Original Article

Correlation between Adenoid Hypertrophy, Tympanometry Findings, and Viscosity of the Middle Ear Fluid in Otitis Media with Effusion

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ABSTRACT

Background: A prominent cause of nasal blockage in children is adenoid hyperplasia. Mouth breathing, snores, sleep apnea, hypo-nasality, sinusitis, as well as otitis media with effusion (OME) are caused by chronic infection and hypertrophy. Compared to the mucoid kind, which typically requires surgical intervention, the serous variety is typically easier to treat.

Objectives: In order to help recommend the best course of treatment, this study attempts to determine whether there is a relationship between the form of middle ear fluid in pediatric patients aged 12 years and under in patients with OME and adenoid hypertrophy.

Methods: 100 patients with COME and adenoid hypertrophy were enrolled in the study. Unilateral or bilateral type B and C tympanometry were used to make the diagnosis of OME. We divided the middle ear fluid into two categories for therapeutic purposes: mucoid, which is thick, heavy, or sticky, and serous, having thin watery fluid. Categorical data such as Tympanoplasty, grade of adenoid hypertrophy and type of fluid were compared using chi-square test for evaluating statistical significance of correlation at $p<0.05$.

Results: Most of the patients with grade IV adenoid hypertrophy had type B tympanometry whereas most of the patients with grade II or grade III adenoid hypertrophy had type Cs tympanometry ($p<0.0001$). All the patients with grade IV adenoid hypertrophy had mucoid middle ear effusion whereas most of the patients with grade II adenoid hypertrophy (88.89%) had serous middle ear effusion ($p<0.0001$).

Conclusions: The strong relationship between adenoid size and OME incidence is supported by this study. Tympanometry type B and grade IV adenoid hypertrophy are significantly correlated.

Keywords: Adenoid Hypertrophy, Tympanometry, Viscosity, Otitis Media with Effusion.

INTRODUCTION

A prominent cause of nasal blockage in children is adenoid hyperplasia.[1] Mouth breathing, snores, sleep apnea, hypo-nasality, sinusitis, as well as otitis media with effusion (OME) are caused by chronic infection and hypertrophy.[2] The definition of OME is fluid in the middle ear without the accompanying symptoms of an acute middle ear infection. [3] Because of the negative pressure in the middle ear, serous and mucoid fluid tends to collect there. One of the most frequent reasons for hearing loss is otitis media with effusion. Prevalence of otitis media with effusion varies from 1.3 percent to 31.3 percent based on racial, environmental, and research approach.[4]

OME is recognized to be caused by eustachian tube dysfunction and adenoid hypertrophy. 5 The adenoid serves as a bacterial reservoir and a mechanical barrier, obstructing the lumen of the Eustachian tube, which creates negative pressure within the middle ear and causes middle ear effusion. 6 When someone has an allergy, their adenoid tissue mast cells generate inflammatory mediators that clog the tubules.[5-7]

Certain children having adenoid hypertrophy don't complain about hearing loss, yet they nonetheless have OME. [8] Untreated OME can have a negative impact on a child's ability to speak and think.

Studies have demonstrated that an increase in nasopharyngeal blockage and adenoid size is indicated by X-ray, nasoendoscopy, or either and is a predictor of the risk of OME.[10, 9] Depending on how adenoid hypertrophy relates to the choanae, Vomer, or torus tubarius, Vomer, or soft palate, various endoscopic grading systems have been established in the literature. [11–13]

Based on their viscosity, middle ear effusions can be divided into various groups. In clinical practice, the distinction between mucoid and serous kinds of effusion is typically made. It has been discovered that serous effusion has a higher bacterial content than mucoid effusion. [14] Compared to the mucoid kind, which typically requires surgical intervention, the serous variety is typically easier to treat.

In order to help recommend the best course of treatment, this study attempts to determine whether there is a relationship between the form of middle ear fluid in

pediatric patients aged 12 years and under in patients with OME and adenoid hypertrophy.

MATERIALS AND METHODS

This was a prospective and observational study carried out on patients having chronic otitis media with effusion (COME) and adenoid hypertrophy in Department of ENT of tertiary care teaching hospital from July 2023 to December 2023. The written informed consent was taken from patients with COME and adenoid hypertrophy as well as their guardians as per guidelines of Good Clinical Practice and Declaration of Helsinki.

Inclusion Criteria:

- Patients of either sex of age less than or equal to 12 years
- Patients with diagnosed middle ear effusion as per tympanometry type B or C
- Patients with diagnosis of adenoid hypertrophy as per endoscopic examination

Exclusion Criteria:

- Patients with hearing loss
- Patients with history of adenoidectomy
- Patients with cleft palate or congenital anomalies involving ear
- Patients with active sinonasal or upper respiratory tract infection

Sampling Method: Consecutive sampling method was used and 100 patients with COME and adenoid hypertrophy fulfilling our eligibility criteria were enrolled in the study.

Based on the adenoid's relationship to the torus tubarius, vomer, as well as soft palate when at rest, a grading system for adenoid hypertrophy was employed in this study. [13]

Four grades of adenoid hypertrophy were documented in accordance with this protocol: grade I indicates that there is no relationship at all between the adenoid size and any one of the structures referred to, grade II indicates a relationship with the torus tubarius alone, grade III indicates a relationship with the torus tubarius and vomer, and grade IV indicates a relationship at all between the adenoid and the torus tubarius, vomer, as well as soft palate.

Clinical observations of unilateral or bilateral tympanic membranes that were dull and retracted, as well as unilateral or bilateral type B and C tympanometry, were used to make the diagnosis of OME. Type C was defined as having no middle ear fluid. In this investigation, tympanometry was conducted using an impedance audiometer (A756 screening).

A predetermined time between no response and medical treatment of 3 months had been employed in all cases, regardless of the size of the adenoid, in order to prevent disease duration bias.

Adenoidectomy and myringotomy were performed on each case, either with or without the insertion of a ventilation tube. Studies have looked at the relationship between adenoid size and the type of middle ear fluid seen during surgery, as well as the correlation between tympanometry results and adenoid size. We divided the middle ear fluid into two categories for therapeutic purposes: mucoid, which is thick, heavy, or sticky, and serous, having thin watery fluid.

Statistical Analysis:

Data from patients of COME with adenoid hypertrophy were collected in a tabular form using Microsoft Excel 2010 and then transferred to graph pad version 8.4.3 for further statistical analysis. Categorical data such as Tympanoplasty, grade of adenoid hypertrophy and type of fluid were expressed as frequency and percentage and compared using chi-square test for evaluating statistical significance of difference at $p<0.05$.

RESULTS

The study included 100 patients with unilateral or bilateral COME with adenoid hypertrophy as per endoscopic examination. Of these 100 patients, 6 patients were lost to follow-up. Their baseline demographic and clinical characteristics are given in table 1.

Table 1: Baseline Demographic & Clinical Characteristics of Patients with COME and Adenoid Hypertrophy

Parameters	Category	Number of Patients	Percentage of Patients (n = 94)
Gender	Female	38	40.43
	Male	56	59.57
Type B Tympanometry	Right	35	37.23
	Left	69	73.40
Type C Tympanometry	Right	12	12.77
	Left	2	2.13
Type Cs Tympanometry	Right	47	50.00
	Left	21	22.34
Laterality	Unilateral	12	12.77
	Bilateral	84	89.36
Grade of Adenoid Hypertrophy	II	27	28.72
	III	18	19.15
	IV	49	52.13

Mean age of the patients with COME and adenoid hypertrophy in our study was 7.31 ± 2.46. There were more females patients with COME and adenoid hypertrophy. There were more cases of type B tympanometry as compared to type C and Cs. 89.36% of cases was bilateral. Most of the patients had grade IV (52.13%) adenoid hypertrophy followed by type II (28.72%) and type III (19.15%).

Table 2: Distribution of Patients with respect to Adenoid Grade and Tympanometry Findings in Right Ear

Tympanometry	Adenoid Size Grade (%)			P-Value (Chi-Square Test)
	II	III	IV	
B	2 (7.41)	5 (27.78)	28 (57.14)	<0.0001
C	9 (33.33)	3 (16.67)	0 (0.00)	
Cs	16 (59.26)	10 (55.55)	21 (42.86)	

Most of the patients (57.14%) with grade IV adenoid hypertrophy had type B tympanometry in right ear whereas most of the patients with grade II (59.26%) or grade III (55.55%) adenoid hypertrophy had type Cs tympanometry in right ear (p<0.0001).

Table 3: Distribution of Patients with respect to Adenoid Grade and Tympanometry Findings in Right Ear

Tympanometry	Adenoid Size Grade (%)			P-Value (Chi-Square Test)
	II	III	IV	
B	11 (40.74)	13 (72.22)	45 (95.74)	<0.0001
C	2 (7.41)	0 (0.00)	0 (0.00)	
Cs	14 (51.85)	5 (27.78)	2 (4.26)	

Most of the patients with grade IV (95.74%) or grade III (72.22%) adenoid hypertrophy had type B tympanometry in left ear whereas most of the patients with grade II (51.85%) adenoid hypertrophy had type Cs tympanometry in left ear (p<0.0001).

Table 4: Distribution of Patients with respect to Adenoid Grade and Type of Middle Ear Effusion

Type of Fluid	Adenoid Size Grade (%)			P-Value (Chi-Square Test)
	II	III	IV	
Serous	24 (88.89)	8 (44.44)	0 (0.00)	<0.0001
Mucoid	3 (11.11)	10 (55.56)	49 (100.00)	

All the patients with grade IV adenoid hypertrophy had mucoid middle ear effusion whereas most of the patients with grade II adenoid hypertrophy (88.89%) had serous middle ear effusion (p<0.0001).

DISCUSSION

In children, adenoid hypertrophy is a prevalent issue. It is involved in the pathophysiology of OME, which is a prevalent cause of hearing loss in young children. [15]

Adenoids may be the source of an upper respiratory tract infection (URITI) by mechanically blocking the Eustachian tube (ET), which results in negative pressure within the middle ear, or by serving as a reservoir for infection through edema of the ET's pharyngeal aperture. [16, 17]

OME can be classified as acute, lasting less than three weeks, subacute, lasting between three weeks and three months, or chronic, lasting longer than three months. [18]

Before they reach school age, 90% of children may experience OME, which is most common between the ages of 6 months to 4 years. 18 The age at which the prevalence of recurrent OME peaks almost exactly corresponds with the duration of maximal lymphoid hyperplasia affecting the nasopharynx. [19]

One of the most helpful quantitative tests for middle ear effusion is tympanometry. [20] According to Orchik et al., type B tympanometry is the most accurate and precise test for identifying middle ear effusions. [21] Type B tympanometry was taken into consideration in this investigation as proof of middle ear fluid effusion. Type A and C were seen as normal, although type C was also thought to have some fluid in the middle ear.

Using a child's postnasal X-ray, Nwosu et al. (2016) investigated the tympanometric results in children with adenoid hypertrophy.[22] They computed the adenoid nasopharyngeal ratio, which was proposed by Fajioka et al.[23] They used the Sade technique to assess the adenoid size (from 0 to III).[24]

Many authors in the literature associated adenoid size with OME using the endoscopic grading system. According to choanal blockage and the fullness of the nasopharyngeal space, Acharya et al. employed the Cassano et al. grading method. [25, 26]

Numerous authors, including Vijayan et al. and Timna and Chandrika's study in 2018, employed endoscopic examination to grade adenoid size and correlate it with the occurrence of OME. These studies employed the Clemens and McMurray grading method, which is based on the adenoid size with respect to the posterior choana. [10, 11, 27]

In order to more clearly identify the relationship between adenoid size and the Eustachian tube, we employed the adenoid size grading system developed by Parikh et al. in this work. [13] The mean age of the patients was 7.31 ± 2.46 years, with a range of 3 to 12 years. In the Timna and Chandrika study, the peak age was between 5 and 7 years, but in the Vijayan et al study, it was between 5 and 10 years. [10, 27]

There was no clear report in the literature showing that patient gender has an impact on COME, despite the fact that 40.53% of the participants in our study were females and the remaining 59.57% were males. This indicates a higher incidence in the male group than in the female group. [10]

In this study, 89.36% of individuals had a bilateral illness, while 12.77% of cases had unilateral COME. This is in contrast to the findings of the Nwosu et al study, which

showed that unilateral instances accounted for up to 27% of all cases. [22]

In the research by Vijayan et al. and Timna and Chandrika, COME was found in just two out of thirty patients with grade I adenoid hypertrophy and in just two out of thirty cases overall.[10, 27] No COME patient in our investigation had grade I adenoid hypertrophy. These findings can be explained by considering that the small adenoid in grade I adenoid hypertrophy has no link to the Eustachian tube, according to the categorization systems used by Clemens and McMurray and Parikh et al. [13]

This study found a highly significant connection between grade IV adenoid enlargement and either a unilateral or bilateral type B tympanometry finding. This is in contrast to the findings of the Timna as well as Chandrika study, which indicated a larger number of COME instances in grade III adenoid hypertrophy. [27] According to Vijayan et al., grade IV adenoid hypertrophy was linked to a higher likelihood of OME occurrence. They also discovered that the grade of adenoid size increased with the likelihood of fluid level and COME. [10] Nwosu et al. discovered that the larger the adenoid, the higher the number of COME instances based on the X-ray data for adenoid size. They discovered that a higher frequency of OME is linked to grade 3 adenoid hypertrophy. [22]

Adenoids that are laterally positioned and intrude on the Eustachian tube have been reported to be associated with a higher prevalence of OME (60 percent of cases). This finding lends credence to our research. [28]

The Acharya et al investigation found that the only significant one linked to a high risk of OME in children was grade 4 adenoid hypertrophy. [25] However, a different study disproved the notion that an adenoidectomy would have any long-term impact on the recurrence rate of OME in children under 4 years old. [29]

According to Maw et al., there were no apparent shifts in hearing threshold following a 12- or 24-month follow-up period for patients with serous versus mucoid effusion, corroborating the notion that fluid thickness has little predictive value for the long-term impact of the condition. 30 According to Acharya et al, there was no relationship between the fluid's thickness with the hypertrophied adenoid. [25]

Higher grades, particularly grade IV adenoid hypertrophy, were found to be highly correlated with the thickness of the fluid in the middle ear in COME cases. Grade IV exhibited a highly significant correlation with the type of effusion that was mucoid, whereas grade II adenoid hypertrophy demonstrated a correlation with a greater likelihood of Eustachian tube dysfunction as determined by type C tympanometry.

CONCLUSION

The strong relationship between adenoid size and OME incidence is supported by this study. Tympanometry type B and grade IV adenoid hypertrophy are significantly correlated. According to this study, there is a strong correlation between mucoid-type middle ear effusion and adenoid hypertrophy grade IV. The viscosity of the middle ear effusion was found to rise with adenoid size. Tympanometry in conjunction with adenoid size assessment can be used to screen for adenoid hypertrophy in pediatric patients. This facilitates early detection (before to the onset of hearing loss), which makes it simple to schedule early intervention and reduces the likelihood that the problem will worsen and that complications will arise.

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