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ORIGINAL ARTICLE

Evaluation of the Effect of Surgeries of the Nasal Septum and Inferior Turbinates on Middle Ear Function

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ABSTRACT

Background : Surgery of the nasal septum and turbinates are among the most frequently performed procedures in otolaryngology. They are performed in varying techniques for decades.

Aim of the work: The aim of this study is to investigate the effect of nasal obstruction surgery (nasal septum combined with inferior turbinates) on middle ear function. Patients and Methods: This study is a prospective case series study carried out at the E.N.T outpatient clinic of Zagazig University Hospitals during the period from October 2018 to April 2019. Patients were recruited from the Otorhinolaryngology Departments, Faculty of Medicine, Zagazig University Hospitals.

Results: There was statistically significant difference between the pre and post-operative tympanometry type and Eustachian tube function with improvement of Eustachian tube function and there was highly statistically significant difference between the pre and post-operative mean ear pressure in both ears and there was highly statistically significant difference between the pre and post-operative mean ear pressure in both ears in successive times.

Conclusion: Nasal obstruction surgeries significantly improved ETF and middle ear pressure. The complete evaluation of nasal air flow is mandatory before middle ear surgery to assess the hypoventilation of the middle ear.

Keywords: Nasal Septum, Inferior Turbinates, Middle Ear Funct.

INTRODUCTION

Nasal obstruction is a common complaint seen by otolaryngologists and is defined as patient discomfort manifested as a sensation of insufficient airflow through the nose.

The etiology of nasal obstruction is generally divided into mucosal and anatomical causes [1]. Nasal obstruction can be caused by several problems. For example, things like allergies can cause nasal obstruction. Another very common cause of nasal obstruction is narrow nasal passages. Often, narrow nasal passages are the result of problems with the nasal septum and turbinates [2]. Septoplasty is a surgical correction procedure for the deviated nasal septum to improve nasal airflow, is the most common ear, nose and throat (ENT) operation in adults [3].

The turbinate reduction surgery or inferior turbinate reduction surgery is a procedure performed to correct nasal obstruction where the inferior nasal turbinates are examined and

reduced in size to provide improved nasal airflow [4].

Tympanometry is an objective, painless method for detecting the presence of middle ear effusion by providing information about tympanic membrane (TM) compliance. A soft plastic probe is inserted into the external auditory canal to obtain an airtight seal. The tympanometer measures the flow of sound energy into the middle ear under conditions of changing air pressure. When the air pressure is equal on both sides of an intact tympanic membrane, with the drum in neutral position, the transmission of sound energy through the tympanic membrane is at its maximum. The peak on the tympanogram represents the pressure at which the flow of sound energy is maximal. For example, in a normal air-filled middle ear cavity, the peak occurs at ambient atmospheric pressure. With eustachian tube dysfunction (a retracted tympanic membrane but no middle ear effusion), the peak occurs in the negative pressure range on the recording [5].

With middle ear effusion, the sound energy flow into the middle ear is reduced, which produces a flat tympanogram. A flat tympanogram may also result from cerumen, foreign body, or from occlusion of the opening of the probe by the wall of the external auditory canal. In a perforated tympanic membrane, the sound energy is readily transmitted through the hole in the tympanic membrane throughout the entire pressure range, resulting in a flat tympanogram [5].

Tympanometry and Eustachian tube function (ETF) tests (Valsalva and Toynbee maneuvers) can assess the ETF; thus, they have been used widely in clinical and basic research investigations. Patients with tubal dysfunction often complain of a sensation of ear fullness, which is a consequence of the functional impairment of the Eustachian tube resulting from a ventilatory disturbance. However, despite the sensation of ear fullness, most patients show normal middle ear pressure as measured by tympanometry. The tube is frequently involved in the pathological processes of the nasal, paranasal and rhinopharynx cavities; therefore, nasal obstruction can alter ETF [6].

The aim of this study is to investigate the effect of nasal obstruction surgery (nasal septum combined with inferior turbinates) on middle ear function.

METHODS

This clinical trial study was carried on 18 patients complaining of unilateral or bilateral nasal obstruction and tinnitus selected among patients attending the Out patient Clinic of Otorhinolaryngology Department, Facultyof Medicine, Zagazig University Hospitals during the period from October 2018 to April 2019.

The study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

An informed written consent was taken from all patient's parents after explaining the nature of surgery in accordance with the standards of regional ethical committee.

Inclusion criteria

Age > 18 years old and no apparent middle ear pathology on otoscopic examination (normal tympanic membrane) on both ear sides.

Exclusion criteria

Patients with tympanic membrane perforation, patients with acute rhinitis and patients with recent history of middle ear infection.

Methods

Patients were subjected to the following all selected:

History taking: Personal history (Name, age, sex, occupation, and marital state). Complaint (Aural discharge, hearing loss and its duration, earache, tinnitus and its duration and sensation of ear fullness). Present history: All symptoms were analyzed regarding time of onset, duration, course, presence, or absence of aggravating factors. Past history to exclude the presence of associated systemic diseases, ENT surgery. Preoperative routine laboratory investigations: (Complete blood count and random blood sugar and Complete ENT

examination: included a general examination and local examination of both ear, nose and throat. Nasal examination of inferior and middle turbinates was examined. Examination of ear included otoscopy including tests for mobility of the tympanic membrnae using the pneumatic ototscopy and detection of (TM) abnormalities.

Preoperative evaluation tests

Tympanometry: Otoscopic and tympanometric examinations were performed at one day before surgery and at 4 and 6 month postoperatively (using impedence tympanometer). Eustachian Tube Function (ETF) tests: Valsalva: Patients were instructed to pinch the nose and inflate the checks through forced expiration with the mouth closed until a sensation of fullness was achieved in the ears to evaluate the ability to inflate the middle ear actively and another instructions to complete the test. Toynbee: Toynbee maneuver was used to evaluate the capacity to equalize the middle ear pressure and the rhinopharyngeal pressure. Patientswere asked to swallow while pinching the nose. Patients were theninstructed to release the nose and refrain from further swallowing and mandibular movement and an experimental tympanogram was obtained from each ear. Endoscopic assessment and photography of the nose and nasophyrnax and ear and CT scan.

Postoperative follow up of patients

All patients exposed ear function tests as the following: Tympanometry: Tympanometry was performed to all patients at 30 days after the removal of nasal packs (using impedence tympanometer. Also, after 6 months, this test was performed to all patients. Eustachian Tube Function (ETF) tests: ETF tests (Valsalva and Toynbee maneuvers) were performed at 30 days after the removal of nasal packs (using impedence tympanometer. Also, after 6 months, these tests were performed to all patients. Endoscopic assessment and photography of the nose nasophyranx and ear.

Statistical analysis

Data were collected, tabulated and analyzed by SPSS 20 software. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance; difference and association of qualitative variable by Chi square test (X^2). Differences between quantitative independent groups by t test. The significance level was considered at $P < 0.05$.

RESULTS

Table (1) showed that the age of the case group was (33.1±8.8) ranged from (19-50) years and (50.0%) of them were females and (50.0%) of them were males. Table (2) showed that (77.8%) of the study group had nasal obstruction and (22.2%) of them had tinnitus preoperatively and after operation only (5.7%) of them had nasal obstruction and tinnitus. Table (3) showed that the tympanometry Pre-operative (66.7%) type A, (11.1%) type B, (22.2%) type C, Post-operative (88.8%) type A, (11.1%) type B, (11.1%) type C and Pre-operative Eustachian tube function (55.6%) Normal, (44.4%) Dysfunction and post-operative (94.4%) Normal, (5.6%) Dysfunction in the right ear. Table (4) showed that the tympanometry Pre-operative 66.7% type A, (11.1%) type B, (22.2%) type C, Post-operative (94.4%) type A, (0.00%) type B, (5.6%) type C and Pre-operative Eustachian tube function (44.4%) Normal, (55.6%) Dysfunction and post-operative (94.4%) Normal, (5.6%) Dysfunction in the left ear. Table (5) showed that the mean ear pressure preoperative (-159.1) in the right ear left ear pressure (-162.7), total ear pressure (-160.4), and post-operative right ear pressure at 1st months (-20) 6th months (-15) at 1st month left ear pressure (-17), 6th months (-11) and total ear pressure (-16). Table (6) showed that the improvement in the Eustachian tube function which was good only in (44.4%) preoperatively to become (94.4%) in the 6th month postoperatively. Table (7) showed that there was statistical significant difference between the pre and post-operative complaint with improvement of nasal obstruction from (77.8%) to (5.6%) and improvement of tinnitus from (22.2%) to (5.6%).

Table 1: Socio-demographic characteristics of the case group:

Variable	The Study group (18) mean ± SD (Range) median
Age (years)	33.1±8.8 (19-50) 25.5
Sex: **Male** **Female**	 9 (50%) 9 (50%)

Table 2: Pre and post-operative complaint in the study group

Variable	No. (18)	%
Pre-operative complaint: **Nasal obstruction** **Tinnitus**	 14.0 4.0	 77.8% 22.2%
Post-operative complaint: **Nasal obstruction** **Tinnitus**	 1 1	 5.7% 5.7%

Table 3: Pre and post-operative tympanometry and Eustachian tube dysfunction in the right ear

Right Ear	No. (18)	%
Pre-operative tympanometry type **A** **B** **C**	 12.0 2.0 4.0	 66.7% 11.1% 22.2%
Post-operative tympanometry type **A** **B** **C**	16.0 1.0 1.0	88.8% 11.1% 11.1%
Pre-operative Eustachian tube function **Normal** **Dysfunction**	 10 8	 55.6% 44.4%
Post-operative Eustachian tube function **Normal** **Dysfunction**	 17 1	 94.4% 5.6%

Table 4: Pre and post-operative tympanometry and Eustachian tube dysfunction in the left ear

Left Ear	No. (18)	%
Pre-operative tympanometry type		
A	12.0	66.7%
B	2.0	11.1%
C	4.0	22.2%
Post-operative tympanometry type		
A	17.0	94.4%
B	0.0	0.00%
C	1.0	5.6%
Pre-operative Eustachian tube function		
Normal	8	44.4%
Dysfunction	10	55.6%
Post-operative Eustachian tube function		
Normal	17	94.4%
Dysfunction	1	5.6%

Table 5: Pre and post-operative mean ear pressure (type C tympanogram) of the study group:

Variable	The study group (18) mean ± SD median (Interquartile range)
Pre-operative right ear pressure (daPa)	-91.2±23.4 -159.1 (-214 to -28.5)
Pre-operative left ear pressure (daPa)	-91.7±15.6 -162.7 (-232 to -27.5)
Pre-operative total ear pressure (daPa)	-91.5±20.4 -160.4 (-214 to-28.1)
1st month post-operative right ear pressure (daPa)	-31.2±24.5 -20 (1.5 to -50.9)
6th month post-operative right ear pressure (daPa)	-25.2±24.5 -15 (0.8 to -30)
1st month post-operative left ear pressure (daPa)	-29.3±13.4 -17 (1.9 to -47.2)
6th month post-operative left ear pressure (daPa)	-20.3±14.6 -11 (0.2 to -26)
Post-operative total ear pressure (daPa)	-26.1±15.3 -16 (1.1 to -40)

Table 6: Pre and post-operative Eustachian tube function in the ears of the study group:

Variable	Ears (36)	
	Good No. %	Poor No. %
Pre-operative Eustachian tube function	16 44.4%	20 55.6%
Post-operative Eustachian tube function **1st month**	28 77.8%	8 22.2%
6th month	34 94.4%	2 5.6%

DISCUSSION

Tympanometry and Eustachian tube function (ETF) tests (Valsalva and Toynbee maneuvers) can assess the ETF; thus, they have been used widely in clinical and basic research investigations. Patients with tubal dysfunction often complain of a sensation of ear fullness, which is a consequence of the functional impairment of the Eustachian tube resulting from a ventilatory disturbance. However, despite the sensation of ear fullness, most patients show normal middle ear pressure as measured by tympanometry. The tube is frequently involved in the pathological processes of the nasal, paranasal and rhinopharynx cavities; therefore, nasal obstruction can alter ETF [6].

This study showed that (77.8%) of the study group had nasal obstruction and (22.2%) of them had tinnitus preoperatively and after operation only (5.7%) of them had nasal obstruction and tinnitus. The present results revealed that surgeries affected significantly in treating complaints in patients with nasal obstruction and tinnitus. These results agreed with the study of Gandomi et al**.** [7], who concluded that the surgery done to relief nasal obstruction was successful and the relief of nasal obstruction was the cause of improvement of middle ear pressure postoperatively. Also,

reported that septoplasty and inferior turbinate surgery have obvious improvement in patients with nasal obstruction.

The present data indicated that preoperative tympanometry for right ear was type A (66.7%), type B (11.1%) and type C (22.2%) and differed significantly ($P < 0.05$) postoperatively to be type A (88.8%), type B (11.1) and type C (11.1). Also, the same trend of results was observed in the left ear. These results revealed that surgery significantly improved ($P < 0.05$) postoperative tympanometry for both ears. This study shows that the improvement in the Eustachian tube function which was good only in (44.4%) preoperatively becomes (94.4%) in the 6th month postoperatively. These results agreed with the study of Hafez et al. [8], who found that the type of tympanometry became less negative (changed from C to A) with relief of nasal obstruction due to the effect of surgery, i.e. the type of tympanometry became less negative than the preoperative values. They concluded that nasal obstruction had a strong relation with Eustachian tube dysfunction and can lead to middle ear hypoventilation. Nasal obstruction surgeries improved Eustachian tube function and middle ear pressure. Also, similar results were found by Gandomi et al., [7].

The data obtained from our work showed that postoperative ETF for both ears improved significantly. These results agreed with that of Osama et al., [9], who reported that the number of patients and ears with poor ETF post-operatively decreased with relief of nasal obstruction after surgery. Also, similar results were obtained by Salvinelli et al**.** who demonstrated that the number of patients with a "go “good” ETF tests significantly higher post-operatively in comparison with the preoperative conditions before nasal surgery.

There was statistically significant difference between the pre and post-operative complaint with improvement of nasal obstruction from (77.8%) to (5.7%) and improvement of tinnitus from (22.2%) to (5.7%). The presented results indicated that surgery, postoperatively, improved significantly middle ear pressure for both ears. These data agree with the results of Osama et al. [9], who studied the role of nasal surgeries in changing ETF and middle ear ventilation. They found that the middle ear pressure became less negative with relief of nasal obstruction because of surgery. Also, Salvinelli et al. [10], investigated the effect of nasal obstruction surgery on ETF and middle ear ventilation. They found that postoperative middle ear ventilation was significantly better than preoperatively.

Similarly, Low and Williat [11], discussed the relationship between middle ear pressure and nasal obstruction surgeries in 55 patients. They found that in the ear on the side of nasal blockage, the middle ear pressure was abnormal preoperatively and following surgery with relief of nasal obstruction, the middle ear pressure increased significantly to approach the normal values. Additionally, similar results were obtained by Şereflican et al. [12]. Also, Duran et al. [13] reported an approximately 30% improvement in the middle ear pressure after septoplasty.

CONCLUSION

Nasal obstruction surgeries significantly improved ETF and middle ear pressure. The complete evaluation of nasal air flow is mandatory before middle ear surgery to assess the hypoventilation of the middle ear.

Conflict of Interest

The authors of this manuscript declare no relevant conflicts of interest, and no relationships with any companies, whose products or services may be related to the subject matter of the article.

Financial Disclosures

None.

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