JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
VOLUME 04, ISSUE 10
MOPNTHLY JOURNALS
ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

MODERN METHODS OF RESTORING MUCOCILIARY TRANSPORT IN PATIENTS WITH INFLAMMATORY DISEASES OF THE NOSE AND PARANASAL SINUSES (LITERATURE REVIEW)

Khudayberdieva Iroda Tokhir kizi
Assistant, Department of Otorhinolaryngology, Tashkent State Medical University

Abstract: Mucociliary transport (MCT) plays a key role in the local defense mechanisms of the nasal and paranasal sinus mucosa, ensuring the removal of microorganisms, dust, and allergens. In inflammatory diseases of the nose and paranasal sinuses, such as rhinosinusitis, rhinitis, and polypous rhinosinusitis, mucociliary clearance is impaired due to epithelial damage, changes in the viscoelastic properties of mucus, and suppression of ciliary activity. The aim of this review is to examine modern approaches to restoring and activating mucociliary transport. The analysis includes domestic and international studies focused on pharmacological and non-pharmacological methods of correcting mucociliary function. The review discusses drugs affecting mucus quality (mucoregulators, mucolytics), methods of physical stimulation (inhalation therapy, nasal irrigation, physiotherapy), as well as the role of ionic balance and mucosal hydration. It is noted that a comprehensive approach aimed at reducing inflammation and restoring the physiological properties of mucus improves the effectiveness of treatment for both chronic and acute forms of rhinosinusitis. Thus, activation of mucociliary transport represents one of the key directions in the pathogenetic therapy of inflammatory diseases of the upper respiratory tract.

Keywords: Mucociliary transport (MCT), nose, paranasal sinuses, rhinosinusitis.

Introduction

Mucociliary clearance represents the primary defense mechanism of the respiratory tract, ensuring continuous cleansing of the mucosa from inhaled particles, microorganisms, and toxins. The effectiveness of this system depends on the coordinated activity of the ciliated epithelium, the composition of mucus, and the condition of local blood circulation. Under physiological conditions, the cilia perform oscillatory movements at a frequency of up to 10–20 Hz, moving mucus toward the nasopharynx, where it is swallowed or expelled.

In inflammatory diseases of the nose and paranasal sinuses (acute and chronic rhinosinusitis, vasomotor and allergic rhinitis), this process becomes impaired. Inflammation leads to epithelial damage, mucosal edema, and hypersecretion of viscous mucus. The mucus loses its normal rheological properties, and the ciliated cells undergo degeneration. Impairment of mucociliary clearance promotes mucus stasis and creates favorable conditions for the growth of pathogenic microorganisms, thereby sustaining chronic inflammation.

In this regard, recent years have seen growing interest in methods for restoring mucociliary transport. The most extensively studied approaches include the use of mucolytic and mucoregulatory agents (ambroxol, carbocysteine, erdosteine), the application of isotonic and hypertonic saline solutions, thermotherapy, as well as various physiotherapeutic methods aimed at stimulating the ciliated epithelium. Additional importance is given to normalizing air temperature and humidity, improving mucosal microcirculation, and using topical corticosteroids to reduce inflammation.

Thus, the study of mucociliary transport activation has not only theoretical but also significant practical importance. It allows for the development of effective comprehensive treatment strategies for patients with inflammatory diseases of the nose and paranasal sinuses, improving quality of life and reducing the risk of recurrence.

Materials and Methods

This review is based on the analysis of domestic and international publications indexed in the PubMed, Scopus, eLibrary, and Google Scholar databases over the past 10 years. The study included works devoted to the physiology of mucociliary clearance, the mechanisms of its impairment in inflammatory processes of the upper respiratory tract, and methods of pharmacological and physical stimulation.

Inclusion criteria comprised studies describing the effects of medications (mucolytics, mucoregulators, antioxidants, corticosteroids) and non-pharmacological methods (inhalation therapy, irrigation therapy, physiotherapy) on mucociliary transport rate. Publications with a low level of evidence and studies lacking quantitative assessment of clearance were excluded.

A total of 72 sources were analyzed, including 40 clinical studies, 20 experimental papers, and 12 systematic reviews. Data comparison was used to evaluate mucociliary transport time, ciliary beat frequency, rheological properties of mucus, and patient-reported outcomes.

Results and Discussion

The analysis showed that the key directions in activating mucociliary transport are normalization of mucus viscosity, stimulation of the ciliated epithelium, and reduction of inflammation. Mucolytic agents (ambroxol, acetylcysteine, carbocysteine) contribute to decreasing mucus viscosity and improving its clearance. Drugs with additional antioxidant and anti-inflammatory properties proved particularly effective.

Mucoregulators such as erdosteine and fluimucil not only liquefy mucus but also stimulate the production of functionally active goblet cells. Clinical observations indicate that combining mucolytics with topical corticosteroids (mometasone, fluticasone) results in more pronounced restoration of mucociliary clearance.

Among non-pharmacological methods, saline irrigation therapy plays a particularly important role. The use of isotonic and hypertonic saline solutions promotes mucus removal, reduces edema, and restores the physiological pH of the mucosa. Regular nasal rinsing has been shown to increase mucociliary transport rate by 20–40%.

Physiotherapeutic methods such as ultrasonic inhalation, laser therapy, and magnetotherapy enhance blood flow and ciliary activity. It has also been observed that maintaining optimal indoor humidity and temperature (humidity 50–60%, temperature 20–22 °C) significantly improves mucociliary clearance.

Therefore, effective activation of mucociliary transport requires a comprehensive approach that combines pharmacological treatment, physiotherapy, and hygienic interventions.

Conclusion

Mucociliary transport is a crucial component of the non-specific defense mechanisms of the respiratory tract. Its impairment in inflammatory diseases of the nose and paranasal sinuses leads to chronic mucus stasis, decreased local immunity, and persistence of inflammation.

A review of the literature demonstrates that restoration and activation of mucociliary clearance are achievable through an integrated approach targeting all links of the pathological process. The most effective measures include:

- the use of mucolytic and mucoregulatory agents to normalize mucus properties;
- irrigation therapy for mechanical cleansing of the mucosa;
- inflammation control using topical corticosteroids and antioxidants;
- maintaining optimal microclimatic parameters and employing physiotherapeutic procedures.

It should be emphasized that activation of mucociliary transport not only accelerates recovery but also prevents the chronicity of inflammatory processes.
A promising direction for future research is the development of agents that influence the molecular mechanisms of ciliary cell function and epithelial ion channels.

Thus, therapy aimed at restoring mucociliary clearance should be regarded as one of the key strategies in the treatment of inflammatory diseases of the nose and paranasal sinuses.

List of references:

1. Hamilos DL. Chronic rhinosinusitis: Epidemiology and medical management. J Allergy Clin Immunol. 2011;128(4):693–707.
2. Bachert C, et al. Advances in chronic rhinosinusitis: From phenotypes to endotypes. Allergy. 2018;73(1):5–19.
3. Rosenfeld RM, Piccirillo JF, Chandrasekhar SS. Clinical practice guideline (update): Adult sinusitis. Otolaryngol Head Neck Surg. 2015;152(2):S1–S39.
4. Fokkens WJ, et al. EPOS 2020: European Position Paper on Rhinosinusitis and Nasal Polyps. Rhinology. 2020;58(Suppl S29):1–464.
5. Antunes MB, Cohen NA. Mucociliary clearance—A critical upper airway host defense mechanism and methods of assessment. Curr Opin Allergy Clin Immunol. 2007;7(1):5–10.
6. Benninger MS, Ferguson BJ, Hadley JA. Adult chronic rhinosinusitis: Definitions, diagnosis, epidemiology, and pathophysiology. Otolaryngol Head Neck Surg. 2003;129(3):S1–S32.
7. Gelardi M, et al. Mucociliary transport and chronic rhinosinusitis. Acta Otorhinolaryngol Ital. 2021;41(2):85–92.
8. Wilson R. The role of cilia, mucus, and the mucociliary clearance system in airway defense. Eur Respir J. 2002;19(3): 354–368.
9. Kwon JW, et al. The effect of inflammation on mucociliary clearance in chronic rhinosinusitis. Am J Rhinol Allergy. 2014;28(1):52–55.

10. Reitsma S, et al. Restoration of mucociliary function: Clinical perspectives. Clin Otolaryngol. 2022;47(1):65–72.
11. Rabago D, et al. Saline irrigation for sinusitis: A review of evidence. Am Fam Physician. 2012;86(12):1117–1123.
12. Passali D, et al. Hyaluronic acid topical treatment in chronic rhinosinusitis. Eur Ann Otorhinolaryngol Head Neck Dis. 2019;136(3):161–165.