Association Between Size of Adenoid and Otitis Media with Effusion Among a Sample of Primary School Age Children in Erbil City

* Farhad Jalil Khayat (Assist. Prof.(M.D, PhD))
** Lawan A. Talat Shareef (M.B.Ch.B)

Abstract

Background: The pharyngeal tonsil (adenoid) constitutes the upper portion of the Waldeyer's ring and it is situated at the top of the nasopharynx, next to the auditory tube and choana. Hypertrophy of the adenoids and eustachian tube dysfunction are often considered to be causal factors for otitis medial with effusion. There are many methods used to measure the size of adenoid such as lateral soft tissue X-ray of nasopharynx.

Objectives: This study aimed to evaluate the grades of adenoidal hypertrophy among schools age children with otitis media and to find of an association between size of adenoid and occurrence of otitis media with effusion.

Subjects and Methods: In this cross sectional study, 17 primary schools were visited; all pupils from the first to the sixth year of elementary study were examined in the period from mid October 2009 to mid May 2010. A total of 1,035 pupils were interviewed and those with positive findings that suggest otitis media with effusion were referred to the otolaryngology outpatient department to confirm diagnosis using further investigations such as tympanometry; and a pure tone audiometry was also used to assess the hearing threshold. Adenoid size was measured by adenoid/nasopharyngeal ratio on cervical lateral views of simple X-rays.

Results: Otitis media with effusion was found in 48 (4.6%) of the studied children. 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 otits media with effusion, accounting for 16% and 37% of all cases of otits media with effusion accordingly. Type B tympanogram was significantly associated with positive history of oral breathing in the studied children (p value < 0.05).

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

* College of Medicine/ Howler Medical University/ Erbil/ Iraq.
** Erbil/ Iraq.

Introduction

The nasopharyngeal tonsil (adenoid) is a median mass of mucosa-associated lymphoid tissue. It is shaped like a truncated pyramid, often with a vertically oriented median cleft, so that its apex points towards the nasal septum with its base at the junction of the roof and posterior wall of the nasopharynx. The adenoid forms part of the lymphatic Waldeyer's Ring. Lymphoid tissue of the adenoid may extend to the fossa of Rosenmüller and to the Eustachian tube (ET)

orifice, where it is enlarged as the Gerlach's tonsil.[1] Otitis Media with Effusion (OME) is chronic accumulation of mucus within the middle ear, and occasionally in the mastoid air cell system. The time that the fluid has to be present for the condition to be chronic is generally around 12 weeks. [2] The prevalence of OME in children is mainly determined by the age of the child and the season of the year. The age prevalence is bimodal with the first and largest peak of approximately 20% at two years of age; and the second peak of approximately 16% at around five years of age. By the age of seven to eight years, the prevalence falls to around 5%.[2, 3] The adenoid can be identified from early gestation. Its growth continues rapidly during infancy and plateaus between two and 14 years of age. Regression of the adenoid occurs rapidly after 15 years of age in most children. The adenoid appears to be at its largest size by the age of seven; however, clinical symptoms are more common in younger children, this is due to the relative small volume of nasopharynx and increased frequency of upper respiratory tract infections among younger children.[4]Adenoidal hypertrophy may fill the nasopharynx and extend through the posterior choanae into the nose, resulting in mouth breathing, rhinorrhea, sleep disordered breathing, speech anomalies, feeding difficulties, chronic sinusitis, OME and craniofacial growth anomalies.[4] Hypertrophy of the adenoids and ET dysfunction are often considered to be causal factors of OME. Furthermore, OME produces a complex multifactorial process, that is why the pneumatization of the mastoids and the variation in the gaseous diffusion in circulation has an important role in the negative pressure phenomenon in the affected middle ear.[5] The association of OME with the ET dysfunction and the disorders of the nose have repeatedly been confirmed.[6,7] The major types of ET functional abnormalities that may cause OME are obstruction, abnormal patency, and the non-optimally functioning ciliated epithelium lining the ET. Adenoid hypertrophy can contribute to the incidence of OME through causing obstruction of ET. In addition, OME may be secondary to chronic nasopharyngeal infection in the adenoidal tissue. Another mechanism is the allergic reaction that occurs in the mucosal membrane of the nasopharynx and/or its related structures such as lymphatic or adenoid tissue. The released mediators affect secondarily, through the nasopharyngeal secretions, the peritubal and tubal mucosa of ET and then that of the middle ear cavity.[8,9] The peak age incidence for recurring middle ear effusions correspond to the period of maximum lymphoid hyperplasia in the nasopharynx. This could be attributed to two possible mechanical factors. The first factor is the effect of direct closure of the Eustachian tubal orifice by excessively enlarged adenoid; and the second one which is more important is the obstruction of the lymphatics draining of middle ear via Eustachian tube. Chronic adenoiditis provides a focus of infection adjacent to the ET orifice, imposing change of Eustachian tubal function as well as retrograde inflammation to the tube. Based on these observations, adenoidectomy in selected cases is a very useful procedure.[10]

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.[10,11] There are many methods used to measure the size of adenoid

such as trans-oral posterior mirror rhinoscopy examination , lateral soft tissue X-ray of nasopharynx , nasopharyngeal magnetic resonance imaging (MRI), nasopharyngoscope examination, and acoustic rhinometry.[12,13] Posterior rhinoscopy is usually not possible in children; and the mirror examination underestimates choanal occlusion. Furthermore, palpation is a poor measure of adenoid hypertrophy and most children are unable to tolerate nasoendoscopy. While acoustic rhinomanometry is a useful research tool, and MRI provides extremely accurate volumetric estimation of the adenoid, these investigations are not applicable in clinical practice.[4] Some authors report that radiographs of the nasal cavity are as important as clinical examinations.[14] Radiological examination of lateral soft tissue of nasopharynx have been chosen as the criterion standard for measuring adenoid size by Paradise et al [15] and in this study because they correlate well with volume of adenoid tissue removed during surgery. Furthermore, they are objective and noninvasive means of estimating the extent of encroachment by the adenoid on the nasopharyngeal airway. Few studies have been performed so far to establish association between the size of adenoid and occurrence of OME.[5, 16-18] This study aimed at evaluating the grades of adenoidal hypertrophy among school age children with OME and to find association between size of adenoid and occurrence of OME.

Subjects and Methods

In this cross sectional study, 17 primary schools were selected out of the 300 schools registered at the Ministry of Education in Erbil. The schools were selected after taking into consideration that various sectors in the city be included in the study. Through visiting the targeted schools after taking consent from the school principle, all the pupils from the first to the sixth class of elementary study with suspected hearing problems and learning difficulties (based on teacher's feedback) were examined by otoscopy and tuning fork test to look for any possibility of otitis media with effusion (OME). The time period of the examination was from mid October 2009 through mid May 2010 during which a total 1,035 pupils were taken.

All children with tympanic membrane perforation, acute otitis media, chronic otitis media, and congenital anomalies of external ear were excluded from the study.

Children with otoscopic findings suggestive of OME and those with suspected hearing problems and learning difficulties based on teachers' feedback were referred to the ENT outpatient departments in both Rizgary and Hawler teaching hospitals in Erbil city for further examination. At the outpatient departments, further examination and investigations were done and a form which was designed by the researchers for the purpose of this study was filled accordingly (Appendix 1). Diagnosis was confirmed using tympanometry which can be considered analogous to pneumatic otoscopy, but with far greater precision.

In tympanometry, pressure changes usually occur from a positive pressure of 200mm.H_2O to a negative pressure of 200mm.H_2O in normal ears. Tympanometry results were classified as Type A (+200 and -99 daPa), Type B (no pressure peak), Type C1 (-100 and -199 daPa), Type C2 (- 200 and -399 daPa). Furthermore a pure-tone audiometry was used to assess the hearing threshold.[2]

A pure-tone audiogram (PTA) was done using six frequencies (250, 500, 1000, 2000, 4000, 8000 Hz). The hearing loss were divided into mild (26-40 dB), moderate (41-55 dB), moderately severe (56-70dB), severe

(71-90 dB) and profound hearing loss (> 90 dB). [19]

Adenoid size was measured by the A/N ratio on cervical lateral views of plain X-rays, where N is the distance between the posterior superior edge of the hard palate and the anteroinferior edge of the sphenobasioccipital synchondrosis, and A is the distance between the maximum convexity of the adenoid and a line drawn along the basoocciput. A/N ratio below 25% was scored as 1+, those between 26% and 50% as 2+, those between 51% and 75% as 3+, and those between 76% and 100% as 4+. [20]

The data were collected and analyzed by using the statistical package for the social sciences (SPSS) program version 17. Analysis of variables was done using distribution of frequencies and Chi –square test in case of category variables; and measures of central tendency , dispersion and Fisher exact test in the case of quantitative variables. Results were presented in figures and tables, and a p value of less than 0.05 was considered as statistically significant.

Results

OME found in 48 (4.6%) pupils. Their mean age was 9.7± 2.5 years, and most cases with OME were among children in their 7th and 12th year of age (Figure 1).

OME was found in 26 (54.2%) females compare to 22 (45.8%) males with a female to male ratio of 1.18 to 1.

Among 48 students, OME was affecting both ears in 32 (66.7%) of the cases, and involving only the left ear in 10 (20.8%) cases. OME affecting only the right ear was found in 6 (21.5%) of cases (Figure.2)

Tympanometry results and their distribution according to the side of ear affected were further illustrated in Figure 3 in which type B tympanogram were seen in 87.5% of right ears and 79.2% of left ears.

The mean pure tone audiometry gap was 23.5 ±10.6 decibels, ranging between 5 to 50 decibels (Appendix 3). Meanwhile, 30 (62.5%) of cases showed mild hearing loss (62.5% of right ears; 58.3% of left ears). Moderate hearing loss was found in 18 (37.5%) of cases (25% of right ears, and in 33% of left ears) (Figure 4).

Regarding the size of adenoid based on A/N ratio (Appendix 4), 8 (16.7%) of cases with OME had grade 2+ adenoid size, 26 (54.2%) had grade 3+ and 8 (16.7%) had grade 4+ adenoid size (Figure 5). The association between size of adenoid and type B tympanogram was as follow:

Table (1) gives the association between size of adenoid according to A/N ratio and the presence of unilateral or bilateral OME (type B tympanogram). Adenoid size of 3+ according to A/N ratio was mainly seen among patients having unilateral and bilateral OME, accounting for 16% and 37% of all cases with OME accordingly. The results were statistically insignificant (p value > 0.05). From those 48 children with OME, (83.3%) children suffered from mouth breathing. The relation between type of breathing and presence of type B tympanogram result was found to be strongly significant (p =0.005).

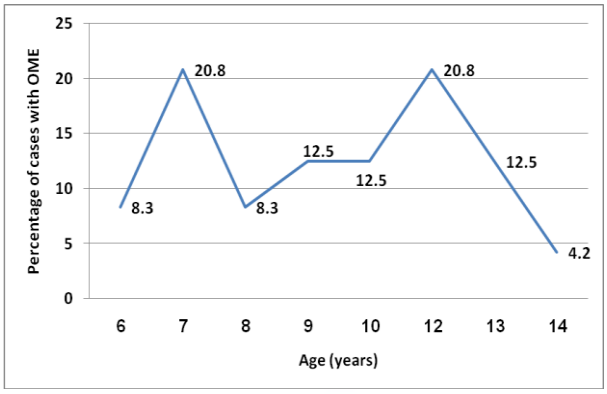

Figure (1): OME distribution according to student age.

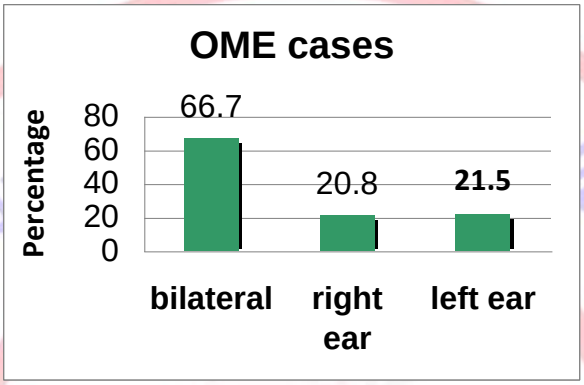

Figure (2): Distribution of OME according to side ear involved.

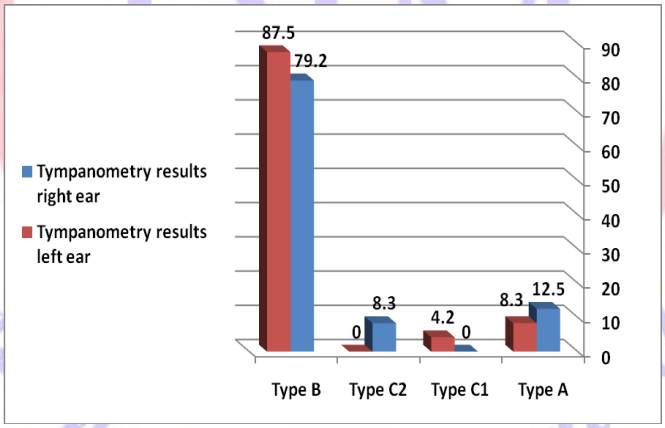

Figure (3): Tympanometry results for both ears (in percentages).

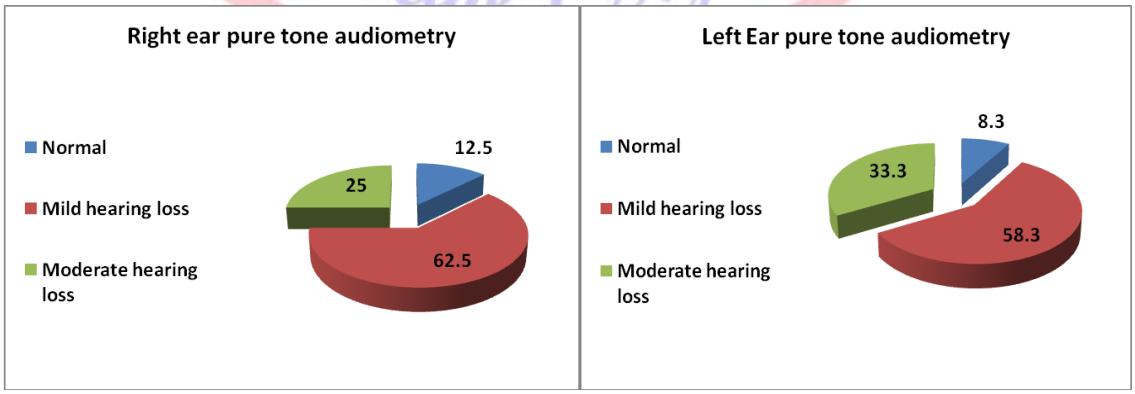

Figure (4): Pure tone audiometry results for cases with OME.

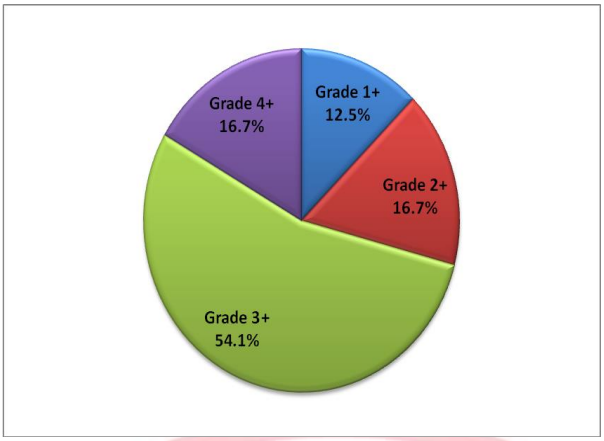

Figure (5): Lateral X-ray of nasopharynx(A/N) ratio of adenoid hypertrophy.

Table (1): Association between size of adenoid (A/N ratio) and presence of OME.

Adenoid size grading (A/N Ratio)	Unilateral OME	Bilateral OME	P Value
1+ (<25%)	2 (4.2%)	4 (8.3%)	0.4 (NS)
2+ (25 - 50%)	4 (8.3%)	4 (8.3%)	
3+ (50-75%)	8 (16.7%)	18 (37.5%)	
4+ (75 - 100%)	2 (4.2%)	6 (12.5%)	

Discussion

In this study, following an examination of 1,035 pupils, OME was found in 48 (4.6%) of them. Such prevalence falls within the range of OME prevalence in many literatures which have revealed to be between 1.3 to 20%.[21,22,23] The mean age was 9.7± 2.5 years, with two peaks of prevalence at 7 and 12 years of age (41% of total cases). When taking the prevalence of OME among all age groups, studies have found that it is most frequent at the age of 16 months to 2 years. Da Costa *et al* [5] found that in regard to the proportion of OME per age group, the prevalence of OME was low for younger children (22%) but sharply increased in children aged three to seven to 49.2%, and then fell and remained stable in the age groups that follow at around 35-39%.[5] The study was able to demonstrate a high prevalence of adenoid size 3+ among patients having unilateral and bilateral OME, accounting for 16% and 37% of all cases with OME accordingly. This is comparable with another recent study done in Nigeria in 2010 on 46 children with OME where they found a significant association between type B tympanogram and the presence of significant (grade 4) nasopharyngeal obstruction with odds ratio of 4.4.[18] It was possible that such adenoid, even though of small size, encroached laterally to obstruct the ET of the involved ear. Such lateral encroachment was reported to be significant in influencing development of OME. It was also possible that other risk factors for OME such as ET dysfunction were probably responsible for the development of OME in those children with small-sized adenoids.[18]

The study also demonstrated that OME was slightly more among females (54.2%) than males (45.8%) with a female to male ratio of 1.18 to 1. This was comparable with another study which gave no significant difference in the prevalence of OME between both genders.[24] However; 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%) ($p<0.001$).[5]In addition, this study revealed a significant association between the presence of type B tympanogram and history of oral breathing in the studied children. A study by Engel did find a similar association and considered mouth-breathing to be a significant risk factor for OME in children. [3] The most common type of tympanometry results seen among children with OME was Type B. This is comparable with a study by Sassen et al which showed that 88% of the children with OME had type B tympanogram.[25]

The mean pure tone audiometry gap was 23.5 ±10.6 decibels, ranging between 5 to 50 decibels. Meanwhile, most cases showed mild degree of hearing loss (62.5% at right ear OME; 58.3% at left ear OME). Moderate hearing loss was found in a quarter of case with right ear OME, and in up to one third of children with left ear OME. This is in consistence with a study by Thompson in 2008 [26] which revealed that the worse conductive hearing loss among children with OME was of moderate degree (10% compared with 20% having mild degree hearing loss). These results suggests that the degree of conductive hearing loss among cases with OME cannot be worse than a moderate hearing loss as the skull vibrates at intensities greater than 60-70 dB hearing level (HL) allowing the signal to go straight to the inner ear; anything greater than this is considered to be a mixed hearing loss.[26]

This study had some limitations. The high rate of children who didn't show up in the ENT outpatient departments after being referred from their school impacted on the ability to obtain accurate occurrence rates. This may be attributed to that parents being not realizing the importance of the follow-up testing. This could have been avoided if the study had been less restricted by time limit for conducting this research. Beginning the testing in winter and completing it in spring meant that the last school tested was likely to have a lower rate of middle ear dysfunction due to the effect of season they were tested in.

Conclusion

The study concluded that adenoid hypertrophy was associated with otits media with effusion in school age children. The proportion of otitis media with effusion increases with the severity of nasopharyngeal obstruction by adenoid hypertrophy, and the most common type of tympanometry results seen among children with OME was type B. Adenoid size of 3+ according to A/N ratio was mainly seen among patients having unilateral and bilateral OME, accounting for 16% and 37% of all cases with OME accordingly.

Recommendations

Screening programs are important for the detection of OME and conductive hearing loss in pre-school and new-entrant school children.It's preferable to do further studies to evaluate the effect of adenoid size using MRI and flexible nasopharyngoscope.

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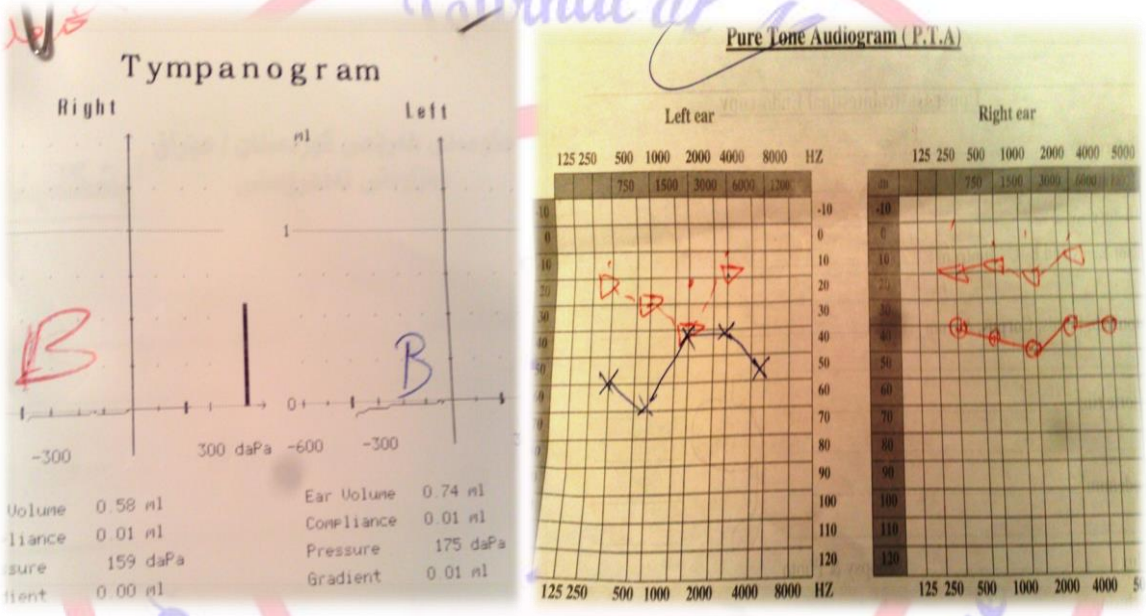
Appendix



Photograph of postnasal x-ray of one of the patients illustrating the measurements for calculation of A/N ratio. Line' B' is tangential to the basiocciput. The adenoidal measurement 'A' is obtained by drawing a perpendicular line to B at the point of maximal adenoidal tissue. The nasopharyngeal measurement 'N' is made

between the posterior border of the hard palate and the antero-inferior aspect 'S' of the spheno-basiccipital synchondrosis. When the synchondrosis is not visible, point 'S' is determined as the point on the anterior edge of the basiocciput which is closest to the intersection of the lines A and B.