

## Original Research Article

# Role of adenoid hypertrophy in causation of chronic middle ear effusion

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### ABSTRACT

**Background:** Hearing plays a valid role in speech development in children. Otitis media with effusion is one among the commonest causes of hearing loss in children especially below 12 years.

**Methods:** A prospective study was carried out in Lourdes Hospital, Kochi, over a period of 1 year from January 2013 to December 2013. 30 patients with chronic middle ear effusion below the age of 12 years were selected.

**Results:** Of 30 patients 59.5% of patients were in age group of 5-7 years, 16.6 % of patients were in age group of 9-11 years, 60% were male children, 40% patients were female children, majority of them had grade 3 adenoid hypertrophy by endoscopic assessment, 66.6 % of them had eustachian tube blockade by adenoid mass, 100% of them with eustachian tube blockade found to have fluid on doing myringotomy. Significant association was found between type B tympanogram and presence of fluid on myringotomy revealing that type B tympanogram and eustachian tube blockade better predictor of otitis media with effusion than grade of adenoid hypertrophy

**Conclusions:** The present study showed that chronic middle ear effusion was found to be most common in the age group of 3-5 years of age group. Tympanogram type B was found to be strongly associated with fluid on myringotomy. All the children with chronic middle ear effusion in the study group were found to have, grade 3 grade 2, and grade 4 adenoid hypertrophy in the descending order of frequency. Grade 3 adenoid hypertrophy was present in majority of the children in the study group. Lateral adenoid hypertrophy, abutting on the nasopharyngeal orifice of Eustachian tube was present in majority of children. Eustachian tube obstruction was found to be strongly associated with fluid on myringotomy and grommet insertion.

**Keywords:** Otitis media with effusion, Adenoid hypertrophy, Eustachian tube blockade

### INTRODUCTION

Hearing plays a important role in speech development in children. Most common cause of hearing loss in children especially below 12 years of age is otitis media with effusion (OME). It is defined as the presence of fluid in the middle ear without signs or symptoms of acute ear infection.<sup>1,2</sup> Persistent middle-ear fluid from otitis media with effusion results in decreased mobility of the tympanic membrane and serves as a barrier to sound conduction.<sup>3</sup> This accumulation of non-purulent effusion

in the middle ear which leads to conductive hearing loss (Figure 1).

Prevalence of otitis media with effusion also known as serous otitis media or glue ear ranged between 2 to 50%.<sup>4</sup>

The duration of the effusion can be acute (less than three weeks), subacute (three weeks to three months) or chronic (longer than three months).<sup>5</sup> The aetiology of otitis media is multifactorial which include adenoids hypertrophy, infection (viral or bacteria), allergy, environment and social factors overcrowding, poor diet

and lack of health care may contribute to the development of otitis media.<sup>5</sup> Other risk factors include male gender, bottle feeding and position of feeding (children fed while in supine position are at a greater risk for OME than are children held upright).<sup>5</sup>



**Figure 1: Otitis media with effusion.**

Hypertrophy of the adenoids and Eustachian tube dysfunction are often considered to be causal factors of Otitis media with effusion. Furthermore, Otitis media with effusion produces a complex multifactorial process, that is why the pneumatization of mastoids and the variation in the gaseous diffusion in circulation has an important role in the negative pressure phenomenon in the affected middle ear.<sup>6</sup>



**Figure 2: Post myringotomy with grommet insertion.**

The association of Otitis media with effusion with the Eustachian tube dysfunction in the disorders of the nose have repeatedly been confirmed.<sup>7,8</sup> Adenoid hypertrophy can contribute to the incidence of Otitis media with effusion through causing obstruction of Eustachian tube. The major types of Eustachian tube functional abnormalities that may cause Otitis media with effusion are obstruction, abnormal patency, and the nonoptimally functioning ciliated epithelium lining the Eustachian tube.

Hypertrophied infected adenoids provides a focus of infection adjacent to the Eustachian tube orifice. Based on these observations, adenoidectomy in selected cases is a very useful procedure.<sup>9</sup>

The lateral position of the hypertrophied adenoid, with abundant on the eustachian tube orifice, is a contributing factor in the final otologic outcome of patients requiring pressure equalization tube insertion for OME. In addition to being a reservoir for bacteria, hypertrophic adenoid serves as a mechanical barrier to the Eustachian tube lumen, causing middle ear under pressures and subsequent effusion formation.<sup>9</sup>

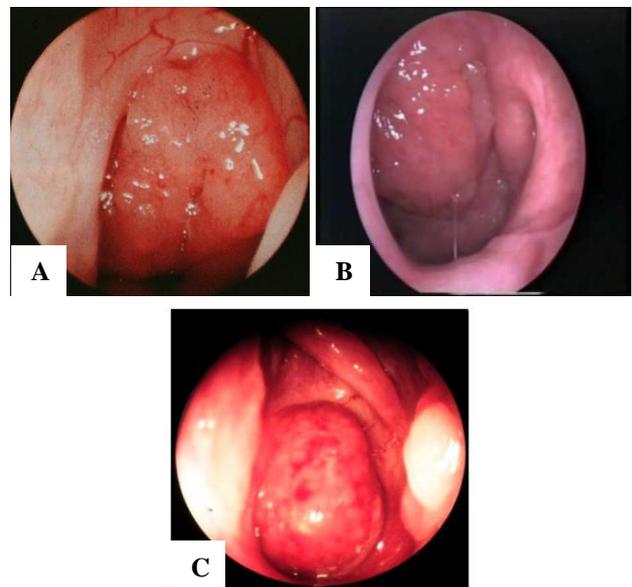
The present prospective study aims to find out the role of adenoid hypertrophy in the causation of chronic middle ear effusion.

#### *Aim*

To assess the role of adenoid hypertrophy in the causation of chronic middle ear effusion in children below 12 years of age.

#### *Objectives*

To study if there is a significant correlation between grade of adenoid hypertrophy, eustachian tube obstruction with the incidence of chronic middle ear effusion.



**Figure 3: Grades of adenoid hypertrophy. (A) Grade 3 hypertrophy, (B) Grade 2 hypertrophy, (C) Grade 2 hypertrophy.**

#### *Grades of adenoid hypertrophy*

The grade of adenoid hypertrophy was assessed using the scale described by Clemens and McMurray, where Grade

1 is adenoid tissue filling 1:3 of the vertical height of the choanae. Grade 2 is filling 2:3 of the vertical height of the choanae. Figure 3(b), figure 3(C). Grade 3 is from 2:3 to near total. Figure 3(a) but not complete. Grade 4 is complete choanal obstruction.<sup>10</sup>

**METHODS**

**Study design and settings**

A prospective study was carried out in Lourdes Hospital, Kochi, over a period of 1 year from January 2013 to December 2013 with approval of ethical committee, scientific committee and informed consents of subjects. Thirty patients with chronic middle ear effusion below the age of 12 years were selected for the study based on the inclusion and exclusion criteria. All selected patients were posted for rigid nasal endoscopy followed by adenoidectomy, myringotomy with grommet insertion.

During nasal endoscopy grade of adenoid hypertrophy, presence or absence of eustachian tube obstruction were noted. Data collected for the study were compiled and analysed statistically using chi square test for the test of goodness of fit of ratios and  $\chi^2$  test for independence of attributes in a contingency table.

**Inclusion criteria**

Patients with chronic middle ear effusion below the age of 12years were included in the study.

**Exclusion criteria**

Patient with cleft palate, submucous cleft palate and other craniofacial anomalies were excluded from the study. Immunosuppressed patients were also excluded from the study.

**To exclude BIAS in patient selection**

Randomised sample selection done. Patients with chronic middle ear effusion selected irrespective of adenoid status.

**RESULTS**

Results of the analysis of the data are presented below

**Age**

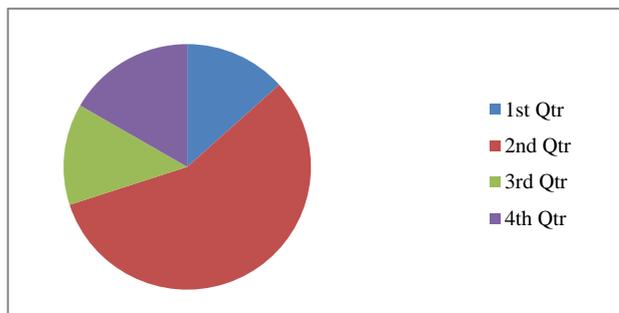
Significantly higher number of patients in this study belongs to the age group of 5-7 years ( $\chi^2=16.132$ ,  $df=3$ ,  $p<0.01$ )

Of the total 30 patients, 59.5% were in the age group of 5-7 years.

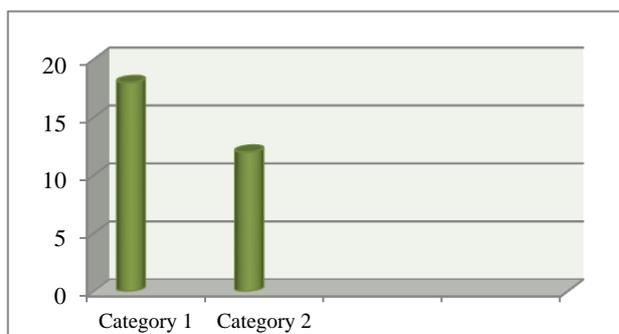
Age distribution of 30 patients: Table 1 and Figure 4.

**Table 1: Age distribution.**

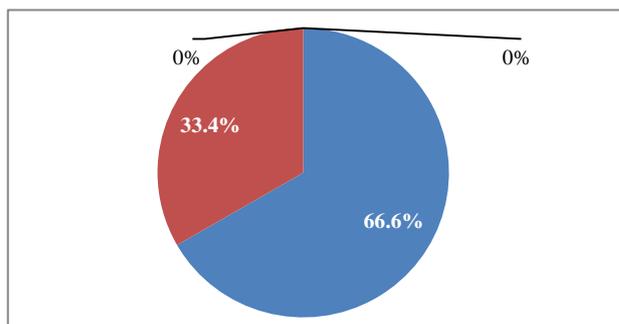
Age groups	Number of patients
3-5 years	4
5-7 years	17
7-9 years	4
9-11 years	5



**Figure 4: Age distribution.**



**Figure 5: Sex distribution.**



**Figure 6: Association between adenoid hypertrophy and Eustachian tube obstruction.**

**Sex distribution**

Sex distribution is, of the total 30 patients 18 males and 12 females (Figure 5).

Among the 30 patients with chronic middle ear effusion, there was significant association found between those who had lateral adenoid hypertrophy abutting on the eustachian tube obstruction and presence of fluid on myringotomy ( $\chi^2=4.285$ ,  $df=1$ ,  $p<0.05$ ).

**Table 2: Association of middle ear fluid with eustachian tube obstruction.**

	Fluid (+)	Fluid (-)	Total
<b>ET obstruction present</b>	20	0	20
<b>ET obstruction absent</b>	8	2	10
<b>Total</b>	28	2	30

- a) Of the 30 patients, 20 patients had eustachian tube obstruction (66.6%) and 10 patients were found to have adenoid hypertrophy without eustachian tube blockade (33.4%) (Figure 6).
- b) In 100% of patients with eustachian tube obstruction by adenoid hypertrophy there was fluid on doing myringotomy.
  - a) In 20% there is absence of fluid if eustachian tube obstruction is not present ( $z=1.781$ ,  $p>0.05$ ) (Table 2).

Of the patients with chronic middle ear effusion, 12 patients had grade 3 adenoid hypertrophy, 10 patients had grade 2 adenoid hypertrophy and 8 patients had grade 4 adenoid hypertrophy and none had grade 1 adenoid hypertrophy (Table 3).

- a) Eustachian tube present and absent fail to indicate any statistical difference between them ( $\chi^2=3.333$ ,  $df=3$ ,  $p>0.05$ ) (Table 4).
- b) Eustachian tube obstruction was significantly higher in 5-7 yrs children than other age groups ( $\chi^2=16.4$ ,  $df=3$ ,  $p<0.01$ )

Of the 30 patients, 12 patients had grade 3 adenoid hypertrophy and 11 of them had eustachian tube obstruction (Table 5).

Of the 8 patients with grade 4 adenoid hypertrophy with clinical features of otitis media with effusion. In 2 patients tympanogram was c type and dry tap obtained on myringotomy (Table 6).

**Table 3: Relation between chronic middle ear effusion and grade of adenoid hypertrophy.**

Age (yrs)	Grade 1	Grade 2	Grade 3	Grade 4	Total
<b>3-5</b>	0	1	3	0	4
<b>5-7</b>	0	6	5	6	17
<b>7-9</b>	0	1	3	0	4
<b>9-11</b>	0	2	1	2	5
<b>Total</b>	0	10	12	8	30

**Table 4: Association between age group and eustachian tube obstruction.**

Age groups (yrs)	ET obstruction present	ET obstruction absent	Total
<b>3-5</b>	3	1	4
<b>5-7</b>	9	8	17
<b>7-9</b>	4	0	4
<b>9-11</b>	4	1	5
<b>Total</b>	20	10	30

**Table 5: Association between grades of adenoid hypertrophy and eustachian tube obstruction.**

	Grade 1	Grade 2	Grade 3	Grade 4	Total
<b>ET obstruction +ve</b>	0	3	11	6	20
<b>ET obstruction -ve</b>	0	7	1	2	10
<b>Total</b>	0	10	12	8	30

**Table 6: Association between grades of adenoid hypertrophy with middle ear fluid.**

	Grade 1	Grade 2	Grade 3	Grade 4	Total
<b>Fluid (+)</b>	0	10	12	6	28
<b>Fluid (-)</b>	0	0	0	2	2
<b>Total</b>	0	10	12	8	30

Taking individual ears those underwent myringotomy with grommet insertion, their type of tympanograms and

presence or absence of fluid on myringotomy were compared (Figure 2 and Table 7).

**Table 7: Association between tympanogram and fluid on myringotomy.**

	Type B tympanogram	Type C tympanogram
<b>Fluid (+)</b>	<b>37</b>	<b>8</b>
<b>Fluid (-)</b>	<b>2</b>	<b>6</b>

Out of the 39 ears with type B tympanograms, 37 ears had fluid on myringotomy (92.5%). Out of the 14 ears with type C tympanograms, 8 (57.1%) ears had fluid and 6 (42.8%) were dry taps.

## DISCUSSION

Otitis media with effusion, a term synonymous with chronic non suppurative otitis media, secretory otitis media, serous otitis media and glue ear is one of the chronic otological conditions of childhood. It results from alteration of mucociliary system in the middle ear cleft and is frequently caused by malfunction of the eustachian tube. Serous or mucoid fluid accumulates within the middle ear where there is a negative pressure.<sup>11</sup> Hypertrophy of the adenoids and eustachian tube dysfunction are often considered to be causal factors for otitis media with effusion.<sup>12</sup>

The present study was conducted in Lourdes hospital in a time period from January 2014 to December 2014. 30 patients, aged between 3 to 12 years who presented with chronic middle ear effusion to our ENT department were selected for the study. Middle ear effusion, which is not subsiding on medical treatment and lasting more than 3 months were selected for the study irrespective of their adenoid hypertrophy status. clinical signs and tympanogram were used as diagnostic tools for selection.

All these patients were subjected for diagnostic nasal endoscopy to know the grade of adenoid hypertrophy and presence or absence of eustachian tube obstruction were noted. All these patients were subjected to myringotomy with grommet insertion and adenoidectomy.

In the results obtained from this study, the most common age group affected is 5-7 years of age. Studies have shown that the prevalence is bimodal with the first and largest peak of approximately 20percent at two years of age. This is the age at which many children first attend a playgroup or nursery school. Thereafter the prevalence declines, but there is a second peak of approximately 16 percent at around five years of age when most children start attending a primary school.<sup>13</sup>

Approximately 90% of children (80% of individual ears) have OME at some time before school age, most often between ages 6 months and 4 years.<sup>4,5</sup> The peak age incidence for recurring middle ear effusions correspond to the period of maximum lymphoid hyperplasia in the nasopharynx.<sup>14</sup>

In results of the present study, regarding the sex distribution, male children were 18 and female children were 12 in number. Male sex, Aboriginal status, lack of breastfeeding, older siblings, daycare, passive smoke exposure and low socioeconomic status have consistently been identified as risk factors during early childhood.<sup>15</sup>

In a study done by Fahadjalil, across sectional study, 17 primary schools were selected out of the 300 schools registered at the Ministry of Education in Erbil. OME was found in 26 (54.2%) females compared to 22 (45.8%) males with a female to male ratio of 1.18 to 1. Another study demonstrated that males had a significantly higher proportion of OME; the proportion was greater in males (37.6%) than in females (29.8%) ( $p < 0.001$ ).<sup>5,16</sup>

In the present study, tympanogram is used as one of the main diagnostic tool. Taking individual ears into consideration, 39 ears had type B tympanogram 14 ears had type C tympanogram, 6 ears had type A curve and 1 ear showed type As curve. Of the 40 ears with type B curve 38 ears, there was fluid on myringotomy and 2 ears, it was dry tap. Of the 14 ears with type C curve 8 ears, there was fluid on myringotomy and 6 ears it was dry tap. Rest of them had dry tap. Tympanometric curve results were classified according to modified Jerger's classification as types A, as, B or C.<sup>5</sup> Type A and C curves were interpreted as no middle ear effusion while type B and as predictive of middle ear effusion.

In the present study grade of adenoid hypertrophy has been assessed in all the 30 patients with chronic middle ear effusion and it has been found that all the patients had equal to or greater than grade 2 adenoid hypertrophy and majority of the patients (11 patients) had grade 3 adenoid hypertrophy, 10 patients had grade 3 adenoid hypertrophy and 9 patients had grade 4 adenoid hypertrophy. In the study group 13 out of 32 had grade 4 adenoid hypertrophy. This grade 4 adenoid hypertrophy was found to be statistically significant in children with otitis media with effusion ( $p < 0.0002$ ). In control group 15 out of 28 had grade 1 adenoid hypertrophy which was significant in the same group ( $p < 0.002$ ). Air-bone gap and thickness of fluid did not correlate with the increasing grade of adenoid hypertrophy. Conclusion of this study was like, Grade 4 adenoid hypertrophy was statistically found to be significant with otitis media with effusion but severity of hypertrophy were not reflected by hearing loss and thickness of fluid.

In a study done Howler medical university in Erbil, Iraq it was found that the most common type of tympanometry results seen among the children with otitis media was type B. Grade 3+ adenoid hypertrophy was mainly seen among patients having unilateral and bilateral otitis media with effusion, accounting for 16% and 37% of all cases of otitis media with effusion accordingly. Type B tympanogram was significantly associated with positive history of oral breathing in the studied children ( $p$  value  $< 0.05$ ).<sup>16</sup>

The study concluded that adenoid hypertrophy was associated with otitis media with effusion in school age children. The proportion of otitis media with effusion increases with the severity of nasopharyngeal obstruction by adenoid hypertrophy.

Studies done to investigate the cause of secretory otitis media resulting from adenoids hypertrophy and the relationship between adenoids hypertrophy and secretory otitis media.

The results suggested that there was a positive correlation among the grades of adenoids hypertrophy, the descendent degree of middle ear function and the incidence of secretory otitis media.<sup>17</sup>

In the present study of the 30 patients with chronic middle ear effusion, presence or absence of lateral hypertrophy of adenoid tissue over the eustachian tube orifice was noted. 60% of the study population had eustachian tube blockade and 100% of them had fluid on doing myringotomy. Nasopharyngeal adenoids may serve as a mechanical obstruction to the Eustachian tube and contribute to the pathophysiology of otitis media (OM). The purpose of this study was to determine whether abutment of adenoids laterally against the torus tubaris affects the outcome of patients requiring pressure equalization tubes (PET) for OME.

Randomized, controlled, prospective clinical trial was done by Nguyen et al in Canada, patients requiring PET for recurrent acute OM or OM with persistent effusion were randomized into two groups: 1) PET placement and 2) PET placement and adenoidectomy, regardless of whether the adenoids were abutting or not abutting the torus tubaris. Patients were followed for a minimum of 1 year to determine rate of treatment failure, defined as recurrence of acute OM (>3 times/year), OM with effusion, or reinsertion of PET. Of the 34 patients in the abutting group, 16 patients underwent only PET insertion, of whom 8 (50%) failed, whereas 18 patients had combined PET placement and adenoidectomy, of whom 3 (17%) failed. There was a statistical difference between these two groups ( $p < 0.05$ ). Of the 29 patients in the non-abutting group, 24 patients underwent only PET insertion, of whom 9 (37.5%) failed, whereas 5 patients underwent combined PET placement and adenoidectomy, of whom 2 (40%) failed. There was no statistical difference between these two groups ( $p = 0.92$ ).

This study demonstrated that the position of hypertrophied adenoids may alter the final otologic outcome of patients requiring PET insertion for OM. Patients with adenoids abutting the torus tubaris may benefit most from an adjuvant adenoidectomy.<sup>18</sup>

## CONCLUSION

The present study showed that chronic middle ear effusion was found to be most common in the age group of 3-5 years of age group and relatively common in the

male children. Tympanogram type B was found to be strongly associated with fluid on myringotomy. All the children with chronic middle ear effusion in the study group were found to have, grade 3 grade 2, and grade 4 adenoid hypertrophy in the descending order of frequency. Grade 3 adenoid hypertrophy was present in majority of the children in the study group. Lateral adenoid hypertrophy, abutting on the nasopharyngeal orifice of Eustachian tube was present in majority of children. Eustachian tube obstruction was found to be strongly associated with fluid on myringotomy and grommet insertion.

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