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Original Article

Ear, Nose and Throat Section

Prevalence of Asymptomatic Otitis Media with Effusion in Children with Adenoid Hypertrophy and its Relation to Adenoid Size: A Cross-sectional Study

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ABSTRACT

Introduction: Otitis Media with Effusion (OME) occurs as a sequelae of adenoid hypertrophy. But most often hearing loss due to OME goes unnoticed in children. This causes poor cognitive development, inattention and thus poor scholastic performance.

Aim: To estimate the frequency of asymptomatic OME in children with adenoid hypertrophy and to find the association between adenoid size and occurrence of OME and hearing loss.

Materials and Methods: This prospective cross-sectional study was conducted in a tertiary care centre in South India, from November 2019 to November 2021. Children of 5-12 years of age, with symptoms suggestive of adenoid hypertrophy and with no complaints of hearing loss, were selected. A detailed ear, nose, throat examination, Pure Tone Audiometry (PTA) and tympanometry were done in all patients. Adenoid size was graded by nasal endoscopy using Mc Murray and Clements scale and also based on radiographs {comparing the distance between maximum convexity of adenoid and line drawn along basiocciput (A) and posterior part of hard palate and sphenobasioccipital synchondrosis (N)} using A/N ratio. All patients subsequently underwent adenoidectomy. Myringotomy was done along with adenoidectomy in cases with bilateral OME. All OME patients were followed-up with tympanometry, one month and three months postoperatively. The frequency of OME was presented as percentage. The association between adenoid size and asymptomatic OME as well as hearing loss was done using Fisher's exact test.

Results: A total of 150 children, aged between 5-12 years with adenoid hypertrophy were analysed. The mean age was 9 years. On analysing the association between adenoid size (both radiographically and endoscopically) and OME, 30 (20%) had bilateral effusion, 18 (12%) had unilateral effusion and prevalence of asymptomatic OME was calculated as 32%. Most of the patients had grade II adenoids radiographically, and grade III adenoids as per nasal endoscopy. Majority of patients had Type B Tympanogram. There was significant association between OME and adenoid size. Association between adenoid size with hearing loss showed significant association between the two with p-value=0.001 on right ear and p-value <0.001 on left ear (radiographically), and p-value=0.027 on right ear and p-value=0.043 on left ear (as per nasal endoscopy). About 93% of children with bilateral Type B tympanogram and all children with unilateral Type B and bilateral Type C returned to normal on three months follow-up.

Conclusion: There was association between adenoid size, and occurrence of OME and hearing loss. About 32% of the study population were detected to have asymptomatic OME.

Keywords: Hearing loss, Pure tone audiometry, Tympanometry

INTRODUCTION

The Otitis Media with Effusion (OME) is the collection of non purulent serous fluid in the middle ear. It commonly occurs in children, the most common cause being adenoid hypertrophy. OME presents clinically with hearing loss, dull aching pain, and autophony. These symptoms are often recognised early in adults, but these subtle changes most often remain unnoticed in children [1]. Adenoid hypertrophy in children presents as mouth breathing, snoring, nasal obstruction and persistent nasal discharge. These are often treated by primary healthcare physicians as upper respiratory infections and are often not dealt with by a specialist, thereby missing the findings in ear. In a developing country like India, the number of children seeking medical treatment for nasal symptoms are much less, as most of them resort to home remedies [2]. This inturn leads to unrecognised OME. The hearing loss produced as a sequela of OME is often recognised much later by teachers or parents when they notice inattention, poor scholastic performance and poor social behaviour [3,4]. Hearing loss as low as 15 decibels (dB) can prove to be at risk for poor academic performance [5].

A study conducted by Garg S et al., showed a prevalence of conductive hearing loss of 10.3% irrespective of the age [6]. Another Indian study done among adults and children showed the cause of reversible deafness due to serous otitis media to be 3% without specifying the impact on children [7].

Kocyigit M et al., in their study on 589 Turkish patients, showed adenoid hypertrophy in 58 patients (9.8%). Also 94 (15.9%) had asymptomatic OME. Among children with adenoid hypertrophy, 10.3% had type B Tympanogram [8]. Not much studies were conducted in India regarding the occurrence of asymptomatic OME in children with adenoid hypertrophy and subsequent hearing loss. Bhat V et al., found 36% prevalence of asymptomatic OME in patients with adenoid hypertrophy and, 40% of them with bilateral Type B tympanogram had significant conductive hearing loss of more than 25 dB [9]. Another study by Diksha et al., on 57 patients, showed unilateral OME in 14% and bilateral OME in 24.6% [10]. The present study aimed to find out the prevalence of asymptomatic OME in children with adenoid hypertrophy and also aimed to evaluate the relation between adenoid size and occurrence of OME and hearing loss.

MATERIALS AND METHODS

The present prospective cross-sectional study was conducted in the Department of Otorhinolaryngology, in a tertiary care centre in Southern

India, during the period November 2019 to November 2021. Ethical committee clearance was obtained for the study by the Institutional Review Board (IRB). (No. PIMSRC/E1/388A/49/2019). Conservative sampling method was chosen as the sampling method.

Inclusion criteria: Children in the age group of 5-12 years who presented with adenoid hypertrophy clinically and showed radiological evidence of adenoid hypertrophy and who did not have any ear symptoms were selected for the study.

Exclusion criteria: Children with history of suppurative otitis media or tympanic membrane perforation, children with complaints of hearing loss, children with cleft palate and those who underwent surgical repair for the same, nasopharyngeal tumour or mass other than adenoid hypertrophy were excluded from the study.

Sample size calculation: Sample size was calculated considering the proportion of asymptomatic OME among children with adenoid hypertrophy (p) from previous study done by Bhat V et al., with 95% confidence level and 8% precision, using the formula;

$$n=\frac{Z(1-\alpha/2)^2 p\,(1-p)}{d^2}$$ taking p as 36 [9].

A written informed consent was taken from caregivers. All children were assessed clinically for adenoid enlargement by taking a proper history and detailed ear, nose, throat examination. X-ray soft tissue nasopharynx lateral view was taken in all cases to assess the adenoid size. The distance between the maximum convexity of the adenoid and a line drawn along the basiocciput (A) and the distance between the posterior superior edge of the hard palate and anteroinferior edge of sphenobasioccipital synchondrosis (N) was measured. A/N ratio was calculated and graded [11,12] as:

- Grade 0- (0.0-0.25): No adenoid enlargement
- Grade I- (0.26-0.50): minimal
- Grade II- (0.51-0.75): moderate
- Grade III- (0.76-1.00): gross enlargement

Transnasal endoscopy was done in outpatient setting for older children to assess adenoid size, and for smaller and uncooperative children, assessments were done prior to adenoidectomy under general anaesthesia. The degree of obstruction by the adenoid tissue over the posterior choana was estimated using the grading system proposed by McMurray and Clements [13]:

- Grade I-Adenoid tissue filling 1/3rd of vertical height of choana.
- Grade II- Adenoid tissue filling 2/3rd of vertical height of choana.
- Grade III-From 2/3rd to nearly all but not completely filling the choana.
- Grade IV-Complete choanal obstruction.

Tympanogram and PTA were done in all cases. Jerger's classification for tympanogram [14] and Global Burden of Disease classification (2010) [15] for hearing loss was used for assessment. All patients subsequently underwent adenoidectomy. Myringotomy was done along with adenoidectomy in cases with bilateral OME. All OME patients were followed-up with tympanometry, one month and three months postoperatively.

STATISTICAL ANALYSIS

The association between adenoid size and occurrence of OME as well as hearing loss were done using Fisher's exact test. A p-value of <0.05 was considered as statistically significant. Statistical analysis was performed by using software Statistical Package for the Social Sciences (SPSS) version 20.0.

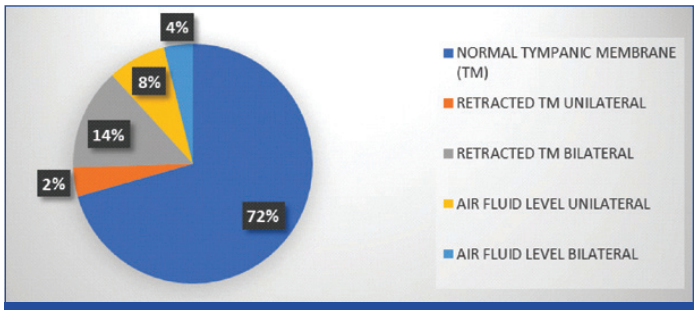
RESULTS

Data from 150 cases of adenoid hypertrophy were analysed and the results were tabulated. Age of the participants ranged from 5 to 12 years with a mean age of 9 years. Out of 150 participants, 105 (70%) were males. On evaluating the symptoms of the participants, all had mouth breathing and the next common symptom was snoring (98%) [Table/Fig-1].

Symptoms	n (%)
Snoring	147 (98)
Mouth breathing	150 (100)
Hyponasal voice	27 (18)
Running nose	108 (72)
Sleep apnoea	18 (12)

[Table/Fig-1]: Symptom distribution of participants.
Data is not mutually exclusive

On examining the tympanic membrane, 108 (72%) had normal tympanic membrane on both sides, 21 (14%) had retracted tympanic membrane bilaterally and 6 (4%) had bilateral air fluid level [Table/Fig-2].



[Table/Fig-2]: Otoscopic findings of participants.

On evaluating the adenoid size radiographically, 90 (60%) participants had grade II and the rest had grade III adenoid hypertrophy. Among those who had grade II adenoid hypertrophy, 9 (10%) had bilateral effusion while 21 (35%) of grade III had bilateral effusion. This association was statistically significant (p-value=0.002) [Table/Fig-3].

Adenoid size	Effusion			Total N (%)	p-value (Fisher's exact test)
	Unilateral n (%)	Bilateral n (%)	No effusion n (%)		
Grade I	0	0	0	0	0.002
Grade II	3 (3.3)	9 (10)	78 (86.7)	90 (60)	
Grade III	15 (25)	21 (35)	24 (40)	60 (40)	
Total	18	30	102	150	

[Table/Fig-3]: Association between otitis media with effusion and radiographic adenoid size.

Association between radiographic adenoid size and PTA findings were tabulated for both ears. The majority of the children with Grade III adenoids showed mild hearing loss, which was present bilaterally [Table/Fig-4].

On assessing adenoid size using nasal endoscopy, majority (82%) had grade III adenoid hypertrophy and 12% had grade IV and rest had grade II. Children with grade II hypertrophy had no effusion [Table/Fig-5].

On analysing the association between adenoid size (both radiographically and endoscopically) and OME, 30 (20%) had bilateral effusion and 18 (12%) had unilateral effusion and prevalence of asymptomatic OME was calculated as 32%.

Association between adenoid size by nasal endoscopy and PTA findings were tabulated for both ears. Those children with grade III adenoids had mild hearing loss bilaterally which was statistically significant [Table/Fig-6].

On impedance audiometric evaluation, out of 150 participants, 30 (20%) had bilateral Type B tympanogram and 15 (10%) had bilateral Type C tympanogram; 27 (18%) had unilateral effusion in either right or left ear and rest 78 (52%) had Type A tympanogram in both ears [Table/Fig-7].

Adenoid size	Hearing loss-Right ear			p-value (Fisher's exact test)	Hearing loss-Left ear			p-value (Fisher's exact test)
	Normal* n (%)	Mild# n (%)	Moderate$ n (%)		Normal* n (%)	Mild# n (%)	Moderate$ n (%)	
Grade II	78 (86.7)	12 (13.3)	3 (3.3)	0.001	78 (86.7)	3 (10)	3 (3.3)	<0.001
Grade III	24 (40)	33 (55)	3 (5)		21 (35)	36 (60)	3 (5)	
Total	102	45	3		99	45	6	

[Table/Fig-4]: Association between radiographic adenoid size and hearing loss.
*Normal-10-19 dB; #Mild-20-34.9 dB; $Moderate-35-49.9 dB; p-value <0.05 considered significant

Adenoid size	Effusion			Total n (%)	p-value (Fisher's exact test)
	Unilateral n (%)	Bilateral n (%)	No effusion n (%)		
Grade II	0	0	9 (100.0)	9 (6)	0.037
Grade III	12 (9.8)	21 (17.1)	90 (73.2)	123 (82)	
Grade IV	6 (33.3)	9 (50.0)	3 (16.7)	18 (12)	
Total	18	30	102	150	

[Table/Fig-5]: Association between otitis media with effusion (by endoscopy) and adenoid size.
p-value <0.05 considered significant

Adenoid size	Hearing loss-Right ear			p-value (Fisher's exact test)	Hearing loss-Left ear			p-value (Fisher's exact test)
	Normal* n (%)	Mild# n (%)	Moderate$ n (%)		Normal* n (%)	Mild# n (%)	Moderate$ n (%)	
Grade II	9 (100)	0	0	0.027	9 (100)	0	0	0.043
Grade III	90 (73.2)	30 (24.4)	3 (2.4)		87 (70.7)	30 (24.4)	6 (4.9)	
Grade IV	3 (16.7)	15 (83.3)	0		3 (16.7)	15 (83.3)	0	
Total	102	30	18		99	45	6	

[Table/Fig-6]: Association between adenoid size (by endoscopy) and hearing loss.
*Normal-10-19 dB; #Mild-20-34.9 dB; $Moderate-35-49.9 dB; p-value <0.05 considered significant

Type of tympanogram	Unilateral		Bilateral n (%)	Total n (%)
	Right ear n (%)	Left ear n (%)		
Type A	6 (4)	6 (4)	78 (52)	90 (60)
Type B	3 (2)	12 (8)	30 (20)	45 (30)
Type C	0	0	15 (10)	15 (10)
Total	9	18	123	150

[Table/Fig-7]: Tympanogram findings of participants.

Association between tympanogram findings and PTA of the participants were calculated for both ears. Majority of patients with bilateral Type B tympanogram had mild hearing loss which was statistically significant (p-value <0.001) [Table/Fig-8].

Of 45 female participants, three (6.7%) had bilateral effusion (Type B tympanogram) and three (6.7%) had unilateral effusion (Type B). Of 105 male participants, 27 (25.7%) had bilateral effusion (Type B) and 15 (14.3%) had unilateral effusion (Type B). There was no significant association between gender and occurrence of otitis media with effusion (p-value=0.179) [Table/Fig-9].

All patients studied underwent adenoidectomy. Among the 150 participants, 30 had bilateral effusion and they underwent

Tympanogram	Hearing loss-Right ear			p-value (Fisher's exact test)	Hearing loss-Left ear			p-value (Fisher's exact test)
	Normal* n (%)	Mild# n (%)	Moderate$ n (%)		Normal* n (%)	Mild# n (%)	Moderate$ n (%)	
Type A	96 (97%)	3 (3)	0	<0.001	90 (96.8)	3 (3.2)	0	<0.001
Type B	0	33 (91.7)	3 (8.3)		3 (7.1)	33 (78.6)	6 (4.9)	
Type C	6 (40%)	9 (60)	0		6 (40)	9 (60)	0	
Total	102	45	3		99	45	6	

[Table/Fig-8]: Association between otitis media with effusion and hearing loss on both ear.
*Normal-10-19 dB; #Mild-20-34.9 dB; $Moderate-35-49.9 dB; p-value <0.05 considered significant

Type of tympanogram	Male participants		Female participants		p-value (Fisher's exact test)
	Unilateral	Bilateral	Unilateral	Bilateral	
Type A	15 (14.3)	63 (60)	0	27 (25.7)	0.179
Type B	15 (14.3)	27 (25.7)	3 (6.7)	3 (6.7)	
Type C	0	12 (11.4)	0	6 (4)	
Total	30	102	3	36	

[Table/Fig-9]: Association between gender and occurrence of otitis media.

myringotomy along with adenoidectomy, 18 participants had unilateral effusion and those with Type C tympanogram, myringotomy was not done. All patients with Type B and Type C tympanogram findings were followed-up with tympanogram taken after one month and three months postoperatively.

Of the 30 participants with Type B tympanogram bilaterally, 93% returned to Type A at the end of three months and two remained as such. All children with unilateral Type B and all of the 15 children with bilateral Type C returned to Type A in three months [Table/Fig-10].

Tympanogram Preoperative	Number of patients	Type A tympanogram on postoperative follow-up	
		1 month	3 months
Type B- Bilateral	30	18	28
Type B- Unilateral	18	12	18
Type C- Bilateral	15	9	15
Type C- Unilateral	0	0	0

[Table/Fig-10]: Follow-up tympanogram of participants.

DISCUSSION

Otitis Media with Effusion (OME) is the accumulation of serous fluid within the middle ear. If OME persists for three months or more, the condition becomes chronic. OME usually follows an infection or inflammation of adenoids like viral upper respiratory tract infection, secondary bacterial infection, nasal allergy and leads to release of cascade of inflammatory mediators [16]. OME can result in hearing impairment which leads to poor social behaviour and delayed speech and language development in children [17]. Occurrence of OME in infants less than 4 years can cause defect in auditory sensitivity [18]. Any impairment in auditory input during the developmental stage of central auditory system plasticity in childhood, results in defective development of auditory cortex and other developmental abnormalities [19].

In this prospective cross-sectional study, 150 children between 5-12 years with adenoid hypertrophy and who required adenoidectomy were selected. The study aimed to assess the frequency of asymptomatic OME in children with adenoid hypertrophy, association between OME and adenoid size and also to find the association between adenoid size and hearing loss. Tympanometry was done for 150 children of which 32% were found to have asymptomatic OME. Those with Type B and C tympanogram showed significant hearing loss. These results were comparable to the study conducted by Bhat V et al., in 100 children in which 36% had asymptomatic OME and they also concluded that those with bilateral Type B tympanogram had significant conductive hearing loss. But in their study no comparison was done between adenoid size and hearing loss [9]. In this study, adenoid size was graded based on radiological and endoscopic findings and showed significant association between OME and adenoid size. The study by Diksha et al., in 57 children showed bilateral abnormal tympanogram in 24.6% of the patients and unilateral abnormal tympanogram in 14%. But they found no association between adenoid size and OME and adenoid size with hearing loss [10].

Skoloudik L et al., in their study on relation between adenoid size and OME, showed that adenoidectomy was more effective in children with adenoids in contact with torus tubarium compared to those with small adenoids. In this study also children with higher grades of adenoids detected both radiologically and endoscopically, showed greater number of bilateral middle ear effusions than lower grades [20]. Similar study by Takahashi H et al., where transnasal endoscopy of pharyngeal opening of eustachian tube was performed in 155 patients with OME, compression of the orifice by adenoid tissue was found in 52% of the patients [21]. The study by Casselbrant ML et al., concluded that OME usually occurs in the age group of 4 years to 8 years and most common symptom of OME was ear block sensation or fluctuating hearing loss. But in most cases, this remained unrecognised until parents notice delay in speech development or poor performance in school or hearing loss [22]. In the present study, although children with complaints of hearing loss were excluded, 32% of the participants were found to have hearing loss which was not recognised by their parents.

The study conducted by Wallace IF et al., showed defect in language development in children with OME [23]. Another study done by Sano S et al., concluded that OME which remained undiagnosed for a longer period, can damage tympanic membrane due to the action of metabolites like prostaglandins [24]. So early detection of OME is important. Results from the present study clearly showed the need to evaluate for OME in children with adenoid hypertrophy, as significant number of the cases had unrecognised hearing loss, which may later lead on to deleterious effects on their social and cognitive development.

Limitation(s)

This study was done in a tertiary care centre and the subjects were children with symptoms suggestive of adenoid hypertrophy with no clinical presentation of hearing loss. But the percentage of children with adenoid hypertrophy and asymptomatic hearing loss will be significantly higher in a country like India where primary healthcare facilities are limited. Hence the study findings might not be generalisable to the common population.

CONCLUSION(S)

Adenoid hypertrophy can cause OME which can lead to hard of hearing and subsequently to impaired language and behavioural development. The present study showed an association between adenoid size, and occurrence of OME and hearing loss. Also 32% of present study population were detected to have asymptomatic OME. Tympanometry is a non invasive procedure to diagnose OME. So, it should be made mandatory to screen all children with adenoid hypertrophy for the presence of fluid in the middle ear to prevent significant language and speech delay.

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