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THE CONDITION OF MUCOCILIARY CLEARANCE IN PATIENTS WITH NASAL SEPTUM DEVIATION AND POSTNASAL DRIP SYNDROME

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Summary

Introduction. Mucociliary clearance is a vital defense mechanism in the human upper respiratory tract that safeguards the body against inhaled harmful substances. Ciliary activity was first discovered by Sharpey in 1835, and it took nearly a century for this function to be recognized as a central component in the physiology of the sinuses.
The aim of this study is to investigate the status of mucociliary clearance in patients with a nasal septum deviation and concomitant postnasal drip syndrome.
Materials and Methods: A total of 54 patients, aged between 23 and 55 years, were enrolled in the study. All participants underwent a saccharin test and an assessment of the motor activity of the ciliated epithelium. Exclusion criteria included the presence of infectious and inflammatory diseases of the upper respiratory tract within the last month.
Results: In the control group of patients, no significant difference was observed in the speed of saccharin test passage, both in the right and left parts of the nasal cavity, with test times ranging from 8.35 to 14.52 minutes. However, in the second clinical group comprising patients with nasal septum deviation, the average time for the saccharin test on the mucous membrane of the concave side of the nasal septum was significantly longer than on the convex side, measuring 21.52 ± 3.04 minutes and 12.36 ± 2.73 minutes, respectively (P = 0.02). When assessing the data from patients in the third clinical group based on the curvature side, a significant difference ($P < 0.05$) was observed in the reduction of saccharin test speed compared to the control group.
Conclusions: The data obtained indicate a significant influence of nasal septum deviation on subsequent changes in nasal cavity physiology, resulting in a slowdown of mucociliary clearance. This can lead to excessive mucus stagnation in the nasal cavity and, consequently, the development of postnasal drip syndrome.

Key words: **nasal septum deviation, postnasal drip syndrome, mucociliary transport, nasal cavity, nasal obstruction**

INTRODUCTION

Mucociliary clearance (MCC), a vital key defense mechanism in the human upper respiratory tract, serves to protect the body from inhaled harmful substances. MCC is a cleansing system that operates to transport the mucus lining the nasal mucosa towards the pharynx. The epithelium of the nasal cavity is lined with cilia that beat at a frequency of 7-16 Hz at normal body temperature [13]. MCC depends on two principal components: the physicochemical properties and quantity of mucus, as well as the properties of the moving cilia (frequency, beating, and coordination) [2].

For the first time, ciliary activity was discovered in 1835 by Sharpey, and only in the past century, this function began to be regarded as a leading link in the physiology of the nasal sinuses [2, 14]. W. Messerklinger was the first to study the direction of mucus movement in the nasal cavity and paranasal sinuses, as well as the drainage pathways for each of the paranasal sinuses. He established the theory of sinusitis pathogenesis and also hypothesized that some areas of the nasal cavity and paranasal sinuses have better drainage due to faster MCC [7]. The photo and video recording of ciliated epithelial cell activity was first conducted by A. Proetz in 1953, but at that time, the method faced significant technical challenges and did not gain widespread use [9].

According to the literature, it is the insufficiency of MCC that is considered one of the key factors in the development of inflammatory conditions in the nasal cavity and the emergence of postnasal drip syndrome. The mechanisms underlying the formation of morphofunctional changes in MCC remain poorly understood, and existing data are highly contradictory. Therefore, there is a significant focus on studying the functioning of ciliated epithelial cells [2]. Despite the accumulation of a substantial amount of information, many questions remain unresolved at present.

The «gold standard» in the study of mucociliary clearance is considered to be the saccharin test, as it is the simplest to administer, non-invasive, widely accessible, and reliable method. This method provides an integrated assessment of the state of mucociliary transport, as the results depend on the condition of both components of clearance (the rheological properties of mucus and the motility of ciliated epithelium). However, despite its numerous advantages, this method of assessing the transport function of the nasal cavity's mucous membrane is subjective, as it indirectly evaluates the state of mucociliary clearance based solely on the patient's sensations. Consequently, there are limitations in using the saccharin test, including early childhood, altered taste sensitivity, and psychiatric disorders. Furthermore, this method provides only a general assessment of MCC, without offering specific information about the state of each of its components [3].

THE AIM OF THE STUDY

To investigate the state of mucociliary clearance in patients with nasal septum deviation and the presence of postnasal drip syndrome.

MATERIALS AND METHODS

The study included 54 patients aged between 23 and 55 years. All patients underwent a saccharin test and an assessment of ciliary epithelial motility as the standard diagnostic method for evaluating MCC function. The first clinical group comprised 18 patients diagnosed with nasal septum deviation. The second clinical group consisted of 16 patients diagnosed with nasal septum deviation and postnasal drip syndrome. The control group consisted of 20 patients who did not have nasal septum deviation or acute ENT pathology. Exclusion criteria for the study included the following: age less than 18 years, presence of atopic pathology, cardiovascular and neurological diseases, chronic sinusitis, as well as a history of prolonged use of nasal decongestants. For the control group, exclusion criteria also involved the presence of infectious and inflammatory diseases of the upper respiratory tract within the last month.

MEASUREMENT OF MUCOCILIARY CLEARANCE

The measurement of mucociliary clearance was conducted using the saccharin test, as described by Rutland and Cole [11]. Patients included in the study were informed that prior to the examination, they should refrain from taking anesthetics, analgesics, nasal sprays, as well as abstain from alcohol and caffeine-containing beverages for 12 hours. Patients were instructed to sit with their heads minimally tilted and to avoid speaking, sniffing, sneezing, coughing, or clearing their throats. A quarter tablet of saccharin was placed 0.5 cm behind the anterior end of the lower nasal turbinate. Patients were asked to swallow every 60 seconds. A normal saccharin test time was considered to be between 7 and 15 minutes, while times exceeding 20 minutes were considered pathological [4].

RESULTS

We analyzed the data from a study involving 54 patients. The average age of the patients was 45.34 ± 8.3 years. The distribution of patients across clinical groups by age and gender is presented in Table 1.

Table 1

Distribution of patients by age and gender

Age	Gender	
	Female (n=30)	Male (n=24)
18-45	15	14
46-65	15	10

Analyzing the data obtained in our study, we did not observe a significant difference in the speed of saccharin test passage in the control group of patients, both in the right and left sides of the nasal cavity. The saccharin test times ranged from 8.35 to 14.52 minutes (Table 2). In contrast, in the first clinical group of patients with nasal septum deviation, the average time for the saccharin test on the mucous membrane of the concave side of the nasal septum was significantly longer than on the convex side, measuring 21.52±3.04 minutes and 14.36±2.73 minutes, respectively (P = 0.021). When assessing the data of patients in the second clinical group with nasal septum deviation and the presence of postnasal drip syndrome, we observed a significant difference ($P < 0.05$) in the reduction of saccharin test speed compared to the control group on the side of deviation. The saccharin test speed on the concave side in patients with nasal septum deviation and postnasal drip syndrome was 22.37±6.85 minutes and did not show a significant difference compared to the results of the mucous membrane test in patients in the control group (P = 0.035).

Table 2

The average values of saccharin test times for the mucous membrane of the nasal cavity in patients from the three clinical groups

Group	Nasal cavity	Saccharin test value, min	P
Control	Right side	11.06±3.53	
	Left side	11.26±4.32	
I	Curved side	14.36±2.73	0.111
	Concave side	21.52±3.04	0.021
II	Curved side	22.37±6.85	0.035
	Concave side	25.32±4.42	0.043

DISCUSSION

In our conducted research, we observed an increase in the saccharin test's speed on the concave side of the deviated nasal septum, corresponding to the convex side. Our literature analysis also provided data on a significant increase in the saccharin test speed in patients with nasal septum deviation. However, in some studies, contrasting data were presented. For example, Passali et al. found that the saccharin test time in patients with a deviated nasal septum was practically the same as in the control group [8]. Such discrepancies in research results may be due to the fact that mucociliary transport in different nasal cavities was not considered independently. The observed deviations on the concave side of the nasal septum may result from acute and chronic inflammatory processes in the nasal cavity, which are caused by changes in the aerodynamic airflow of inhaled air. This can also lead to an increased loss of cilia in the mucous membrane of the septum on the concave side. This could be due to an increased nasal cavity volume and stronger irritation of the mucous membranes caused by intensified airflow passing through them. This was also confirmed in a study by Kumar L. [5]. Analyzing the data, the authors found that the mucosa exhibited atrophic-degenerative changes on the concave side of the nasal septum.

The mucociliary clearance serves as the first barrier of the nasal cavity and paranasal sinuses against various biological and physical damages [1]. Differences in mucociliary transport parameters between different nasal areas depend on the ciliary beat frequency, ciliary population density, ciliary length, and mucus quality [10]. The results of our study, which identified disruptions in MCC on the concave side of the nasal cavity, can be explained by a reduced ciliary population on the concave side, indicating a loss of the mucociliary apparatus. Additionally, the impairment of MCC in the mucosal lining of the concave side of the septum may be associated with changes in mucus properties covering the epithelium, resulting from increased inflammatory infiltration and a reduction in glandular tissue distribution [12, 6]. Thus, the results of our study suggest that nasal septum deviation is not a simple condition characterized solely by mechanical changes in nasal airflow but rather a more complex pathological process involving disruption of the mucociliary clearance of the nasal mucosa. This disruption may lead to an increased frequency and severity of diseases in both the nasal cavity and the accessory sinuses on the side opposite to the nasal septum deviation.

CONCLUSIONS

Mucociliary clearance is an extremely important indicator of nasal cavity function. In the presence of a deviated nasal septum and postnasal drip syndrome, the mucociliary activity of the ciliated epithelium will be significantly disrupted due to changes in the architecture of the nasal cavity. The obtained data indicate the influence of a deviated nasal septum on subsequent changes in the physiology of the nasal cavity, slowing down mucociliary clearance, which can lead to excessive mucus stagnation in the nasal cavity and, consequently, the development of postnasal drip syndrome.

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COMPLIANCE WITH ETHICAL REQUIREMENTS

The study was conducted in accordance with the principles of the Helsinki Declaration of the World Medical Association «Ethical principles of medical research involving a person as an object of research».

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Резюме

СТАН МУКОЦИЛІАРНОГО КЛІРЕНСУ У ПАЦІЄНТІВ З ВИКРИВЛЕННЯМ НОСОВОЇ ПЕРЕДІЛКИ ТА СИНДРОМОМ ПОСТНАЗАЛЬНОГО СТІКАННЯ

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Вступ. Мукоциліарний кліренс, життєво важливий ключовий механізм захисту у верхніх дихальних шляхах людини, що захищає організм від шкідливих речовин, що вдихаються. Вперше циліарна активність була відкрита 1835 р. Sharpey і лише через століття дану функцію стали розглядати як провідну ланку у фізіології приносових пазух.
Мета дослідження – дослідити стан мукоциліарного кліренсу у пацієнтів з викривленням носової передiлки та наявним синдромом постназального стікання.
Матеріали та методи. До дослідження було включено 54 пацієнтів віком від 23 до 55 років. Всім хворим було проведено сахариновий тест та вивчення рухової активності миготливого епітелію. Критерієм виключення була також наявність інфекційно-запальних захворювань верхніх дихальних шляхів в останній місяць.
Результати. В контрольній групі пацієнтів ми не отримали суттєвої різниці у швидкості проходження сахаринового тесту, як в правій так і в лівій частині порожнини носа, час сахаринового тесту варіювався від 8.35 до 14.52 хв. В той час як в другій клінічній групі у пацієнтів з викривленням носової передiлки середній час сахаринового тесту на слизовій оболонці увігнутої сторони перегородки носа був значно більше, ніж на вигнутій і складав 21.52±3.04хв і 12.36±2.73хв відповідно (P = 0,02). При оцінці даних пацієнтів 3 клінічної групи зі сторони викривлення ми отримали достовірну різницю (P < 0,05) в зниженні швидкості сахаринового тесту у порівнянні з контрольною групою.
Висновки: отримані дані свідчать про суттєвий вплив викривлення носової перегородки на подальші зміни в фізології носової порожнини, уповільнення мукоциліарного кліренсу, що може призводити до надмірного застою слизу в носовій порожнині, і, як наслідок, формування синдрому постназального стікання.

Ключові слова: **викривлення носової перегородки, синдром постназального стікання, мукоциліарний транспорт, порожнина носа, назальна обструкція**