

Modern Approaches to Diagnostics and Treatment of Sinusites

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Abstract: Sinusitis is one of the most pressing problems of modern otorhinolaryngology, characterized by inflammatory lesions of the paranasal sinuses of various etiologies and pathogenesis. According to the World Health Organization, sinusitis ranks second in frequency among all diseases of the upper respiratory tract, after only acute respiratory infections, and is diagnosed annually in 10-15% of the adult population of developed countries.

Keywords: sinusitis, rhinosinusitis, endoscopic diagnostics, functional endoscopic surgery for nasal sinuses, FESS, computed tomography, chronic rhinosinusitis, acute sinusitis, polypous rhinosinusitis, balloon sinusoplasty, intranasal corticosteroids, antibacterial therapy.

Introduction

The medical and social significance of the problem of sinusitis is обусловлена its high prevalence, tendency toward a chronic course, development of serious complications, and significant impact on patients' quality of life. Economic losses associated with sinusitis in the countries of the European Union exceed 8 billion euros annually, including direct medical costs and indirect losses resulting from reduced work capacity [1]. Sinusitis refers to inflammatory diseases of the mucous membrane of the paranasal sinuses, which occupy one of the leading positions in the structure of otorhinolaryngological pathology in terms of prevalence, frequency of medical consultations, and socio-economic burden. This pathology is characterized by significant polymorphism of clinical manifestations, a wide variety of etiological factors, and diverse pathogenetic mechanisms of development, which necessitates the use of modern comprehensive approaches to diagnosis and treatment [2]. In recent decades, there has been a steady global increase in the incidence of sinusitis, which is associated with the deterioration of environmental conditions, an increased prevalence of allergic diseases, changes in microbial resistance to antibacterial drugs, and improvements in diagnostic methods that allow the detection of previously unrecognized forms of the disease. According to epidemiological studies, acute sinusitis is diagnosed in 6–15% of the adult population annually, while chronic forms affect 10–12% of the population in developed countries [3].

The modern concept of sinusitis diagnosis is based on the principles of evidence-based medicine and involves the use of standardized clinical criteria in combination with objective diagnostic methods. Endoscopic diagnosis has become the gold standard for visualizing the nasal cavity and paranasal sinuses, providing a detailed assessment of anatomical structures, the nature of the inflammatory process, and the effectiveness of treatment. Imaging methods, including computed tomography (CT) and magnetic resonance imaging (MRI), allow comprehensive evaluation of the extent of the pathological process and facilitate planning the scope of surgical intervention [4]. Therapeutic approaches to the treatment of sinusitis have undergone significant evolution with the introduction of new pharmacological agents, improvements in drug delivery methods to the site of inflammation, and the development of minimally invasive surgical technologies. The modern treatment strategy is based on a personalized

approach, taking into account etiological factors, phenotypic characteristics of the disease, comorbid conditions, and individual patient characteristics [5]. Surgical treatment of sinusitis has evolved from radical procedures to function-preserving endoscopic operations, aimed at restoring natural ventilation and drainage of the paranasal sinuses while preserving anatomical structures and physiological functions as much as possible. The introduction of navigation systems, balloon sinuplasty, and other innovative technologies has significantly improved the effectiveness and safety of surgical interventions [6]. The relevance of modern approaches to the diagnosis and treatment of sinusitis is determined by a combination of medical, social, and economic factors, which necessitate the continuous improvement of methods for providing specialized care to patients with this pathology [7].

The medical relevance is обусловлена the high prevalence of sinusitis in the population, reaching 134 cases per 1,000 adults per year for acute forms and 52 cases per 1,000 population for chronic variants of the disease. Of particular concern is the increasing incidence of chronic sinusitis, which has risen by 37% over the past 15 years, associated with increased life expectancy, a higher prevalence of allergic diseases, and immunodeficiency conditions. The significant heterogeneity of clinical manifestations of sinusitis, including various disease phenotypes (eosinophilic, neutrophilic, mixed), requires the application of personalized diagnostic and therapeutic approaches. Traditional diagnostic methods do not always allow accurate determination of the disease endotype or prediction of therapeutic response, which necessitates the introduction of modern biomarkers and molecular-genetic research methods. The problem of antibiotic resistance among sinusitis pathogens is becoming increasingly important in clinical practice. According to multicenter studies, resistance of *Streptococcus pneumoniae* to penicillin reaches 15–25% in various regions, while *Haemophilus influenzae* resistance to ampicillin ranges from 20–40%, which requires reconsideration of traditional antibacterial therapy regimens and the development of new therapeutic strategies. The social relevance is determined by the significant impact of sinusitis on patients' quality of life. Chronic sinusitis has a negative impact comparable to such diseases as chronic obstructive pulmonary disease, congestive heart failure, and angina pectoris. Patients with chronic sinusitis demonstrate a reduction in physical functioning by 25–40%, emotional well-being by 30–45%, and social functioning by 20–35% compared with the healthy population. Sinusitis is one of the leading causes of temporary disability among adults, accounting for 18–25 million days of work incapacity annually in European Union countries. In children, sinusitis leads to an average of 3.5–5.2 missed school days per year, negatively affecting the educational process and creating additional burdens for parents.

The economic relevance is обусловлена significant direct and indirect costs associated with sinusitis. Total economic losses due to sinusitis in the United States exceed 13 billion dollars annually, while in the European Union they reach approximately 8 billion euros. Direct medical costs include expenses for diagnosis (15–20% of total costs), conservative treatment (45–55%), and surgical interventions (25–35%) [8]. Indirect economic losses associated with reduced labor productivity account for 65–70% of the total economic burden of sinusitis. The average cost of treating one patient with acute sinusitis ranges from 350 to 580 USD, while treatment of chronic sinusitis costs 1200–2400 USD per year, creating a substantial burden on healthcare systems [9].

Scientific and technological relevance is determined by the emergence of new diagnostic and therapeutic technologies that require scientific justification and clinical validation. The introduction of molecular diagnostic methods, including the determination of inflammatory biomarkers (periostin, eosinophilic cationic protein, interleukins), opens new opportunities for phenotyping sinusitis and personalizing therapy. The development of pharmacogenomics makes it possible to predict individual sensitivity to different groups of medications and optimize pharmacotherapy for sinusitis. Polymorphisms of genes encoding drug-metabolizing enzymes (CYP2C19, CYP3A4), receptors (ADRB2, LTC4S), and transporter proteins (ABCB1) influence the effectiveness and safety of therapy, which should be considered when choosing treatment strategies [10]. Biological therapy of sinusitis using monoclonal antibodies (dupilumab, omalizumab, mepolizumab) represents a revolutionary approach to the treatment of severe forms of the disease that are resistant to traditional therapy. However,

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the high cost of biological drugs requires pharmacoeconomic studies to justify their use in clinical practice [11].

Organizational relevance is associated with the need to improve the healthcare delivery system for patients with sinusitis at different levels of the healthcare system. Modern clinical guidelines recommend a differentiated approach to patient management depending on disease severity, the presence of complications, and response to previous therapy [12].

Primary healthcare should ensure early diagnosis of sinusitis, differentiation between viral and bacterial forms, rational prescription of antibacterial therapy, and timely referral to specialists when treatment is ineffective. Specialized care includes endoscopic diagnostics, comprehensive allergological examination, and planning and performing surgical interventions. The introduction of telemedicine technologies improves access to specialized care, enables remote consultations, and facilitates monitoring of treatment effectiveness. Augmented reality systems and artificial intelligence are increasingly used in surgical planning and intraoperative navigation [13].

Educational relevance is обусловлена the need for continuous professional development of medical personnel due to the rapid advancement of diagnostic and treatment methods for sinusitis. Modern educational programs should include training in endoscopic diagnostic techniques, interpretation of imaging data, rational use of antibacterial and anti-inflammatory drugs, and the techniques of functional endoscopic surgery [14].

Simulation-based training allows healthcare professionals to practice practical skills in a safe environment and improves the quality of specialist training. Virtual simulators for endoscopic surgery enable repeated practice of procedures and reduce the risk of complications during the learning process.

Thus, the relevance of modern approaches to the diagnosis and treatment of sinusitis represents a multifaceted problem that requires the integration of achievements in fundamental science, clinical medicine, healthcare organization, and medical education in order to ensure optimal treatment outcomes and improve the quality of life of patients [15].

Conclusion

Modern diagnosis of sinusitis is based on an integrative approach that combines standardized clinical criteria (EPOS 2020), endoscopic examination of the nasal cavity, and computed tomography of the paranasal sinuses. The implementation of symptom assessment systems (SNOT-22, VAS) and endoscopic scoring scales (Lund–Kennedy, Lanza–Kennedy) ensures the objectification of diagnosis and monitoring of treatment effectiveness. Phenotyping of chronic sinusitis based on cytological examination of secretions (eosinophilic, neutrophilic, mixed types) and the determination of inflammatory biomarkers (periostin, eosinophilic cationic protein, IL-4, IL-5, IL-13) allows for the personalization of therapeutic approaches and prediction of treatment response with an accuracy of 85–92%.

Rational antibacterial therapy for acute bacterial sinusitis should be based on local data on pathogen resistance and include first-line drugs (amoxicillin/clavulanate 875/125 mg twice daily) with a treatment duration of 7–10 days. In cases of β -lactam allergy, respiratory fluoroquinolones (levofloxacin 750 mg once daily for 5 days) serve as an alternative. Topical anti-inflammatory therapy with intranasal corticosteroids (mometasone, fluticasone, budesonide) represents the cornerstone of treatment for chronic sinusitis, providing clinical improvement in 73–89% of cases with long-term use (at least 3–6 months) and demonstrating a favorable safety profile. Functional endoscopic sinus surgery (FESS) remains the gold standard of surgical treatment when conservative therapy is ineffective, improving quality of life in 78–92% of cases. The use of navigation systems increases surgical accuracy and reduces the risk of complications to 0.8–2.1%.

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