

# Mucociliary Flow Rate in Allergic Rhinitis Patients

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DOI: <https://doi.org/10.52403/ijshr.20230260>

## ABSTRACT

The vital part of this mechanism is an adequate quantity of mucus with appropriate rhinological qualities and adequate functioning of cilia which beat in metachronous fashion towards nasopharynx at a frequency of 7-16 Hz at body temperature. Nasal Mucociliary Clearance (NMC) is determined to obtain an in vivo measurement of the effectiveness of the interaction between the cilia and mucus. Any disturbance in the number and movement of cilia and mucus production leads to altered mucociliary clearance as occurs in allergic rhinitis. Aim of this study was to find the mucociliary clearance time and mucociliary clearance rate in group of 100 patients of allergic rhinitis. We found that the MCT is prolonged and MCR is reduced in these patients.

**Keywords:** MCC- Nasociliary clearance, NMC- Nasal Mucociliary Clearance, MCT- Mucociliary clearance time, MCR- Mucociliary clearance rate

## INTRODUCTION

Rhinitis is defined clinically as having two or more of the following symptoms of anterior or posterior rhinorrhea, sneezing, nasal blockage and/or itching of the nose during two or more consecutive days for more than one hour on most days<sup>1</sup>. Allergic rhinitis is characterized by inflammatory changes in the nasal mucosa by exposure to inhaled allergens.

Nasociliary clearance is a defense mechanism of the upper and lower respiratory tract. The removal of debris-laden mucus in the sinuses completely

depends on MCC, whereas in the lower airways, MCC can be compensated for by other mechanisms like coughing. The vital part of this mechanism is an adequate quantity of mucus with appropriate rhinological qualities and adequate functioning of cilia which beat in metachronous fashion towards nasopharynx at a frequency of 7-16 Hz at body temperature<sup>6</sup>. Nasal Mucociliary Clearance (NMC) is determined to obtain an in vivo measurement of the effectiveness of the interaction between the cilia and mucus. Any disturbance in the number and movement of cilia and mucus production leads to altered mucociliary clearance as occurs in allergic rhinitis. Nasal mucociliary clearance can be assessed by determining the time taken for the elimination of inhaled or inspired aerosole<sup>7</sup>. Mucus contains water (95%), glycoproteins lipids (0.5–5%), mineral salts (0.5–1%), and free proteins 1%<sup>8</sup>. Airway clearance is the crucial mechanism which mainly acts via mucociliary system for removal of allergens, pathogens and xenobiotics that contribute to airway diseases<sup>9</sup>. The early diagnostic tools to measure MCC include saccharine tests and radioactive isotope assays that measure mucociliary clearance from nasal mucosa to oropharynx<sup>10,11</sup>. Though several approaches serve to determine NMC by measurement of the transport of markers placed on the mucosa - Mucociliary transit time with saccharin - Saccharin test, Mucus flow rate with - 99m Tc-labelled particles Rhinoscintigraphy and

<sup>99m</sup>Tc-labelled resin particle, mucus flow rate with radiopaque Teflon dics, mucociliary transit time with colouring substances, mucociliary transit time with a combination of dye and saccharin and Gamma scintigraphy. Saccharin test is an inexpensive, simple and non-invasive method while methods using radio labeled particles are time consuming, cumbersome and expensive.

The mean normal MCT in our population is 8.2 min in children and 9.5 min in adults with an average 5.6-13 min, and the MCR is 11.1 mm/min in normal children and 12.7 mm/min in normal adults<sup>16</sup>. The present study was undertaken to evaluate the mucociliary flow rate in patients of allergic rhinitis.

Aim of this study is to find the mucociliary clearance time and mucociliary clearance rate in patients of allergic rhinitis.

## LITERATURE REVIEW

A study done on Nasal mucociliary clearance in perennial rhinitis by Schuhl<sup>7</sup> (1995), to compare the nasal mucociliary clearance in allergic and non-allergic patients with perennial rhinitis and a healthy control group. Nasal mucociliary clearance was assessed with the saccharin test modified with a food dye to add a visual parameter. A significant difference in nasal mucociliary clearance was observed between the three groups, with a mean of 8.8 minutes for the controls, 10.27 minutes for allergic rhinitis and 11.73 minutes for non-allergic patients.

Study on Evaluation of Nasal Mucociliary Clearance Function in Allergic Rhinitis Patients with Technetium <sup>99m</sup>Tc-Labeled Macro aggregated Albumin Rhinoscintigraphy by Shung et al (2002), to assess the clinical role of rhinoscintigraphy in evaluation of nasal mucociliary clearance function in allergic rhinitis patients and in sinusitis patients and healthy controls for comparison. The mean velocity of nasal mucociliary transport in the allergic rhinitis patients was  $2.71 \pm 0.76$  mm/min ( $2.65 \pm 0.76$  mm/min in the right nostril;  $2.77 \pm$

$0.76$  mm/min in the left nostril). The mean velocity of nasal mucociliary transport in the sinusitis patients was  $1.80 \pm 0.64$  mm/min ( $1.79 \pm 0.65$  mm/min in the right nostril;  $1.82 \pm 0.63$  mm/min in the left nostril). The mean velocity of nasal mucociliary transport in the 25 healthy controls was  $4.28 \pm 1.38$  mm/min ( $4.30 \pm 1.35$  mm/min in the right nostril;  $4.27 \pm 1.42$  mm/min in the left nostril). A significant difference in nasal mucociliary clearance was observed among the 3 groups. Another study done on Nasal Mucous Clearance in Patients of Perennial Allergic Rhinitis by Yadav et al (2003). The nasal mucociliary clearance was studied by using the method described by Anderson. Mean nasal mucous clearance time in allergic rhinitis was  $4.16 \pm 0.11$  minutes which was significantly lower as compared to controls  $8.21 \pm 0.25$  minutes. The decrease in NMC time may be either due to mediators or simply due to the increased secretions in allergic rhinitis, cleaned by nasal mucociliary functions.

Another study on Nasal mucociliary clearance in health and disease was done by Pandya and Tiwari (2006), the Mean normal nasal mucociliary transport time by using saccharin in the population was 8.2 minutes for children and 9.5 minutes for adults, the mucociliary clearance rate was 11.1 mm/minute for normal children and 12.7 mm/minute for normal adults. They found that the mucociliary clearance is hampered in almost all pathological conditions affecting the nose.

Another study done on Nasal Mucociliary clearance in allergic rhinitis in children by Ranga et al (2010), with the objective to evaluate the effect of Allergic Rhinitis on Nasociliary clearance (NMC) using Anderson saccharin method. The nasal mucociliary clearance time in healthy controls was found  $5.11 \pm 1.51$  minutes. A significant impairment ( $p < 0.01$ ) in nasal mucociliary clearance time of  $12.46 \pm 3.45$  minutes was observed in children suffering with allergic rhinitis, signifying that AR

may predispose to sinusitis and allergic diseases.

## MATERIALS & METHODS

Our study is a one year prospective study. The Nasal Mucociliary Clearance were evaluated on basis of Anderson's method<sup>4</sup> in which a saccharin particle of size 1.5mm diameter was placed on the floor of nasal cavity approximately 1.5 cm behind the anterior end of inferior turbinate. Patients were advised not to eat or drink for at least 30 min before the test. Patient were asked to swallow every 30 seconds and report when they felt the sweet taste of saccharin. Time taken from placement of particle to appreciation of sweet taste by the patient was taken as MCT. The test was repeated on each side and the average of two was taken as the mean MCT. After measuring mucociliary clearance time, measurement of the length of the nose from anterior nares to posterior pharyngeal wall just lateral to uvula was done with help of a thin soft rubber catheter. With the help of nasal MCT and the approximate length of the nose the mucociliary clearance rates in mm / minute was calculated. Study population included 100 adult patients ( $\geq 18$  years) suffering with AR.

## RESULT

**Table 1. Distribution of patients on the basis of mean nasal MCT.**

|                            |                      | Number of patients |
|----------------------------|----------------------|--------------------|
| Mucociliary clearance time | Decreased (<5.6 min) | 2                  |
|                            | Normal (5.6-13 min)  | 42                 |
|                            | Prolonged (>13 min)  | 56                 |

Table 1 shows the number of patients with decreased, normal and prolonged MCT. The number of patients decreased, normal and prolonged MCT was 2, 42 and 56 respectively.

**Table 2. Mean Mucociliary Clearance time in AR patients**

| Mucociliary clearance time in AR patients |                      |
|---|----------------------|
| Time                                      | 13.21 $\pm$ 3.55 min |

Table 2 shows the MCT in AR patients is 13.21 $\pm$ 3.55 min.

The mean mucociliary clearance rate in AR is found to be 5.98 $\pm$ 2.48 mm/min.

## DISCUSSION

### Mucociliary Clearance Time in AR

Our study shows that the percentage of patients with decreased (<5.6 min) MCT was 2%, patients with normal (5.6-13 min) MCT was 42% and patients with prolonged (>13 min) MCT was 56%. The mean normal MCT in our population is 8.2 min in children and 9.5 min in adults with a range of 5.6-13 min, and the MCR is 11.1 mm/min in normal children and 12.7 mm/min in normal adults. We found that most of the patients with AR have prolonged MCT, suggesting that the differences observed were due to changes in the rheology of nasal mucus as a consequence of the underlying inflammatory process in allergic rhinitis. The mean mucociliary clearance rate in AR is found to be 5.98 $\pm$ 2.48 mm/min

Schuhl et al observed that NMCC in normal and AR and non AR as 8.8 min and 10.27 respectively due to change in the rheology of nasal mucosa as a consequence of the underlying inflammatory process in rhinitis nasal<sup>7</sup>. Using rhinoscintigraphy to evaluate the velocity of NMC, Shung et al found the velocity as 2.71 $\pm$ 0.76 mm/min in AR, in healthy controls velocity was found 4.28 $\pm$ 1.38 mm/min. Pandya and Tiwari found that MC was hampered in almost all pathological conditions affecting the nose. Prior and Range, observed the MCT to be significantly elevated in chronic mucoid rhinitis and in children suffering with AR respectively.

Contrary to these studies Yadav found MCT to be significantly lower in AR 4.16 $\pm$ 0.11 min as compared to control 8.21 $\pm$ 0.25 min.

The Mucociliary rate were found reduced in the patients of AR.

## CONCLUSION

Allergic rhinitis is caused by an inflammatory response to an allergen to which the patient has already been exposed. In this abnormal response the individual has produced allergen specific immunoglobulin E(IgE) which binds to the mast cell surface

receptor. In India 20-30% of the population suffers from allergic rhinitis and/or other allergic diseases, prevalence being increasing over past many years. AR is most prevalent in young age group. AR causes significant disability and is often poorly managed. Intranasal glucocorticosteroids are the most effective treatment for allergic rhinoconjunctivitis and are recommended in current guidelines as first-line therapy for patients with moderate to severe Allergic Rhinitis, particularly when nasal congestion is the prominent symptom. Early treatment with INCS should be helpful in alleviating the severity of the disease and reduce the suffering of patients of AR.

#### **Declaration by Authors**

**Ethical Approval:** Approved

**Acknowledgement:** None

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

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How to cite this article: Richa Mehra, Varun Sachdeva. Mucociliary flow rate in allergic rhinitis patients. *International Journal of Science & Healthcare Research*. 2023; 8(2): 468-471.  
DOI: <https://doi.org/10.52403/ijshr.20230260>

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