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ORIGINAL RESEARCH

Eustachian tube dysfunction in patients with chronic otitis media

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ABSTRACT

Background: The Eustachian tube (ET) plays a critical role in middle ear ventilation, protection, and drainage. Eustachian Tube Dysfunction (ETD), characterized by impaired ET function, is a significant contributor to chronic otitis media (COM), yet remains poorly defined with limited diagnostic clarity. **Objective:** This observational study aims to evaluate the prevalence and types of ETD among adult patients with Chronic Otitis Media and determine the utility ofEustachian Tube Function Tests (ET FT) in clinical evaluation. **Methods:** Conducted from May 2023 toJuly 2024 at GMERS Medical College, Gotri, Vadodara, this study included 27 adult patients (40 ears) presenting withsymptoms of ear discharge, fullness, hearing loss, and abnormal tympanic membranes. Patients underwent otoscopy, tympanometry, and ET FT using impedance audiometry (William's and Toynbee's tests). Inclusion criteria included age >18 and abnormal ET FT results. Pediatric patients, pregnant women, and those with normal ETFTs were excluded. **Results:** The majority of patients were females aged 31-40 years, with a mean age of 34.9 years. Of the 40 ears, 36 (90%) had chronic otitis media—20 mucosal and 16 squamosal type. Four ears included 1 with otitis media with effusion and 3 with normal tympanic membranes. The strong association between mucosal-type COM and ETD was consistent with prior literature. **Conclusion:** ETD is a key etiological factor in chronic otitis media, particularly of themucosal type. ETFT is a valuable, objective tool in diagnosing ETD and should be routinely incorporated into the assessment and management of COM. Larger-scale studies are recommended for further validation.

Keywords: Eustachian Tube Dysfunction,Chronic Otitis Media, Tympanometry, Impedance Audiometry, Eustachian Tube Function Test, MucosalCOM

INTRODUCTION

The Eustachian tube (ET), also called the auditory or pharyngotympanic tube, is vital for maintaining middle ear balance. It is also known as ventilation and drainage tube. It ensures proper hearing by facilitating sound transmission from the tympanic membrane to the cochlea and preserving a healthy middle ear environment. It serves several functions, including protection from nasopharyngeal secretions, drainage of secretions from middle ear into the nasopharynx, and ventilation of the middle ear to equilibrate air pressure with atmospheric pressure.[(7)]The tube naturally opens during activities like yawning, sneezing, swallowing, and performing the Valsalva maneuver in response to positive pressure.When the Eustachian tube fails to function properly, it leads to Eustachian Tube Dysfunction (ETD). It leads to conditions such as tympanic membrane retraction, perforation, cholesteatoma, and middle ear effusion.It is a poorly defined condition lacking comprehensive guidelines and affects nearly 1% of the total population [(1)].Diagnostic tools include otoscopy, tympanometry, and nasal endoscopy. Tympanometry is especially useful for assessing middle ear function and tracking treatment progress.Normal Eustachian tube function is crucial for successful middle ear surgeries, such as those for Chronic Suppurative Otitis Media (CSOM). Patients with middle ear disease should be evaluated using the Eustachian Tube Function Test (ETFT) to assess for possible Eustachian tube dysfunction.This study evaluates the prevalence of Eustachian tube dysfunction in patients of CSOM. ET dysfuntion is evaluated on the basis of ETFT at GMERS General Hospital, Gotri, Vadodara, over a one-year period in objective way.

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EUSTACHIAN TUBE DYSFUNCTION (ETD)

ETD is characterized by impaired function of the Eustachian tube and can be classified as acute and chronic. Acute ETD occurs during conditions causing nasal congestion with a duration of less than 3 months. Whereas chronic ETD lasts for more than 3 months, caused by either obstruction or abnormally open (patulous) Eustachian tube.Mechanical obstruction can be intrinsic causing inflammation of the Eustachian tube e.g., Barotrauma, allergy or it can have extrinsic causes such as hypertrophic adenoids and nasopharyngeal tumors. [(7)] Functional obstruction is caused by inadequate function of the tensor veli palatini muscle which results in insufficient active opening of the tube.Patulous ETD is caused by an overtly patent Eustachian tube, whereby the failed tube closure at rest provides continuous communication between the nasopharynx and the middle ear. creating the symptom of autophony.[(8)]Blockage of the tube leads to negative pressure in the middle ear and tympanic membrane retraction, which causes "locking" of the Eustachian tube[(5)]. This causes symptoms such as ear fullness, popping, tinnitus and a sensation of being "underwater". This may cause fluid to accumulate in the middle ear called Otitis Media with Effusion(OME) causing symptoms such as otalgia and hearing loss. Signs such as retracted tympanic membrane, amber-colored fluid behind the membrane and conductive hearing loss are seen in OME. This condition can progress to a collapsed eardrum, called Atelectatic ear. The common sites of the retraction pockets are pars flaccida and posterosperior quadrant of pars tensa as the anterior part remains ventilated. As a retraction pocket deepens, desquamated keratin accumulates, leading to the formation of a cholesteatoma. [(5)]ETD is diagnosed with hearing tests such as tympanometry and Eustachian Tube function tests. Its medical management includes nasal steroids, antihistamines, decongestants or maneuvers like Valsalva to equalize the pressure and analgesics. In refractory cases, myringotomy with or without tube placement, Eustachian tuboplasty or Eustachian tube balloon dilatation can be performed.

Tests and maneuvers to test the function of the tube include Valsalva in which forceful exhalation is done with the nose and mouth closed to create positive pressure. Other tests include the Politzer test and Eustachian tube catheterization. The Toynbee test, which requires swallowing while pinching the nostrils, creates negative pressure. Additional methods include tympanometry, which measures eardrum movement in response to pressure changes, mucociliary clearance, and sonotubometry, which detects sound transmission through the Eustachian tube.

Impedance Audiometry measures acoustic immittance, which includes acoustic admittance (ease of sound energy passage) and acoustic impedance (resistance to sound flow).[(6)] The principle involves sound waves striking the tympanic membrane, where a portion of energy is absorbed and the rest is reflected back. The amount of reflected sound energy indicates the compliance or stiffness of the tympano-ossicular system, measured as a tympanogram.

Fig 1: Impedance Audiometer

Tympanometry measures the acoustic immittance in the ear canal as a function of variations in air pressure in the ear canal. [(6)]It estimates theintratympanic pressure, Eustachian tube function, tympanic membrane mobility, and ossicular chain continuity. The middle ear pressure is the point where the ear transmits most of the sound energy effectively. The test uses a 3-channel probe: a speaker (220 Hz tone), microphone (detects reflected sound), and manometer (varies air pressure in the ear canal).

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Fig 2: RIGHT: Soft rubber probe tip to create airtight seal in the ear canal, LEFT: Probe tip having 3 channels

The interpretation of tympanometry involves a graph called tympanogram, with the X-axis representing air pressure and the Y-axis representing compliance. Normal parameters include a middle ear pressure range of -100 to +100 daPa, static compliance between 0.6 and 1.6 ml, and external canal volume ranging from 0.6 to 1.6 ml. A Type A tympanogram indicates normal middle ear pressure and compliance. Subtype Ad shows high compliance, often due to ossicular chain discontinuity, while As has low compliance, typically seen in otosclerosis. Type B is flat, suggesting otitis media with effusion or tympanic membrane perforations. Type C shows normal compliance but negative middle ear pressure, indicating Eustachian tube dysfunction or early otitis media.Eustachian tube function can be assessed by impedance audiometer through tests like William's and Toynbee's for intact and perforated tympanic membrane respectively.

METHODOLOGY

This is an **observational** study, conducted in the ENT Department of GMERS Medical College, Gotri, Vadodara, from May 2023 to July 2024. Aim of this study is to establish Eustachian Tube Dysfunction as a cause of Otitis Media and its various types.

INCLUSION CRITERIA

1. Adults (Age: 18+)
2. Abnormal Eustachian tube function test (Eustachian tube dysfunction)

EXCLUSION CRITERIA

1. Pregnant women
2. Normal Eustachian tube function test
3. Patients in whom ETFT is contraindicated
4. Paediatric age group (due to organic causes e.g. adenoids, cleft palate)

Following the above inclusion and exclusion criteria, all adult patientspresenting to the ENT OPD with symptoms like ear discharge, aural fullness, popping sounds, ear blockage, decreased hearing, retracted or perforated tympanic membrane on otoscopic examination underwent ETFT. Out of them, a total of 40 ears of 27 patients with an abnormal ETFT were taken in this study.

A comprehensive evaluation was conducted, including: Otoscopic Examination, Tympanic Membrane, Movement on Valsalva, Impedance Audiometry (Tympanometry & ETFT). Written and informed consent was obtained from all participants.

Fig 3: A probe is inserted into the ear canal to create an airtight seal

Modern impedance audiometers can assess Eustachian tube function. William's Test, for an intact membrane, involves three tympanograms: first a regular tympanogram, followed by a Valsalva maneuver at +400 daPa, which shows a negative shift, and then swallowing with nose and mouth blocked at -400 daPa, which should result in a positive shift. A 15-20 daPa change between tympanograms indicate normal function; no change suggests dysfunction. Toynbee's Test, for perforated membrane, changes the middle

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ear pressure to +250 or -250 mm of water, and repeated swallowing should neutralize the pressure. A step-ladder pattern indicates normal function; any deviation suggests impairment of the Eustachian Tube function.

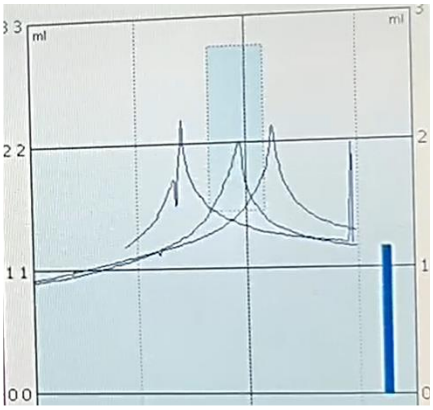

Fig 4: Normal ETF in a patient with an intact tympanic membrane

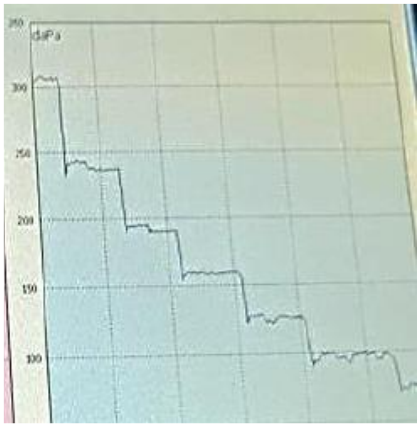

Fig 5: Normal ETF in a patient with perforated tympanic membrane

OBSERVATION AND RESULTS

A total of 40 ears of 27 patients were taken in the study between the age group of 18 to 65 years. The maximum patients were between the age group of 31 to 40 years. The mean age was 34.9 years. This finding is consistent with a similar study by **Swain et al., 2020** [3].

Out of 27 patients 12 patients were male, 15 patients were female. **Vila PM et al. 2017**[4] found that males are more likely to be diagnosed with Eustachian tube dysfunction before the age of 20, while females are more commonly affected at older ages. This pattern aligns our study.

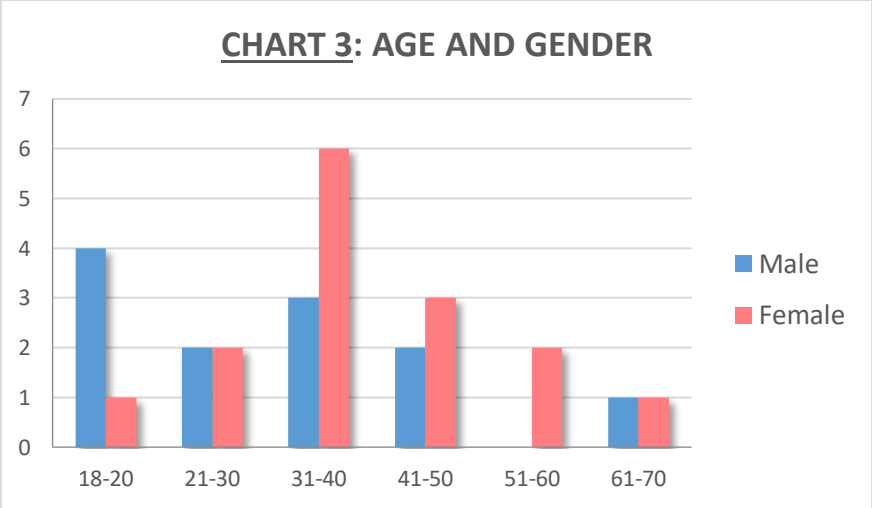

Chart 1: Age and Gender distribution in ETD

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Of the 40 ears of 27 patients diagnosed with Eustachian tube dysfunction, 36had chronic otitis media, out of which 16 had squamosal-type disease and 20 had mucosal-type disease. Out of the remaining 4 ears, 1 had OME and 3 had no middle ear disease with a normal TM. Similar result was seen in a study conducted by **Feba et al., 2024,** where ETD was found in 96.4% of the mucosal type of CSOM. [9]

Type of Otitis Media (OM)	No. of ears
Chronic OM Mucosal type	20
Chronic OM Squamosal type	16
OM with Efffusion	1
No OM (Normal TM)	3
Total	40

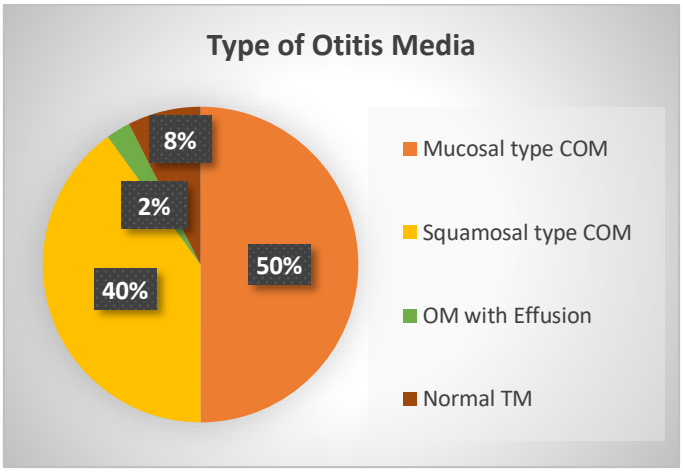

Chart 2: Type of Otitis Media seen in ETD patients

From this we can see that 90% of the patients are of Chronic Otitis media and will require surgical intervention with appropriate middle ear surgery such as Tympanoplasty with or without mastoidectomy.

CONCLUSION

Eustachian tube function is crucial for middle ear health, and chronic dysfunction can lead to chronic otitis media. This study is aimed at studying the demography of the Eustachian tube dysfunction patients and its relation to Chronic Otitis Media.

Eustachian Tube Dysfunction is more common in females than in males and more likely to be seen in the age group of 31-40 years.Eustachian Tube Dysfunction is a significant factor in the development and persistence of Mucosal type also called as the Tubotympanic type of COM. Hence, Eustachian Tube Function Test is an important test and is must in all the cases of Chronic Otitis Media especially mucosal type. In this study 90% of the ears are chronic otitis media, including squamosal and mucosal type and will require surgery. Our conclusion is based on only a pilot study, for more accurate results, a larger study is required.

REFERENCES

1. Browning GG, Gatehouse S. The prevalence of middle ear disease in the adult British population. ClinOtolaryngol Allied Sci. 1992; 17:317-21.
2. Anirban Biswas's Clinical Audio Vestibulometry for Otologists and Neurologists ch:3 Impedance Audiometry
3. Swain SK, Janardhan, Mohanty JN. Endoscopy guided eustachian tube balloon dilation: Our experiences. S287-294. DOI 10.22038-IJORL.2019.41623.2359.
4. Villa, PM, Thomas T, Liu C, Poe D, Shin JJ. The Burden and Epidemiology of Eustachian Tube Dysfunction in Adults Otorhinolaryngology, Head and Neck Surgery, 2017.1-56(2)-278-284.DOI : 10.1177/ 0194599816683342
5. Diseases of ear, nose and throat: Mohan Bansal, second edition, 2013, section 1, Basic sciences, page-11-16,19-21
6. Cummings Otorhinolaryngology Head and Neck Surgery International edition 6, Volume 2
7. Fireman P. Otitis media and eustachian tube dysfunction: connection to allergic rhinitis. *J Allergy Clin Immunol*. 1997;99(2):S787-S797. doi:10.1016/s0091-6749(97)70130-1
8. Hamrang-Yousefi S, Ng J, Andaloro C. Eustachian Tube Dysfunction. [Updated 2023 Feb 13]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-.
9. Sunny FA, Nalamate R, Chandran S, Kumar P, Kurien M. Mucosal-Type Chronic Otitis Media: Clinical Predictors of Postoperative Success. *Cureus*. 2024;16(3):e56213. Published 2024 Mar 15. doi:10.7759/cureus.56213