TYMPANOMETRIC FINDINGS AMONG CHILDREN WITH ADENOID ENLARGEMENT

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ABSTRACT

BACKGROUND

Adenoid hypertrophy (AH) is a common disorder of childhood.[1] Adenoid or nasopharyngeal tonsil plays a significant role in the pathogenesis of otitis media with effusion (OME). Enlarged adenoids cause obstruction of eustachian tube (ET) at its pharyngeal opening. It causes reduction in middle ear pressure towards negative side due to absorption of gas leading to OME. There is close relationship between enlarged adenoids and possible middle ear pathology due to alteration of middle ear functions. Otitis media with effusion is the commonest cause of hearing difficulty seen in pre-school and school going children. The aim of this study is to critically appraise the tympanometric findings among children with AH. Tympanometry with an impedance meter has been advocated as a reliable method of detecting OME and is perhaps the most common reference standard diagnostic method because of its availability and semi-objective nature.

MATERIALS AND METHODS

This observational cross-sectional study was conducted in the Department of Otolaryngology, Government Medical College, Thrissur, for a period of one year from October 2016 to September 2017. Hundred patients were enrolled based on inclusion and exclusion criteria. Detailed history, clinical examination, nasal endoscopy, digital X-ray nasopharynx lateral view and tympanometry were analysed.

RESULTS

Majority of the children were in the age group 3-5 years and 5-7 years in our study, with male preponderance. Majority of the children presented with the nasal symptoms than aural symptoms. The most common tympanogram found was type B (96 ears, 48%) and the least common was type A (40 ears, 20%). Among the 200 ears tested, 28 cases had unilateral type B, 34 cases had bilateral type B, 36 cases had unilateral type C and 14 cases had bilateral type C tympanograms.

CONCLUSION

This study has shown that adenoidal hypertrophy is a significant risk factor for OME in children. An Adenoidal-Nasopharyngeal Ratio of 0.72 should be considered as significant pathological enlargement and these children should be routinely sent for tympanometry.

This establishes the need for prompt hearing evaluation and management in patients with AH.

KEYWORDS

Adenoid Hypertrophy, Eustachian Tube Dysfunction, Tympanometry.

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BACKGROUND

The adenoid forms the uppermost part of the ring of lymphoid tissues in the pharynx (Waldeyer's ring). It is located in the posterior superior wall of the nasopharynx adjacent to the choana and ET opening. The size of adenoids varies from child to child and also in the same individual as the child grows. In general, it attains maximum size between the ages of 3 and 7 years and then regresses.[2]

OME is defined clinically as the presence of effusion behind an intact tympanic membrane (TM) without symptoms of acute infection. The most common complication of OME and ET dysfunction is conductive hearing loss and advocates audiometric evaluation to test the hearing loss and tympanometric evaluation to test the middle ear system.[3] When overt it may present as speech, language or learning delay and sometimes as behavioural and educational problems.

Tympanometry is defined as the measurement of the change of impedance of the middle ear at the plane of the TM as a result of changes in air pressure in the external auditory canal (EAC). Tympanometry is an objective test useful in children to assess the middle ear pressure and fluid. It is rapid and reliable and shows a flat Type B tympanogram with reduced compliance with a shift to negative side. Type B tympanogram is 93% sensitive in detecting OME.

The function of middle ear is to transmit sound wave from external ear to inner ear by its transformer mechanism. The normal middle ear pressure is -150 daPa to +25 daPa and the normal middle ear compliance is 0.39 ml to 1.30 ml.[4] In otitis media with effusion middle ear pressure usually reduces below -100 mm of H_2O. It is associated with

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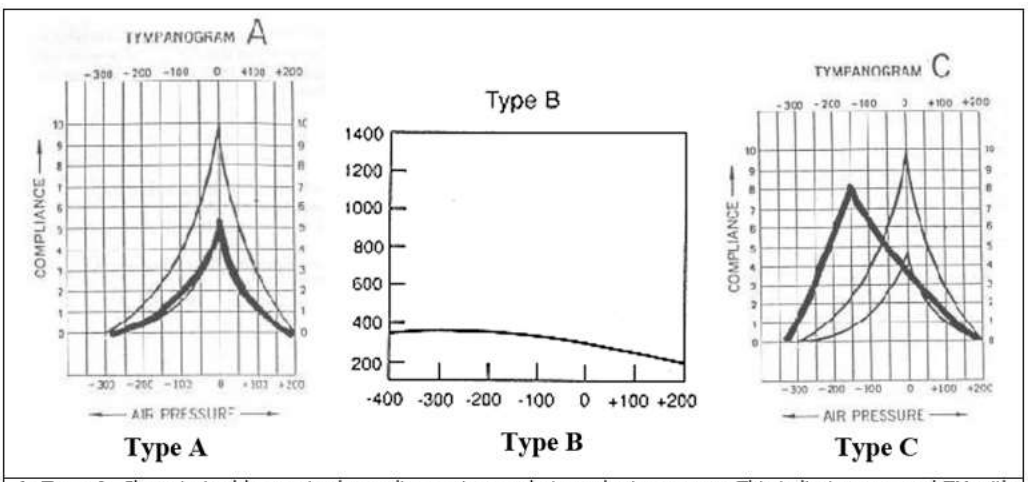
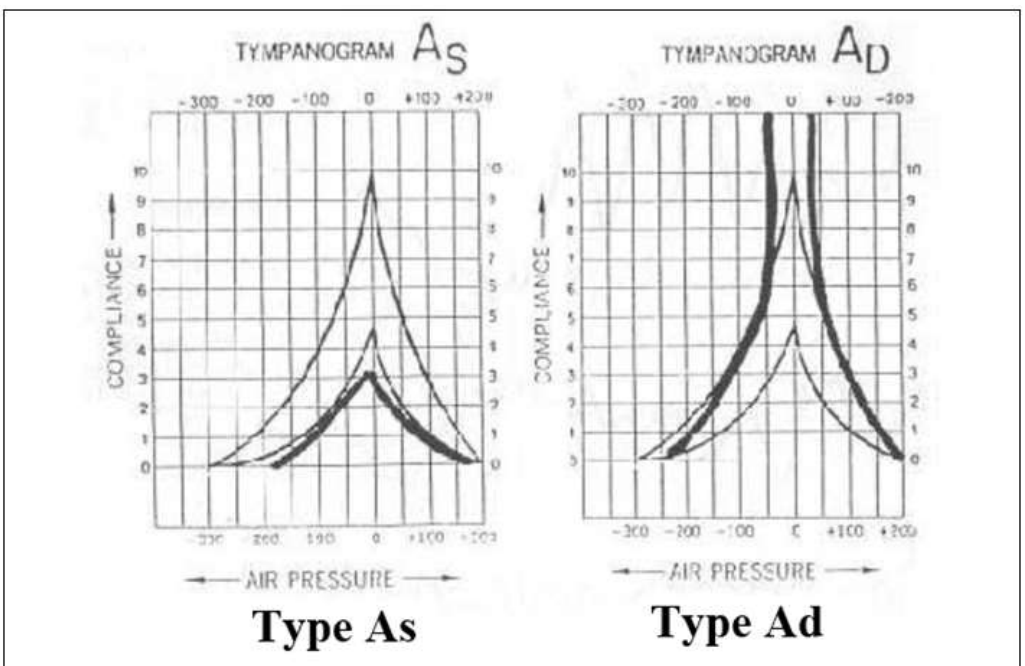
reduction of compliance of middle ear below 0.10 ml and conductive deafness of variable degree.[5] When sound strikes TM, some of the sound energy is absorbed while the rest is reflected. This physical and mechanical property is a mixture of three parameters, that is stiffness, mass and friction, all together referred as impedance. A stiffer TM would reflect more of sound energy than a compliant one. By changing the pressure in a sealed EAC and then measuring the reflected sound energy, it is possible to find the compliance or stiffness of tympano-ossicular system and thus find healthy or diseased status of the middle ear.

Impedance audiometry has been one of the major advancements in the field of otology and neuro-otology in recent times which provides a wide range of otological and neurological information about the nature and anatomical site of lesion. Tympanometry provides a reasonably accurate indication of the presence of OME. By charting the compliance of tympano-ossicular system against various pressure changes in EAC, different types of graph called tympanograms are obtained which are diagnostic of certain middle ear pathologies.

Types of Tympanograms



1. Type A: Characterized by maximal compliance at normal atmospheric pressure. This indicates a normal TM with good ET function and absence of effusion.
2. Type B: Flat or dome shaped graph with no change in compliance with pressure change indicating thick TM or fluid in middle ear.
3. Type C: Maximum compliance occurs at negative pressure in excess of -100 mm of H_2O seen in ET dysfunction. Middle ear effusion is present in 20% of patients with type C pattern.



4. Type As: Compliance is lower at 0 pressure, seen in ossicular fixation and otosclerosis.
5. Type Ad: Compliance is higher at 0 pressure, seen in ossicular discontinuity.

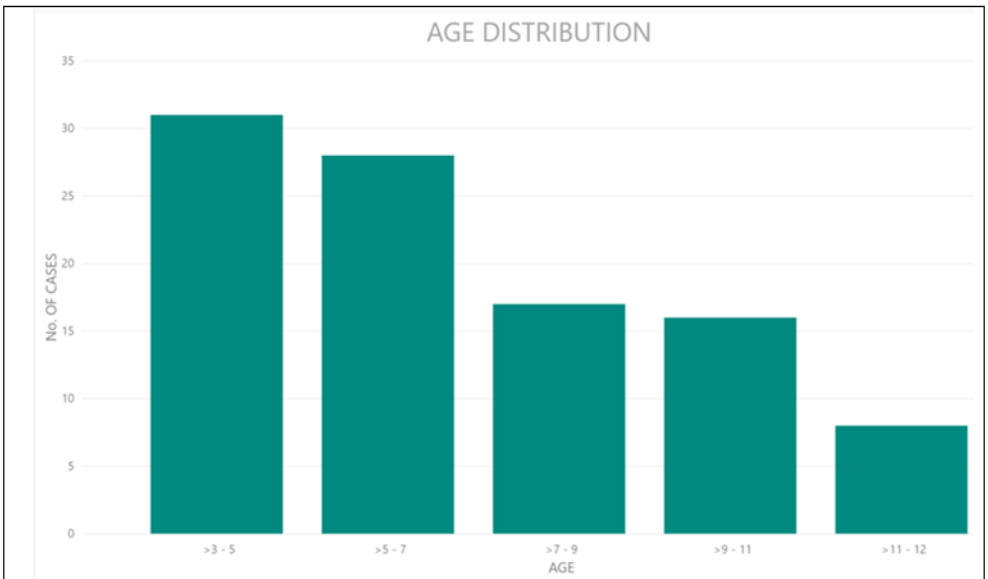
MATERIALS AND METHODS

This study was conducted in the department of otolaryngology, government medical college Thrissur, Kerala for a period of one year from October 2016 to September 2017. This was an observational cross-sectional study, 100 patients were enrolled based on inclusion and exclusion criteria. Inclusion criteria consisted of all new cases in the age group of 3-12 years with clinical and radiologic features of AH attending our department. Patients excluded from this study were those with previous adenoidectomy, cerebral palsy, genetic syndrome, ear discharge, TM perforation, cleft palate and congenital ear deformities. Detailed history and clinical examination including otoscopy to see the status of tympanic membrane were done. Nasal endoscopy and digital X-ray nasopharynx lateral view of all the patients were analysed. Tympanometry was done in all cases.

RESULTS

A total of 100 children who presented with snoring, mouth breathing, nasal obstruction, nasal discharge, recurrent respiratory infections, hard of hearing and diagnosed clinically as chronic adenoiditis were studied clinically with relevant investigations. Majority of the children were in the age group 3-5 years and 5-7 years in our study. There was male preponderance (M: F = 1.6: 1). Most of the cases presented with snoring and mouth breathing (n=75), nasal obstruction (n=68), recurrent respiratory infections (n=58) and hard of hearing (n=62).

In our study majority of the children presented with the nasal symptoms than aural symptoms indicating that the parents identify nasal symptoms easily compared to aural symptoms secondary to adenoids. In the present study, almost equal number of children presented with (52%) and without (48%) features of adenoid facies. On Otoscopic examination TM appearance varied from normal (19%) to dull and retracted (47%) and dull and bulging (34%), may be because of different pathological stages of OME. Patients with Grade 2 and 3 AH were shown to be statistically significant with the occurrence of OME ($p< 0.05$).

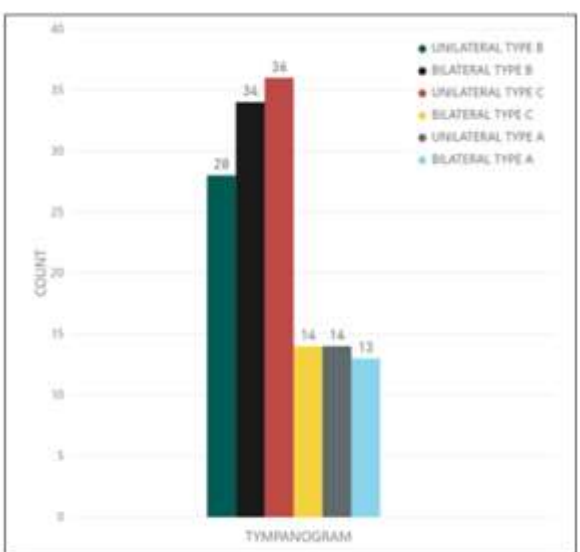


Graph 1. Age Distribution

Types	Number of Ears	Percentage
Type A	40	20%
Type B	96	48%
Type C	64	32%
Total	200	100%

Table 1. Type and Distribution of Tympanograms

Among the 200 ears tested, 28 cases had unilateral type B, 34 cases had bilateral type B, 36 cases had unilateral type C and 14 cases had bilateral type C tympanograms.



Graph 2. Distribution of Tympanogram

DISCUSSION

OME is defined as an inflammation of the middle ear mucosa along with an accumulation of liquid without signs or symptoms of acute infection (especially fever). The criteria for diagnosing OME refer to the presence of a fluid in the middle ear without signs of acute infection and without another underlying medical condition. If the liquid persists for more than three weeks, we consider it a chronic OME as diagnostic.

Tympanometry is an excellent diagnostic test, with 85% specificity in cases of middle ear secretion, in which it shows an increased impedance in the propagation of sound by the tympanic-ossicular chain complex, measured and recorded in a tympanogram.[6,7]

One of the earliest uses of tympanometry was to estimate the middle ear pressure and, indirectly, to measure the ET functions because normal Eustachian function is necessary for the maintenance of normal middle ear pressure. Middle ear pressure is now routinely estimated from the tympanogram. Tympanometric peak pressure (TPP) is the pressure at which the peak of the tympanogram occurs and is assumed to be the point at which the pressure in the ear canal equals the middle ear pressure. Therefore, TPP is an estimate of the pressure that provides the greatest admittance, or least impedance, to the flow of acoustic energy into the middle ear. Related to the measure of middle ear pressure is the measurement of the ET function. The major reason to assess the ET function in patients with intact TM is the association of the ET dysfunction and otitis media. Deviations in TPP from the atmospheric pressure can suggest a disorder of the ET, which can be associated with OME. In a study of children scheduled for myringotomy, negative pressure peaks on tympanograms were related to a high incidence of the recurrent acute otitis media with effusion. Further, the more negative the pressure peak was, the more likely the child was to suffer from repeated episodes of middle ear effusion cautions, because there are different diagnostic implications for a flat tympanogram with a severe negative peak: a wide pressure range should be used to verify that there is not a peak at a pressure beyond the pressure range, that is normally evaluated.[6,8]

In this study the most common tympanogram found was type B (96 ears, 48%) and the least common was type A (40 ears, 20%).This is comparable with the study done by Sassen et al which showed that 88% of the children with OME had type B tympanogram,[9] which clearly indicates an association of ET dysfunction and OME in the population who presents with clinical features of adenoid hypertrophy. A study by Engel did find a similar association and considered mouth-breathing to be a significant risk factor for OME in children.[10] Study by Haughton et.al on comparison of audiometry and tympanometry to determine the middle ear status in school going children shows that OME was diagnosed in greater number by using pure tone audiometry and tympanometry than by using PTA alone.[11] According to a Yockel et.al, pneumatic otoscopy with tympanometry improves the accuracy of diagnosis of OME and the most common cause of type B tracing is decreased mobility of TM secondary to middle ear fluid.[12] Sente M et al correlated the degree and type of hearing loss in children under 5 years of age with established ET dysfunction by Tympanometry and PTA and concluded that ET dysfunction is characterized by C type tympanogram and conductive hearing loss does not exceed 25 dB, and in case of type B tympanogram the conductive hearing loss is between 20-40 dB.[13]

Our study correlated the Adenoid–Nasopharyngeal Ratio (ANR) and tympanogram in children 5-7 years of age and found that the middle ear effusions and C- type tympanogram were both related to ET dysfunctions resulting from enlargement of adenoids with ANR higher than 0.72. The adenoid size reduction after 3 weeks of antibiotics therapy has a positive effect on recovery of ET functions but insufficient in patients with middle ear effusions. Early ventilation tube insertion may be an alternative therapy for the effusions not improving by 3 weeks of medical therapy.

CONCLUSION

There is association of size of adenoids in chronic adenoiditis with OME in paediatric age group. The proportion of otitis media with effusion increases with the severity of nasopharyngeal obstruction by adenoid hypertrophy, and the most common type of tympanometry results are seen among children with chronic adenoiditis was type B. An ANR of 0.72 should be considered as significant pathological enlargement and these children should be routinely sent for tympanometry.

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