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Effect of Chronic Nasal Obstruction on Pulmonary Functions in North Indian Population

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1. Introduction

1.1. Abstract: The relationship of upper and lower airway diseases has been documented in literature but is still poorly understood. The present study aims at studying the effect of chronic nasal obstruction on pulmonary functions in a North Indian population.

1.2. Materials and Methods: The present study was conducted in the Department of ENT and Head Neck surgery, Dr RPGMC Kangra at Tanda between April 2021 and December 2022. 50 cases with chronic nasal obstruction and 50 controls from general population were included in the study from the state of Himachal Pradesh. Spirometry findings were compared in the two groups.

1.3. Results: The most common age group affected was less than 30 years which included more than 90 percent of the patients. There were 42 males (84%) and 8 females (16%) amongst the cases. The controls included 35 males (70%) and 15 females (30%). The mean duration of nasal obstruction was 6.27 +- 6.25 years. 19 patients had a VAS score of 6. Similarly, 19 patients had a VAS score of 7. No statistically significant correlation could be established between Visual Analogue Scale for nasal obstruction score and pulmonary function alterations in chronic nasal obstruction patients. Statistically significant difference was observed between FEV1 and FVC values of the cases and controls.

1.4. Conclusion: Patients with chronic nasal obstruction had poorer pulmonary functions than controls.

2. Introduction

Nose is an important landmark for facial aesthetics and has an equally important function if not more in respiratory physiology. It functions to filter out large particles from inspired air. The mucosal surface of the nose allows it to condition the inspired air. Its roof houses the sensory receptors which function for olfaction. Nasal obstruction can be defined as the subjective sensation of insufficient airflow through the nasal cavity and can be anatomical, physiological or of combined aetiology [1]. Chronic nasal obstruction is defined as nasal obstruction which is present for 12 or more than 12 weeks. Anatomic causes of nasal obstruction include septal deviations, turbinate hypertrophy, or internal or external nasal valve collapse or stenosis. Adenoid hypertrophy should be considered in children. Rare causes of nasal obstruction include foreign bodies within the nose and nasal masses which may be benign or malignant [2]. The relationship between upper and lower airway diseases is documented in literature but the alteration in pulmonary functions due to upper airway diseases is still not fully understood. The nasal obstruction can be measured by subjective measurements like patient derived measurements, physician observed measurement and objective measurement. The objective methods include- acoustic rhinometry, rhinomanometry, CT, and MRI. The subjective methods include symptom scores like VAS and NOSE. Visual analogue scale (VAS) rates nasal obstruction on a continuous scale from 0 to 10 with the reported outcome as the closest integer [3]. Pulmonary function tests are used for the diagnosis of various pulmonary conditions. Pulmonary function tests are a group of tests that asses lung volumes, capacities, rates of flow and gas exchange. Spirometry is one of the most important components to asses the ventilatory function of the lungs. Spirometry measures forced exhaled or inhaled air. The forced vital capacity (FVC) is the amount of air that can be forcefully expelled, beginning with the lungs completely full (at total lung capacity [TLC]) and blowing maximally until as empty as possible (at residual volume [RV]). The forced expiratory volume in the first second (FEV1) is the amount expelled during the first second of the FVC manoeuvre. The ratio of FEV1 and FVC (FEV1/FVC) is used as an indicator of obstruction [4]. A decreased FVC identifies a restrictive pattern, whereas the combination of a decreased FEV1/FVC ratio and decreased FVC is classified as a mixed pattern [5].

3. Materials and Methods

This study was carried out from July 2021 to December 2022 in the Department of Otorhinolaryngology and Head - Neck surgery

in Dr Rajendra Prasad Government Medical College and Hospital Kangra at Tanda, a tertiary care teaching hospital in Himachal Pradesh, India. All patients of chronic nasal obstruction due to septal deviation attending the OPD in Department of Otorhinolaryngology and Head - Neck Surgery, Dr Rajendra Prasad Government Medical College and Hospital Kangra at Tanda in the stipulated period fulfilling the inclusion criteria were enrolled for the study. All patients with chronic nasal obstruction between the age group 5 years to 60 years giving consent were included in the study. Patients who were known cases of heart or lung diseases, those not giving consent and those with previous history of nasal surgery were excluded from the study. Controls were selected from general population. The controls did not have complaint of nasal obstruction, history of heart or lung disease and were age matched with the cases. A thorough ENT examination with appropriate investigations was done as required. All the cases and controls underwent spirometry. The method and purpose of spirometry was explained to the patient. It was ensured that the patient exhaled for at least 6 seconds during the PFT. The procedure was repeated until 3 readings of which at least 2 of the FVC and FEV1 components were reproducible. Following parameters were assessed.

1. FVC

2. FEV1

3. FEV1 /FVC

The values of PFT between cases and controls was compared and were divided into mild, moderate, moderately severe, severe and very severe.

4. Statistical Analysis

The data was collected, tabulated and statistically analysed using paired t test.

5. Observations and Results

The study consisted of 50 patients which had chronic nasal obstruction due to structural reasons mostly deviated nasal septum who fulfilled the inclusion criteria. Chronic nasal obstruction was defined as an obstruction present for a duration 12 weeks or more. The most common age group affected was less than 30 years which included more than 90 percent of the patients. The mean age was 20.78 +- 3.51 years (Table 1). A total of 50 age matched controls were taken who had no complaint of chronic nasal obstruction or other nasal complaints. The mean age of the controls was 21.58 +- 3.23 years (Table 1). There were 42 males (84%) and 8 females (16%) amongst the cases (Table 2). The controls included 35 males (70%) and 15 females (30%). The mean duration of nasal obstruction was 6.27 +- 6.25 years (Table 3). Majority of the patients had nasal obstruction less than 2 years (38 percent) followed by 20 percent of the patients who had nasal obstruction between 4-6 years. When comparing the pattern of restriction between cases and controls, majority of the controls had normal (16) and mild (26) pattern of restriction (Table 5), while only 6 of the cases had normal spirometry (Table 4) and 8 amongst the cases had mild degree of restriction in the spirometry. Majority of the patients had moderate (12) and moderately severe (13) pattern of restriction (Table 4). Ten cases had severe pattern of restriction and 1 case had very severe pattern of restriction. None of the controls had severe or very severe pattern of restriction.

A statistically significant difference was found in the FEV1 of cases and controls (p value= 0.00002) in the age group less than 20 years (Table 6). There was a statistically significant difference when the FVC of the cases and controls was compared in the age group less than 20 years (p value= 0.00007) (Table 6), whereas the difference in the FEV1/FVC was not statistically significant in this age group (p value= 0.47) (Table 6). In the age group between 21 and 30 years which included 19 patients, there was a statistically significant difference in FEV1 value when compared between the cases and the controls (p value= 0.002) (Table 6). Also, there was a statistically significant difference in the FVC between the two groups (p value= 0.014), while there was no statistically significant difference between the FEV1/FVC value (p value= 0.56) (Table 6). The difference in pulmonary functions between the different age groups was more in the less than 20 years age group as compared to the 21- 30 years age group, while the age group 31-40 years consisted of only one patient so the statistical significance in pulmonary functions in this group could not be commented upon. When comparing the visual analogue scale score of the patients, 19 patients had a score of 6 and another 19 patients had a score of 7. Nine patients had a score of 8 and remaining 3 patients had a score of 3 while none of the patients had a score of 10 (Table 7). Thirty-nine of the cases had unilateral nasal obstruction and 11 of the cases had bilateral nasal obstruction (Table 8). When the average FEV1 and average FVC were compared, the patients with bilateral nasal obstruction had poorer average FEV1 scores (59.45), in comparison the average FEV1 value of the patients with unilateral nasal obstruction was 66.46 (Table 8). Similarly, the patients with unilateral nasal obstruction had better average FVC scores (63.89) in comparison to the patients with bilateral nasal obstruction whose average FVC scores were 62.63 (Table 8). When the FEV1 values of the patients with less than 2 years of nasal obstruction was compared with patients with more than 10 years of nasal obstruction, no statistically significant difference was observed between the two (p value= 0.09) (Table 9). When the FVC value of the two groups was compared, there was a statistically significant difference between the two (p value= 0.02). There was no statistically significant difference between the FEV1/FVC ration of the two groups (p value=0.37) (Table 9). When the FEV1 of patients with VAS scores 6 was compared with those with VAS score 9, there was no statistically significant difference between the two (p value>0.05) (Table 10). Similarly, when the FVC values of the two groups was compared, there was no statistically significant difference between the two (p value= 0.15) (Table 10). Also, there was no statistically significant difference between the FEV1/FVC values of the two groups (p value= 0.69) (Table 10).

Table 1: Age distribution of cases and controls

AGE	CASES	CONTROLS
<20 years	30	20
21-30 years	19	29
31-40 years	1	1

Table 2: Sex distribution of cases and controls

SEX	CASES	CONTROLS
MALE	42	35
FEMALE	8	15

Table 3: Duration of nasal obstruction in patients

Duration of obstruction	Number of patients	Percentage
0-2 years	19	38
2-4 years	5	10
4-6 years	10	20
6-8 years	5	10
8-10 years	3	6
>10 years	8	16

Table 4: Pattern of restriction amongst cases

PATTERN OF RESTRICTION AMONGST CASES	NO
NORMAL	6
MILD	8
MODERATE	12
MODERATELY SEVERE	13
SEVERE	10
VERY SEVERE	1

Table 5: Pattern of restriction amongst controls

PATTERN OF RESTRICTION AMONGST CONTROLS	NO
NORMAL	16
MILD	26
MODERATE	8
MODERATELY SEVERE	0
SEVERE	0
VERY SEVERE	0

Table 6: FEV1, FVC, FEV1/FVC of cases and controls by age groups

	<20			21-30			31-40	
	CASES	CONTROLS	P	CASES	CONTROLS	P	CASES	CONTROLS
FEV1	62.37	78.13	0.00002	70.58	84.84	0.002	34	74
FVC	59.4	74.8	0.00007	70.47	81.73	0.014	60	70
FEV1/FVC	109.53	107.17	0.47	104.37	106.68	0.56	57	109

Table 7: VAS scores of cases

VAS SCORE	NO
6	19
7	19
8	9
9	3
10	0

Table 8: Average FEV1, FVC, FEV1/FVC of patients with unilateral and bilateral nasal obstruction

	UNILATERAL	BILATERAL
NO	39	11
AVG FEV1	66.46	59.45
AVG FVC	63.89	62.63
AVG FEV1/FVC	108.26	100.36

Table 9: Average FEV1, FVC and FEV1/FVC by duration of nasal obstruction

	0-2 YRS	2-4 YRS	4-6 YRS	6-8 YRS	8-10 YRS	>10 YRS
AVG FEV1	63.16	67.4	61.1	70.6	50.67	74.12
AVG FVC	62.52	61.6	58.4	63.4	54.67	77.5
AVG FEV1/FVC	107.42	111.8	107.6	113.6	95.33	99.5

Table 10: Average FEV1, FVC and FEV1/FVC by VAS scores

	VAS 6	VAS 7	VAS 8	VAS 9
AVG FEV1	72.68	61.31	63.44	43
AVG FVC	70.31	58.31	63.22	56
AVG FEV1/FVC	106.52	110.36	104.22	89

6. Discussion

Nasal obstruction as a symptom has been one of the commoner complaints by which patients present to the otorhinolaryngologist. The association between the upper and lower airway diseases has long intrigued the physicians. The upper and lower airway relationship has been documented in literature and one has been found dependent on the other and vice versa. This study aims to establish the relationship between chronic nasal obstruction and pulmonary functions in a North Indian population. This is a case control study wherein the patients with the complaint of nasal obstruction for more than 12 weeks were compared with controls from general population who did not have any complaint of nasal obstruction. This is a unique study as no case control study has been done in the past for similar objectives.

In a study by Akshay Saxena et al., thirty-three (58.9%) patients were males while 23(41.07%) patients were females, mean age being 24.2±6.98 years [6]. This was comparable to our study, where mean age was 20.78 +- 3.51 years. 42 patients were males (84%) and 8 females (16%). However mean age was less than the study conducted by Sahin Ogreden et al., 53 patients, 44 were male (83%) and 9 were female (17%) with the mean age of 31.71 +- 9.46 [7]. A similar difference was observed in the mean age seen in a study by Karaman et al., (32 years) [8].

In a study conducted by S Karuthedath et al., (2014) The age of patients involved in the study ranged from 18 to 55 years with a mean of 33.20 ± 20.38 years. The maximum number of patients (14) were in the age group 31–40 years representing 46.7 % of the total. The mean difference in FEV1 values at 1 month post operative and preoperative was 0.0413. The mean difference in FEV1 values at 3- and 1-month post operative was 0.081. The mean difference in FEV1 values at 3 months post operative and preoperative was 0.02113. The difference was found to be statistically significant in all the three cases using 2 tailed t test (p value<0.05) [9]. In another study conducted by Emel Bulcun et al., (2010) the postoperative values of forced expiratory volume in 1 second, forced vital capacity, and peak expiratory flow percentages were higher than preoperative ones, and these results were statistically significant (p = .007, p = .04, and p = .007, respectively) [10].

In the cases in the present study, the average FEV1 was 64.92, the average FVC was 63.62 and the average FEV1/FVC was 106.52. A statistically significant difference was found in the FEV1 and FVC values between the cases and the controls in the present study. The difference in the FEV1 and FVC values was more significant in the less than 20 years age group (p value<0.001). In this study 39 patients (78%) had unilateral nasal obstruction and 11 patients (22%) had bilateral nasal obstruction. The patients with unilateral nasal obstruction had better average FEV1 and FVC scores in comparison to patients with bilateral nasal obstruction. The difference between FEV1 values between patients with unilateral and bilateral nasal obstruction was not statistically significant (p value= 0.09). The difference in the FVC values of patients with unilateral and bilateral nasal obstruction was also not statistically significant (p value= 0.79). In the study conducted by Akshay Saxena et al., Patients with bilateral nasal obstruction had worse pulmonary function pre-operatively and relative gain was more in this group post surgery as compared to those with unilateral nasal obstruction. the difference in pulmonary functions between both the groups for FVC, FEV1 and FEV1 /FVC were found to be more for bilateral nasal obstruction calculated using paired t test [6]. No statistically significant correlation could be established between VAS scores and spirometry findings in the present study. This could be attributed to the different duration of nasal obstruction in patients with different VAS scores.

J. H. Ogura et al., (2009) conducted a study in which they noted a decrease in compliance and an increase in pulmonary resistance, during oral as well as nasal breathing, in the majority of subjects tested with relatively severe nasal pathology. These values revert to the normal range in approximately the same number of cases, following successful surgical correction of the obstruction [11]. The spirometry findings in the present study correlated with nasal obstruction, there were poorer results in the cases than controls. There were poorer FVC scores in the cases than controls. Thus the patients showed a restrictive pattern in the spirometry when compared with controls, as shown by the statistically significant difference in the FVC and FEV1 scores between the two groups. In the study conducted by Akshay Saxena et al., 25 patients (44.64%) and 16 patients (28.57%) had nasal obstruction between 2-4 years had nasal obstruction for less than 2 years [6]. In our study, nineteen patients (38%) had nasal obstruction for less than 2 years while 10 patients (20%) had nasal obstruction for 4-6 years. When the FEV1 values of the patients with less than 2 years of nasal obstruction was compared with patients with more than 10 years of nasal obstruction, no statistically significant difference was observed between the two (p value= 0.09). When the FVC value of the two groups was compared, there was a statistically significant difference between the two (p value= 0.02) which indicates that there was a restrictive pattern in the cases when compared with controls. There was no statistically significant difference between the FEV1/FVC ration of the two groups (p value=0.37). Therefore, no statistically significant correlation could be established between duration of nasal obstruction with pulmonary functions.

7. Conclusion

It has long been documented that upper and lower airway diseases are interrelated. This study shows the interdependence of the two. Presence of long duration of nasal obstruction leads to changes in compliance of the lungs due to pulmonary hypertension. From this study it is evident that the pulmonary functions deteriorate when there is presence of structural obstruction in the nose which is part of the upper airways. This study also tries to correlate the subjective assessment of nasal obstruction by subjective scales like Visual Analogue Scale with the degree of restriction found in spirometry but does not find a correlation between the two. There was also no significant correlation between the duration of nasal obstruction and pulmonary functions in the present study. The patients with bilateral nasal obstruction had poorer results on spirometry than patients with unilateral nasal obstruction but the difference was not statistically significant. This study is a one of a kind study where cases with chronic nasal obstruction were compared with the controls from general population who did not have nasal obstruction. This study also establishes the relationship between upper airway and lower airway disease in a Northern Indian population by means of simple tools such as Visual Analogue scale and spirometry. This study is helpful for assessment of pulmonary distress and the likely etiology for that. It may also be helpful for identifying the patient who will benefit from septal correction for the relief of their symptoms. Visual analogue scale is a useful measure in a setting where more complicated objective assessments are not feasible. It is also helpful and easily understood by the patients for necessary compliance.

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