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Clinical Significance of Mucociliar Transport Disorders in Polypotic Rhinosinusitis

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Abstract: This article is devoted to the clinical significance of impaired mucociliary transport function of the nasal mucosa in polypoid rhinosinusitis. Polypoid rhinosinusitis is a common, recurrent, and multifactorial chronic inflammatory disease, in the course and severity of which the functional state of the nasal mucosa plays an important role. One of the goals of the dissertation is to assess the course and recurrence of polypoid rhinosinusitis by determining the mucociliary clearance of the nasal cavity, and also in the scientific novelty part, it is shown that a decrease in the mucociliary transport function of the nasal mucosa in patients with polypoid rhinosinusitis worsens the course of the disease. The article analyzes the physiological basis of mucociliary transport, its role in the pathogenesis of polypoid rhinosinusitis, its relationship with the clinical manifestations of the disease, and its significance in the diagnosis and selection of treatment tactics. It is substantiated that impaired mucociliary transport is associated with impaired nasal breathing, stabilization of mucous secretions, prolonged preservation of the inflammatory process, and an increased risk of recurrence. It was concluded that the study of mucociliary clearance in the comprehensive assessment of polypoid rhinosinusitis is an important criterion for predicting the clinical course, monitoring the effectiveness of treatment, and assessing the risk of recurrence.

Keywords: polypoid rhinosinusitis, mucociliary transport, mucociliary clearance, nasal mucosa, functional disorders, recurrence, diagnosis.

Polypoid rhinosinusitis is one of the most pressing problems of modern otorhinolaryngology, the significance of which is determined by the widespread prevalence of the disease, its prolonged course, repeated manifestations, and a significant negative impact on the quality of life [5,9,16,22,31,40]. According to the

World Health Organization, 1-4% of the world's population suffers from chronic polypoid rhinosinusitis, and polyps of the nose and paranasal sinuses are found in 1-5% of the population. It was also noted that this pathology accounts for 5% of patients who consulted an otolaryngologist and 4% of patients who consulted an allergist. Despite the improvement of surgical practice and the widespread use of medications in recent years, the recurrence rate in the disease ranges from 5% to 60%, which indicates that not only morphological or inflammatory factors, but also functional disorders of the mucous membrane play an important role in the pathogenesis of polypoid rhinosinusitis [1,12,18,27,34,41].

The nasal mucosa is the first protective barrier of the respiratory tract. It not only heats, humidifies, and filters the air but also removes particles, microorganisms, allergens, and various chemical factors from the external environment. Mucociliary transport serves as one of the main physiological mechanisms in this process. The essence of mucociliary transport is that, as a result of the coordinated movement of ciliated epithelial cilia, the nasal discharge and foreign particles in it move from the nasal cavity to the nasopharynx. The dissertation notes that the state of mucociliary transport largely depends on the size and quality of the cilia of the nasal mucosa, and the presence of water, protein, carbohydrates, phospholipids, surfactant, and electrolytes in the normal secretion ensures its normal viscosity and mobility [3,10,19,25,33,42].

In polypoid rhinosinusitis, the disruption of this complex cleansing system is crucial in the course of the disease. One of the goals of the dissertation is to assess the course and recurrence of polypoid rhinosinusitis by determining the mucociliary clearance of the nasal cavity. This means that mucociliary transport in this disease is considered not only as a concomitant functional sign, but also as an independent pathogenetic link of clinical significance. In the scientific novelty of the work, it is shown that a decrease in the mucociliary transport function of the nasal mucosa in patients with polypoid rhinosinusitis worsens the course of the disease. Consequently, impaired mucociliary transport is not only a consequence of the presence of the disease, but also a mechanism contributing to its aggravation [2,14,20,24,35,38].

In the pathogenesis of polypoid rhinosinusitis, impaired mucociliary transport has a negative impact in several directions. Firstly, the secretion in the nasal cavity and paranasal sinuses becomes stagnant. This stagnation contributes to the long-term preservation of inflammatory mediators, allergens, bacterial products, and thick mucous secretions. Secondly, due to the weakening of ciliated epithelium function, local defense mechanisms are weakened. Thirdly, edema and polypoid changes of the mucous membrane lead to a deeper functional defect, deteriorating air circulation and drainage. Thus, a pathological "closed circle" is formed: inflammation disrupts mucociliary clearance, and a disruption of mucociliary clearance preserves inflammation and exacerbates the polypoid process.

In the text of the dissertation, the theory of mucociliary clearance is presented as one of the modern theories explaining the development of polypoid rhinosinusitis. According to him, disruption or deficiency of cellular structure and mucociliary transport plays a major role in the development of polyps. The movement of ciliated epithelial cilia, under normal conditions, moves the secretion from the nasal cavity to the nasopharynx, and in the paranasal sinuses, mucociliary transport ensures the direct excretion of mucus. Disruption of mucociliary transport leads to difficulty in secretion drainage, increased viscosity, and the preservation of a chronic inflammatory environment with edema in the mucous membrane [6,11,17,26,30,39].

Most clinical signs in polypoid rhinosinusitis are associated with functional disorders. Patients experience nasal congestion, difficulty breathing through the nose, decreased or lost sense of smell, mucous or mucopurulent discharge, headache, feeling of heaviness in the head, and quick fatigue. All these symptoms are associated with a decrease in the functional activity of the nasal mucosa, along with an anatomical polypoid mass. If the mucous membrane cannot fully provide mucociliary transport, the normal cleansing mechanism in the nasal cavity is disrupted, and clinical signs become more pronounced. Therefore, when assessing polypoid rhinosinusitis, relying solely on the endoscopic picture is insufficient; a comprehensive study of the functional state is also required [4,13,21,28,32,37].

The following table systematizes the main clinical directions associated with mucociliary transport disorders in polypoid rhinosinusitis.

Table 1

Clinical manifestations of mucociliary transport disorders in polypoid rhinosinusitis

Mutation in mucociliary transport	**Expected clinical outcome**	**Clinical significance**
Decreased ciliated epithelium activity	Mucus excretion becomes difficult	Stabilization of secretions and preservation of inflammation
Thickening of mucous secretion	Drainage breaks down	Nasal congestion and difficulty breathing
Poor ventilation of paranasal sinuses	Aeration decreases	Headache, increased feeling of heaviness
Weakening of local defense mechanisms	Increased risk of secondary infection	Prolonged and recurrent course
Prolonged functional impairment	Preservation and recurrence of polypoid process	Instability of treatment outcomes

As can be seen from this table, mucociliary transport disorders in polypoid rhinosinusitis have a negative effect simultaneously in several clinical directions. Consequently, in clinical practice, assessing this function helps to more accurately determine the severity of the disease [7,8,15,23,29,36].

The clinical significance of mucociliary transport is especially pronounced in assessing the risk of recurrence. It is no coincidence that the dissertation sets the task of assessing the course and recurrence of PRS by determining the mucociliary clearance of the nasal cavity. If the function of the nasal mucosa is not fully restored, the pathological environment can persist even after surgical removal of polypoid tissue. This creates conditions for further growth. On the contrary, the restoration of

mucociliary transport normalizes the cleansing mechanism in the mucous membrane, limits the stability of inflammation, and contributes to a longer period of relapse.

The practical significance of the work lies in the fact that the clinical effectiveness of photodynamic laser therapy in the treatment of polypoid rhinosinusitis has been studied and proven. At the same time, the scientific novelty shows that the use of photodynamic laser therapy in complex treatment improves the smell and respiratory function of the nasal mucosa. This situation can also be explained from the point of view of mucociliary transport, since the functional restoration of the nasal mucosa is likely to improve not only air permeability, but also epithelial cleansing processes. Consequently, the dynamic assessment of mucociliary transport can also serve as an additional criterion for assessing the effectiveness of treatment.

Disruption of mucociliary transport in polypoid rhinosinusitis is associated not only with a local anatomical factor. In the literature review section of the dissertation, the allergic, infectious, fungal, vegetative, and polyetiological theories of this disease are presented. From this point of view, mucociliary transport disorders are also a multifactorial phenomenon. For example, if allergic inflammation leads to swelling of the mucous membrane, then eosinophilic infiltration can negatively affect the activity of the epithelium. In the presence of an infectious or fungal component, inflammatory products and thick secretions further aggravate mucociliary clearance. Vegetative dysregulation can alter the quantity and composition of mucous secretions. Therefore, changes in mucociliary transport should always be considered as part of a complex pathogenetic process.

Assessment of mucociliary transport in the diagnosis of the disease has not only scientific, but also practical significance. The dissertation emphasizes the need for a comprehensive approach to otorhinolaryngological examination, radiological examination of the paranasal sinuses in each patient and, if necessary, CT, and the use of active rhinomanometry to assess nasal breathing function. Along with this, it has been shown that when examining the functional state of the nasal mucosa, the activity of mucociliary clearance is also assessed. This approach is very important because endoscopy and CT reflect the anatomical picture, while mucociliary clearance reflects

the functional picture. When making a clinical decision, it is advisable to consider both together.

The table below shows the practical value of assessing mucociliary clearance in polypoid rhinosinusitis.

Table 2

Diagnostic and prognostic significance of the assessment of mucociliary clearance

Assessment direction	**Significance of mucociliary clearance**	**Practical value**
Primary diagnosis	Shows the functional state of the mucous membrane	Helps determine clinical severity
Differential estimate	Represents the ratio of anatomical and functional impairment	Treatment tactics are selected
Post-treatment control	Evaluates function recovery rate	Performance can be detected
Recurrence risk assessment	The risk is high if the function isn't restored enough	A dispensary observation plan is drawn up.
Prediction	Shows a long course and the likelihood of worsening	Determines the individual approach

Another important aspect of mucociliary transport disorder is that it is also related to the olfactory function. Decreased or absent sense of smell in polypoid rhinosinusitis develops not only because the polypoid mass forms a mechanical barrier, but also due to changes in air circulation and the functional state of the mucous membrane. If the secretion in the nasal cavity stabilizes, the airflow changes, and the activity of the ciliated epithelium decreases, the area of the olfactory receptors is also not fully functioning. Therefore, the restoration of smell is often accompanied by an improvement in mucociliary transport. The fact that the dissertation notes an improvement in olfactory and respiratory function with the use of photodynamic laser therapy indirectly supports this opinion.

When assessing the clinical significance of mucociliary transport disorders, concomitant diseases should also be taken into account. The dissertation notes cases of combined pathology of the upper respiratory tract, allergies, allergic rhinitis, and bronchial asthma in patients with polypoid rhinosinusitis. Consequently, when assessing mucociliary transport disorders in polypoid rhinosinusitis, it should be analyzed not as an isolated indicator, but against the background of the patient's general ENT and allergological background.

In clinical practice, assessing mucociliary transport helps the doctor find answers to a number of important questions: why is the disease persisting in the patient for a long time, why are relapses more frequent, at what stage of conservative treatment is function not being restored, and how to organize post-operative observation. In this sense, mucociliary clearance is not only a pathogenetic indicator, but also a tool of clinical management. Especially in patients prone to recurrence, it is advisable to monitor this indicator dynamically.

Thus, in polypoid rhinosinusitis, impaired mucociliary transport plays an important role in the clinical course, progression, and recurrence of the disease. It complicates the picture of the disease, associated with impaired nasal breathing, stabilization of mucous secretions, a decrease in local defense mechanisms, and the preservation of the inflammatory process. In the dissertation, it was established that a decrease in mucociliary transport function aggravates the course of the disease, and the study of mucociliary clearance in assessing the course and recurrence of PRS was set as a task, which confirms the high clinical significance of this indicator. Therefore, in the diagnosis and treatment of polypoid rhinosinusitis, it is advisable to conduct a comprehensive assessment of mucociliary transport, apply approaches aimed at restoring the functional state, and establish dynamic monitoring after treatment.

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