

## INTEGRATED CLINICAL AND LABORATORY DIAGNOSTICS OF TONSILLITIS

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**Abstract.** Tonsillitis is one of the most common infectious and inflammatory diseases of the upper respiratory tract, characterized by involvement of the palatine tonsils and a tendency toward a recurrent course. The disease is widely observed in both children and adults and may lead to the development of local as well as systemic complications. Due to clinical polymorphism and the similarity of its symptoms to other oropharyngeal disorders, timely and accurate diagnosis of tonsillitis is of particular importance. This paper reviews the main laboratory diagnostic methods, including complete blood count, biochemical markers of inflammation, as well as microbiological, immunological, and molecular genetic techniques.

**Keywords:** Tonsillitis, Laboratory diagnosis, Inflammatory markers, Microbiological analysis, Immunological methods, Molecular genetic techniques, Upper respiratory tract infections

**Relevance.** Tonsillitis remains one of the most pressing problems in otorhinolaryngology and clinical medicine as a whole, due to its high prevalence

among various age groups, especially children, adolescents, and the working-age population. The disease is often characterized by a recurrent course and a tendency toward chronicity, which leads to a reduced quality of life, temporary disability, and significant economic costs for the healthcare system. Tonsillitis acquires particular medical and social significance because of the risk of developing severe local and systemic complications. Streptococcal etiology of the disease, primarily caused by group A  $\beta$ -hemolytic streptococcus, may lead to rheumatic fever, glomerulonephritis, infective endocarditis, and other autoimmune and inflammatory lesions of organs and systems. In this regard, timely and accurate diagnosis of tonsillitis is of fundamental importance for the prevention of late complications and unfavorable outcomes. [6,17,21].

The clinical presentation of tonsillitis is often mild or atypical, especially in chronic forms of the disease, as well as in patients with comorbid conditions and impaired immune status. This significantly complicates diagnosis based solely on clinical data and necessitates the use of modern laboratory diagnostic methods. Laboratory diagnostics make it possible to objectively assess the activity of the inflammatory process, identify the etiological factor, and determine the degree of the immune response. In recent years, modern clinical and laboratory diagnostic approaches have been actively introduced into clinical practice, including the determination of specific inflammatory markers, microbiological examination of throat swabs, rapid tests for streptococcal infection, as well as molecular genetic and immunological methods. Their use significantly increases the accuracy and speed of diagnosis, contributes to the rational prescription of antibacterial therapy, and reduces the risk of unjustified antibiotic use. [9,14,15].

Tonsillitis is an infectious and inflammatory disease of the palatine tonsils that may occur in acute or chronic forms. The inflammatory process in the tonsils develops as a result of exposure to pathogenic microorganisms against the background of reduced local and general immune defense. The diversity of clinical manifestations and etiological factors of tonsillitis determines the need for a comprehensive diagnostic

approach, in which modern clinical and laboratory diagnostics play a leading role. [6,7,10].

Clinical and laboratory evaluation of patients with tonsillitis begins with the assessment of general clinical parameters. A complete blood count is a basic diagnostic method and allows the detection of signs of a systemic inflammatory response. In acute bacterial tonsillitis, leukocytosis with a left shift of neutrophils, an increased erythrocyte sedimentation rate, and elevated band neutrophil counts are most commonly observed. In cases of viral etiology, normal leukocyte counts or moderate leukopenia with relative lymphocytosis may be present. Dynamic monitoring of hematological parameters is important for assessing the activity of the inflammatory process and the effectiveness of therapy. [7,14,15].

Biochemical laboratory diagnostic methods allow a more accurate assessment of the severity of inflammation and the risk of complications. Determination of C-reactive protein levels is of significant diagnostic value, as it reflects the intensity of the acute-phase inflammatory response. Elevated procalcitonin concentrations may indicate the bacterial nature of tonsillitis and can be used to justify the initiation of antibacterial therapy. An important laboratory marker in streptococcal infection is antistreptolysin O, an increased level of which indicates a recent or ongoing infection caused by group A  $\beta$ -hemolytic streptococcus. Microbiological diagnostics is a key stage in establishing the etiology of tonsillitis. Bacteriological examination of throat swabs makes it possible to identify the causative agent and determine its sensitivity to antibacterial drugs. However, the duration of culture-based methods and the influence of prior antibiotic therapy may limit their diagnostic value. In this context, rapid tests for the detection of group A  $\beta$ -hemolytic streptococcal antigens are increasingly used, providing rapid confirmation of streptococcal etiology of tonsillitis. [3,9,13].

Modern molecular genetic methods, primarily polymerase chain reaction (PCR), have significantly expanded the possibilities of laboratory diagnosis of tonsillitis. PCR enables the detection of the genetic material of pathogens with high sensitivity and specificity, including atypical and difficult-to-culture microorganisms. The use of these

methods is especially important in chronic forms of the disease and in recurrent tonsillitis. Immunological research methods complement the diagnostic complex and are aimed at assessing the patient's immune status. Determination of immunoglobulin levels, circulating immune complexes, and cellular immunity parameters allows for a deeper understanding of the pathogenetic mechanisms of the disease and individualization of therapeutic strategies [7,15].

Tonsillitis is a polyetiological disease whose development is caused by the impact of various infectious agents on the palatine tonsils in conditions of reduced local and general resistance of the body. Bacterial pathogens play a leading role in the etiology of tonsillitis; however, viruses and, less frequently, fungal flora are also of significant importance. The most common bacterial causative agent of acute tonsillitis is group A  $\beta$ -hemolytic streptococcus (*Streptococcus pyogenes*), which is characterized by high virulence and the ability to cause both local and systemic complications. In addition, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Haemophilus influenzae*, as well as associations of opportunistic oropharyngeal microflora may participate in the development of tonsillitis. In chronic tonsillitis, mixed bacterial flora is often detected, which maintains a prolonged inflammatory process in the tonsillar tissues [3,8,11].

The viral etiology of tonsillitis is more common in childhood and during acute respiratory viral infections. The main viral agents include adenoviruses, influenza and parainfluenza viruses, Epstein–Barr virus, rhinoviruses, and coronaviruses. Viral tonsillitis may occur as an independent disease or create favorable conditions for subsequent bacterial infection. Fungal etiology of tonsillitis is relatively rare and is mainly observed in patients with immunodeficiency states, endocrine disorders, as well as during prolonged use of antibiotics or glucocorticosteroids. The most common causative agents of fungal tonsillitis are fungi of the genus *Candida*. Factors contributing to the development of tonsillitis include hypothermia, chronic foci of infection in the oral cavity and nasopharynx, impaired nasal breathing, decreased immune reactivity, unfavorable environmental conditions, and frequent respiratory

infections. Thus, the diversity of etiological factors of tonsillitis determines the need for a comprehensive clinical and laboratory approach to the diagnosis and treatment of this disease. The clinical presentation of tonsillitis is characterized by a variety of manifestations and depends on the form of the disease (acute or chronic), the etiological factor, the patient's age, and the state of the immune system. The inflammatory process is predominantly localized in the palatine tonsils but may be accompanied by a pronounced systemic response [3,12,15].

Acute tonsillitis, or angina, usually begins suddenly and is characterized by a pronounced intoxication syndrome. The main clinical symptoms include an increase in body temperature to febrile values, chills, general weakness, headache, and muscle and joint pain. A characteristic local sign is sore throat, which worsens during swallowing and often radiates to the ears. Enlargement and tenderness of regional (submandibular and cervical) lymph nodes are also typical manifestations of acute tonsillitis. Examination of the oropharynx reveals hyperemia and edema of the palatine tonsils, arches, and soft palate. Depending on the clinical form, purulent coatings, follicular eruptions, or lacunar plugs may be observed on the tonsillar surface. The coatings are usually easily removed without leaving a bleeding surface, which has diagnostic significance [1,4,6].

Chronic tonsillitis is characterized by a prolonged, recurrent course with periods of exacerbations and remissions. Outside exacerbation, patients may complain of discomfort and irritation in the throat, halitosis, a foreign body sensation during swallowing, increased fatigue, and subfebrile body temperature. During exacerbations, clinical manifestations resemble those of acute tonsillitis but are often less pronounced. Clinical manifestations of tonsillitis may be accompanied by symptoms of damage to other organs and systems, especially in streptococcal etiology. Signs of cardiovascular, joint, and renal involvement are possible, emphasizing the importance of timely diagnosis and adequate treatment. Thus, the clinical picture of tonsillitis is often variable and nonspecific, requiring a comprehensive assessment of clinical data in combination with laboratory findings [3,15].

Laboratory diagnosis of tonsillitis is an important stage of the comprehensive clinical diagnostic process and is aimed at confirming the inflammatory nature of the disease, establishing its etiology, assessing the activity of the pathological process, and preventing possible complications. The use of modern laboratory methods allows differentiation between bacterial and viral tonsillitis and substantiates the choice of rational therapy. Complete blood count is a basic laboratory test in patients with tonsillitis. In acute bacterial tonsillitis, leukocytosis with a neutrophilic left shift, increased erythrocyte sedimentation rate, and elevated band neutrophil levels are usually detected, indicating a pronounced inflammatory response. In viral etiology, normal leukocyte counts or moderate leukopenia with relative lymphocytosis may be observed. Dynamic monitoring of complete blood count parameters allows evaluation of treatment effectiveness and disease course [1,7,15].

Biochemical research methods have significant diagnostic and prognostic value. Determination of C-reactive protein levels makes it possible to assess the intensity of inflammation and disease activity. Elevated procalcitonin levels are more commonly observed in bacterial infections and may be used for differential diagnosis between bacterial and viral tonsillitis, as well as to justify antibiotic therapy. Determination of antistreptolysin O is also important, as its elevation indicates streptococcal etiology and the risk of post-streptococcal complications.

Microbiological diagnostics are aimed at identifying the causative agent of tonsillitis and include bacteriological examination of throat swabs. Culture allows identification of the pathogen and determination of its antibiotic susceptibility. However, due to the duration of the study and the possible influence of prior therapy, rapid tests for the detection of group A  $\beta$ -hemolytic streptococcal antigens are widely used in clinical practice [3,13].

Modern molecular genetic methods, primarily PCR, provide high sensitivity and specificity in the diagnosis of tonsillitis. PCR diagnostics make it possible to detect DNA or RNA of pathogens, including viral and atypical agents, and are especially valuable in chronic forms of the disease and unclear clinical presentations.

Immunological methods complement laboratory diagnostics and are aimed at assessing the patient's immune system. Determination of immunoglobulin levels, cellular immunity indicators, and circulating immune complexes allows for a more comprehensive characterization of the pathogenetic mechanisms of tonsillitis and individualization of therapeutic approaches [6,10].

**Conclusion.** Tonsillitis is a common infectious and inflammatory disease that requires timely and accurate diagnosis. Modern laboratory methods allow determination of disease etiology, assessment of inflammatory activity, and justification of rational therapy. A comprehensive clinical and laboratory approach helps reduce the risk of complications and improves the effectiveness of treatment in patients with tonsillitis.

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