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Tympanometric changes following adenoidectomy in children with adenoid hypertrophy

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ABSTRACT

Background: Adenoid Hypertrophy is the commonest disorder in children. The size of adenoids varies from child to child and also in the same individual as he grows and attains maximum size between age of 3 to 7 years. Adenoid hypertrophy plays a significant role in the pathogenesis of otitis media with effusion. Our objective was to study the tympanogram changes following adenoidectomy. i.e to find out the effect of adenoidectomy on Otitis Media with Effusion.

Methods: Patients showing >50% of airway obstruction by the adenoids were included in the study. 20 patients with adenoid hypertrophy underwent adenoidectomy. Pre-operative and postoperative tympanograms of 40 ears were studied.

Results: Type A curve (normal) was found in 12 ears. Type B Flat tympanogram – 12 ears s/o Gross Serous Otitis Media. Type C tympanogram – 8 ears s/o uncomplicated eustachian tube obstruction. 5 ears showed tympanogram s/o Eustachian tube block without significant collection of middle ear fluid. 3 ears showed tympanogram s/o uncomplicated eustachian tube obstruction. Post adenoidectomy, 32 ears showed normal tympanogram. 8 ears showed tympanogram s/o negative middle ear pressure with normal compliance.

Conclusions: Our study shows high prevalence of Otitis Media with Effusion in patients with adenoid hypertrophy. Otitis Media with Effusion is treated by adenoidectomy in most of the patients which is confirmed by post adenoidectomy tympanogram. Also, problem of decreased attention in school due to reduced hearing secondary to OME can be corrected by adenoidectomy. Hence, all patients should undergo pre and post-adenoidectomy tympanometry to know the compliance and pressure changes in the middle ear.

Keywords: Adenoid hypertrophy, Tympanogram, Otitis media with effusion

INTRODUCTION

Adenoid Hypertrophy is the commonest disorder in children.¹ The size of adenoids varies from child to child and also in the same individual as he grows. In general, normal adenoids attain their maximum size between ages of 3 to 7 years and then regress. Chronically infected adenoids act as a reservoir in upper respiratory tract infections with oedema and obstruction of nasopharyngeal end of Eustachian tube. What may be important in considering the harmful effects of adenoids

is not the absolute size, but more the size in relation to that of the nasopharynx. The disease processes which affect the adenoids and cause problems are infective. An associated upper respiratory tract infection affects the adenoids and results in hyperplasia with enlargement and multiplication of lymphoid follicles. Large adenoids can partially or totally obstruct nasal respiration causing snoring, hyponasal speech, sleep apnoea, sinusitis and mouth breathing.²

Clinical examination of children with nasal obstruction is notoriously unreliable. Anterior rhinoscopy may be normal or increase secretion, inferior turbinate hypertrophy with congestion. In some children examination of the nasopharynx with a post nasal mirror will identify large adenoids. Unfortunately, in many children it is impossible to assess the adenoids in this way. The most reliable way of assessing the size of the adenoids is to take a lateral radiograph. This will give the measure of the absolute size of the adenoids and also an amusement of the relation to the size of the airway.²

Adenoid hypertrophy plays a significant role in the pathogenesis of otitis media with effusion. ¹Untreated otitis media with effusion may result in series of consequences in the form of poor speech and intellectual development and permanent anatomical distortions within the middle ear cavity.³ Otoscopy shows dull tympanic membrane or air fluid level seen on the tympanic membrane. Tympanometry provides an effective screening test for the detection of negative middle ear pressure. Tympanometry was 1st introduced in Scandinamia. It is rapid and reliable even in infants. It provides an effective screening test for detection of negative middle ear pressure. Tympanometry is the graphical representation of the admittance (or impedance or compliance) of the middle ear. The mobility or compliance of tympanic membrane is maximum when air pressure in middle ear is equal to that of external auditory canal and the membrane is thus free from stress. Under normal conditions the pressure in middle ear is maintained equal or close to atmospheric pressure by the functional Eustachian tube.5

Subdividing tympanograms into 3 types:

Type A- middle ear pressure +200 to -99 mm of water, sharp peak at 0 mm H_2O : Normal, otosclerosis.

Type B- little or no compliance, no sharp curve

Flat curve: Serous otitis media, adhesive otitis media, perforated TM.

Type C- middle ear pressure -100 to -400 mm of water, significantly negative middle ear pressure, normal compliance: uncomplicated Eustachian tube obstruction.

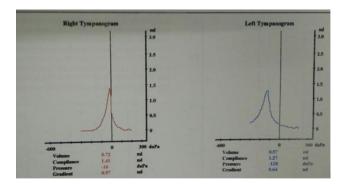


Figure 1: Right ear shows type A and left ear shows type C tympanogram.

Right ear shows normal compliance and mild negative pressure (-20 mm of H_2O). Left tympanogram shows normal compliance with gross negative middle ear pressure (-150 mm of H_2O).

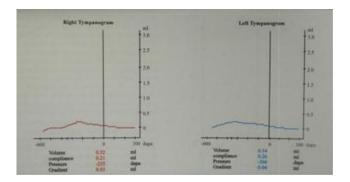


Figure 2: B/L ears show type B tympanograms.

Bilateral tympanograms are at slightly low compliance and significantly negative middle ear pressure (flat tympanogram or Type B). It is suggestive of Otitis Media with Effusion. ⁶

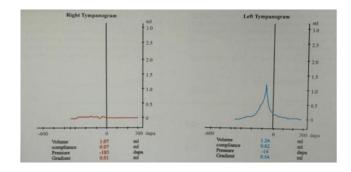


Figure 3: Right ear shows type B and left ear shows type C tympanogram.

Right tympanogram shows flat curve suggestive of OME. Left tympanogram shows normal compliance significant negative middle ear pressure suggestive of uncomplicated Eustachian tube obstruction.⁶

METHODS

The study was a prospective study conducted for a period of 6 months from 1 January 2017 to 30 June 2017 at Dr. D.Y. Patil Medical College.

Inclusion criteria

- 1. Children aged between 5 to 15 yrs.
- 2. Lateral X-ray nasopharynx for adenoids showing >50% obstruction in airway.
- 3. Children having 3 or more complaints (mouth breathing, snoring, nasal obstruction, hyponasal speech, decrease attention in school, recurrent URTI).

Exclusion criteria

- 1. Patients with acute upper respiratory tract infection.
- 2. Patients with tympanic membrane perforation.

3. Patients with craniofacial anomalies.

Patients aged 5-15 years who suited the inclusion criteria were enrolled in the study irrespective of their socioeconomic strata. Approval of the Ethical Committee of the institute was obtained before commencing the study. A questionnaire was prepared to carry out the study. Questionnaires, translated in the familiar local language (Hindi/Marathi/English) of the people, were given to the patients. They were instructed to get the questionnaires filled by their parents. The questionnaire included questions pertaining to the symptoms of enlarged adenoids, i.e. nasal obstruction, rhinorrhoea, hypo-nasal voice, snoring, difficulty in hearing, repeated sore throat and previous ear problems. The questionnaires were then collected from the patients.

After going through the answers, the patients who suited the selection criteria and who had more than 3 of the above stated complaints frequently were then examined. Consent was taken from the parents of the children. A detailed history, including all the primary information in consultation with the parents, was filled regarding the name, place of residence, family income, the living conditions, and if possible history of major illness in the past, in the student or family. Complete examination of Ear, nose and throat was done. Rinne's, Weber's test and Absolute Bone Conduction Test were performed on all the selected patients before and after adenoidectomy. Xray nasopharynx lateral view (soft tissue) was taken to confirm the presence of adenoids. Pure Tone Audiometry (PTA) was performed among the patients diagnosed with adenoid hypertrophy to assess the hearing status before and after adenoidectomy. Tympanometry was then conducted on all patients.

Tympanometry was done on 20 patients i.e. 40 ears before adenoidectomy and 6 weeks after adenoidectomy. Preoperative and postoperative tympanograms were compared and the changes noted.

Tympanometry procedure

Before the test, otoscopy is done to make sure there's no earwax or foreign object obstructing patients ear canal. A probe is placed in the ear canal and the patient hears loud tones as the device begins to take measurements. The test changes the air pressure in the ear to make the eardrum move back and forth. Measurements of the movement of the eardrum are recorded in a tympanogram. Moving, speaking or swallowing during the test can give an incorrect result.

Adenoidectomy procedure

Before the procedure of adenoidectomy, blood tests are done to ensure no excessive bleeding during and after the surgery. Pre-anaesthetic evaluation is done and fitness taken. Procedure is performed under general anesthesia in an inpatient setting.

Patient is intubated, painted and draped. Patient is in supine position with sand bag below the shoulder and head rested on the head ring. Oral cavity opened with Boyle Davis mouth gag and supported by Draffins bipod. Head is flexed and the adenoids are palpated in the nasopharynx through the oral cavity. Adenoids are curetted with St. Clair Thomson's adenoid currete with guard. The area is packed with absorbent material such as gauze which will control bleeding during and after the surgery. Postoperatively, patient will be NBM (nil by mouth) for 6 hrs, following which he can eat ice-creams if adenoidectomy accompanies tonsillectomy. Intravenous antibiotics, analgesics, antihistamines are given. Post-operatively after 6 weeks the tympanometry procedure is repeated.

Statistical analysis

All the continuous data were expressed as mean \pm standard deviation. Categorical data has been presented in proportion. Appropriate graphs have been used for presenting the data.

RESULTS

The total patients were distributed as per their age groups. 14 patients were in 5-10 years of age and 6 were from 10-15 years. We observed adenoid hypertrophy to be more common in age group between 5-10 years. Male children with adenoid hypertrophy were 12 and female children with adenoid hypertrophy were 8.

Table 1: Mean value of age and symptoms of all patients.

Duration	Mean
Age (years)	9.75
Mouth breathing (months)	15.4
Snoring (months)	12.75
Nasal obstruction (months)	7.8
Decreased hearing (months)	3.9
Hyponasal speech	1.5
Recurrent URTI	2.1

Percentage of normal tympanogram in 40 ears with adenoid hypertrophy was 30%. Percentage of abnormal tympanogram in 40 ears with adenoid hypertrophy was 70%.

Type "A" curve (With normal pressure and normal compliance) was seen in 12 ears (30%). Type "B" Flat tympanogram i.e without any measurable compliance or pressure peak was seen in 12 ears (30%) which was s/o gross serous otitis media. Type "C" tympanogram (Significantly negative middle ear pressure and normal compliance) was seen in 8 ears (20%). This was suggestive of uncomplicated eustachian tube obstruction. 5 ears showed graphs with negative middle ear pressure and normal compliance. This is suggestive of Eustachian

tube block without significant collection of middle ear fluid. 3 ears showed graphs suggestive of significantly negative middle ear pressure and normal compliance. This is suggestive of uncomplicated Eustachian tube obstruction (Figure 5).

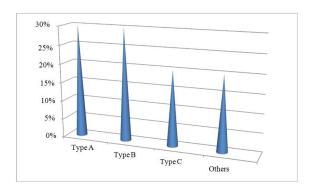


Figure 4: Pre-operative tympanometric findings.

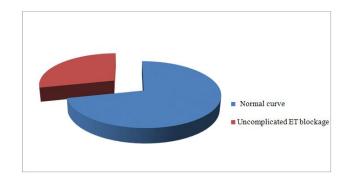


Figure 5: Postoperative tympanometric findings.

Percentage of abnormal tympanograms becoming normal (Type A), 6 weeks after adenoidectomy was 71.4%. Percentage of tympanograms showing negative middle ear pressure with normal compliance i.e uncomplicated Eustachian tube obstruction was 28.6% (Figure 5).

Table 2: Pre and postoperative tympanogram findings.

Pre-operative tympanogram	Post-operative Tympanogram Type "A"	Post-operative Tympanogram Type "B"& Type "C"	Post-operative Tympanogram (negative ME pressure & normal compliance)
Type "A" – 12 ears	12	Nil	Nil
Type "B" – 12	12	Nil	Nil
Type "C" – 8	6	Nil	2
Negative ME pressure normal compliance - 5	2	Nil	3
Significant negative ME pressure normal compliance - 3	Nil	Nil	3

DISCUSSION

When considering diseases of adenoids it is as well to remember that the mass of lymphoid tissue in the nasopharynx generally referred to as the adenoids is a normal structure with a definite function, namely production of antibodies (IgA locally and IgG and IgM systemically). The classical concept is that enlargement of the adenoids or repeated recurrent infections of the adenoids results in recurrent acute otitis media and of otitis media with effusion (glue ear). It has been demonstrated by both radiological techniques and by pressure studies that adenoids can and do obstruct the Eustachian tube and that adenoidectomy relieves the obstruction. As children who have had their adenoids removed still do suffer from acute otitis media and recurrent glue ear they are obviously not the sole cause of the problem. Two studies have shown a definitive reduction in the recurrence rate of glue ear in children who have had an adenoidectomy. There are, however, other studies which have suggested that adenoidectomy has no part to play in the treatment of childhood ear problem.2

Indications of adenoidectomy are nasal obstruction, otitis media with effusion, recurrent acute otitis media and sleep apnoea. Otitis media with effusion can be either treated by adenoidectomy alone, adenoidectomy with grommet insertion or only grommet insertion and adenoidectomy only if serous otitis media recurs.²

Otitis media with effusion (OME) is the presence within the middle ear cleft of an effusion which may be serous or mucoid but not frankly purulent. A survey by showed that 80% of otolaryngologists in the UK advised adenoidectomy as part of the treatment for OME. In 1991 similar survey showed that 64% advised such treatment. The rationale for adenoidectomy for treatment of OME was based on the assumption that, in some way adenoids affect Eustachian tube function. It might be anticipated that adenoidectomy would be more effective in those children presenting with signs and symptoms of nasal obstruction, snoring, speech hyponasality. There is commensurate change in tympanometric conversion from flat type B tracer to peaked A or C curves. These changes are associated with progressive hearing improvement.⁴

The study carried out by the Haydarpasa Numune Research and Education Hospital, Istanbul, Turkey that 95 consecutive children complaining of one or more of the symptoms of upper airway obstruction (presence of snoring, mouth breathing or difficulty in breathing during sleep) were included in the study. Symptom severity was assessed by a standardized questionnaire. All patients underwent digital lateral soft tissue radiographs. Of 190 ears, 79 were type A, 49 were type B and 62 were type C tympanograms.

The adenoid hypertrophy in both means of radiologic measurements and symptom severity does not correlate with the changes in tympanograms. The study carried out by University of Port Harcourt Teaching Hospital, Post Harcourt, Nigeria says that 68 cases of adenoid hypertrophy were seen within the study period and 136 ears were studied. 40 ears had type B tympanogram, while 36 ears had type C. The incidence of otitis media with effusion was 55.9%. There were 12 unilateral OME, while bilateral OME was 32. This study had shown adenoid hypertrophy as a significant risk factor for OME in children. There was more bilateral OME than unilateral.⁷

Study carried out by Medical Faculty of Adnan Menderes University, Aydin, Turkey was that that 56 children who underwent adenoidectomy were analysed using otoscopy, nasal endoscopy and tympanometry (before 1 week and 3 months after adenoidectomy).

The median negative middle ear pressure before the adenoidectomy was significantly higher from after adenoidectomy. Type B tympanogram were detected in 13 of the 112 ears preoperatively. About 17.9% of the ears with otitis media with effusion were confirmed by myringotomy.³

This prospective study included 71 children aged 3-10 years old Rizgary Teaching Hospital for adenotonsillectomy attending between august 2013-2014. Questions about upper airway obstruction symptoms were directed to parents and patients. Tympanometry and plane radiological study of lateral soft tissue of the neck were done for each case. Of 71 children, 20 children had gross adenoid enlargement of which tympanometry was found to be normal in 75% and abnormal in 25%. Although the incidence of abnormal tympanometry was higher with the increased adenoid size but it was statistically non-significant.⁸

A study conducted in which 35 children presenting to the Department of ENT, Government Medical College, Thrissur, Kerala, India over one and a half years with features suggestive of secretory otitis media, tonsillar and adenoid hypertrophy who underwent adenoidectomy with tonsillectomy were included in the study. Out of 35 children included in the study, 56% of cases after 6 weeks showed complete resolution of OME which improved in 67% after 3 months. It was assessed by PTA

and tympanometry. 33% showed partial improvement with type C curve in tympanometry and improvement in PTA values.⁹

In another study, patients who presented with symptoms of adenoid hypertrophy were further evaluated for associated OME. A total of 50 patients who had adenoid hypertrophy and OME confirmed with preoperative PTA and tympanometry were included in the study. All patients underwent adenoidectomy under general anaesthesia. Follow up was done with repeat pure tone audiometry and tympanometry at 3rd and 6th months. In this study, tympanometry showed type B curve in 54% of ears. Postoperative audiometric assessment showed mean hearing gain at 3rd and 6th months being 5.32 and 4.09db respectively. At 6th month follow up, 25 ears had type A curve, only 8 ears had type B curve and 67 ears C type curve. ¹⁰

In our study, 20 patients aged between 5 and 15 years were initially selected using a questionnaire. These children had hypertrophic adenoids. Tympanometry was performed before and after adenoidectomy. According to observation, among 40 ears, 28 ears showed abnormal tympanogram. Postoperatively, 20 ears showed normal (Type A) tympanogram. 2 ears showed Type C tympanogram and 6 ears showed evidence of mild Eustachian tube blockage.

In our study, most common age group with adenoid hypertrophy was 5 to 10 years, 80% of this age group showed abnormal tympanogram. The reason for this is that adenoid size reaches its maximal size at age seven years old and will gradually decrease afterward.

In our study, out of 20 patients, 12 (60%) were male and 8 (40%) were female who had adenoid hypertrophy. With regard to gender distribution in the study carried out in Rizgary Teaching Hospital for adenotonsillectomy revealed that 61.5% of patients with abnormal tympanometry were male and 38.5% were female. This finding was similar to the previous studies that showed male predominance for abnormal tympanometry over females.8 Both Yassan in 2003 and Agidir in 2006 showed that 60% of cases with abnormal tympanometry were males and the rest were females. 11,12 Khayat in 2008 also found that 55% male patients had abnormal tympanometry and OME and 45% of females had OME. 13 While in other studies like Tong 2005 did not find any significant difference between both genders in the prevalence of OME.¹⁴

CONCLUSION

Our study shows high prevalence of Otitis Media with Effusion in patients with adenoid hypertrophy. Otitis Media with Effusion is treated by adenoidectomy in most of the patients which is confirmed by post adenoidectomy tympanogram. Also, problem of decreased attention in school due to reduced hearing secondary to OME can be corrected by adenoidectomy. Hence, all patients should undergo pre and post-adenoidectomy tympanometry to know the compliance and pressure changes in the middle ear.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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