

# Effect of Steam Inhalation on Nasal Mucociliary Clearance in Normal Individuals and Nasal Disease State

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## ABSTRACT

**Introduction:** Nasal Mucociliary Clearance is a basic defense mechanism of upper respiratory tract to maintain milieu interior. It removes obnoxious material and particulate matter along with pathogenic micro-organisms. Steam Inhalation is a simple, non-pharmacological method used in allopathy, ayurveda and naturopathy for various different purposes. Till date there are no reports to show that steam inhalation improves the nasal mucociliary clearance. Hence, this study is designed to know the effects of steam inhalations on nasal mucociliary clearance in normal individuals and in rhinitis and sinusitis. Objective of the research was to study the nasal mucociliary clearance in normal individuals and in patients of rhinitis and sinusitis and to study the effect of steam inhalation on nasal mucociliary clearance.

**Material and methods:** A case control study. All the study population were subjected to saccharine test and results were noted, steam inhalation given and after 1 hour and 24 hour saccharine test repeated and results were tabulated. *Duration of study:* April 2014 to May 2014 = 2 months.

**Result:** The nasal mucociliary clearance is significantly improved by steam inhalation and after repetition of remedy, more improvement was seen.

**Conclusions:** Research shows that steam inhalation definitely improves nasal mucociliary clearance.

**Keywords:** Nasal mucociliary clearance, Steam inhalation, rhinosinusitis.

## INTRODUCTION

Nasal Mucociliary Clearance is a basic defense mechanism of upper respiratory tract to maintain milieu interior.<sup>1</sup> It removes obnoxious material and particulate matter along with pathogenic micro-organisms. Unfortunately very little attention is paid to this mechanism until last few years.

Steam Inhalation is a simple, non-pharmacological method used in Allopathy, Ayurveda and Naturopathy for various different purposes. There are some stray reports indicating that steam inhalation acts as a good adjuvant in nasal disorders like rhinitis and sinusitis. It is a method of introducing warm, moist air into the lungs via the nose and throat for therapeutic benefit. The hot steam moistens the nasal passages, thus clearing the blocked nose and opens up congested sinuses allowing breathing more easily.<sup>2</sup>

Till date there are no reports to show that steam inhalation improves the nasal mucociliary clearance. However, the reason to believe that effects of steam inhalations in reliving nasal symptoms of rhinitis and sinusitis is mostly by improving nasal mucociliary clearance.

Hence, this study is designed to know the effects of steam inhalations on nasal mucociliary clearance in normal individuals and in rhinitis and sinusitis.

Aims and objectives of our study were to study the nasal mucociliary clearance in normal individuals and in patients of rhinitis and sinusitis. Along with that our main aim is to study the effect of steam inhalation on nasal mucociliary clearance.

## MATERIAL AND METHODS

This was a case control study and was carried out in the department of ENT, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, India. This study was conducted between the periods of April 2014 to May 2014 i.e. 2 months.

Sample size was carried out according to the earlier study on mucociliary clearance conducted at our department. Considering mean value 17 with standard deviation of 7.3 and allowable error of 2 minutes. We calculated the sample size for this study. So the sample size for our study was 53. As this was a case control study we have taken 53 controls i.e. normal volunteers and 54 patients having nasal symptomatology. Subject selection was done as per Exclusion – Inclusion criteria as

### Normal individuals (control group)

Individuals who have no rhinological disorders at least in last 1 month and desirous to participate in study were included and children below 12 years of age and those having nasal disorders in recent past or present were excluded from study.

### Study group (cases)

Individuals having nasal disorders - rhinitis and sinusitis and willing to participate in the study were included in the study and children below 12 years of age and also patients with clear evidence of osteo-meatal blockage on computed tomography of paranasal sinuses and sinus endoscopy were excluded from study. Especially we had focused on those patients who were not responded to any conservative or operative procedure and their quality of life got hampered due to rhinitis or sinusitis.

### Methodology

As per exclusion-inclusion criteria, study population was

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selected. After thorough ENT examination and necessary investigations they were subjected to saccharine test. Saccharine test was done by using Anderson’s technique. After noting the results patients were given steam inhalation in presence of investigator through commercially available inhaler for period of three minutes. Saccharine test was repeated after 1 hour and results were noted. After a period of 24 hour again steam inhalation given for same duration and saccharine test done after 1 hour and results were noted. Similar method was applied for control group.

Blinding was done to avoid bias in the study. Patient’s clinical examination and selection in study and control group were done by departmental residents. Patients were given unique patient identification number (patient\_id) and investigators were only got patient\_id and no other information. Investigator divided into 2 groups. They were conduct saccharine test without the knowledge whether the individual belong to study or control group and saccharine test is pre or post therapy. They were submitting the report to the principal investigator. Results so obtained were tabulated, analyzed and inferred.

**Saccharine Test (Anderson’s Technique)<sup>3</sup>**

The saccharin test is inexpensive and simple to perform, and its results are similar to those obtained using a radioactively labeled particle.<sup>3</sup> Recently it has been proposed as a screening test to detect abnormal mucociliary clearance.<sup>4</sup> We have used the test to measure nasal mucociliary clearance.

After taking informed and written consent, patients were subjected for saccharine test using saccharine tablet of size 1 × 1 × 1 mm.

The test was performed as follows

- Patients were kept in sitting position.
- One nostril tested at a time.
- Saccharine tablet kept in inferior meatus 1 cm posterior to the anterior end of inferior turbinate with Tilly’s forceps.
- Patient was asked to do swallowing movements every 30 sec.
- Patients must be instructed not to sniff, eat or drink and to avoid coughing and sneezing if possible.
- Time noted between the placement of tablet and feeling of first sweet taste.
- Then patient was asked to blow nose to remove undissolved tablet.

After collecting all the data, we considered a hypothesis, “Steam inhalation accelerates nasal mucociliary clearance” and applied statistical analysis was done.

**RESULTS**

In our study, among case group we found 37 males and 17 females i.e. total 54. And among control group we found 39 males and 14 females i.e. 53

Table No. 1 showing nasal mucociliary clearance time of study population before steam inhalation. In normal individuals the nasal mucociliary clearance time of normal volunteers was 8.2 minutes with standard deviation of 3.8 and in symptomatic patients it was 10.9 minutes with standard deviation of 4.4.

From table No. 2, effect of steam inhalation on nasal muco-

ciliary clearance 1 hour and 24 hour after steam inhalation among control group i.e. normal volunteers. We found that the nasal mucociliary clearance time of normal individuals was shortened in 75.5% of individuals after 1 hour and 24 hour of steam inhalation, means there is improvement in nasal mucociliary clearance in 75.5% of individuals.

Table No. 3 showing effect of steam inhalation on nasal mucociliary clearance 1 hour and 24 hour after steam inhalation among study group i.e. symptomatic patients. We found that the nasal mucociliary clearance time of patients was shortened in 72.2% of cases after 1 hour and 83.3% of cases after

	Subjects	Mean NMCC	SD
Controls	53	8.2 min	3.8
Cases	54	10.9 min	4.4
Total	107		

NMCC – Nasal Mucociliary Clearance

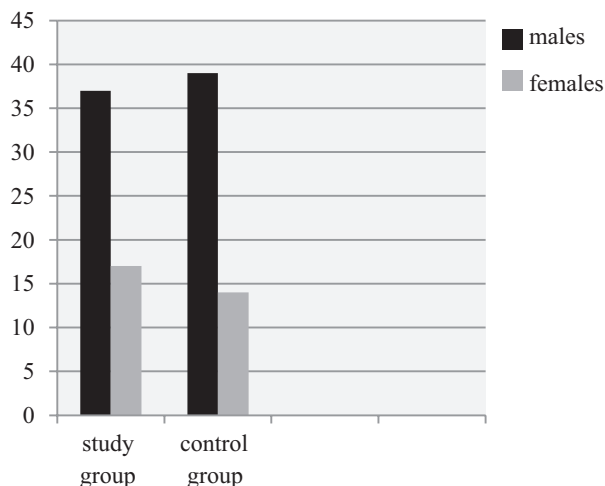
**Table-1:** Nasal mucociliary clearance time of cases and controls before steam inhalation.

Effect of steam inhalation on NMCC	No. of subjects	Percentage (Out of 53)	No. of subjects	Percentage (Out of 53)
	After 1 hr		After 24 hr	
Prolonged	5	9.4	10	18.9
No effect	8	15.1	3	5.6
Shortened	40	75.5	40	75.5
Total	53		53	

**Table-2:** Effect of steam inhalation on control group

Effect of steam inhalation on NMCC	No. of subjects	Percentage (Out of 54)	No. of subjects	Percentage (Out of 54)
	After 1 hr		After 24 hr	
Prolonged	10	18.5	6	11.1
No effect	5	9.3	3	5.6
Shortened	39	72.2	45	83.3
Total	54		54	

**Table-3:** Effect of steam inhalation on Case group.



**Figure-1:** Bar diagram showing sample size

24 hours of steam inhalation, means there is improvement in nasal mucociliary clearance in 72.2 % and 83.3 % of patients after 1 hour and 24 hours of steam inhalation.

## DISCUSSION

Mucociliary clearance is a key defence mechanism in human upper and lower airways, and its impairment, both acquired and genetically determined, predisposes to chronic infection of the nose, paranasal sinuses, and respiratory tree.<sup>6,7</sup> It protects the airway against ambient microorganisms, foreign particles and noxious substances. Its mechanism is delicate but vigorous to entrap and remove particles. Many chronic nasal conditions may have detrimental effects on mucociliary transport. Acute upper respiratory tract infections may reduce the nasal mucociliary clearance by direct damage to the cilia and change in the rheological properties of the nasal secretions.<sup>9-11</sup> The Results of our study confirm those of Stanley et al<sup>8</sup> that the saccharin test is an useful screening technique for measuring nasal mucociliary clearance as it is inexpensive, simple to do and reproducible.

No any human studies of the effects of steam inhalation on mucociliary function have been reported up till now. Therefore this is our sincere efforts to study the utility of steam inhalation in chronic rhinosinusitis. The saccharine test, despite being an established bedside investigation for assessing NMCC, has not been used to evaluate the effects of steam inhalation on mucociliary clearance till date. It has been suggested that the mucus transport is usually impaired in cases of chronic rhinosinusitis.<sup>6</sup> Sakakura et al<sup>9</sup> reported the marked impairment of nasal mucociliary clearance in chronic rhinosinusitis.

Age groups 12 – 60 years were included in study. Most of subjects were in 3<sup>rd</sup> decade of life.

In our study we found male preponderance i.e. 71 % of males and 29 % of females. This might be due to our social and cultural ethics as males forms the main source of earnings for the family and was exposed outside pollutants and females stay at home and were protected.

We found that the nasal mucociliary clearance time of normal individuals was shortened in 75.5% of individuals after 1 hour and 24 hour of steam inhalation, means there is improvement in nasal mucociliary clearance in 75.5% of individuals. Also there was no response of steam in 15.1 % and 5.6 % of individuals after 1 hour and 24 hours of steam inhalation.

We found that the nasal mucociliary clearance time of patients of rhinosinusitis was shortened in 72.2% of cases after 1 hour and 83.3% of cases after 24 hours of steam inhalation, means there is improvement in nasal mucociliary clearance in 72.2 % and 83.3 % of patients after 1 hour and 24 hours of steam inhalation. Also there is no response of steam in 9.3% and 5.6% of patients after 1 hour and 24 hours of steam inhalation. All the patients of nasal chronic rhinosinusitis in whom there were improvement in NMCC, the symptoms were drastically reduced and they were satisfied with steam inhalation.

Hence from these results, we proudly say that the nasal mucociliary clearance was *significantly improved* by steam inhalation and after repetition of remedy, more improvement

was seen.

'p value' after 1 hr of steam inhalation (p1) and after 24 hr of steam inhalation (p2) was calculated, both are (< 0.05) statistically significant and found that p2 > p1.

## CONCLUSIONS

The nasal mucociliary clearance time for the cases before steam inhalation was 10.9 minutes with the standard deviation of 4.4. 1 hour after steam inhalation it was 9.3 minutes with standard deviation of 4.2 and after 24 hours 8.7 minutes with standard deviation of 4.1 were found.

Similarly, the nasal mucociliary clearance time for the controls before steam inhalation was 8.2 minutes with standard deviation of 3.8. 1 hour after steam inhalation it was 7.1 min with standard deviation of 3.2 and after 24 hours 6.7 minutes with standard deviation of 3.2 were found.

Hence, Steam Inhalation Definitely Improves Nasal Mucociliary Clearance and also symptomatology of our patients were drastically reduced.

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