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THE CLINICAL AND MICROBIOLOGICAL SIGNIFICANCE OF STAPHYLOCOCCI.

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Annotation

The microbiological characteristics, pathogenicity factors, clinical significance, and antibiotic resistance mechanisms of Staphylococcus aureus were scientifically analyzed. This Gram-positive coccus is a facultative anaerobe and can be found as part of the normal microflora of the human body; however, under favorable conditions, it can cause invasive and purulent-inflammatory processes.

The bacterium's virulence factors, including coagulase, hemolysin, leukocidin, and enterotoxins, among others, contribute to tissue damage, systemic inflammatory reactions, and foodborne toxic infections. Clinically, it can lead to severe complications such as skin and soft tissue infections, pneumonia, osteomyelitis, endocarditis, bacteremia, and septic shock.

In recent years, the widespread prevalence of methicillin-resistant strains (MRSA) has complicated treatment strategies. Laboratory diagnostics include Gram staining to study morphological and tinctorial characteristics, the coagulase test, cultivation on selective media, and molecular methods. Preventive measures involve adherence to hygiene rules and the rational use of antibiotics.

The results of the study highlight the prevalence of Staphylococcus aureus infections and emphasize the importance of their control in modern microbiology and clinical practice.

Keywords

Staphylococcus aureus, Gram-positive cocci, pathogenesis, virulence factors, MRSA, antibiotic resistance, foodborne toxic infection, laboratory diagnostics, nosocomial infection, dysbiosis.

In modern medical and microbiological practice, problems related to pathogenic microorganisms that threaten human health are of urgent importance. Among these, Staphylococcus aureus holds a special place among highly invasive and virulent bacteria commonly found in hospitals and community settings. This microorganism causes purulent-inflammatory processes, invasive infections, and

severe diseases in the human body, such as sepsis, pneumonia, and toxic shock syndrome. Staphylococci exist as opportunistic pathogens within the normal microflora of human internal organs, skin, and mucous membranes. In turn, under conditions of compromised immunity or a breach in skin integrity, they transition from an opportunistic state to a truly pathogenic form. The pathogenic properties of the bacterium are associated with numerous virulence factors, including cell wall components, adhesin proteins, enzymes, and toxins. These factors enable the bacterium to adhere to host tissues, evade the immune system, and spread the infection. The bacterium's enzymes—coagulase, hyaluronidase, staphylokinase, lipase, and proteases—enhance the spread of infection and accelerate local purulent processes. Concurrently, hemolysins, enterotoxins, exfoliative toxins, and TSST-1 toxin determine the clinical manifestation of the infection, exacerbate purulent processes, and lead to the development of severe systemic diseases [2,4,7,15,22,25,26,34].

In recent years, the widespread proliferation of antibiotic-resistant strains, particularly Methicillin-resistant Staphylococcus aureus (MRSA), has posed a serious challenge to the global healthcare system. Through the mecA gene, MRSA strains produce a protein resistant to β-lactam antibiotics (PBP2a), form biofilms, and exacerbate chronic infections. The ability to form a biofilm protects the bacterium from environmental factors and antimicrobial agents, which complicates the treatment of these infections. MRSA infections manifest in both hospital-associated (HA-MRSA) and community-associated (CA-MRSA) forms. CA-MRSA strains are highly virulent and can cause severe necrotizing pneumonia and skin infections, even in healthy individuals. The extensive spread of antibiotic resistance leads to prolonged treatment durations, dysbiosis, longer hospital stays, increased economic costs, and higher mortality rates. In this context, the biological characteristics, pathogenic mechanisms, clinical manifestations, and antibiotic resistance of S. aureus are of great scientific and practical importance for modern microbiology and infectious disease practice [1,6,10,13,24,29,32,36]. Research on this topic provides an important scientific basis for the early diagnosis of bacterial infections, the development of effective treatment strategies, and the control of the spread of antibiotic-resistant strains. The emergence of antibiotic-resistant strains has further increased the clinical significance of these microorganisms. Staphylococcal infections are caused by a group of bacteria called staphylococci, which can affect various parts of the body. They are commonly found on the skin or even in the noses of healthy people. Often, these bacteria cause no problems or result in relatively minor skin infections. However, the infection can become

serious if it spreads deep into the tissues, entering the systemic bloodstream, joints, lungs, heart, and other organs [3,14,17,19,21,23,28,,30,35].

Staphylococci cause a variety of diseases, including furuncles, impetigo, arthritis, phlegmon, osteomyelitis, and several others. Staphylococcal scalded skin syndrome can be caused by toxins produced during an infection, which damages the upper layers of the skin in children and infants, leading to various skin diseases. Staphylococci are also responsible for food poisoning, one of the most common infections, which occurs when consuming food contaminated by staphylococci; this causes diarrhea, dehydration, vomiting, and nausea. Septic arthritis, another consequence, frequently leads to fever with severe pain, causing swelling in the knees, shoulder joints, fingers, and toes. Toxic shock syndrome, resulting from toxins produced during the illness, can cause high fever, rash, vomiting, nausea, mental confusion, body aches, diarrhea, and abdominal pain, and may lead to life-threatening conditions. It can also cause bacteremia, an infection of the systemic circulation where bacteria enter the bloodstream, leading to fever and sepsis [38,40,41,42,43,44,47]. Furthermore, as mentioned above, staphylococci can affect other internal organs, such as the brain, lungs, heart, bones, and muscles. They also play an important role in the development of dysbiosis in humans, which in turn causes somatic and infectious diseases in people to have a more severe course. People often carry these bacteria on their skin without immediately developing an infection. These bacteria are also transmitted from person to person and even from surfaces, as staphylococci can easily survive in dry conditions and at extreme temperatures [31,33,37,39,45,46,47]. To prevent staphylococcal infection, several precautions can be taken; keeping hands clean and avoiding trauma are the best forms of protection. Food safety measures include properly storing hot and cold foods, refrigerating leftovers, and washing dishes, cutting boards, and countertops. Personal items such as towels, razors, bedsheets, and clothing should be used in accordance with hygiene rules. Tampons left in for a long time can cause infection; change tampons frequently or switch to sanitary pads, replacing them every 6 hours. People with weakened immune systems and those with diabetes, HIV, kidney failure, or respiratory diseases are considered risk factors, and such patients are more susceptible to staphylococcal infections. Additionally, consuming contaminated food prepared by a vendor who is a carrier of staphylococcus bacteria can cause infection. A major complication associated with staphylococcal infection is that if the bacteria enter the systemic circulation, it can cause life-threatening septic shock [5,8,9,11,12,16,18,20,27].

Therefore, in the prevention and control of staphylococcal infections, we believe that ensuring strict adherence to sanitary and hygienic regulations at food

enterprises, medical and prophylactic institutions, and other facilities is the primary factor in reducing the incidence of staphylococcus-caused infections among the population.

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