

Nasal Mucociliary Clearance in Allergic Rhinitis in Children

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Abstract

Allergic rhinitis in children is not an uncommon disease in India. Our objective was to evaluate the effect of allergic rhinitis on nasal mucociliary clearance. The nasal mucociliary clearance time (NMC) was studied using Andersen's saccharin method in fifty controls and fifty age and sex matched patients of allergic rhinitis. The nasal mucociliary clearance time in healthy controls was found to be 5.11 ± 1.51 minutes. A significant impairment ($p < 0.01$) in nasal mucociliary clearance time of 12.46 ± 3.74 minutes was observed in children suffering with allergic rhinitis, signifying that allergic rhinitis may predispose to sinusitis and pulmonary diseases.

Keywords: Allergic rhinitis, nasal mucociliary clearance, children.

Allergic rhinitis in children is common world wide chronic debilitating diseases, affecting at least 10 to 20% of populations.¹ It significantly affects child's quality of life and school performance as well as has an economic impact on society. It is caused by an overreaction of immune system to particles like pollens, cosmetics, detergents, tobacco, smoke, vehicular fumes, domestic spray, bleach, food additives and preservatives, clothes, household and industrial pollution products in the air.² It precedes the development of recurrent or chronic sinusitis. It is usually associated with nasal obstruction due to inflammation of nasal cavity which interrupts normal mucociliary clearance and leads to retention of secretions within sinus cavities. As pediatrics age advances food sensitivities are usually lost, inhalant sensitivities are gained and pollen allergy begins later with peak incidence in teenage.^{2,3}

Nasal mucociliary clearance is a defense mechanism of upper and lower respiratory tract. The vital part of this mechanism is an adequate quantity of mucus with appropriate rhinological qualities and adequately functioning cilia, which beat in metachronous fashion towards nasopharynx.⁴ Any disturbance in number and movement of cilia and mucus production leads to an altered nasal mucociliary clearance as occurs in allergic rhinitis. The present study was undertaken to evaluate the effect of allergic rhinitis on nasal mucociliary clearance in children using Andersen's method as this method is very simple, reliable, reproducible and economical.

MATERIALS AND METHODS

The present study was conducted in 50 children of either sex in age group 6 to 14 years suffering from allergic rhinitis and 50 age and sex matched healthy children acted as controls. The diagnosis was made on basis of history and clinical examination. A detailed history was taken with special reference to sneezing, itching, nasal discharge, nasal obstruction and loss of smell, which are generally the chief symptoms of allergic rhinitis. A thorough clinical examination of ear, nose and throat was carried out. Presence of pale blue nasal mucosa and hypertrophied boggy turbinate confirmed our diagnosis. Children suffering from diseases known to affect the mucociliary clearance like nasal polyps, DNS, adenotonsillar hypertrophy, etc. were excluded from the studies. X-ray nasopharynx was done in every child to rule out adenoid hypertrophy.

The nasal mucociliary clearance was evaluated with Andersen's method,⁵ in which a saccharin particle of 1.5 mm diameter was carefully placed on the floor of nasal cavity approximately 1 cm behind the anterior end of inferior turbinate. The subject consumed nothing orally at least 30 minutes before the test, to minimize the disturbance of perception of taste. The subjects were asked not to sniff, sneeze, eat or drink during the test. They were asked to swallow every thirty seconds and to report any change in taste nasopharynx. The time taken by the subjects from placement of particle to perception of taste was taken as

mucociliary clearance time. The nature of particle was not disclosed to the subject to increase the reliability of procedure. The results were statistically analyzed by using 'z' test.

RESULTS

The mean age in control group (A) was 10.6 years (range 6 to 14) and in study group (B) it was 10.3 (range 6 to 14). In control group, there were 32 (70%) males, 18 (30%) females, whereas in study group there were 37(74%) males and 13(26%) females (Table 1).

The mean value of nasal mucociliary clearance time in control group was 5.11 ± 1.51 minutes where as in allergic rhinitis patients, it was 12.46 ± 3.78 minutes. The difference in mean values of two samples was statistically significant ($p < 0.01$) (Table 2).

Table 1: Age and sex distribution of controls and patients

Group	Age (in years)		Sex	
	Mean	Range	Male	Female
A. Control	10.6	6-14	32 (70%)	18 (30%)
B. Patients	10.6	6-14	37 (74%)	13 (26%)

Table 2: Nasal mucociliary clearance in controls and patients

Group	N	NMC time value (in minutes)	Mean \pm SED
A. Controls	50	5.07- 13.50	5.11 ± 1.51
B. Patients	50	12.20- 25.13	12.46 ± 3.74

p value A vs. B < 0.01

DISCUSSION

In the present study, the mean value of normal nasal mucociliary clearance time in the control group was 5.11 ± 1.54 minutes. Mehra et al reported the normal value of nasal mucociliary clearance in healthy subjects is 5.06 minutes,⁶ which is comparable to our results, however, wide range from 3.3 to 3.5 minutes has been reported in western countries in adults.^{7,8} The mean value of nasal mucociliary clearance time at Haryana, Chandigarh, Calcutta and Nagpur are reported to 5.7 minutes, 5.06 minutes, 4.4 minutes and 7.1 minutes respectively.^{6,9-11} At the place of present study the mean nasal mucociliary clearance time has been reported to 7.5 minutes in adults. There is considerable variation in value at different places even in India. The nasal mucociliary clearance differs from place to place, habit, habitat, climate and facial configuration.

The mean value of nasal mucociliary clearance was found to be 12.46 ± 3.74 minutes in patients with allergic rhinitis. When this was compared with control group the difference was found to be statistically significant ($p < 0.01$). This finding of increased value of nasal mucociliary clearance time in allergic rhinitis is comparable with earlier reports.¹²

It is based on the possible hypothesis that nasal secretions tend to become more alkaline in nature in allergic rhinitis and allergic inflammatory events involving mucus membrane. The nasal secretions pH *in vivo* is lower, but some workers described the average pH value of 7 where as others opinion that the nasal pH is towards acidic side and fluctuates between 5.5 to 6.5 in healthy individual.¹³ Second hypothesis is obstructive effect exerted by congestion of nasal passage as a result of local vasodilation and consequent mucosal edema.¹⁴

Mucociliary clearance may be disturbed by factors including increased mucus production, abnormal mucus quality and quantity and abnormal ciliary activity, which causes stagnation of secretions in the sinuses.¹⁵ The mucus layer which is present over the ciliated cells has two properties viscosity and elasticity. Outer layer is thick, viscoelastic, semi solid mucus layer where the cilia do not strike directly, is found over a layer of watery serous fluid. Low viscosity of layer of watery serous fluid or sol layer facilitates the movement of cilia which moves the sol layer affecting the movement of upper thick layer. If the movement of the mucus is slowed, bacteria can multiply as the mucus thickens and stagnates which play major role in pulmonary and sinus diseases.¹⁶

We did not study the nasal mucociliary clearance after treatment of allergic rhinitis. However, some authors have reported restoration of almost normal nasal mucociliary clearance after treatment of allergic rhinitis, which is of great importance for the restoration of normal physiology of the nose.^{17,18}

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