

Effect of Nasal Surgery on Eustachian Tube Function and Middle Ear Ventilation

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ABSTRACT

OBJECTIVE: To evaluate the effect of nasal surgery on Eustachian Tube Function (ETF) and Middle Ear (ME) ventilation.

STUDY DESIGN: Quasi experimental single group study.

PLACE AND DURATION: Audiology Section of ENT Department of Lahore General Hospital, over a period of 1 year from 1st August 2015 to 31st July 2016.

METHODOLOGY: Patients who presented with nasal obstruction and were planned for surgery were included using non probability sampling technique. Acoustic impedance test (typanometry), with Valsalva and Toynbee Tests was performed one day pre-operatively and 30 days post-operatively and results noted. In Valsalva test, the effect of high positive nasopharyngeal pressures at the proximal end of the Eustachian tube was evaluated by obtaining an experimental tympanogram, while in Toynbee test, a tympanometric peak pressure shift of >10 daPa indicated good ETF.

RESULTS: Among total of 75 patients, 80% were diagnosed with type B graph whereas 20% with type C graph preoperatively, among 80% Type B graph cases, 62% improved to Type C. The remaining 38% patients with Type B and all patients of Type C graphs i.e., 20% of the total cases, improved to Type A (Normal graph), indicating significant improvement. Pearson correlation between the two variables i.e., pressure on Eustachian tube (daPa) before surgery (DaPaBS) and after surgery (DaPaAS), was significant with a value of 0.858 indicating a positive association.

CONCLUSION: Nasal surgery results in improvement in Eustachian tube functions and middle ear ventilation.

KEYWORDS: Nasal obstruction, Nasal surgery, Eustachian tube, Middle ear ventilation, Acoustic impedance tests.

HOW TO CITE THIS:

Farooqi S, Saqulain G, Mumtaz N. Effect of Nasal Surgery on Eustachian Tube Function and Middle Ear Ventilation. *Isra Med J.* 2018; 10(6): 336-339.

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INTRODUCTION

Air entry through the Eustachian tube (ET) is essential for normal physiologic functioning of the middle ear (ME) and the

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Received for Publication: 23-02-18
1st Revision of Manuscript: 31-03-18
2nd Revision of Manuscript: 27-07-18
3rd Revision of Manuscript: 28-10-18
Accepted for Publication: 10-12-18

Eustachian tube (ET) and ET functions not only to ventilate the middle ear, but also provides protection to the ME, from pathogens and responsible for drainage of secretions¹. Also ME pressure is maintained by middle ear mucosal gas exchange and intermittent opening of the ET to equalize ME pressure². Swallowing movement opens up the ET resulting in air entry to middle ear cavity, failing of which results in negative ME pressure³. Assessment of Eustachian tube function (ETF) can be carried out by tympanometry with Valsalva and Toynbee maneuvers. Though patients with Eustachian tube dysfunction (ETD) have complaint of fullness of the ears, however 13.4% cases with ear fullness show normal tympanometry results⁴. Obstructive pathologies of nose, nasopharynx and paranasal sinuses may affect ETF⁵ and consequently ME dysfunction these include pathologies like allergic rhinitis⁶, inferior turbinate enlargement⁷, and septal deviations⁸. Septal deviation and turbinate enlargement are the common pathologies encountered with middle ear dysfunction. These may result in Eustachian tube dysfunction (ETD) and cause changes in Tympanic Membrane (TM) and ME like otitis media with effusion (OME), middle ear atelectasis and chronic otitis media (COM). However, the role of ETD in causation of other ME conditions is not clear^{5,9}. The present study is significant since no such study is available in literature from Pakistan and therefore this study was conducted to investigate the effect of

nasal surgery to relieve nasal obstruction on ETF and ME ventilation.

METHODOLOGY

This is a Quasi experimental single group study comprising of a study population of 75 patients selected through Non probability Purposive sampling technique, to access the effects of nasal surgery to relieve nasal obstruction on Eustachian Tube Function (ETF) and middle ear ventilation through Acoustic Impedance tests (tympanometry) and ETF tests. These were patients who presented in the Audiology Section of ENT Department of Lahore General Hospital, Lahore, Pakistan over a period one year from 1st August 2015 to 31st July 2016. It included patients of either gender from ages of 18 to 40 years, who presented with the complaint of nasal obstruction (unilateral or bilateral) and were awaiting surgery to relieve nasal obstruction with diagnosis like deviated nasal septum (DNS), turbinate hypertrophy, chronic rhinosinusitis (CRS), antrochoanal polyp or bilateral nasal polypi. Patients with tympanic membrane perforation, otosclerosis, tympanosclerosis, otitis media, benign/ malignant tumors of the ear and patients presenting with nasal obstruction with suspicion of malignancy were excluded from the study. Following detailed history and examination, including queries regarding the ETD, history of treatment, and the associated problems like muffled or reduced hearing, a feeling of fullness, pain, tinnitus, and problems with balance, data was recorded on a departmental patient record performa. Pre and Post-operatively, tympanometry including Valsalva Test and Toynbee Test were applied to investigate the effect of surgery on ETF and middle ear ventilation. These tests were performed one day before the surgery and 30 days after the surgery to compare two states. In Valsalva test, the effect of high positive nasopharyngeal pressure at the proximal end of the Eustachian tube was evaluated by obtaining an tympanogram, while in Toynbee test, a tympanometric peak pressure shift of >10 daPa indicated good ETF.

Data Analysis: After data collection, it was coded and organized in MS Excel worksheet, and SPSS 20.0 was used for data analysis and statistical tests. Qualitative data like gender was presented by frequency and percentage, and age of presentation was presented by Mean + SD. Variables specially studied included diagnoses i.e., The Jerger Graph Type before surgery and after surgery, pressure on ET before surgery (DaPaBS) and pressure after surgery (DaPaAS). These were presented by frequency and percentage and cross tabulated. Paired sample T-Test and ANOVA test were applied to authenticate the experimental test results. The results were then compared with local and international literature.

RESULTS

Our study population comprised of total of 75 cases including 42(56%) males and 33(44%) females with male female ratio of 1.27:1, having age range of 18 to 40 years with a mean age of 29.03 + SD of 6.125 years, scheduled for surgery to relieve nasal obstruction.

Among the study population, 60 (80%) patients were diagnosed with type B whereas 15 (20%) were diagnosed with type C graph. Independent of surgical procedure for correction of nasal obstruction, 30 days post-operatively, of the 60 (80%) of Type B graph, 37 (62%) improved to Type C. The remaining 23(38%) patients of Type B and 15(20%) of type C became Type A (normal graph) as shown in Table-I.

Table-I: Diagnoses (Tympanometric Jerger graph) Before Treatment (1 Day Pre-Operative) ,*After Treatment (30 Days Post-Operative) Cross Tabulation (N=75)

JERGER GRAPH	Pre-operative No (%)	30 Days Post- Operative		
		Type A No (%)	Type B No (%)	Type C No (%)
Type A	0	0	0	0
Type B	60 (80%)	23 (38%)	0	37 (62%)
Type C	15 (20%)	15 (100%)	0	0
Total	75 (100%)	38 (50.7%)	0	37 (49.3%)

Table-II shows, Correlation between the two variables i.e., pressure on Eustachian tube before surgery (DaPaBS) and after surgery (DaPaAS). Pearson correlation was of the value of 0.858 in this case which clearly indicates that there is a positive association between pressure before surgery (DaPaBS) and after surgery (DaPaAS) and is highly significant (where 5% error and 95% confidence level was set). The Paired Sample T-Test value was 0.858, Sig. (2-tailed) value .000 and value of t - 35.490, were all significant. This proved that the surgery to relieve nasal obstruction improves Eustachian tube function and middle ear ventilation. ANOVA with Friedman's Test having a sig value of zero, were all highly significant indicating the reliability of our data.

Table-II: Middle Ear Pressure (daPa) Before Treatment (1 Day Pre-Operative) and After Treatment (30 Days Post-Operative) (Paired Sample Statistics) (N=75)

Category	Middle Ear Pressure (daPa)		Pearson Correlation
	Pre-operative (daPaBS)	Post-operative (daPaAS) (30 days)	
N	75	75	0.858 (Where 5% error and 95% confidence level was set) and Sig 0.000
Mean	-300.75	-82.41	
Std. Deviation	95.601	61.274	
Std. Error Mean	11.039	7.075	

The aforementioned results clearly indicate the effectiveness of surgical procedure. As clear from the given tables, most of the patients were moved from Type B (abnormal condition) to Type A (normal condition) after surgery. Furthermore, the results of correlation, Cronbach test, and Paired sample T-test were also highly significant proving that Surgery for nasal obstruction improves Eustachian tube function and middle ear ventilation.

DISCUSSION

Eustachian tube dysfunction (ETD) is a state when the ET fails to perform its function i.e., failure to ventilate the middle ear, prevent ME from disease and remove secretion¹. The negative ME pressure is considered a hallmark of ETD. Tympanometry is a valid tool to assess the ME pressure and has been used for diagnosis as well as follow up of some of the diseases of the middle ear¹⁰. Its results are classified into three main tympanometry graphs, i.e., type A, B and C developed by Liden in 1969 and Jerger in 1970. Jerger's Type A graph is normal (compliance of 0.6 to 1.6 at 0 pressure), B indicates fluid or pus behind TM and Type C represents Eustachian tube dysfunction (-ve ME pressure with normal compliance peak). Since nasal obstruction influences the ME pressure by causing ETD^{6,7,11}, various treatment options including surgery to relieve nasal obstruction, may result in cure. Even unilateral nasal obstruction can cause ETD¹². The procedures to relieve nasal obstruction may include operations for septal deviations, turbinate reduction procedures, endoscopic sinus surgery etc.

This study was designed to evaluate the effect of surgeries for correction of nasal obstruction on ETF and ME ventilation. In the present study improvement in ETF and ME ventilation following the nasal surgery was observed in cases diagnosed with Jerger Type B graph preoperatively, were seen to improve one month post-operatively, 37 (62%) patients shifted to Type C and the rest 38 (23%) patients of type B and the 15 cases (20%) of type C improved to type A (normal graph). This improvement was independent of side of nasal obstruction. This positively correlates with the study of Awad et al¹³, and the study by Nanda et al¹⁴, that nasal surgery to relieve nasal obstruction has significant positive relation with the ETF and middle ear ventilation. Different surgeries to relieve nasal obstruction improve ETF and ME ventilation as has been seen in our study. Duran et al, found significant improvement in middle ear ventilation or pressure following septoplasty¹⁵ and in correlation with our study, they also took preoperative reading a day before surgery, however in contrast to ours they took post-operative readings on constant random days and noticed minor change in the beginning but a significant improvement with time. In another similar study, Stoikes et al, reported improvement in ETD due to endoscopic sinus surgery¹⁶.

In contrast to surgery to relieve nasal obstruction, McCoul et al, proposed Balloon Dilatation Eustachian Tuboplasty (BDET) as authenticated treatment of Eustachian tube dysfunction¹⁷. Jagdish et al in a study on cadavers reported a new prototype treatment for equalization of pressure, clearing of the mucous and widening of ET including an articulating camera, a balloon dilator and an expander¹⁸. According to Farenti G et al, ETD following nasal obstruction may be due to: air turbulence in nasal obstruction leading to deposition of micro-organisms and air pollutants resulting in inflammation around the ET and mechanical obstruction; air turbulence can also result in increased viscosity of mucous in the ET; and/ or the air turbulence can also stimulate receptors of autonomic nerves in the post nasal area causing reflex ET dysfunction¹⁹. However

McCurdy²⁰, has proposed that instead of nasal obstruction, ET dysfunction might be associated with lymph stasis in the peritubal area. Transient ET dysfunction has also been reported to occur following adenoidectomy with micro-debrider²¹.

In this study, it has been seen that there is a significant positive relation between pre-operative and 30 days post-operative results. Though some studies, conducted earlier, showed no significant impact of nasal obstruction surgery on Eustachian Tube Functions and middle ear ventilation. However, it cannot be discounted that most studies conclude that there is a positive impact of nasal surgery on middle ear ventilation and ETF; although, the type of surgery may vary.

CONCLUSION

Nasal surgery results in improvement in Eustachian tube functions and middle ear ventilation.

CONTRIBUTION OF AUTHORS

Farooqi S: Data Collection, Data analysis and interpretation
Saqlain G: Conceived idea, Manuscript writing
Mumtaz N: Critical revision of the article

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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