Tympanometric Findings among Adults with Chronic Nasal Obstruction Due to Sinonasal Pathology

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Abstract

Background: The nasal obstruction is one of the causes that affect the middle ear function, but the physiological mechanism of this effect is not well understood. This study aims at 1st; evaluation of the middle ear function among adults with chronic nasal obstruction due to sinonasal pathology using tympanometry, and 2nd, at comparison between the anatomical and mucosal inflammatory causes of nasal obstruction and its impact on the middle ear function.

Patients and Method: A prospective case study of (310) adult patients with chronic nasal obstruction were subjected to tympanometry for study of middle ear pressure in the private ENT clinic for a period of two years in the Salah Al-Deen governorate.

Results: this study found that (13%) of adults with chronic nasal obstruction had abnormal tympanogram (type B or C), (17.2%) was due to mucosal inflammation and (7%) due to anatomical and structural cause. Commonly one ear affected (unilateral) was (67.5%). Myringotomy and aspiration of middle ear found that (64%) had OME and VT was inserted.

Conclusion: The study statistically proved that adults with chronic nasal obstruction due to mucosal inflammation differs from others due to anatomical and structural causes in the followings; 1.The incidence of abnormal tympanogram (type B and C) is more. 2.The type B (OME) was more than type C (Eustachian tube dysfunction). 3.In the treatment ,it was found that the need to VT insertion was more.

Keywords: *Tympanometry, Chronic nasal obstruction, Otitis media with effusion, Nasal polyposis, Chronic rhinosinusitis.*

Introduction

One of the major ENT complaints is chronic nasal obstruction. A definite relation between nasal obstruction and middle ear diseases, where Eustachian tube dysfunction (ETD) caused by nasal obstruction, that may cause middle ear hypoventilation resulting in otitis media with effusion (OME), that may be definitely diagnosed through use of otoscopic findings associated with a B tympanogram [1,2,3]. Some previous researches have been carried out on how the nasal obstruction that influence middle ear function, but the physiologic impact of this effect is not well defined [4,5,6]. The evaluation of the middle ear function with a high rate of success in the management and follow up of middle ear diseases can be carried out by Tympanometry, because of its compliance, flexibility of the ear drum to changing air pressure [7]. This study aims at 1st; evaluation of the middle ear function among adults with chronic nasal obstruction due to sinonasal pathology using tympanometry, and 2nd, at comparison between the anatomical and mucosal inflammatory causes of nasal obstruction and its impact on the middle ear function.

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Patients and Method

A prospective case study of 310 adult patients with chronic nasal obstruction (>3 months) were subjected to tympanometry (620 ears) for study of middle ear pressure in a private ENT clinic during a period from 1st January 2017– 1st January 2019 , in the salah El-den governorate. Iraq. Male were 184 (59%) and female were 126 (41 %), age ranging from 18–63 years (mean age

31 years). The diagnosis of nasal pathology was based on detailed history taken , proper ENT examination includes nasal endoscopy and investigation includes computed tomography of the nose and paranasal sinuses. Ear examination includes. otoscopic examination, Tuning fork tests. Tympanometry, PTA when abnormal tympanometry. Exclusion criteria includes nasaopharyngeal mass or tumor, recent history of acute rhinitis or middle ear infection, chronic suppurative otitis media, previous nasal or ear surgery, tympanosclerosis, no case with nasal malignancy. Patients were classified according to the causes of nasal obstruction in to;

1. Patients with nasal obstruction due to anatomical and structural causes includes Septal deviation, hypertrophied turbinates, concha bullosa, nasal valve collapse, synechia, choanal atresia.

2. Patients with nasal obstruction due to Mucosal inflammation, such as allergic rhinitis with or without nasal polyposis (NP), non allergic rhinitis, and chronic rhinosinusitis (CRS).

Tympanometry was carried out using viola middle ear analyzers from inventis audiology equipment / Italy to conduct automatic tympanometry tests at low frequency (226Hz)

The tympanometer probe was inserted into the clean ear canal. The types of tympanogram are classified according to Jerger/Fiellau-Nikolajsen in to the following;

1.Type A is a normal peaked curve with pressure between +50 and - 99 daPa, Compliance from 0.3-1.5 ml. Suggests normal middle ear functioning

2.Type B is a flat curve without peak, Compliance less than 0.3 ml suggests middle ear effusion.

3.Type C is a peak curve with negative pressure (-100 or more negative),compliance from (0.3-1.5 ml). Suggest Eustachian tube dysfunction) [8].

Treatment involves surgical correction of nasal obstruction according to the causes ,and myringotomy procedure was carried out for the ear with type B and type C tympanogram , when there is fluid aspirated and the ventilation tube (VT) is inserted .

Results

From total 310 patients with chronic nasal obstruction 40 patients (13%) had abnormal tympanogram (type B or C). (Table 1). An abnormal tympanogram was found in patients with chronic nasal obstruction due to the mucosal inflammation was 31/180 patients (17.2%), and in patients due to anatomical causes was 9/130 patients (7%),Which is statistically significant association p-Value 0.018. (Table 1). Patients complaining of nasal obstruction due to mucosal inflammation the type B/C tympanogram were as follows, in allergic and non-allergic rhinitis was 7/57 patients (10.5%), nasal polyposis (NP) was 17 /94 patients (18%), and in chronic rhinosinusitis (CRS) was 7/29 patients (24%), anatomical and structural causes 9/130 (7%) as shown in (Table 2). Patients who had an abnormal tympanogram in one ear (unilateral) were 27/40 patients (67.5%) and in both ears (Bilateral) were 13/40 patients (32.5%) (Table 2). Regarding the type of tympanogram, the normal type A was in 567/620 ear (91.5%),type B was 25/620 ear (4%),and type C was 28/620 (4.5%), this statistically very strong association p-value =0.005 (Table 3).

Patients who underwent surgical treatment were 31 /40 patients (77.5%) (9 patients refused to carry out the operation or were missing). Total number of ears who have abnormal tympanogram was 39 ear (8 patients were in both ears and 23\patients in one ear). Those patients have undergone myringotomy and aspiration of middle ear and found that 25/39 ear (64 %) fluid was aspirated (OME) so that a VT was inserted. Shah VT was inserted in 23/39 patients (59%) and Good T-tube in 2/39 patients (5%) who had adhesive otitis media, this results was statistically significant association P-value =0.05 (Table 5) The study found that the Shah VT was inserted in 23/33 ear (70%) of patients with chronic nasal obstruction due to mucosal inflammation ,and in 2/6 ear (33%) of patients with anatomical causes. (Table 4) The research found that 24/40 (60 %) of Patients who had abnormal tympanogram were complaining from hearing loss or fullness of ears and tinnitus and (40%) of patients deny the presence of such ear symptoms.

Table 1: Relation between causes of nasal obstruction and abnormal tympanogram.

Pathological causes of nasal obstruction	Patients No	Abnormal tympanogram
Anatomical and structural causes	130 (42%)	9 (7%)
Mucosal inflammation	180 (58%)	31 (17.2%)
Total	310 (100%)	40 (13%)

X^2=5.58, P.value=0.018, d.f.=1

Table 2:The relation of sinonasal pathology and abnormal tympanogram.

Sino-nasal pathology	Patients No (%)	Abnormal tympanogram		
		Total	Unilateral	bilateral
Anatomical and structural causes*	130 (42%)	9 (7%)	7 (78%)	2 (22%)
Nasal polyposis**	94 (30.3%)	17 (18%)	11 (62%)	6 (38%)
Allergic and non allergic rhinitis	57 (18.4%)	7 (10.5%)	5 (71%)	2 (29%)
Chronic rhinosinusitis	29 (9 %)	7 (24%)	4 (62.5%)	3 (37.5%)
Total	310(100%)	40 (13%)	27 (67.5%)	13 (32.5%)

* Includes ;Septal deviation ,hypertrophied turbinates, concha bullosa,nasal valve collapse. Congenital choanal atresia.

**Includes ;Antrochoanal polyp.

Table 3:The relation between causes of nasal obstruction and type of tympanogram.

Pathological causes of nasal obstruction	Ear No	Type of tympanogram		
		Type A	Type B	Type C
Anatomical and structural causes	260	249 (95.8%)	4 (1.5%)	7 (2.7%)
'Mucosal inflammation.	360	318 (88%)	21 (6 %)	21 (6%)
Total	620	567 (91.5%)	25 (4%)	28 (4.5%)

X^2=10.77, P-value=0.005, d.f.=2

Table 4:Relation between the causes of nasal obstruction and surgical procedure on the ear.

Causes of nasal obstruction	patients	Ear No	Surgical procedure			
			Myringotomy only	Grommet insertion		
				Shah VT	T-tube	Total
Anatomical & structural causes	5	6	4 (67%)	2	0	2 (33%)
Mucosal inflammation	26	33	10 (30%)	21	2	23 (70%)
Total	31	39	14 (36%)	23 (59%)	2 (5%)	25 (64%)

X^2=2.9, P-value=0.05, d.f.=1

Discussion

The incidence and severity of middle ear diseases has been found to be related to the cause of nasal obstruction, whether anatomical and structural causes or mucosal pathologies. There are several suggested theories about the effect of nasal obstruction on the Eustachian tube ,one theory suggest that nasal obstruction leads to turbulence of air flow in the nasopharynx [7]. The turbulent air flow may leads to Eustachian tube dysfunction (ETD) by the following supposed mechanisms, 1. Dryness of mucosal film leads to increased viscosity of the mucous and the surface tension at the tubal orifice interfering the opening of the Eustachian tube. 2 .The air pollutant and microorganisms deposited in the (ET) orifice causing tubal or pre tubal inflammation and obstruction. 3. Stimulation of the mechanoreceptors, leading to reflex alteration of (ET) function [6]. Many studies have been conducted to assess the correction of nasal obstruction due anatomical causes and the study of its impact on the middle ear dysfunction. Nanda. et al, & Osama G. et al have found that septoplasty improve hearing and middle ear function by improving ET function ([3, 9]), but Şahin, et al found that no effect of septoplasty on middle ear pressure and ET function [10]. The whole mucosa of the upper respiratory tract, including the nasal cavity, sinuses, nasopharynx, eustachian tube, and middle ear, which belong to a system called the rhino-pharyngo-tubal unit or the "unified airspace" [11]. Therefore, the presence of inflammatory disease that affects both the nasal and middle ear mucosa is considered the more likely physiologic mechanism that leads to middle ear diseases.

The mucosal inflammation in Allergic rhinitis, NP and CRS contribute to congestion, including increased venous engorgement, nasal secretions from nasal glands and tissue swelling (edema) [12], the accumulated secretion and edema block the eustachian tube. This can reduced middle ear ventilation leading to negative middle ear pressure.There is a significant association between OME and persistent symptoms of allergic rhinitis, these results suggest a direct involvement of the middle ear mucosa [(13,14)]..Parietti-Winkler et al .they reported an association between OME and nasal polyposis [(15,16)]. They concluded that the mechanism causes of OME in NP and CRS is more likely the presence of inflammatory disease that affects the nasal and middle ear mucosa, and less likely the obstruction of the ET by polyps or by congestion of the nasopharyngeal mucosa .There is a study concluded that the OME seem to be an inflammatory disease that extends to the middle ear rather than a consequence of the nasal disease itself .Because even when the symptoms of nasal obstruction are well controlled, the OME can develop or persist.

The current study found that patients with CRS and NP are at greater risk of developing abnormal tympanogram (24%) and (18%) respectively (Table 2). as found by other authors Rennie et al [17], study on Eustachian tube dysfunction found that 69% were due to CRS with NP, 28% CRS without NP, and 14% due to allergic rhinitis. In CRS the mucopurulent or purulent Secretions pass over the pharyngeal end of Eustachian tube and it can lead to inflammation of ET and hypertrophy of tubal tonsil results in ET obstruction . Patel et al (2016)[18] found that symptoms of ET dysfunction are frequent in CRS, and respond well to endoscopic sinus surgery. The current study found that the VT was indicated in 70% of patients with sinonasal mucosal inflammation because of glue like aspirate of the middle ear (OME). While in the anatomical causes VT was indicated in (33%). This results goes with Mary, et al who found that by [4], where they found that patients with severe CRS with NP are at greater risk of developing OME, and often highly viscous middle ear effusion.

Limitation in this study that combined pathology may be found commonly septal deviation and/or hypertrophied turbinates with allergic rhinitis, nasal polyposis or chronic rhinosinusitis. In this study they were classified with mucosal inflammation causes. This study statistically proved that adults with chronic nasal obstruction due to mucosal inflammation differs from patients with nasal obstruction due to anatomical and structural causes in the followings; 1.The incidence of abnormal tympanogram (type B and C) is more. 2.The type B (OME) was more than type C (Eustachian tube dysfunction). [3]. In the treatment, it was found that the need to VT insertion was more. This study has the following recommendations recommendation: It is preferable to do tympanomtry for patients with chronic nasal obstruction, especially when it is due to NP and CRS, even if they not complain of hearing loss, tinnitus or fullness in the ear.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols

were approved under the Tikrit Medical College, Iraq and all experiments were carried out in accordance with approved guidelines.

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