Original Article

Rhinomanometric Measurement of Nasal Resistance in Treatment of Nasal Obstruction

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Summary:

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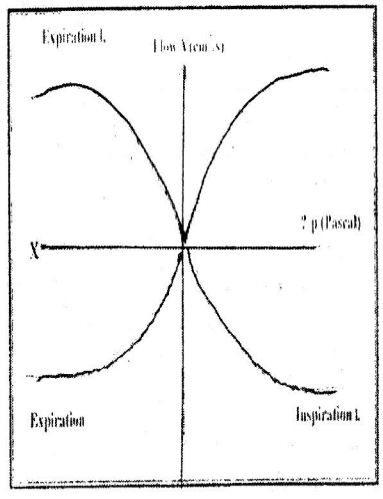
Background:-*The rhinomanometer is a device that measures the pressure and the amount of the air that passes through the nasal air way and calculates the nasal resistance during respiration. Evaluation of the change in measurement of nasal resistance after surgical treatment of various forms of nasal obstruction is studied.*
Patient& methods:- *Sixty patients of different age and sex distribution complained of nasal obstruction had been examined and their nasal resistance were measured by active anterior rhinomanometry pre and postoperatively.*
Results: *- The average preoperative measurement of nasal resistance was ranged from (0.34 - 0.74) Pas./cm/sec. The average postoperative measurement of nasal resistance was ranged from (0.23 - 0.29) Pas./cm'/sec. Therefore the average reduction was ranged from (0.1 1 -0.45) Pas./cm. sec.*
Conclusion:-*Rhinomanometrr is a valuable method to determine the degree of nasal obstruction in numerical figures. it can be utilized in comparative studies of various forms of nasal obstruction and evaluate reduction in the total nasal resistance after surgical treatment especially in those with high level of nasal resistance who needed septorhinoplasty and partial inferior turbinectomy.*
Key wards*: Nasal obstruction, Rhinomanometry, Nasal resistance*

Introduction:

Many patients attend rhinology clinics complaining of nasal obstruction. This is usually either due to structural deformities of the nose or due to hypertrophied mucosal diseases. Evaluation of nasal obstruction b\ measuring the amount of airflow and pressure through the nasal cavities is valuable investigation. Various methods have been used to measure the respiratory nasal airflow for a least a century. In the 1870s, the size of the spot of condensation on a cool mirror or glass slide was used to semiquantitavely measure nasal airflow (1). Presently, computerized pressure-sensitive rhinomanometere is available of small sensitive pressure and How measuring devices and a powerful small computers assembled in an apparatus . known as Rhinomanometer. This made has made nasal air-flow measurement reliable and useful. Rhinomanometry measures the pressure required to produce air flow through the nasal airway and provides an objective measurement of nasal resistance at a specific point in time but it does not determine the cause of obstruction (2). The results of the rhinomanometric measurement appear in the form of graphs and numerical units on the display of the monitor. The graphs demonstrate the nasal resistance on each side of nasal cavity during the respiratory phase, and the numerical units are in Pascal / cm '/ Sec. as shown in the following figure:



(Respiratory pillars according to Bachmann using anterior measurement)

Values above 0.24 Pas./cm/sec. on repeated measurement are regarded abnormal and may require treatment. The most common method of measurement is the active anterior Rhinomanometry. The change in the values of nasal resistance after treatment is presented in this study. *The aims of this study are :*

l. To obtain a quantitative measurement of the percentage reduction of air-flow resistance after treatment.
2.To asses the significance of this reduction in our clinical and surgical practice of Rhinology.

Patients and Methods:

This study was carried out on sixty patients suffered from nasal obstruction treated at the otolaryngology departments of both Al Rashead military hospital and the Medical City Hospital in Baghdad during a period of 18 months in the years 2001-2002. 50 patients were males and 10 patient were females .Their ages ranged from 18- 42 years.
The nasal obstruction was mainly due to structural abnormality; deviated nasal septum. in association with mucosal disease (50 patients), and in the others10 patients, the nasal obstruction was mainly due to hypertrophied turbinates .unassociated with structural abnormality.
Surgical procedures performed include the following:
20 = septoplasty + SMD (Submucous diathermy) +IMA(Inferior meatus antrastomy)
20 =SMR (Submucous resection) -SMD+ IMA
8-SMDalone
6 = Septoplasty alone
2 = SMR +AWO(Antrum wash out)
2 = Septorhinoplasty
2 =PIT (Partial inferior turbineclomy).

Technique:

The patient waited in the examination room on a comfortable chair with minimal activity for at least 30 minutes prior to the test. The measurement was performed in a non-irritating environment in a well ventilated room with constant temperature and humidity. Then, the test procedure was explained properly to the patient to alleviate his /her anxiety. The patient should not take any interfering medication, or coffee before the test. The rhinmanometric apparatus is switched on for 20 minute prior to recording to allow- for acclimatization to standard room temperature and humidity (22C, humidity 58%).and it should be properly calibrated. Active anterior rhinomanometry was performed 24 hours preoperatively before and after application of pharmacological decongestant nasal drop of oxymetazoline Hcl 0.05%.The first measurement was performed without application of nasal drops, and should be the mean 3-5 recordings of each nasal cavity The second measurement was performed alter application of nasal decongestant in each nasal cavity to obtain a maximum effect on the nasal mucosa. The decongestant was applied twice with five minutes intervals between the two applications. Ten to fifteen minutes later the second measurement was performed as before. Any distortion of nasal alae during the test should be avoided. The postoperative rhinoinanoinetric measurement was performed after (4) weeks using the same steps as described in the preoperative measurement. The nasal cavities should be clear of any secretion or crustation prior lo the assessment. Then a comparison between the pre and postoperative measurement was done. The subjective feeling of improvement in the nasal symptom was also noted.

Results and Discussion:

In this study, sixty patients underwent surgical treatment for their nasal obstruction, 50 were males, and 10 were females, as shown in table No.l

Age incidence :

AGE (YEARS)	No. OF PATIENTS	%
18 - 20	4	6.66 %
21—30	22	36.6%
31-42	34	56.6%

Their ages ranged from 18-43 years. The mean age was (30.4years), male: female ratio 5:1.
In the studies of: Farhat Nofal, Micheal Thomas 10 (1990:-50 patients were examined, their age ranged 19-42 years, male: female ratio 9:1.
Gordon-As, etal(7) (1989).: 60 patients were examined their age ranged 20-45 years. The mean age was 27.5, male: female ratio was 3:1. Siplia-J; Soonpacae J.K; Laippala P.(8)(1990):62 patients were examined, their age ranged from 19-41. the mean age was 26.2 male: female ratio 4:2.

Gender -incidence:

GENDER	No. OF PATIENTS	%
MALE	50	83.3 %
FEMALE	10	16.6%
TOTAL	60	100%

Table No. **2**

: The age and sex distribution *of* our patient reflect the usual kind of' patients requiring medical or surgical management for their nasal disorders in our practice

Preoperative assessment:

In this study, .the preoperative measurements before the use of nasal decongestant ranged from 0.24 to 0.90 Pascal/cm/sec. After the use of nasal decongestant the measurement of the nasal resistance ranged from 0.23 to 0.75 Pas./cm **/sec**

Marked reduction of the nasal resistance after the application of the decongestant suggests mucosal disease while persistence of high nasal resistance suggests a structural cause of nasal obstruction. In our study the reduction of the nasal resistance after the use of nasal decongestant was minimal especially in those with structural deformity, perhaps duo to the chronicity of their nasal disorder and due to tolerance to the decongestant.. Table (3)

Age	Gender	Before decongestant Rn.	After Decongestant Rn.
36	M	0.27	0.25
34	F	0.24	0.22
35	M	0.34	0.32
25	M	0.45	0.41
37	F	0.38	0.37
34	M	0.39	0.35
28	M	0.54	0.39
19	M	0.40	0.35
30	M	0.53	0.51
20	F	0.90	0.75
35	F	0.37	0.36
33	M	0.35	0.30
22	M	0.57	0.52
18	M	0.36	0.34
32	M	0.34	0.32

Table No. 3 Preoperative assessment (sample of patients)

Postoperative assessment

A valuable reduction in the nasal resistance was obtaind in about (90%) of the pateint.The results before the decongestant ranged from (0.19 - 0.36) Pas/cm3/sec. And after decongestant (0.18 -0.34) Pas./cm3/sec..

Table No 4:

Age	Gender	Type of procedure	Before decongestant Rn.	After Decongestant Rn.
36	M	Septoplasty ,I.M.A.S.M.D	0.20	0.19
34	F	Septoplasty ,I.M.A.S.M.D	0.20	0.18
35	M	Septoplasty ,I.M.A.S.M.D	0.31	0.29
25	M	Septoplasty ,I.M.A.S.M.D	0.28	0.27
37	F	Septoplasty ,I.M.A.S.M.D	0.24	0.24
34	M	S.M.R. ,I.M.A.S.M.D	0.18	0.18
28	M	S.M.R. ,I.M.A.S.M.D	0.22	0.21
19	M	S.M.R. ,I.M.A.S.M.D	0.26	0.26
30	M	Partial inferior turbinectomy	0.25	0.25
20	F	Septorhinoplasty	0.28	0.27
35	F	Septoplasty ,I.M.A.S.M.D	0.25	0.24
33	M	S.M.R. ,I.M.A.S.M.D	0.22	0.22
22	M	S.M.R. ,I.M.A.S.M.D	0.21	0.20
18	M	Septoplasty	0.25	0.25
32	M	S.M.R ,Antral wash out	0.22	0.22

Table No :4 Postoperative assessment (sample of patients)

In the present study:

Group A. 20 patients ;(18) (90%) had septoplasty with inferioreatal antrostomy and submucosal diathermy. They showed significant decrease in total nasal resistance. The mean preoperative measurement of this group before decongestant:- 0.34 Pas/cm/s, and after decongestant:- 0.32 Pas/cmVs, The mean postoperative measurement of this group before decongestant 0.24 Pas/cmVs, and after decongestant 0.23 Pas/cm/s,

Therefore the mean gain in the reduction of nasal resistance is 0.10 & 0.09 Pas/cm7s, respectively.

Group B: 20 patients, (17) (85%) submucosal resection with inferior meatal antrostomy and submucosal diathermy. The mean preoperative measurement of this group before decongestant 0.48 Pas/cm'/s, and after decongestant 0.27 Pas/cm7s, The mean postoperative measurement of this group before decongestant 0.23 Pas/enrVs, and after decongestant:- 0.22 Pas/cnrVs,

Therefore, the mean gain in the reduction of nasal resistance is 0.25 & 0.05 Pas/cm/s respectively.

Group C. 6 patients; (6) (100%) had septoplasy, all of them showed decrease in total resistance 4 weeks postoperatively documented by rhinomanometry.

The mean preoperative measurement of this group: Before decongestant 0.35 Pas/cmVs, and after decongestant 0.34 Pas/cmVs. The mean postoperative measurement of this group before decongestant 0.25 Pas/cmVs, and after decongestant:- 0.25 Pas/cmVs,

Therefore the mean gain in the reduction of nasal resistance is 0.10& 0.09 Pas/cmVs respectively.

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Group D. 2 patients; (2) (100%) had partial inferior turbinectomy.

The mean preoperative measurement of this group before decongestant 0.50 Pas/cm/s, and after decongestant 0.48 Pas/cm/s,

The mean postoperative measurement of this group before decongestant 0.24 Pas/cm7s, and After decongestant:- 0.24 Pas/cmVs,

Therefore, the mean gain in the reduction of nasal resistance is 0.26 & 0.24 Pas/cm^3/s, respectively.

Group E. 2 patients; (2) (100%) had submucosal resection with antral wash out,

The mean preoperative measurement of this group before decongestant 0.35 Pas/cm7s, and after decongestant 0.34 Pas/cmVs, The mean postoperative measurement of this group before decongestant:- 0.24 Pas/cmVs, and after decongestant:- 0.23 Pas/cm7s,

Therefore the mean gain in the reduction of nasal resistance is 0.11 & 0.11 Pas/cmVs, respectively.

Group F. 2 patients; (2) (100%) had septorhinoplasty and all of them showed an improvement in the nasal airway postoperatively documented by rhinomanometry.

The mean preoperative measurement of this group: before decongestant 0.74 Pas/cmVs, and after

decongestant:- 0.64 Pas/cm7s, The mean postoperative measurement of this group before decongestant 0.25 Pas/cmVs, and after decongestant:- 0.24 Pas/cmVs,

Therefore the mean gain in the reduction of nasal resistance is 0.49 & U.40 Pas/cmVs, respectively.

Group G. 8 patients; (7) (84.5%) had submucosal diathermy and all of them showed decrease in total resistance 4 week postoperatively documented by rhinomanometry as a total result. The mean preoperative measurement of this group before decongestant 0.46 Pas/cmVs, and after decongestant 0.44 Pas/cm Vs, The mean postoperative measurement of this group before decongestant 0.29 Pas/cm^3/s, and after decongestant:- 0.28 Pas/cm^3/s,

Therefore the mean gain in the reduction of nasal resistance is 0.17 & 0.16 Pas/cm7s, respectively.

Table No:'(5)

	BEFORE DECONGESTANT							AFTER DECONGESTANT						
	A GRO UP 1	B GROU P 2	C GRO UP 3	D GRO UP 4	E GROU P 5	F GRO UP 6	G GRO UP 7	A GROU P 1	B GRO UP 2	C GRO UP 3	D GROU P 4	E GROU P 5	F GROU P 6	G GROU P 7
MEAN PREOPERAATIVE Rn.IN Pa./cm^3/s	0.34	0.48	0.35	0.50	0.35	0.74	0.46	0.32	0.27	0.34	0.48	0.34	0.64	0.44
MEAN POSTOPERATIVE Rn.In Pa./cm^3/s	0.24	0.23	0.25	0.24	0.24	0.25	0.29	0.23	0.22	0.25	0.24	0.23	0.24	0.28
Mean fall in total Rn.In Pa./cm^3/s	0.10	0.25	0.10	0.26	0.11	0.49	0.17	0.09	0.05	0.09	0.24	0.11	0.40	0.16

Table (7)

GROUP A : Septoplasty +S.M.D +I.M.A.
GROUP B : S.M.R. +S.M.D. +I.M.A.
GROUP C : Septoplasty.
GROUP D : Bilateral partial inferior turbinectomy .
GROUP E : S.M.R. +Antral wash out.
GROUP F : Septorhinoplasty.
GROUP G : S.M.D.

In the studies of:

Stevens etal(6)(1985). 1.5 patients (out of 17) (88%) showed reduction in the total nasal resistance post operatively after S.M.D.

Jones A. Lancer J.M.(10)(1987) showed the mean fall **in** total nasal resistance in 18 patients underwent S.M.D. in 0.22 pa/cm3/s.2 months after surgery.

Bruins etal(ll) (1982): evaluated the operation of functional septoplasty using active anterior rhinomanometry. They found that most patients did indeed showed a reduction **in** nasal resistance after the procedure.

Brom etal(ll) (1982): showed significant improvement in nasal airway with decrease **in** nasal resistance in more obstructed side and in total nasal resistance after septal surgery.

Wight R.G. Jones A.S and Clegg R.T.(5)(1988): showed mean fall **in** total nasal resistance in 8 patients were underwent anterior trimming of the inferior turbinate is 0.21 pa/cm3/s. The mean fall in total nasal resistance in 10 patients were carried out radical trimming of the inferior turbinate is 057 pa/cm3/s.

Farhat Nofal, Michael Thomas(4)(1990): 43 patients underwent S.M.R. showed mean fall in total nasal resistance in 0.24 Pa/cm3/s.

Sipila J; Suonpaa J; Laippala P(12). (1994): conclude that rhinomanometry rather than the subjecive sensation of the subject is more suited to detect subtle side difference in resistance between the nares.

Gordon AS et al(13) (1989): Showed 60 patients underwent nasal surgery for obstruction, normalize the nasal resistance of the study group in relation to control group.

Piccini A; Biagini C; Sensini 1(14) (1991): showed that rhinomanometry as an objective test for surgical selection and functional results.

In our study. The improved in the obstruction of the nasal cavity has been obtaind in 54 pateint(90%).Table (6).

Type of surigcal procedure	No. of pateints preoperativly	No. of pateints postoperativly	%
Septoplasty ,I.M.A,S.M.D	20	18	90%
S.M.R. ,I.M.A,S.M.D	20	17	85%
Septoplasty	6	6	100%
Partial inferior turbinectomy	2	2	100%
S.M.R.+Antral wash out.	2	2	100%
Septorhinoplasty	2	2	100%
S.M.D	8	7	84%
	60	54	90%

Table (6)

Conclusions

1- Rhinomanometer is a valuable method in determining the degree of nasal obstruction in numerical ligures and it can be used in comparative studies of various forms of nasal obstruction.

2-Nasal decongestant has minimal effect on the nasal resistance in patients with chronic nasal disease and in those with structural nasal obstruction.

3- Patients with high preoperative values of nasal resistance had shown a significant reduction in the nasal resistance postoperatively

4-The average reduction in nasal resistance postoperatively was ranging from (0.11 - 0.45 Pas/cm3/sec).

5-Nearly (90%) of the patient has shown reduction in the nasal resistance and improvement in their obstructed nasal cavity.

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