ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 11, Issue, 06, pp.4610-4614, June, 2019

DOI: https://doi.org/10.24941/ijcr.35645.06.2019

INTERNATIONAL JOURNAL OFCURRENTRESEARCH

RESEARCH ARTICLE

DEVIATED NASAL SEPTUM RELATIONSHIP WITH EUSTACHIAN TUBE DYSFUNCTION-RELATED SYMPTOMS IN STUDY COMPARED

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ARTICLEINFO

Article History:
Received 17th March, 2019
Received in revised form
06th April, 2019
Accepted 19th May, 2019
Published online 30th June, 2019

KeyWords:

Deviated nasal septum (DNS),
Eustachian Tube Dysfunction (ETD),
Middle Ear Pressure (MEP),
Tympanometry,
Eustachian Tube function (ETF) Tests.

ABSTRACT

***Objective*:** The aim of this study was to evaluate the relationship between chronic nasal obstruction caused by nasal septal deviation and Eustachian tube dysfunction–related symptoms using the Eustachian Tube Dysfunction Questionnaire (ETDQ-7) as an assessment in compared study with Tympanometry Eustachian tube function tests result.

***Methods*:** This study was carried out at a private clinic in BAGHDAD from May 2018 to February 2019A total of 80 adults were enrolled and divided into 2 groups matched by age and sex.

Group 1 (cases) 40 patient (24 male 16 female) age from (18 to 60), with complaint of unilateral or bilateral chronic nasal obstruction due to septal deviation.

Group 2 (controls) were healthy adults without any clinical signs or history of persistent nasal obstruction or others nasal problems. The ETDQ-7 scores, ETF tests and Tympanometry results of both groups were compared.

***Results*:** In group 1 the median total score of the ETDQ-7was ((2.8) which are Significant higher than in group 2 (1.0)in group 1 (80 ears) 60 had type A, 20 had Type C in Tympanometry results and 30 had Poor ETF test, 10 had Good EDF Test results. In group 2 (80 ears) 72 had type A, 8 had type C tympanogram results and 22 had Poor ETF test, 18 had Good ETF.

***Conclusion*:** Patients with nasal obstruction due to DNS had significantly more symptoms related to ETD compared to the healthy controls as subjective data which shown a great association with the results of objective data (Tympanometry and ETF tests).

Recommendations

1. We prefer to increase the awareness of otolaryngologist doctor to relationship between septal deviation and Eustachian tube dysfunction.
2. We recommend to do further studies on this subject by make relationship of types of Septal deviation and Eustachian tube dysfunction, as there's new septal deviation Classifications and match every type of septal deviation with Eustachian tube dysfunction

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***Citation: Jalel Fakri Salama AL-Shujairi,* 2019.** "Deviated nasal septum relationship with Eustachian tube dysfunction-related symptoms in study compared", *International Journal of Current Research*, 11, (06), 4610-4614.

INTRODUCTION

Nasal septum: The nasal septum serves many functions, including separation of the nasal airway into two nasal cavities, support of the nasal dorsum, and maintenance of the nasal tip and forms part of the nasal valves. Deviation of the nasal septum can lead to significant nasal airway obstruction and-cosmetic deformity. The nasal septum consists of a bony cartilaginous and membranous portion, The bony portion is comprised of the perpendicular plate of the ethmoid bone, vomer, maxillary crest and palatine bone, The perpendicular plate of the ethmoid forms the upper one-third of the nasal septum. It is continuous superiorly with the cribriform plate and crista galli and abuts a variable amount of the nasal and frontal bones. Posteriorly the perpendicular plate articulates with the sphenoid crest, poster inferiorly with the vomer and anteroinferiorly with the septal cartilage.

The vomer forms the posterior and inferior nasal septum and articulates by its two alae with the sphenoid rostrum creating the vomerovaginal canals through which the pharyngeal branches of the maxillary artery travel. The inferior border of the vomer articulates with the nasal crest formed by the maxillary and palatine bones. The anterior border articulates with the septal cartilage and the posterior edge of the vomer forms the posterior free edge of the septum. The cartilaginous portion of the nasal septum is composed of the septal or quadrilateral cartilage the quadrilateral cartilage is bound firmly by collagenous fibers to the nasal bones, perpendicular plate of the ethmoid and vomer. The septal cartilage is continuous with the upper lateral cartilages towards the bridge of the nose A projection of the septal cartilage called the sphenoidal process or septal tail extends posteriorly between the vomer and perpendicular plate of the ethmoid. The septal tail can serve as an additional source of cartilage to harvest especially during revision rhinoplasty. The inferior attachment

sits within the nasal crest of the maxilla and is bound by looser connective tissue creating a pseudoarthrosis. This joint allows mobility of the septal cartilage base during flexion thereby reducing the risk of fracture or dislocation with trauma. The membranous septum is a segment of connective tissue between the caudal portion of the septal cartilage and columella.

Nasal Function: The nose has various physiological functions. Respiratory functions include heat exchange, filtration, humidification, nasal neurovascular reflexes and voice modification Olfaction functions are stimulus pathways and there is trigeminal input.

Nasal septal deviation

Etiology: Nasal obstruction can be caused by septal defection which can be developmental or secondary to trauma. In some cases, the trauma occurs in childhood and the patient does not necessarily remember the incident.

Diagnosis

Septal examination should include inspection as well as palpation. During inspection, the position of deviation should be mapped in relation to the L-strut Nasendoscopy will allow inspection of the anatomy in the neutral position and it also allows inspection of the elements that are not visible in anterior rhinos copy; this at times can reveal adenoid tissue, mucosal abnormalities, nasal polyps or choanal pathology which can cause nasal obstruction. Palpation is used to feel for attachment of the septum to the anterior nasal spine and to feel for fracture lines. In patients who have undergone septal surgery in the past gentle palpation of the septum with an applicator (e.g. Jobson Horne probe) might indicate the areas deficient of cartilage.

The Eustachian tube: The Eustachian tube is a dynamic channel that links the middle ear with the nasopharynx. In adults, it is about 36 mm in length, a size that is normally reached by the age of 7 years. It runs downwards from the middle ear at 45° and is turned forwards and medially. The tube can be considered to consist of two unequal cones, connected at their apices. The lateral third is bony and arises from the anterior wall of the tympanic cavity. This joins a media cartilaginous part, which makes up two-thirds of the tubal length, just after its narrowest portion, called the isthmus The tube is lined with respiratory, mucosa containing goblet cells and mucous glands, having a carpet of ciliated epithelium on its floor. At its nasopharyngeal end, the mucosa is truly respiratory; however, in passing along the tube towards the middle ear, the number of goblet cells and glands decreases, and the ciliary carpet becomes less profuse.

Function: The Eustachian tube has at least three physiologic functions with respect to the middle ear: ventilation of the middle ear to equilibrate air pressure in the middle ear with atmospheric pressure, drainage and clearance into the nasopharynx of secretions produced within the middle ear, and protection from nasopharyngeal sound pressure and secretions. Also, it is involved in ensuring air exchange in the middle ear. Maintaining the physiological pressure in the middle ear depends on the gaseous balance between air intake through the Eustachian tube and gas diffusion from the middle ear to the systemic circulation. T e adequacy of ventilation through the tube plays a central role in preserving pressure equilibrium. When the tube opens during swallowing, air reaches the middle ear equalizing the pressure between the external and the internal surface of the tympanic membrane.

Eustachian tube dysfunction (ETD) is a common condition in Otorhinolaryngology practice. Symptoms include fullness or clogging of the ears, pain or discomfort, hearing loss, tinnitus, dizziness, and an inability to rapidly equilibrate middle ear pressure (McCoul *et al.,* 2012) ETD is in most cases caused by mucosal inflammation and edema in the Eustachian tube (ET) lumen. It has been presented that Sino nasal diseases, such as nasal viral upper-respiratory tract infections, allergic rhinitis, deviated nasal septum, inferior turbinate enlargement and chronic rhino sinusitis can cause mucosal inflammation that leads to ETD (Ohrui *et al.*). Many subjective and objective methods have been reported for measuring ET function, including otoscopic appearance, Valsalva and Toynbee tests, Tympanometry tubomanometry (Liu *et al.,* 2016), and Sonotubometry. However, due to the complexity of the functional anatomy and physiology of the ET, there is still no diagnostic "gold standard" for obstructive ETD (McCoul *et al.,* 2012). McCoul et al have developed the Eustachian Tube Dysfunction Questionnaire (ETDQ-7).which is validated, organ-specific tool for the assessment of symptoms in ETD ETD (McCoul *et al.,* 2012). Its usefulness has been shown in recent studies (Liu *et al.,* 2016; Van Roeyen *et al.,* 2015 & 2016). Thus far, it has not been used in the evaluation of the relationship between ETD-related symptoms and nasal problems. The aim of this study was to evaluate the relationship between chronic nasal obstruction caused by septal deviation and ETD-related symptoms using the ETDQ-7 as an assessment method and Tympanometry results.

PATIENTS AND METHODS

Subjects: This study was carried out at a private clinic in BAGHDAD from May 2018 to February 2019. A total of 80 adults were enrolled and divided into 2 groups matched by age and sex. Group 1 (cases) 40 patient male (24) & female (16) age from (18 -60),with complaint of unilateral or bilateral chronic nasal obstruction due to septal deviation

Inclusion Criteria: Patients above the age of 18 years with Deviated nasal septum

Exclusion Criteria: Patients had different nasal pathologies causing their nasal obstruction such as chronic rhino sinusitis, inferior turbinate enlargement, antrochoanal polyp, chronic hypertrophic rhinitis, and bilateral nasal polyposis Patients with tympanic membrane perforation, acute rhinitis, and one or a recent history of middle ear infection were excluded from the study.

Group 2 (controls) (40) male (29) & female (11) were healthy adults without any clinical signs or history of persistent nasal obstruction or others nasal problems. The group consisted of volunteer and relatives of patients. The appearance of their nasal septum was normal in nasal examination. The clinical exclusion criteria were the same as Group 1. After signing the informed consent, all participants underwent a complete otorhinolaryngologic examination with Tympanometry included. Next, the participants completed the ETDQ-7, an instrument for the assessment of symptoms related to obstructive dysfunction of the ET and treatment outcome. The ETDQ-7 consists of 7 questions and a 7-item Likert-type scale, with a response of 1 indicating no problem and 7 indicating a

severe problem. The total score is divided by 7 to give an overall score ranging from 1.0 to 7.0 (4) . IBM SPSS Statistics 22.0 was used for the statistical analyses. All the nonparametric data were statistically processed using the Mann–Whitney test. The chi-square test was used in the evaluation of sex distribution and Tympanometry results. Correlations were evaluated using Spearman rho.

Eustachian Tube Dysfunction Questionnaire-7 (ETDQ-7(Questions).

1. Pressure in the ears?
2. Pain in the ears?
3. A feeling that your ears are clogged?
4. Ear symptoms when you have a cold or sinusitis?
5. Crackling or popping sounds in the ears?
6. Ringing in the ears?
7. A feeling that your hearing is muffled?

Design: ETF tests in the form of (Valsalva and Toynbee maneuvers) together with Tympanometry were performed for both group 1 and group 2

Equipment: OSCILLA TSM 500 Tympanometer& Audiometer made in Denmark used. The tympanogram were classified in the standard manner according to Jerger (Jerger, 1970). tympanogram with middle ear pressure peak between +50 and −100 daPa was classified as type A. Tympanogram with middle ear pressure peak of −100 daPa or more negative was classified as type C, a tympanogram with a flattened peak of less than 0.3ml admittance was classified as type B.

Eustachian tube function tests

Valsalva maneuver

To evaluate the ability to inflate the middle ear actively patients were asked 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. Patients were then instructed to release the nose and refrain from further swallowing or mandibular movement and an experimental tympanogram was obtained in each ear. A Tympanometric peak pressure shift (generally positive) between baseline and experimental tympanogram less than 10 daPa indicated poor ETF, whereas a Tympanometric peak pressure shift greater than 10 daPa indicated a good ETF (Jonathan, 1989).

Toynbee maneuver

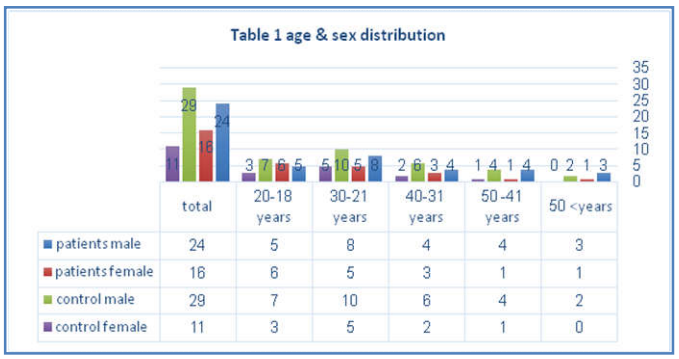
To evaluate the capacity to equalize the middle ear pressure and the rhino pharyngeal pressure, patients were asked to swallow while pinching the nose Patients were then instructed to release the nose and refrain from further swallowing and mandibular movement and an experimental tympanogram was obtained from each ear. Tympanometric peak shift (generally negative) between baseline and experimental tympanogram less than 10 daPa indicated poor ETF where as a Tympanometric peak pressure shift of greater than 10 daPa indicated a good ETF (Jerger, 1970).

RESULTS

The study was carried out on (40) patients complaining of unilateral or bilateral chronic nasal obstruction due to nasal septal deviation of any type or degree, and (40) control healthy adults without any clinical signs or history of persistent nasal obstruction or others nasal problems.

There were (24) male patients (60%) and (16) female patients (40%) & (29) male control 72.5% and (11) female control 27.5%

The age and sex distribution shown in Table 1.



Age	18-20years	21-30years	31-40 years	41-50 years	>50 years	total
Patients male	5	8	4	4	3	24
Patients female	6	5	3	1	1	16
Control male	7	10	6	4	2	29
Control female	3	5	2	1	0	11

The results of the ETDQ_7 in group 1(patients) the median total score (2.8) &the median total score in group 2(control) are (1.0)

The score was significantly higher in patient group than control group, (Table 2).

Table 2. Results of eustachian tube dysfunction questionnaire

	Questionnaire-7 (ETDQ-7) Questions.	Group 1 patients	Group 2 control
1	Pressure in the ears?	4	1.0
2	Pain in the ears?	1	1.0
3	. A feeling that your ears are clogged?	4	1.0
4	Ear symptoms when you have a cold or sinusitis?	4	1.0
5	Crackling or popping sounds in the ears?	3	1.0
6	Ringing in the ears?	2	1.0
7	A feeling that your hearing is muffled?	2	1.0
	Median Total score	2.8	1.0

The distribution of the ETDQ_7 total score is described in Table 3.

In Group1 (patient) (11) 80% had total score (1_1.9), (20) 50% had total Score (2.0 _2.9) and (8) 20% had. Total score (3.0 or more)

In Group 2 (control)). (35) 88% had. Total score (1.0 _1.9), (5) 12% had total score (2.0 _2.9) and (0) 0% had total score (3.0 or more)

Table 3. Distribution of Eustachian Tube Dysfunction Questionnaire Total Score

Total score	Group1 (patients	Group 2(control)
1.0_1.9	12 _30%	35 _ 88%
2.0_2.9	20 _50%	5 _ 5%
3.0 or more	8 _20%	0 _ 0%

The Tympanometry results of group 1 (40 patients) 80 ears. And group2 (40control) 80ears shown in Table 4

In Group 1. 60ears (75%) had type A tympanogram And 20 ears (25%) had type C

In Group 2. 72 ears (90%) had type A tympanogram, and 8 ears (10%) had type C

Table 4. Tympanometric type Results

Tympanometry types	Group 1(patients)N _ %	Group2(control) N _ %
Type. A	60 _75%	72 _ 90%
Type. C	20 _25%	8 _ 10%
Total	80 _100%	80 _ 100%

The results of Eustachian Tube function tests of group 1 (40 patients) 80 ears. And group2 (40control) 80ears shown in Table5

In Group 1 (patients). 30 (75%) had Poor function &10(25%) had Good function

In Group 2 (control), 22 (55%) had Poor function &. 18 (45%) had. Good function.

Table 5. Eustachian tube function results

Eustachian Tube function	Group 1(patients)N _ %	Group2(control) N _ %
Poor	30 _75%	22 _ 55%
Good	10 _ 25%	18 _ 45 %

DISCUSSION

Deviated nasal septum (DNS) one of the most common causes of chronic nasal obstruction, can be unilateral or bilateral and Eustachian Tube dysfunction (ETD) is a common condition in Otorhinolaryngology practice Eustachian tube, also known as the auditory tube, links two of the major areas of interest, the ear and the nasopharynx, and also serves the ear through two important functions: ventilation by maintaining a good middle ear pressure and clearance, by being a drainage route(Bluestone and Doyle, 1988). As a consequence of Eustachian tube obstruction a negative pressure appears in the middle ear and an accumulation of fluid behind the tympanic membrane. Eustachian tube dysfunction is the starting point for the most acute and chronic otic inflammatory diseases and their complications of One the causes leading to a malfunction of the auditory tube is the deviated nasal septum. The effect of deviated nasal septum on ET function has been evaluated in a few previous studies,. Low and Willatt (1993) evaluated the relationship between middle ear pressure and a deviated nasal septum. They found out that middle ear pressure ipsilateral to the obstructed nasal passage was negatively correlated to the degree of asymmetry of the potencies of the two nasal passages. Middle ear pressure improved in both ears after septal surgery. They postulated that postnasal airflow turbulence associated with a deviated nasal septum may lead to Eustachian tube dysfunction. Deron *et al.* (1995) in turn found out that correction of the septal deviation improved the passive opening pressure of the Eustachian tube on the deviated side similarly to the no deviated side. In previous studies, the relationship between ETD and DNS has been evaluated using various methods, including symptom questions (Ohrui *et al.,* Stoikes and Dutton, 2005), Tympanometry (Low and Willatt, 1993; Lazo-Saenz *et al.,* 2005)-and the Toynbee and Valsalva tests (2016). To carry out a placebo-controlled study, it is suitable to use a validated questionnaire, if possible. In the present study,-the relationship between nasal obstruction and ETD-related symptoms was evaluated using the ETDQ-7(4), which is the only patient-reported outcomes tool to have Comparing these results with those of the earlier studies in, the study by Duran *et al.* (2014) the middle ear pressure improved by approximately 30% at the side of nasal obstruction and a statistically significant decrease was found at the side of nasal obstruction ($P<0.05$).

In the study by Salvinelli *et al.* (2005) results of postoperative tubal function tests were significantly better than preoperative ones (90% versus 46%; $P<0.001$). In the study by Abdel-NabyAwad *et al.* (2014) significant improvement in Tympanometric values was found ($P<0.05$) postoperatively. Preoperatively, 93.3% patients had sensation of ear fullness, but 30 days after surgery, only66.7% had sensation of ear fullness, with significant improvement ($P <0.001$). In the present study, the relationship between ETD-related symptoms and DNS was evaluated for the first time. The aim of this study was to examine possible EDTQ-7 related symptoms among patients with DNS and adult healthy (control) and compared the results with Tympanometry, Eustachian tube function tests (Toynbee and Valsalva tests) In the present Study (patient group) Had median ETDQ-7 Total score 2.8 which relatively higher than the median ETDQ-7 Total Score (1.0) of healthy adult(control group), patient group ETDQ-7total score (1.0-1.9) had (30%) and in control group are (88%), patient EDTQ-7 total score(2.0-2.9) had (50%) and in control group are(12%), patient EDTQ-7 total score(3.0 and more) had (20%) and In control group (0%). The Tympanometry results among (40) patients group (80 ears with intact TM) 20 (25%) showed a negative MEP (Type C) and 60 (75%) had Type A Tympanogram. in healthy control group only 8 (10%) had a negative MEP (type C) and 72 (90%) had Type. A Tympanogram. The Eustachian tube function tests results (Valsalva maneuver and Toynbee maneuver), among (40) patients group (80 ears with intact TM) 30 (75%) had Poor ETF and 10 (25) had Good EDF, among 40 healthy control group (80 ears with intact TM) 22 (55%) had Poor EDF and 18 (45%) had Good ETF.

Conclusion

Patients with nasal obstruction due to DNS had significantly more symptoms related to ETD compared to the healthy controls as subjective data which shown a great association with the results of objective data (Tympanometry and ETF tests). Base on the present study the ETDQ-7 may be useful tool in detecting patients with mild level of ETD without Clear objective findings. In addition to septum deviation, the existence of Para nasal and pharyngeal diseases, such as allergic rhinitis, concha hypertrophy, and-adenoid hypertrophy, should be taken into consideration in studies that evaluate the effects of DNS on ET functions (Maier and Krebs, 1998). When these diseases are present, DNS can further disrupt the functions of ET, and in these patients, DNS can contribute to the recovery of ET functions. In our study we aimed to see the effects of only septum deviation on ET by excluding patients with additional pathologies.

Recommendations

1. We prefer to increase the awareness of otolaryngologist doctor to relationship between septal deviation and Eustachian tube dysfunction.

2. We recommend to do further studies on this subject by make relationship of types of Septal deviation and Eustachian tube dysfunction, as there's new septal deviation Classifications and match every type of septal deviation with Eustachian tube dysfunction.

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