Assessment of Nasal Airflow Resistance in the Healthy Population of Chattisgarh by Active Anterior Rhinomanometry

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Abstract The aim of present study was to define a normal range of total nasal airflow resistance in the healthy population of Chattisgarh. This study was conducted at the Department of Otorhinolaryngology, Medical College Raipur, Chattisgarh over 93 healthy adults. A proper otolaryngology examination was done prior to the study and all the subjects were free from any type upper respiratory tract infection. This was the main inclusion criteria for the present study. All the subjects were distributed according to age and sex. Active Anterior Rhinomanometry is the best recommended method for evaluating the objective assessment of nasal airflow resistance; it was preferred for the assessment of total nasal airway resistance in present study also. The present study concluded that the mean value of total nasal airway resistance was 0.21 at 150 Pa pressure. However the range of total nasal airway resistance was from 0.142 to 0.34 Pa/cm³/s at the same pressure. The present study presents the normal range and mean value of total nasal airway resistance for the healthy adult population of Chattisgarh. Total nasal airway resistance is independent of age and sex.

Keywords Total nasal airflow resistance · Active anterior rhinomanometry · Chattisgarh

Introduction

Nose is the main channel for the entry of air to the respiratory system, but this also exerts a resistance to the airflow. This nasal airflow resistance consists of half to 2/3rd of total airway resistance. The study for the measurement of nasal airflow was first done by Kayser in 1895 [1]. After that various modifications have been made in instrument as well as in the technique. The final version of recommendation was approved in 1984 by normalization committee of European Rhinology Society (ERS) [2] but till today no study clearly defines the dimensions of normal nasal resistance in Indian population. In present study, it is tried to define the normal range and a mean value of total nasal airway resistance (NAR) by examining the healthy adults of the Chattisgarh by active anterior rhinomanometry.

Material and Method

This study was conducted at the Department of Otorhinolaryngology, Pt JNM Medical College and its associated Dr BRAM Hospital over 93 healthy adults. Among the 93 study subjects, 48 were males and 45 were females. This selection was done randomly. Written and informed consent was taken before the procedure. All the subjects were free from any systemic and nasal diseases and were having no nasal complaint or any history of nasal allergy for last 3 months. None of these subjects was using any medicine affecting systemic or nasal circulation. A proper

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otorhinolaryngological examination of all participants was done prior to the present study and it was found normal. Subjects who were taking any medication or having any disease related to upper airways were not included in this study as it may cause a variation in total NAR. Subjects below the age of 16 years or above the 40 years were also not included as the aim of present study was to decide the total NAR in adult population only.

All the subjects were distributed according to the age and sex. Active anterior rhinomanometry is proved as the gold standard method for evaluating the objective assessment of total nasal airflow resistance and same technique was also preferred for the assessment in present study.

The technique of the whole procedure was explained in full detail to all subjects. Series of trial experiment were performed with intension that they were familiar with the technique and equipment thereby eliminating any anxiety which is a known factor for reducing nasal resistance. All participants were adapted to the laboratory environment with strict protocol for 30 min. Rhinomanometry examination was performed during quite breathing with close mouth in an upright sitting position.

Equipment used had following features:

- (1) During spontaneous respiration transnasal pressure differences and nasal air flow were recorded simultaneously.
- (2) Nasal air flow and pressure curve was displayed on a visual display unit (VDU) which allowed controlling the regularity of patients breathing.
- (3) Data obtained in the form of printed graph which contained nasal airflow and pressure-flow relation at 75, 150 and 300 mm Pa pressure.

Nasal resistance was kept static at 150 Pa because at this pressure difference both laminar and turbulent airflow were prevailed and nasal resistance can be assessed with minimal physical effort. Calculations of transnasal resistance were made according to Ohm's law.

Nasal resistance to airflow was calculated by following equation

$$R = \Delta P / V$$

R is total nasal airflow resistance in Pa/cm³/s, ΔP is 150 Pa pressure, V is nasal airflow (sum of left and right) during inspiration.

Total nasal airflow resistance reflects the resistance of both side of nasal cavity. The advantage of measuring the total nasal airflow resistance is to avoid the effect of nasal cycle over unilateral nasal airflow resistance as the nasal cycle may lead to a change of 4-fold in unilateral nasal airflow resistance [3].

Result

In present study 78.5% healthy adults showed the total NAR in the range of 0.14–0.34 Pa/cm³/s. The normal range for total nasal airflow resistance in healthy adult population of Chattisgarh was found to be 0.14–0.34 Pa/cm³/s. Mean value for total NAR was 0.2144 Pa/cm³/s. Age and sex factors did not show any differences in results (*P* value < 0.001). The Institutional Review Board and Ethical Committee of the institution have approved this study.

Discussion

Aerodynamics of the nasal cavity is determined by two components one is static and others are variable factors which affect nasal cavity. Static component includes bony and cartilage framework of nasal cavity in comparison to the variable factors which are mainly affected by functional status of nasal mucosa, physical activity, endocrine stimuli, air temperature, humidity, O₂ and CO₂ pressure in the blood and nasal cycle.

Table 1 Age and sex wise distribution of total nasal resistance

S. no.	Age group	Total nasal resistance [Pa/cm ³ /s] (at 150 Pa Pressure)					
		[0.14–0.24]		[0.25–0.35]		[0.36–0.37]	
		Male	Female	Male	Female	Male	Female
1	16–20	08	09	0	02	0	0
2	21–25	11	07	01	02	0	0
3	26–30	04	07	02	01	0	0
4	31–35	10	07	02	03	01	0
5	36–40	05	05	03	02	01	0
6	Total	38	35	08	10	02	00
7	%	78.50		19.35		2.15	

Total nasal resistance gives an overall measure of nasal functions and also reflects the degree of nasal obstruction during breathing. Previous study by Ohki et al. in 1991 [3] over nasal airflow resistance showed that there is a difference in the mean value of nasal airflow resistance between Caucasian, Negros and Orientals. This difference was found due to difference in nasal width and ventral and transverse nostril diameter. These differences were more marked when the nasal airflow resistance was calculated in decongested nose. The mean nasal resistance in Caucasians, Negros and Orientals was 0.129, 0.146 and 0.184 Pa/cm³/s respectively [3].

An another study of 85 healthy adults has showed that the mean value of total NAR was 0.24 Pa/cm³/s ranged from 0.12 to 0.52 Pa/cm³/s at a reference pressure of 150 Pa in Malay population [4], while this value was 0.21 Pa/cm³/s at a reference pressure of 150 Pa in German population [5].

A study by Morris et al. in 1992 [6] on healthy adult subject showed that the mean total NAR was around 0.23 Pa/cm³/s with range from 0.15 to 0.39. The NAR was not related to vital capacity and height [6].

In present study, mean total NAR in Chattishgarh population was found 0.2144 Pa/cm³/s ranged from 0.14 to 0.37 Pa/cm³/s. It was observed that the maximum NAR in healthy subject recorded was 0.37 Pa/cm³/s. But this can be explained on the basis of anatomical differences among individuals as well as pollution in the experimental city habituate high nasal resistance without producing symptoms.

Factors such as age, sex and smoking did not have a statistically significant impact on nasal airway resistance in

the asymptomatic group [7]. Present study also noticed that there was no statistically significant impact of age and sex on nasal airway resistance (Table 1).

Conclusion

This study presents the normal range and mean value of total NAR for the healthy adult population of Chattisgarh. Total NAR is independent of age and sex.

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