| 3 | *Escherichia coli* | 4 | 13.3% |
| 4 | *Pseudomonas aeruginosa* | 3 | 10% |
| | **Total** | 30 | 100% |

According to the obtained results, the most common causative agent of purulent inflammatory diseases was *Staphylococcus aureus*, accounting for 60% of all cases. This indicator is consistent with the results of international scientific studies and confirms that this bacterium is the main pathogen.

*Streptococcus* spp. were identified in 16.7% of cases, ranking second. Gram-negative bacteria, particularly *Escherichia coli* and *Pseudomonas aeruginosa*, were detected less frequently; however, they were observed to play an important role in severe infectious conditions.

Table 2

**Antibiotic susceptibility results (*Staphylococcus aureus*)**

| Antibiotic name | Sensitive (%) | Resistant (%) |
|---|---|---|
| Penicillin | 30% | 70% |
| Erythromycin | 55% | 45% |
| Ceftriaxone | 75% | 25% |
| Vancomycin | 100% | 0% |

The results indicate that a large proportion of *Staphylococcus aureus* strains were resistant to penicillin (70%). This further confirms the relevance of the problem of antibiotic resistance.

Sensitivity to ceftriaxone and erythromycin was observed at a moderate level, while the highest effectiveness was recorded for vancomycin (100%). This demonstrates that vancomycin is an effective agent against resistant strains such as MRSA. Microscopic examination stood out for providing rapid results; however, its accuracy was observed to be relatively low. The culture method, while highly reliable, is limited by the long time required for results.

Table 3

**Effectiveness of diagnostic methods**

| Method | Detection time | Accuracy level |
|---|---|---|
| Microscopy | Rapid (1–2 hours) | Moderate |
| Culture method | 24–48 hours | High |

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| | | |
|---|---|---|
| PCR | 4–6 hours | Very high |

The PCR method, on the other hand, delivered highly accurate results in a short time and proved particularly effective for detecting antibiotic-resistant strains. Therefore, the combined use of these methods represents the most optimal approach in modern diagnostics.

**Conclusion.** According to the results of the study, *Staphylococcus aureus* was identified as the primary causative agent of purulent inflammatory diseases, and a high level of antibiotic resistance was observed. Although bacteriological diagnostic methods (microscopy, culture method, biochemical tests) are effective for detecting infections, the time required for the culture method is a notable limitation.

The PCR method, in contrast, provides rapid and highly accurate results and is particularly important for detecting resistant strains. Therefore, the combined use of classical and modern methods represents the most effective approach in diagnostics.

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