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SUBJECTIVE AND OBJECTIVE NASAL EVALUATION OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME

ABSTRACT

Objective:
To evaluate and compare the nasal cavities of Obstructive Sleep Apnea Syndrome (OSAS) patients using subjective measures and objective measures (Nasal endoscopy, Acoustic Rhinometry, Rhinomanometry).

Methods:
55 OSAS patients were included. Two studies were carried out. Study 1 was between subjective measures and objective measures. Study 2 was between endoscopic measures and subjective measures.

Results:
In study 1, there was a poor negative correlation between subjective measures and AR (NOSE and MCA: R= -0.099, NOSE and Nasal volume: R=-0.048, VAS and MCA: R=-0.091, VAS and Nasal volume: R=-0.031). There was a poor positive correlation between subjective measures and RM (NOSE and airway resistance: R=0.083, VAS and airway resistance: R=0.107). There was a strong positive correlation between two subjective methods (NOSE and VAS: R=0.887) and weak correlation between two objective methods, AR and RM (MCA and Airway resistance: R= -0.073, Nasal volume and Airway resistance: R= 0.073). In study 2, there was no association between subjective measures and nasal endoscopy ($X^2=2.49$; $P>0.1$). There were association between nasal endoscopy and RM ($X^2=7.695$; $P<0.01$) as well as with nasal endoscopy and AR ($X^2=3.61$; $P<0.05$).

Conclusion:
Although most results of correlation were in the expected direction, they were not highly significant. There was a poor correlation between the different evaluations methods used and there was a discrepancy between the subjective perception of the patients and the objective findings.

Keywords: Acoustic Rhinometery, Nasal Endoscopy, Nasal Obstruction, NOSE, Rhinomanometer, VAS.

INTRODUCTION

Nasal obstruction is a very common complaint among people. There are various causes by which a nasal cavity can be obstructed. Anatomical nasal alteration like deviated nasal septum, hypertrophy of turbinates and narrowing of nasal cavity can cause nasal obstruction. Disorders like rhinosinusitis, acute nasopharyngitis, rhinitis, nasal polyps, papillomas, and hemangiomas are also some of the causes of nasal obstruction. Patients with obstructive sleep apnea syndrome have also shown to have obstruction of the nose.

There are different ways to evaluate nasal obstruction. Subjective evaluation using the Nasal Obstruction Symptom Evaluation (NOSE) scale and Visual Analogue Scale (VAS) are widely used. This subjective measure evaluates patient's perception of nasal obstruction. VAS evaluates patient's perception on the day of the examination whereas NOSE scale is used to evaluate the nasal obstruction for the past one month. Acoustic Rhinometry (AR) is an objective tool used to measure the cross-sectional area and nasal volume within a given distance in the nasal cavity. It is a painless, noninvasive procedure that requires little cooperation of the patients and has been applied to both children and adults.[1,2] This works by evaluating nasal geometry by analyzing reflections of sound introduced into the nostrils.[3]

Rhinomanometry (RM) is another objective tool used to measure the airway resistance in the nasal cavity. Nasal resistance is defined as the relationship between transnasal pressure and nasal airflow.[4] RM measures the transnasal pressure and airflow and provides a nasal resistance value and a graph of the relationship between pressure and airflow.

Nasal endoscopy involves evaluation of the nasal and sinus passages with direct vision using a magnified high-quality view. It serves as an objective diagnostic tool in the evaluation of sinonasal anatomy and nasal pathology. Nasal endoscopy can be done using either a flexible fiberoptic endoscope or a rigid endoscope.

It is quite unclear to see which of these measurement methods are the most important to assess nasal obstruction. Discordance between objective measures of disease severity and subjective patient self-assessments has been established in other medical conditions including sleep apne.[5,6] It has been argued that objective and subjective evaluations often measure different aspects of disease burden and in such cases both should be included in the assessment of the disease.[7] Although some studies have established a correlation between objective and subjective measures of nasal obstruction [8-10] others have not.[11] To investigate the relationship between subjective and objective measures of the nasal airway, this study compares two subjective measures (NOSE and VAS) and AR, RM and nasal endoscopy.

MATERIALS AND METHODS

55 OSAS patients were included in this study. They were patients who underwent Epworth Sleepiness Scale (ESS) evaluation and then were subjected to overnight polysomnography evaluation (PSG).

Philips A5 polysomnogram developed by Respironics, inc. with Alice Sleepware version 2.7 software was used in this study. Patients with Apnea Hypopnea Index (AHI) 5 or more were diagnosed to have OSAS. All patients were informed of the study and consent was taken from them. The principles of good clinical practice were followed in this study.

Two studies were carried out (Figure 1). Study 1 was between subjective measures and AR, RM measures of 55 OSAS patients. Spearman correlation was used to see the correlation between them. Study 2 was between endoscopic measures and subjective, AR and RM measures. Chi square test was used to see the association between them. Subjective evaluation was done using VAS and NOSE scale. Objective evaluation was done using nasal endoscopy, acoustic rhinometry and rhinomanometry.

All the OSAS patients were evaluated using the NOSE scale and nasal obstruction VAS to assess the subjective parameters of nasal obstruction. The NOSE scale is a reliable, validated and responsive method for assessing a patient's subjective perception over the past one month. It has 5 questions, each with a scale from 0 to 4 and is scored on a scale from 0 to 20. Patients with NOSE score of 10 or more were categorized to have a significant nasal problem. The nasal obstruction VAS is based on patients' overall nasal obstruction on that particular day. It has a scale from 0 to 10 with 0 indicating no obstruction and 10 indicating total obstruction. Patients with VAS score of 5 more were categorized as having significant nasal obstruction.

Acoustic rhinometry was performed in each patients using Acoustic Rhinometer A1 developed by GM Instruments Ltd. A1 Clinical software version 3.0.0.969 was used which was delivered by the manufacturer. The acoustic values of special interest were the minimal cross sectional area and the nasal cavity volume between 0 and 6 cm from the nostril, measured from the left and right cavities separately. The normal value of the minimal cross sectional area is 0.45 to 0.78 cm^2 and the normal value of nasal cavity volume is 6.45 to 12.65 cm^3.

Rhinomanometry was done in all patients using Rhinomanometer NR6 developed by GM Instruments Ltd. Clinical sotware version 3.0.0.969 was used which was delivered by the manufacturer. The normal value for airflow resistance is 0.131 to 0.441 Pa/cm3/s.

Patients then underwent nasal endoscopy using a flexible fiberoptic endoscope to evaluate the anatomy of the nasal cavity. Besides examining the nasal cavity and nasopharynx, the presence or absence of deviated nasal septum (DNS), hypertrophy of the turbinates and narrowing of the nasal cavities were noted.

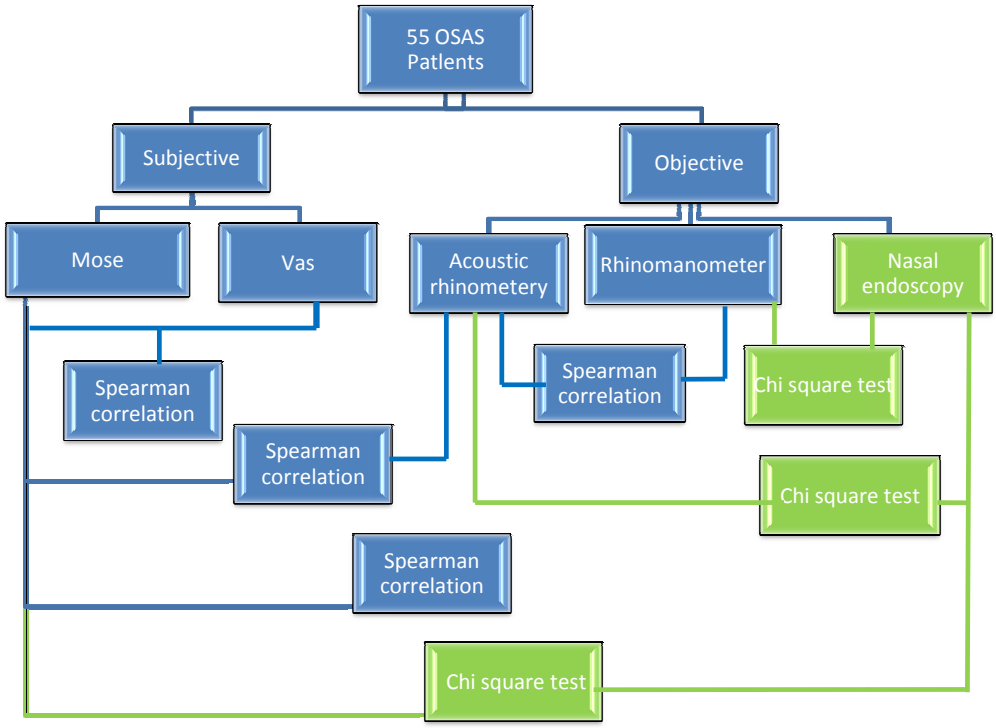

Figure 1: Flow chart showing study method. Colour blue: study 1 Colour green: study 2

RESULTS

In study 1, statistical analysis was done using Spearman correlation to establish the negative or positive correlation between NOSE, VAS and AR, RM. P value was also determined between all the categories.

There was a poor negative correlation between subjective measures and AR. There was positive correlation between the NOSE and VAS and also positive correlation between MCA and Nasal volume. (Table 1)

Table 1: SPEARMAN CORRELATION ANALYSIS

	Acoustic Rhinometry • MCA • Nasal Volume	Subjective • NOSE • VAS
MCA	1.00	
Nasal Volume	• 0.274(p=0.0429) • 1.00	
Subjective		
NOSE	•-0.099(p=0.4721) •-0.048 p=0.7278)	1.00
VAS	•-0.091(p=0.5088) •-0.031 p=0.8222)	•0.887(p=0.0001) •1.00

MCA= minimal cross-sectional area,

NOSE= nasal obstruction symptom evaluation scale,

VAS= visual analogue scale.

There exists a negative correlation between subjective measures and acoustic rhinometry. The relationship between the variables is weak with p value >0.05. Therefore, by conventional criteria, this difference is considered to be not statically significant. For NOSE and VAS, there exist a strong positive correlation and as the p value is <0.0001, it is statistically significant.

Statistical analysis was also done to establish the correlation between subjective measures and RM using Spearman correlation analysis. Poor positive correlation was seen between the variables (Table 2).

Table 2: SPEARMAN CORRELATION ANALYSIS

	Rhinomanometry Nasal Airway Resistance	Subjective •NOSE •VAS
Nasal Airway Resistance	1.00	
Subjective		
NOSE	0.083 (P=0.5469)	1.00
VAS	0.107 (P=0.4368)	0.887(p=0.0001) 1.00

NOSE= nasal obstruction symptom evaluation scale,
VAS= visual analogue scale.

Finally, statistical analysis was done to evaluate the correlation between two objective measures (AR and RM). There was a very weak negative correlation between MCA and nasal airway resistance whereas there was poor positive

correlation between nasal volume and nasal airway resistance (Table 3).

Table 3: SPEARMAN CORRELATION ANALYSIS		
	Rhinomanometry Nasal Airway Resistance	Acoustic Rhinometry •MCA •Nasal Volume
Nasal Airway Resistance	1.00	
Acoustic Rhinometry		
MCA	-0.073 (P=0.5964)	1.00
Nasal Volume	0.073 (P=0.5964)	•0.274(p=0.0429) •1.00

MCA= minimal cross sectional area.

There is negative correlation between MCA and airway resistance. The relationship between the variables is very weak. However, there is a weak positive correlation between nasal volume and airway resistance with p value >0.05.

In study 2, 55 OSAS patients underwent nasal endoscopy checking for DNS, Hypertrophy and Narrow nasal cavity. The patients with anatomical alteration seen by nasal endoscopy were placed under 'yes' group and patients without anatomical alteration were placed under 'no' group. Three statistical analysis using chi square tests were carried out.

First statistical analysis: 23 patients with NOSE and VAS score of 10 or more and 5 or more respectively were considered as positive group and 32 patients with NOSE and VAS score of 9 or less and 4 or less were considered as negative group. Chi square test was used to see the association between subjective and nasal endoscopy (table 4)

TABLE 4: ASSACCATION BETWEEN SUBJECCTVE & NASA ENDOJCETY				
		Anatomical alteration seen with nasal endoscopy		
		YES	NO	TOTAL
NOSE+VAS	POSITIVE	22	1	23
	NEGATIVE	26	6	32
	TOTAL	48	7	55

X2 = 2.49; P=0.1146

As P >0.05 it suggests that there is no association between subjective data and nasal endoscopy.

Second statistical analysis (Table 5) was carried out between Nasal endoscopy and AR. 55 OSAS patient underwent both the tests. Among them, 51 had abnormality in MCA and/or Volume and 52 had anatomical alteration as seen through nasal endoscopy. Chi square test was used to see the association between them.

TABLE 5: ANALYSES BETA NASD ENDOSCELY & A12				
Acoustic Rhinometery		Anatomical alteration seen with Nasal Endoscopy		
		YES	NO	TOTAL
Abnormality in MCA and/or Volume	Present	49	2	51
	Absent	2	2	4
	TOTAL	51	4	55

X2 =11.67; P=0.0006

As P<0.05 it suggests there is association between endoscopy and AR.

Third statistical analysis: Chi square test was used to see the association between Nasal endoscopy and RM (Table 6). Among 55 OSAS patients, 53 had airway resistance more than normal (0.491 Pa/cm3/s) and 52 had anatomical alteration as seen through nasal endoscopy.

Table 6:				
Rhinomanometer		Anatomical alteration seen with Nasal Endoscopy		
		YES	NO	TOTAL
Airway resistance	>0.491	51	2	53
	<0.491	1	1	2
	TOTAL	52	3	55

X2 = 7.695; P=0.0055

As P<0.05 it suggests there is association between nasal endoscopy and RM.

DISCUSSION

Nasal obstruction is a very common complaint among people. The differential diagnosis of nasal obstruction includes acute nasopharyngitis, rhinosinusitis, rhinitis, deviated nasal septum, nasal polyps, papillomas, and hemangiomas.[12] Patients with severe obstructive sleep apnea tend to have a smaller minimal crosssectional area.[13] Objective measurement of nasal obstruction may aid in proper diagnosis and management as well.

Perception of nasal obstruction is a subjective feeling of the patency of the nasal airway. Nasal obstruction is associated with decreased cross-sectional area, decreased nasal cavity volume and increased nasal resistance. AR is a reliable and

valid objective method for measuring cross-sectional area and nasal cavity volume. The severity of nasal obstruction has been significantly associated with objective measures of acoustic rhinometry.[12] RM is used to measure the resistance of the airflow in the nasal cavity. Nasal endoscopy involves evaluation of the nasal and sinus passageswith direct vision using a magnified high-quality view. It serves as an objective diagnostic tool in the evaluation of sinonasal anatomy and nasal pathology.

This study suggests that there is a discrepancy between patient's perception of nasal obstruction and anatomical measures of the nasal airway. There have been various studies in the past with regards to the degree of correlation between subjective and objective measures with mixed results.[14] This study does not differentiate the two sides of the nasal airway. The side with the lowest value was taken as reference. Since patients typically seek overall improvement of nasal breathing, we believe the overall nasal airway is most clinically relevant to patients.

The result of this study shows a relative lack of correlation between subjective and AR measures. One could say that this may be due to lack off validity or reliability for one or more of the measures being compared. However, each has been extensively and independently validated.[14] It may seem surprising to see that there is a poor correlation between subjective and AR measures but as expected, the correlations between subjective and AR measures in this analysis were in the negative direction. Although none of these negative correlations was statistically significant, this finding supports the validity of the methods used (Table 1).

There was a relative lack of correlation between subjective measures and nasal airway resistance (rhinomanometry). Although not significant, the result was consistently in the positive direction. This suggested that nasal airflow resistance increased with increasing severity of nasal obstruction (Table 2). There was a weak positive correlation between nasal volume and nasal airway resistance. Although not significant, the result was in the negative (unexpected) direction. One would argue that increase in the nasal volume would decrease the airway resistance which was not the case in our study. This may be due to the fact that AR measures cross-sectional area along the length of the nasal passage whereas RM is limited to measuring the narrowest point of the nasal airway (Table 3). The study also showed a negative correlation between minimal cross-sectional area (MCA) and airway resistance which was as expected. This suggests that increase in the minimal cross-sectional area decreases the resistance in the airflow. This lack of significant correlations suggests that different nasal measures may capture different aspects of the nasal airway.

In study 2, there was no association between subjective measures and endoscopic findings. This result suggests that there is a discrepancy between the subjective perception of the patients and the endoscopic findings (Table 4).

One reason for the lack of association is that a patient's perception of nasal obstruction may depend on factors beyond the physical caliber of the nose. Patients with longstanding nasal obstruction due to deviated nasal septum or hypertrophy of turbinates may have become desensitized to the severity of the obstruction over time and rate themselves as not having any nasal obstruction. This finding suggests that objective findings may be more useful clinically.

Another explanation for the lack of association may be due to the fact that there is no fixed standard to determine the size of a turbinate and deviated nasal septum. Since endoscopy involves direct visualization of the nasal cavity, different examiners may have different opinions as to the size and severity of the turbinates and nasal septum. A relatively large turbinate may be interpreted as normal turbinate by some examiners while others see it as a large turbinate. Similarly, a small deviated nasal septum may be seen as clinically insignificant by some examiners while others find it significant.

However, there was a strong association between endoscopic measures and AR as well as between endoscopic measures and RM. This suggests that, presence of DNS, hypertrophy and narrowing of the nasal cavity decreases the MCA and nasal cavity and increases the nasal airflow resistance.

Since none of the subjective and objective measure seems to capture the full spectrum of clinically important aspects of the nasal airway when used individually, we hypothesize that a composite measure that includes components of all these assessment methods will provide a more

sensitive and responsive measure of the nasal airway. Hence, nasal obstruction can be assessed more accurately.

CONCLUSIONS

This study establishes poor correlation between subjective and objective methods of nasal measurement that have each been shown to be valid and reliable. There is a discrepancy between the subjective perception of the patients and the objective findings. This suggests that these different methods of assessment are capturing different aspects of the nasal airway and should be considered complementary rather than contradictory.

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