



Republic of Iraq

Ministry of Higher Education and scientific  
Researches

University of Diyala / College of Medicine 2022 /2023

**Tympanometric findings in children with  
adenoids hypertrophy**

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## Abbreviations:

<b>OME</b>	Otitis Media with Effusion
<b>AH</b>	Adenoids Hypertrophy
<b>ET</b>	Eustachian Tube
<b>EAC</b>	External Auditory Canal
<b>ENT</b>	Ear, Nose, Throat doctor

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## Abstract:

**Background:** Adenoid hypertrophy is the enlargement or unusual growth of the adenoid (pharyngeal tonsil), adenoid hypertrophy is one of the etiologies of otitis media effusion (OME) the chronic accumulation of mucus within the middle ear and in mastoid air cell system, which is the commonest cause of hearing impairment in children. the sign and symptoms that was obtained from the patients' parents included; difficulty breathing through the nose, snoring, restless sleep or obstructive sleep apnea due to nasal obstruction, hypo nasal speech, frequent sinus symptoms.

**Objective:** This study aims to investigate the effects of adenoid hypertrophy on negative middle ear pressure and diagnostic efficiency of tympanogram in the detection of otitis media with effusion in children attending Ba'qubah teaching hospital, in Diayala, Iraq.

**Patient and Method:** In a prospective case-control study advocated in Ba'qubah General Teaching Hospital we evaluated sixty patients all within the ages of 2-11 years, from September 2022 to February 2023. Candidates who presented with symptomatic adenoid hypertrophy were selected for the study. Individuals who complained of otological symptoms, each of the sixty cases were examined through nasal endoscopy and skull lateral soft tissue X-ray and patient with grade 3 and 4 were send for hearing assessment using tympanometry were considered for the study. Questions were directed to the parents and patients to obtain the signs and symptoms that included: nasal obstruction, rhinorrhea, moth breathing, snoring and obstructive sleep apnea. Patients cleared of other pathological otological conditions were evaluated with tympanometry for evaluating the middle ear status and hearing loss.

**Results:** The mean age in the sixty cases was 5.2, there was male preponderance (M: F= 1.3:1). This study showed a total of patients evaluated presented with symptomatic otitis media with effusion and adenoid hypertrophy. Candidates who presented with type (B) tympanogram (50% of total cases) had significant conductive hearing loss of more than 25dB. The incidence of type (A) tympanogram was 23%, type (C) was 27%. There is a significant relation between AH grade 4 and type B tympanogram, so there is a significant relation between adenoid hypertrophy and OME incidence.

**Conclusion:** An objective test such as tympanometry in all patients with adenoid hypertrophy would aid in the diagnosis of fluid in the middle ear, so that timely intervention can be done and possible complications be averted.

## Introduction:

Otitis media with effusion (OME) defined as inflammation of the middle ear mucosa causing a fluid collection behind an intact tympanic membrane, several synonyms to describe this condition such as glue ear, secretory otitis media, catarrhal otitis media. The peak incidence is between 2 years and 5 years of age, by the age of 11 years of age the annual incidence is 2%. 50% of OME episodes last 3 months. OME is more common in male children particularly with frequent upper respiratory tract infection and those with early first episode of acute otitis media, also those with anatomical abnormalities like craniofacial anomalies and cleft palate. Atopic and bottle-feeding children are also at high risk to develop OME. <sup>(1)</sup>

The pathophysiology involved in OME is thought to be chronic inflammatory changes of middle ear mucosa caused by upper tract infection, otitis media or allergic response that may increase mucus production in the middle ear, also eustachian tube dysfunction due to any cause may interfere with mucus clearance and to accumulate in the ear. <sup>(1)</sup>

The main function of the eustachian tube is middle ear ventilation to equalize the middle ear pressure with atmospheric pressure. Adenoids (nasopharyngeal tonsils) hypertrophy is a known etiological factor for OME and a good reservoir for bacteria, as it causes mechanical obstruction of the eustachian tube lumen and fluid accumulation in the middle ear. Chronic infection of the adenoid tissue can cause epithelial metaplasia and connective tissue fibrosis which impede the function of the cilia and adenoid tissue in clearing infection <sup>(2)</sup>. Studies have shown that there is an increase in number of mast cells and allergic mediators in adenoid tissues which are capable of binding immunoglobulin E (IgE) and releasing histamines and other inflammatory mediators following exposure to allergens<sup>(3)</sup>. The mediators released influence the mucociliary transport time, modify the ciliary function and structure, and increase the secretory activity of the mucosal cells of the middle ear<sup>(4)</sup> the resultant effects show that ET dysfunction is the most important factor in the pathogenesis of otitis media with effusion<sup>(5)</sup>. Obstruction of the ET leads to increased middle ear pressure, while there is influx of bacteria and viruses from the nasopharynx following adenoidal infection. This causes mucosal oedema, inflammation, and increased secretory activity of the middle ear mucosa, leading to formation of effusion <sup>(6)</sup> 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. Several studies show

increasing adenoid size seen by nasopharyngeal endoscopy or X-ray through the nasopharyngeal region increases the incidence of OME<sup>(7)</sup>. Children with adenoid facies (sunken eyes, opened mouth, drooling saliva, crowded and protruding teeth, Rhinorrhea, snoring, and loss of nasolabial fold) are usually presented to clinical trials with conductive hearing loss suggesting adenoid induced otitis media. Behavioral changes, poor speech development and sensation of imbalance are also common clinical presentations.<sup>(1)</sup>

The important investigation of this study that we concentrate on is the tympanometric findings for patients with adenoid hypertrophy that previously clinically confirmed and the presence of hearing loss complaint. 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)<sup>(8)</sup>. 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<sup>(8)</sup>. Type B curve with a normal canal volume is the most common positive predictive value for OME in tympanometry.

After the clinical correlation we found between the adenoid size enlargement and hearing changes, we elicited that the Aim of this study is to confirm the association between adenoid hypertrophy and tympanometric findings in those suspected to have otitis media with effusion.

## **Method:**

**Data collection:** This is a prospective case-control study carried out among newly diagnosed cases of adenoid hypertrophy (AH) at the Ear Nose and Throat (ENT) Clinic of Ba'qubah General teaching hospital. The study was carried out between September 2022 and February 2023 and it included all new cases with clinical and radiologic features of AH, Ethical clearance was given by our institution and informed consent was taken from the parents of all recruited patients. A complete ENT and physical examination were carried out for all patients.

**The criteria for patient selection:**

1. Age between 2-11 years

2. Children has no previous adenoidectomy
3. Clinically suggest having enlarged adenoids (adenoid facies: Opened mouth, Dull face, Crowded teeth, narrow and high arched palate) patients also had rhinorrhea, ear pain, decrease of hearing, nasal discharge and other clinical presentations.
4. An adenoid nasopharyngeal ratio of more than 0.5
5. An intact tympanic membrane

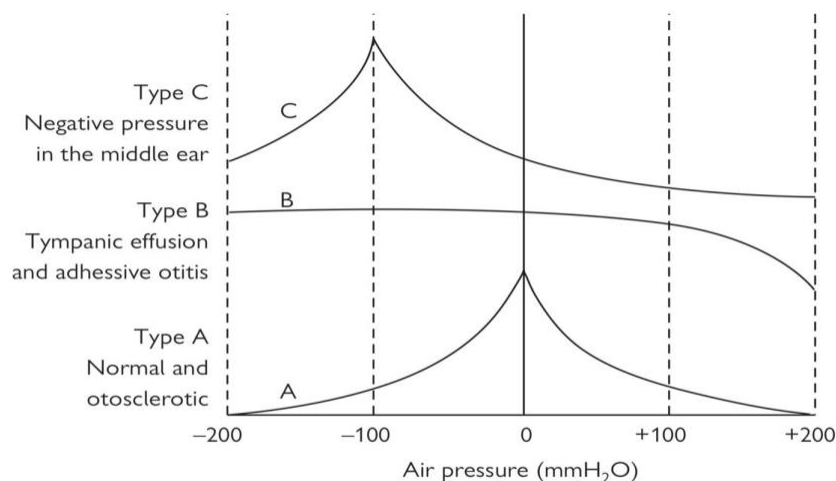
#### The criteria for patients Exclusion:

1. Sensory neural hearing loss
2. tympanic membrane perforations.
3. Below 2 years of age

**Investigations:** Evaluation included history, otolaryngological examination, otoscopic examination, and tympanometric assessment.

#### Tympanometry:

tympanometry test was done to the all 60 patients by a specialist doctor of ENT using impedance Audiometer, the equipment used a probe tone frequency of 226 Hz and a positive and negative pressure sweep between +200 and -400 daPa. The readings were of three main categories: A, B, C. The category (A) finding in tympanometry reveals normal membrane function the wave peaks at 0 daPa, while the (B) category reveals restricted membrane movement that has flat wave, no peak usually indicates middle ear fluid, the (C) category reveals negative pressure as abnormal negative peak <sup>(14)</sup>, see this picture:



**Fig. 14.5** Tympanogram graphs. Reproduced from *Diseases of the Ear* (Harold Ludman and Tony Wright), with permission of Edward Arnold (Publishers) Ltd ©1997 Arnold.

### Statistical analysis:

The data was collected in a Proforma and analyzed using Kruskal Wallis test that used to compare between the means, Chi-square analysis was done for statistical confirmation of the data.

### Results:

Sixty (60) cases of AH were seen within the study period. They were all within the ages of 2–11 years. This is shown in Table 1. The mean age was 5.2. There was male predominance (M: F = 56.6%: 43.4%). As shown in the (Table 1) in the next page the incidence of the clinical manifestations of patient with adenoids hypertrophy in all the 60 cases has common and convergent values. As seen 45 patients have nasal obstruction, 40 patients have nasal discharge, snoring and ear pain presents in 42,34 respectively.

Parameter	Number	Percentage
Number of patients	60	100%
age	2-11	Mean (5.2)
sex	M:34    F:26	M:56.6% F:43.4%
Nasal obstruction	45	75%
Nasal discharge	40	66.6%
snoring	42	70%
Ear pain	37	61.6%
Sore throat & odynophagia	40	66.6%
Decrease of hearing	31	51%%
Opened mouth	23	38%
Dull face	15	25%
Rhinorrhea	25	41.6%
High arched palate	8	13%

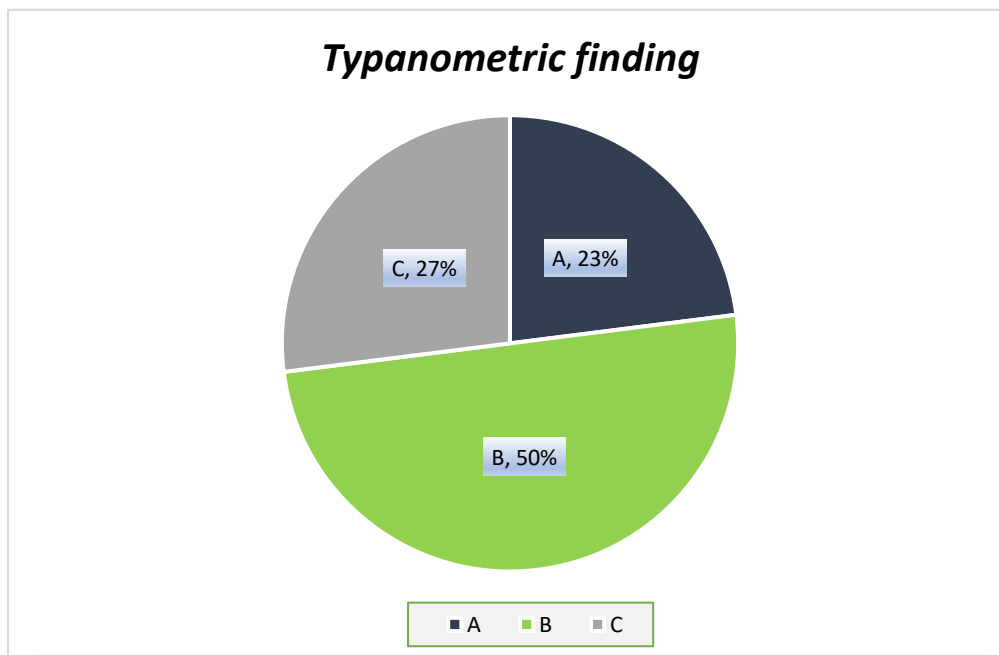
**Table 1: shows the comparison between the incidence of clinical presentations shown on the parameters section**

An important clinical features like odynophagia and decrease hearing were in 40 and 31 patients respectively. A characteristic adenoid facies were 23 patients for opened mouth for breathing and protruded teeth, 15 patients were of dull face, 25 patients for rhinorrhea and 8 patients with high arched palate. The evaluation of the tympanic membranes showed that, 23% of the study group presented with a normal tympanic membrane.

Tympanometric findings: The incidence of type a tympanogram was 23%, the type B was 50%, while type C was 27% as shown on the (Table 2):

<i>tympanometry</i>	<i>frequency</i>	<i>percentage</i>
A	14	23%
B	30	50%
C	16	27%
<i>TOTAL</i>	60	100%

**Table 2: Tympanometric readings as number and percentage**



**Figure 1: chart formula compares percentages of tympanograms**



**Discussion:** The most reliable risk factor was found in this study is the AH, almost all the patients that has a positive adenoid facies presentation has unilateral or bilateral otitis media with effusion. Therefore, the early identification of the adenoid's enlargement is a good protective way from developing OME, and to prevent its complication on the middle ear, if untreated, OME might end up in serious consequences in the form of poor speech and intellectual development and permanent anatomical distortions within the middle ear cavity. Thereby, correct and early diagnosis and appropriate treatment of OME in children is imperative<sup>(9)</sup>. Adenoid hypertrophy can partially or completely obstruct the nasal airway. The influence of adenoid hypertrophy on eustachian tubes has been extensively studied. Current studies showed the mean values of middle-ear pressure were significantly higher in patients with adenoid hypertrophy<sup>(10)</sup>. The airflow passing through the relatively narrower lumen will cause a negative pressure which will induce tubal dysfunction. Tympanometry provides useful quantitative information about the presence of fluid in the middle ear. usually, tympanometry is more easily performed than otoscopic examination in children<sup>(11)</sup>. The incidence of OME in this case study was higher in those patients with tympanometric B finding as it the most predictive value in the study, where it was less in the type C finding and negative with those patient of type A.

Another study performed at 22 May 2016 by the academic Jeffrey P. Pearson on sixty-eight cases found the incidence of type B tympanogram was 29.4%, while type C was 26.5% and the rest was of normal readings,<sup>(12)</sup>

also, another Indian study was performed at 18 October 2018 by Vadisha Bhat, Ivan Paraekulam Mani, Rajeshwary Aroor, Marina Saldanha, M.K. Goutham, Deepika Pratap about Association of asymptomatic OME in patients with adenoid hypertrophy, this study evaluated one hundred candidates concluded that the Impedance audiometry showed that 55% of the candidates presented with 'A' type tympanogram. In patients with an 'A' tympanogram 75% had bilateral 'A' type tympanogram, the remaining 25% had either unilateral 'B' type or 'C' type. Unilateral 'B' tympanogram was identified in 12% of the cases and the remaining 6% identified with having a unilateral 'C' tympanogram. A total of 24% of the study subjects presented with bilateral 'B' tympanogram only 3% of the study group presented with a bilateral 'C' type tympanogram.<sup>(13)</sup>

**Limitation:** It is very difficult to examine the tympanic membrane when the ear canals are narrow. Nevertheless, the tympanic membrane can be congested due to children often crying during the examination. Therefore, OME can easily be overlooked by otoscopy, especially in children without hearing loss complaints.

**Conclusion:** This study had shown a high incidence of OME among patients with AH with type B tympanogram being more common. The more severe grade of AH was more prevalent and it was shown to be statistically significant with OME, thus being a significant risk factor for OME in children. This establishes the need for prompt hearing evaluation and management.

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