ORIGINAL ARTICLE

The Role of Adenoidal Obstruction in the Pathogenesis of Otitis Media with Effusion in Nigerian Children

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Abstract

Background: *Although adenoidectomy is generally applied in the treatment of otitis media with effusion (OME), there is still much debate about the role of adenoid in the pathogenesis of OME. The purpose of this study is to determine the incidence of OME in children with obstructive adenoid disease in comparison with normal control, and the degree of nasopharyngeal obstruction by adenoid as it relates to the development of OME in Nigerian children.*

Method: *Controlled, prospective clinical study was carried out. Diagnosis of OME was made with finding of type B tympanogram on tympanometry evaluation. The incidence of OME among adenoidal patients was compared with its incidence in normal control. The degree of nasopharyngeal obstruction among the adenoidal subjects was evaluated with an adenoidal-nasopharyngeal ratio parameter obtained from soft tissue radiograph of nasopharynx, and was related to the results of tympanometric evaluation of the adenoidal subjects.*

Results: *The incidence of OME was significantly higher in the adenoidal children than the normal control ($p < 0.001$). The risk of OME was more than 7 times as more among adenoidal group than among the non-adenoidal control. Gross nasopharyngeal obstruction was significantly associated with type B tympanogram ($p = 0.002$). The diagnosis of OME correlated significantly with the degree of nasopharyngeal obstruction ($r = 0.32$; $p = 0.002$).*

Conclusion: *Our study found adenoid obstruction as a significant risk factor for OME in children. The risk of OME increases with the increasing degree of nasopharyngeal obstruction.*

Keywords: *Adenoid, Nasopharyngeal obstruction, Etiology, Otitis media with effusion*

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Introduction

It is common practice among otolaryngologists to apply adenoidectomy as part of the treatment of medically resistant otitis media with effusion ('OME')[1–4]. Although some literatures associated enlarged adenoid with OME[1-2,4-6], there have been some studies questioning this relationship[7,8]. There are a large number of prevalence studies of OME in general population of children[9-14], however there has been no detailed research of its prevalence in children having adenoidal obstruction. An observation was made that children with large adenoids in Nigerian population rarely had aural manifestations even when the enlargement was severe enough and sufficiently prolonged to produce grotesque adenoid facie[15].

The purpose of this study is to compare the incidence of OME in series of Nigerian children with obstructive adenoid disease with a series of normal control non-adenoidal children. It also aimed to determine whether the development of OME among adenoidal children correlates with the degree of nasopharyngeal obstruction.

Method

Study Design: A twenty-month prospective, control clinical study ending December 2005 was carried out in the department of otolaryngology of the University of Nigeria Teaching Hospital Enugu; and in a nearby community primary school.

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Ethical Consideration: The research protocol was reviewed and approved by both the health institutional ethical review committee and the local primary school board. Written informed consent was obtained from the parents.

Patient Recruitment and Data collection: The subject groups consisted of 46 consecutive patients (26 boys and 20 girls), ranging in age from 4 to 8 years with a mean of 5.7years, who were treated for obstructive adenoid disease (adenoid group) in the Otolaryngology department of the University of Nigeria Teaching Hospital (UNTH) Enugu, from April 2004 to December 2005; and 270 control, primary school children (147 boys and 133 girls) who were in primary one grade ranging in age from 5-7 years with a mean of 5.9years. Each ear was considered as a separate entity suitable for analysis. In the control group, subjects were excluded if they had history of symptoms suggestive of adenoidal obstruction like: nasal obstruction, mouth breathing, snoring, and obstructive breathing during sleep.

The adenoidal group consisted of consecutive pediatric patients referred to the Otolaryngology clinics on account of chronic nasal obstruction. Subjects included met the following criteria: (1) continuous nasal obstruction for at least three months, (2) presence of one or more of the following symptoms - snoring, mouth breathing and obstructive breathing during sleep. Exclusion criteria were: history of previous adenoidectomy, those with craniofacial anomalies, nasal septal deviation, and active ear discharge. At the time of first visit by each patient, a detailed medical history was obtained and physical examinations of the ear, nose, and throat were carried out. Diagnosis of obstructive adenoid disease was made if a child had a history of chronic nasal obstruction associated with snoring, and/or mouth breathing, and/or obstructive breathing during sleep.

The presence of OME was evaluated clinically with otoscopy in all the subjects by finding dull and/or retracted tympanic membrane, air-fluid level or air bubbles in the middle ear. Diagnosis of OME was made in all subjects by finding type B tympanogram on tympanometric evaluation.

Tympanometry was carried out with a “SAT 12-Audio Med” impedance meter which automatically measured the compliance of the middle ear system as the pressure swept automatically from + 200 mm of water to – 400 mm of water and was plotted as a curve on a tympanograph. A probe tone of 226hz was used to test both ears of each patient. The tympanograms obtained were analyzed using the modified Jager”s classification[19]. We graded the 'middle ear function' into three categories: 'normal' = type A tympanogram, 'reduced with negative middle ear pressure' = type C tympanogram, and poor = type B tympanogram.

The degree of adenoidal obstruction of the nasopharynx was evaluated for each subject in the adenoidal group with the measurements extracted from lateral soft tissue radiograph using adenoidal nasopharyngeal ratio (“AN ratio”) parameter as described by Fujioka et al[17]. (figure 1). To make the measurements more objective, the AN ratio measurements obtained were graded as: grade I (0.0 – 0.25), II (0.26 – 0.50), III (0.51 – 0.75), IV (0.76 – 1.0). The degrees of obstruction of the nasopharyngeal airway obtained were classified as showing either 'no obstruction' (grade I), or 'minimal' (grade II), or 'moderate' (grade III), or 'gross' (grade IV) obstruction.

Data Analysis: The data was analyzed with the Statistical Package for the Social Sciences (SPSS 11.5). The incidence of OME among the adenoidal group was compared with that of the control group using chi-square test. Correlation between the degree of nasopharyngeal obstruction and OME was tested in the adenoidal group with Pearson correlation.

Results

Of the 92 ears (46 patients) in the adenoidal group, 35% (32 ears) were diagnosed with OME using type B tympanogram , whereas 7% (36 ears) of the 540 ears (270 children) in the control group were diagnosed with OME; the difference in the proportions of OME in the two groups was significant ($\chi2 = 64.72$; $p < 0.001$. table I). The risk estimate of OME in adenoidal patients was 7.5.

The proportions of male subjects diagnosed with OME were not significantly different from that of the female subjects in both the adenoidal and control groups ($p = 0.69$ and $p = 0.33$ respectively). Table II shows the calculated mean AN ratio for the various types of tympnogram obtained for the adenoidal group. The analysis of the differences in mean AN ratio within the tympanogram groups with the ANOVA test was highly significant ($F = 5.20$; $p = 0.007$). Moreover, the difference in mean AN ratio between type B tympanogram (OME) group and combined types A and C tympanogram (non-OME) group was also significant ($t = 3.15$; $p = 0.002$). Table III outlined grades of AN ratio (degrees of nasopharyngeal obstruction) in relation to the tympanogram types.

No patient had AN ratio in the region of grade I. Type B tympanogram was recorded in 48% of the ears of the children with grade IV (gross) nasopharyngeal obstruction, while 10% and 20% of the children with minimal and moderate obstructions had type B tympanogram respectively. Type B tympanogram was significantly associated with gross nasopharyngeal obstruction with odds ratio of 4.4 ($\chi 2 = 9.32$; $p = 0.002$. Figure2). The degrees of nasopharyngeal obstruction correlated significantly with the decrease in middle ear function as well as presence of OME ($r = 0.32$; $p = 0.02$ and $r = 0.31$; $p = 0.002$ respectively).

Table 1: Tympanogram Distribution among the Adenoidal and Control Groups in Relation to the Ears of the Male and Female Subjects

	Tympanogram			
Subject group/ Gender	type A	type B	type C	Total
Adenoidal Group				
Male	21	19	12	52
Female	19	13	8	40
Total	40	32	20	92
Control Group				
Male	235	19	18	272
Female	219	17	32	268
Total	454	36	50	540

Each ear in each subject was treated separately as an individual case

Table II: Mean AN Ratio for the Various types of Tympanogram. n = 92 ears

Tympanogram	Number of Ears	Mean AN Ratio	Standard Deviation
Type A	40	0.68	0.105
Type C	20	0.70	0.116
Type B	32	0.77	0.112
Total	92	0.72	0.115

Table III: Distribution of tympanogram types in relation to the Grades of AN Ratio

AN Ratio Grade/Degree of nasopharyngeal obstruction	Tympanogram type A	type B	type C	Total
I (no obstruction)	0	0	0	0
II (minimal obstruction)	6	1	3	10
III (moderate obstruction)	18	6	6	30
IV (gross obstruction)	16	25	11	52
Total	40	32	20	92

Each ear in each subject was treated separately as an individual case

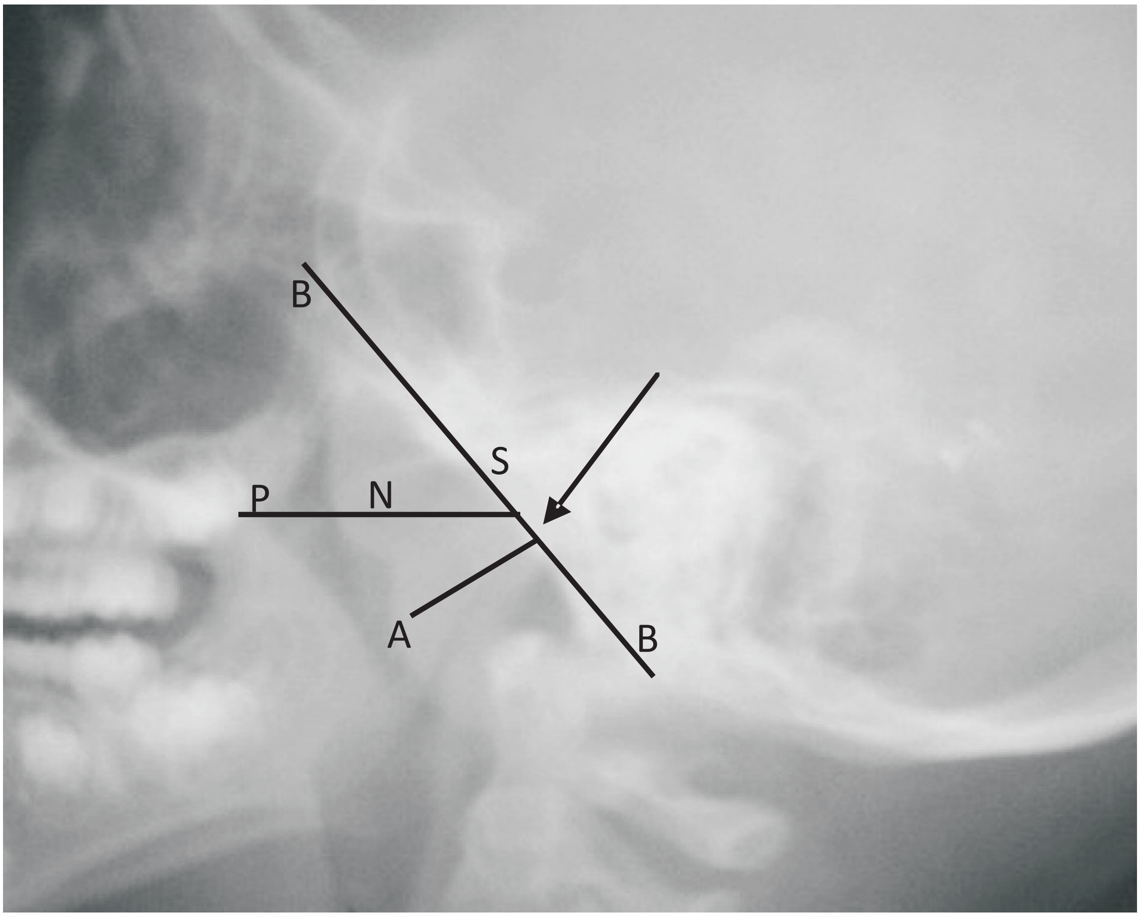

Figure 1: Photograph of postnasal x-ray of one of the patients illustrating the measurements for calculation of AN ratio. Line' B' is tangential to the basiocciput. The adenoidal measurement 'A' is obtained by drawing a perpendicular line to B at the point ofmaximal adenoidal tissue. The nasopharyngeal measurement 'N' is made between the posterior border of the hard palate and the antero-inferior aspect 'S' of the spheno-basiccipital synchondrosis (black arrowhead). 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[17, 18].

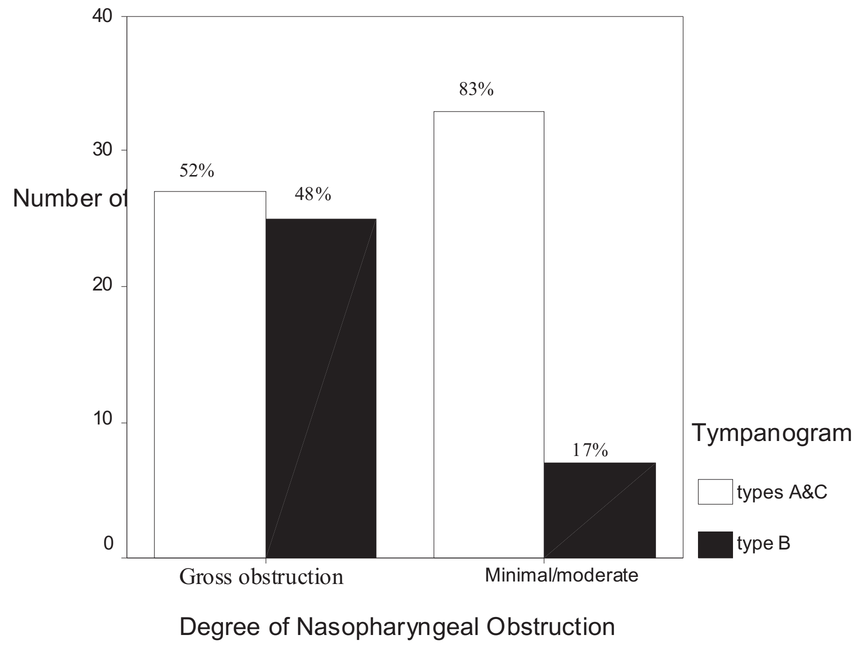

Figure 2: 'The degree of nasopharyngeal obstruction in relation to the tympanogram'. The degree of nasopharyngeal obstruction was grouped into two: those that were considered gross and those that were less than gross obstruction. The tympanogram was considered in relation to the presence of OME (type B) and non-OME group (types A and C).

Discussion

Previously Reported Studies

Prevalence of OME in normal and adenoidal children: The prevalence of OME in children was reported in the range of 1.3% to 20% in the literature [9 - 14, 20]. Its prevalence was concluded to be lower in African children than in Caucasian children [12-14]. It was suggested that the Eustachian tube function may be better in the African races[12-14]. While there was little scientific evidence to support this suggestion, it was speculated that Eustachian tube function may be genetically determined[10, 14]. In a well designed study among African children, a strong association was found between OME and history of adenoiditis[16]. This finding contrasted with an observation made that children with large adenoids in Nigerian population rarely had aural manifestations even when the enlargement was severe enough and sufficiently prolonged to produce grotesque adenoid facie[15]. However, the observation was empirical with little or no scientific proof.

Role of Adenoidal enlargement in the Aetiology of OME: There is still much debate about the role of adenoid in the pathogenesis of OME. Some researchers found positive correlation and strong association between grades of adenoid enlargement and decrease in middle ear function as well as incidence of OME [6, 21]. Others found that history of snoring 9 and month-breathing [22] were significant risk factors for OME in children. However, other researchers reported no significant difference in the radiological size of adenoid between children with middle ear fluid and a set of age and sex-matched children who sustained head injury[8].

However, their methodology did not state whether children with symptoms of adenoidal obstruction were specifically excluded in their control. Moreover, the radiological parameter used in their study in determining adenoidal size was more observer-dependent than the AN ratio parameter used in our study which made use of fixed land marks and was shown to reliably measure the relative size of the adenoid to the nasopharynx as well as determined the degree of nasopharyngeal airway obstruction by the adenoid tissue[17,18]. The relative size of the adenoid to that of the nasopharynx as well as the direction of the enlarging adenoid within the nasopharynx have been recognized as more reliable factors than the mere size of adenoid in the evaluation of the obstructive effect of the adenoid [23-25].

The Present Study in Comparison with Other Studies

The risk of OME in Adenoidal Children: In this study, the prevalence of OME among the adenoidal children was significantly higher than its prevalence among our normal control. Our results showed adenoidal obstruction as a significant risk factor for OME. The adenoidal children had more than 7 times the risk of developing OME (Odds ratio = 7.5) than the normal non-adenoidal children. This agreed with the reports of other researchers that portrayed history of snoring[9], mouth-breathing[22], and adenoiditis[16] as significant risk factors for OME. However in these studies, the researchers did not relate the risks to the degree of adenoid enlargement.

Relationship between degree of nasopharyngeal obstruction and OME: Our study showed a positive correlation between the degree of nasopharyngeal obstruction and decrease in middle ear function, as well as the presence of OME. Gross nasopharyngeal obstruction was significantly associated with OME. Children with larger adenoids had more than four times the risk of developing OME than children with minimal and moderate degrees of nasopharyngeal obstruction. Our results agreed with other similar published works[6,21].

Otitis media with effusion was however observed in 10% of the ears of the children with small adenoids. It was possible that such adenoid, even though of small size, encroached laterally to obstruct the Eustachian tube of the involved ears. Such lateral encroachment was reported to be significant in influencing development of OME[24].

It was also possible that other risk factors for OME such as Eustachian tube dysfunction were probably responsible for the development of OME in those children with small-sized adenoids.

The results of our study contrasted sharply with the empirical observation made by an earlier researcher that children with large adenoids in Nigerian population rarely had aural manifestations even when the enlargement was severe enough and sufficiently prolonged to produce grotesque adenoid facie [15]. There is therefore the need to recognize the higher risk of OME when evaluating children with adenoidal obstruction in Nigeria. This may well increase the chances of identifying and indeed, treating more children with OME in Nigeria who would otherwise be missed out, with possible resultant risk of residual hearing loss and subsequent poor language and speech acquisition[26].

Conclusion

Our study found adenoidal obstruction as a significant risk factor for OME in children. The risk of OME increases with the increasing degree of nasopharyngeal obstruction.

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