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Original Research Article

Effect of adenotonsillectomy on otitis media with effusion

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ABSTRACT

Background: Otitis media with effusion (OME) is a common cause of childhood hearing loss. In children, it may co-exist with adenotonsillar enlargement. In such cases, adenotonsillectomy combined with myringotomy and tympanostomy tube insertion is the standard surgical treatment approach worldwide. This study however, investigated whether adenotonsillectomy alone can resolve OME in children with concurrent adenotonsillar disease, with implications for reducing surgical morbidity and healthcare expenditures.
Methods: This prospective pre-test-post-test study was conducted at the Department of Otolaryngology, National Hospital Abuja, Nigeria. Ninety-five children (aged 1-8 years) with adenotonsillar hypertrophy and preoperative tympanogram types B or C underwent adenotonsillectomy. Tympanometric evaluations were performed at baseline (2 weeks preoperatively) and 6 weeks postoperatively to assess changes in middle ear function.
Results: Pre-operative tympanometry identified OME in 166 ears. Post-operative tympanometry at 6 weeks demonstrated resolution of OME (type B or C to type A tympanogram) in 88 ears (53%, χ^2=22.5, p=0.001) which was statistically significant. Among the remaining 78 ears, 41 (24.7%) showed no change, while 37 ears demonstrated changes to alternative tympanogram types, (B to C, C2 to C1, B/C to as), which was considered a partial improvement (resolving OME, but not complete resolution).
Conclusions: Findings from this study suggest that adenotonsillectomy alone may resolve otitis media with effusion (OME) in children with coexisting adenotonsillar hypertrophy, with significant improvements observed at a minimum follow-up of 6 weeks.

Keywords: Adenotonsillar disease, Adenotonsillectomy, Otitis media with effusion, Otitis media with effusion treatment outcomes, Pediatric otolaryngology, Tympanometry

INTRODUCTION

Otitis media with effusion (OME) is defined as an inflammatory state of the middle ear characterized by the accumulation of fluid in the middle ear resulting in decreased mobility of the tympanic membrane and a conductive type of hearing loss, in the absence of signs and symptoms of acute infection.[1] OME is a prevalent chronic ontological condition in early childhood and the leading cause of acquired hearing loss in pediatric population.[2] It usually presents as hearing loss, delayed speech and language development, behavioral issues and in younger children, difficulties with balance.[1] OME has been reported to be more common in children with diseased adenoids.

It has been postulated that repeated infections of the adenoid or its enlargement extending to the fossa of Rosenmüller and to the Eustachian tubal orifice, play a significant role in the pathogenesis of otitis media with effusion.[3] The best surgical treatment option for children with concurrent otitis media with effusion (OME) and

obstructive adenotonsillar enlargement remains debated in our setting. Globally, the standard treatment often involves a combination of two surgeries; myringotomy with tympanostomy tube insertion and adenotonsillectomy.[1,3]

Some studies however advocate that in these children, adenotonsillectomy alone should be considered as the initial surgical management, with myringotomy reserved for refractory cases.[4-7]

The primary rationale for adenotonsillectomy as a means of treatment of OME have centered on the size of the adenoids and their role as a focus for ascending Eustachian tube infection.[3,8] Removal of the adenoid appears to reduce OME primarily by removal of the source of obstruction and infection in the nasopharynx, which reduces inflammation around the nasopharynx and eliminates the mass effect of the adenoid on the ET, thereby improving the active ventilatory function of the tube. Tonsils have also been implicated as a potential source of infection due to its proximity to the nasopharyx.[1,4]

This study investigates whether adenotonsillectomy alone can resolve OME in children with both conditions, potentially eliminating the need for these patients to undergo two surgeries, thus reducing patients' morbidity and caregiver financial burden in resource-constrained settings.

METHODS

Study design and participants

This was a prospective study conducted on 95 children between the age group 1-8 years, in National Hospital Abuja (NHA), Nigeria.

Study duration

The study duration was from January 2021–March 2022.

Sample size calculation

Sample size calculation was done using the Cochrane sample size formula which yielded sample size of ninety-five, including an attrition of 10% to allow for unexpected data losses.[9]

The study had both pre-and post-intervention assessment with a longitudinal design. The primary outcome was categorized as recovery or no recovery of otitis media with effusion after adenotonsillectomy.

Sampling technique

Study participants were consecutively recruited using the convenience sampling technique and informed consent was obtained from their parents/wards.

Clinical evaluation

A detailed history was obtained and clinical examination, including oropharyngeal and otologic examination were performed. Tonsils were graded into 5 grades ranging from grade 0 to 4, using the Brodsky grading scale.[10] Otoscopy was carried out to assess status of the tympanic membrane (TM).

X-ray of the post nasal space was reviewed and adenoid nasopharyngeal ratio (ANR) measured as proposed by Fujioka et al.[11]

Tympanometry

Tympanometry was performed on the patients two weeks prior to adenotonsillectomy to establish OME. Otowave 202 (by Amplivox® England) tympanometer was used, with the tone frequency set at 226Hz and intensity level of 85dB SPL +/- 1.5dB, compliance range of 0.3–1.6 mmH2O and a pressure ranging between +200 to -400 daPa. Repeat tympanometry was done 6 weeks post adenotonsillectomy.

Inclusion criteria

All participants satisfied all criteria below before being included in the study, clinical features suggestive of adenotonsillar enlargement - a combination of 2 or more of the following symptoms; nasal obstruction, mouth breathing, snoring, sleep apnea, recurrent nasal discharge, recurrent sore throat, swallowing difficulty. Adenoid Nasopharyngeal ratio (ANR) of 75% and above on X-ray of the nasopharynx. Children already booked for adenotonsillectomy. Type B or C tympanogram, age within 1-12 years, parental/guardian consent to participate in the study.

Exclusion criteria

Perforated tympanic membrane, acute otitis media, cleft palate, downs syndrome, craniofacial anomalies, previous ear or palatal surgery, neurological abnormalities such as cerebral palsy, parent/Guardian refusal to consent; including parents who opted for adenotonsillectomy with tympanostomy tube insertion, children with severely retracted tympanic membranes (these ones were rather booked for adenotonsillectomy with myringotomy and grommet insertion)

Surgical procedure

Adenotonsillectomy was performed under general anesthesia using blind curettage for adenoid removal and cold steel dissection for tonsil removal. Adenoid tissues were weighed using a digital beam balance and their weights recorded.

No antibiotics were prescribed within 2 weeks before surgery. However, post-operatively all 95 participants

received amoxicillin-clavulanic acid for 5-7 days, as per hospital protocol.

Data analysis

Data analysis of both pre-operative and post-operative tympanograms were compared and changes were documented in the results.

Ethical approval

Ethical approval was obtained from the Health Research Ethical Committee of National Hospital Abuja (HREC number-NHA/EC/032/2020).

Statistical analysis

Data obtained from the study was collated and analyzed. Statistical analysis of the obtained data was carried out using Statistical Product and Service Solution (SPSS version 20 Chicago Illinois Inc.) software programme. A p value of <0.05 was considered to be statistically significant.

RESULTS

A total of 208 patients were booked for adenotonsillectomy during the study period and had pre-operative tympanometry done. 113 had bilateral type A tympanogram, thus were excluded from the study. The final study cohort consisted of 95 consecutively recruited children who met the inclusion criteria, with a total of 190 ears assessed.

Socio-demographics of study participants

Of the 95 participants, 59 were males while 36 were females. The age of the patients ranged from 1 to 8 years (mean=3.2±1.8 years). The 1-3 years' age group were the most affected (70%). Overall, there was no statistically significant age difference (Table 1).

Symptoms and signs of the participants

All symptoms seen among the patients are as shown in Table 2. Most of the patients presented with snoring (69.5%) while the least presenting complaints were hearing loss (15.8%) and delayed speech (6.3%). Majority of the study participants presented with multiple symptoms.

Pre operative tympanometry findings

Types B, C1 and C2 tympanograms were used as indicators for OME in this study. Of the 190 ears studied, 166 ears were found to have OME. A total of 64 (67.4%) out of the 95 participants had type B tympanogram which was the most predominant tympanogram type, involving 125 (75.3%) out of the 166 ears with OME while type C was seen in the 31 (32.6%) participants, involving 41 (24.7%) ears, as depicted on Table 3. Unilateral OME was seen in 24 children (25.3%) while 71 children (74.7%) had bilateral OME. Tables 4-5 shows the distribution of study participants with unilateral and bilateral type B or C tympanograms respectively.

Post op tympanometric findings

Three patterns of tympanogram changes were identified on the 6 weeks post op tympanogram. Changes from type B or C to A. Changes from type B or C to other forms apart from A. No change.

Resolution of OME in this study was defined as change from type B or C tympanogram (pre-op) to type A tympanogram on repeat tympanometry 6 weeks post op. OME resolution was seen in 88 (53.0%) out of the 166 ears, which was statistically significant ($\chi 2$=22.5 and p value=0.001), 32 ears changed from types B or C to other forms apart from type A, while 41 ears (24%) remained unchanged (Table 6).

Out of the 125 ears that had type B tympanogram preoperatively, 54 (43.2%) changed to Type A, while of the 41 ears with type C, 34 (82.9%) changed to type A.

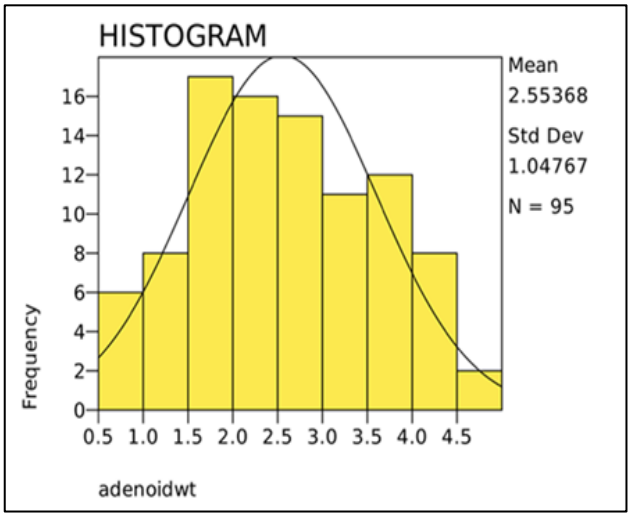

Figure 1: Histogram of adenoid weights.

Thus, OME resolution was higher in ears with pre-op type C tympanograms than those with type B tympanograms. Out of the 30 ears of the 15 patients who reported hearing loss, 14 ears (46.7%) had complete OME resolution, 3 changed to other tympanogram forms while 13 (43.3%) ears remained unchanged after surgery (Table 7). There was no statistical significance in OME resolution after surgery in participants with pre-op history of hearing loss. (χ^2=5.3, p value=0.15).

Findings from adenoids weight

The weight of the adenoids obtained intra-op ranged from 0.6 g to 4.9 g, with a mean of 2.55±1.05. The largest

adenoid weight of 4.9g was seen in a 4-years-old male with hearing impairment and delayed speech as his presenting complaints, with bilateral type B tympanogram pre-surgery. Using the mean, the adenoids were subdivided into large adenoids–those weighing ≥2.55 grams, small adenoids–those weighing less than 2.55 grams. A total of 50 (52.6%) of the participants had small adenoids while 45 (47.4%) had large adenoids. Distribution of the adenoid weights is depicted in Figure 1. OME resolution was observed to be better in the group with small adenoids, with 47 (60%) out of 78 ears with OME converting to type A post adenotonsillectomy, as against 23 (26.1%) out of 88 ears in the large adenoid group (Tables 8 and 9). The study also observed that 27 (71.2%) out of the 38 ears who recorded no changes in tympanometry after adenotonsillectomy belonged to children who had large adenoids.

Table 1: Sociodemographic characteristics of study participants (n=95).

Variable	Frequency (n=95)	%
Gender		
Male	59	62.1
Female	36	37.9
Age (in years)		
1 to 3	66	69.5
4 to 6	23	24.2
> 7 years	6	6.3
Mean age (mean±SD)	3.2±1.8	
Weight		
Mean weight (mean±SD)	15.0±3.9	
Parental education		
None	1	1.1
Primary	15	15.8
Secondary	11	11.6
Tertiary	68	71.6

Table 2: Distribution of symptoms of study participants.

Symptoms	Frequency (n=95)	%
Snoring	66	69.5
Recurrent nasal discharge	29	30.5
Cessation of breathing while sleeping	29	30.5
Chronic mouth breathing	29	30.5
Swallowing difficulties	28	29.5
Poor hearing	15	15.8
Delayed speech	6	6.3

Table 3: Distribution of study participants with tympanogram type B or C.

Tympanogram	No. of participants (%)	No of ears affected (%)
B	64 (67.4)	125 (75.3)
C1	12 (12.6)	18 (10.8)
C2	19 (20.0)	23 (13.8)
Total	95 (100.0)	166 (100.0)

Table 4: Tympanogram pattern in participants with unilateral OME.

Tympanogram	Left ear (%)	Right ear (%)	No. of participants (%)	No. of ears affected (%)
B	3 (75.0)	11 (55.0)	14 (58.3)	14 (58.3)
C1	0 (0.0)	5 (25.0)	5 (20.8)	5 (20.8)
C2	1 (25.0)	4 (20.0)	5 (20.8)	5 (20.8)
Total	4 (100.0)	20 (100.0)	24 (99.9)	24 (99.9)

Table 5: Tympanogram pattern in participants with bilateral OME.

Tympanogram		Bilateral ear involvement	
Left ear	**Right ear**	**No. of participants (%)**	**No. of ears affected (%)**
B	B	47 (66.2)	94 (66.2)
B	C1	3 (4.2)	6 (4.2)
B	C2	11(15.5)	22 (15.5)
C1	C1	4 (5.6)	8 (5.6)
C1	C2	2 (2.8)	4 (2.8)
C2	B	3 (4.2)	6 (4.2)
C2	C2	1 (1.4)	2 (1.4)
Total		71	142

Table 6: Total OME resolution (Pre and post-operative comparison of tympanogram).

	Before surgery	After surgery (%)			
Tympanogram		**A**	**B**	**C1**	**C2**
B	125 ears	54 ears (43.2)	37 ears (29.6)	16 ears (12.8)	14 ears (11.2)
C1	18 ears	15 ears (83.3)	0 ears (0.0)	2 ears (11.1)	0 ears (0.0)
C2	23 ears	19 ears (82.6)	1 ear (4.3)	1 ear (4.3)	2 ears (8.7)
Total	166 ears	88 ears	38 ears	19 ears	16 ears

Note: 4 ears changed from type B to As (3.2%). One ear changed from type C1 to As (5.6%).

Table 7: Tympanogram changes post-operatively in participants that presented with hearing loss).

	Before surgery	After surgery (%)			
Tympanogram		**A**	**B**	**C1**	**C2**
B	26	11 (42.3)	12 (46.2)	2 (7.7)	1 (3.8)
C2	4	3 (75.0)	0 (0.0)	0 (0.0)	1 (25.0)
Total	30	14	12	2	2

Table 8: Tympanogram changes post-operatively in participants with large adenoids.

	Before surgery	After surgery (%)			
Tympanogram		**A**	**B**	**C1**	**C2**
B	74 ears	29 ears (39.2)	27 ears (36.5)	8 ears (10.8)	8 ears (10.8)
C1	5 ears	5 ears (100)	0 ears	0 ears	0 ears
C2	9 ears	7 ears (77.8)	0 ears	1 ear (11.1)	1 ear (11.1)
Total	88 ears	23 ears	27 ears	9 ears	9 ears

* 2 persons changed from type B to As.

Table 9: Tympanogram changes post-operatively in participants with small adenoids.

	Before surgery	After surgery (%)			
Tympanogram		**A**	**B**	**C1**	**C2**
B	51 ears	25 ears (49%)	10 (19.6)	8 (15.7)	6 (11.8)
C1	13 ears	10 ears (76.9%)	0 (0.0)	2 (15.4)	0 (0.0)
C2	14 ears	12 ears (85.7%)	1 (7.1)	0 (0.0)	1 (7.1)
Total	78 ears	47	11	10	7

*2 persons had type B changed to type As, 1 person changed from C1 to As.

DISCUSSION

Otitis media with effusion has been reported in multiple studies to be common in children with adenotonsillar pathology. In our study, 45.6% (95/208) of children with adenotonsillar disease had tympanograms indicative of OME. Comparable prevalence rates were reported by Nwosu et al, (55.9%) in Nigeria, Zephenia et al, in Tanzania (61.7%) and Nishanth et al, in India (46%).[12-14] Consequently, it is imperative to consider the increased risk of OME when assessing children with adenoidal obstruction, which will facilitate timely diagnosis and intervention. Interestingly, despite 74.7% of participants

having bilateral OME, suspected hearing impairment was reported by only 15 parents/caregivers. This finding is consistent with existing literature which suggests that OME can occur in children with adenoid enlargement without noticeable hearing symptoms, as the associated mild hearing loss is often overlooked by parents or caregivers.[15,16] This again highlights the importance of physicians maintaining a high index of suspicion for OME when evaluating children with adenoid obstruction.

In the present study, post-operative tympanometry at 6 weeks revealed complete OME resolution (Type B/C to Type A tympanogram) in 88 (53.0%) out of the 166 ears, which was statistically significant ($\chi 2=22.5$, $p=0.001$). These findings suggest that adenotonsillectomy alone may be an effective treatment for resolving OME in children with adenotonsillar enlargement. Changes to other forms of tympanograms ((B to C, C2 to C1, B/C to As) was noted in 37 ears. These subsets may further represent ears with partial resolution of OME when considering a meta-analysis of multiple studies on OME which divided criteria for resolution of OME into Strict criterion (change from B to A), Relaxed criterion (change from B to A/C1) and Liberal criterion (change from B to any non-B tympanogram – C1/C2/As).[17]

Ajayan et al, reported that 56% of their study participants showed complete resolution of OME at 6 weeks post adenotonsillectomy, while 33% showed partial improvement from Type B to Type C tympanogram by 6 weeks' post-surgery.[5] Similarly, Maw et al, observed OME resolution in 59% participants at 6 weeks post adenotonsillectomy compared to 16% improvement rate in their no-surgery control group at 6 weeks, while Somayaji et al, reported that by 6 weeks post adenotonsillectomy, 25 ears (92.6%) out of the 27 ears with type B tympanogram improved to Type A, while out of 55 ears with Type C tympanogram, 54 ears (98%) improved to Type A.[4,18]

In this study, 41 ears showed no improvement 6 weeks post-adenotonsillectomy. However, it is possible that some of these ears may demonstrate improvement with longer follow-up, as studies with extended follow-up periods (≥2 months) have reported higher rates of OME resolution over time.[19-21] Results obtained when the intra-op weight of adenoid tissues were compared to the tympanogram types demonstrated that the weight of adenoids did not affect the occurrence of OME, as 52.6% of the 95 participants had adenoid weighing less than 2.55grams, which for the purpose of this study was considered as small adenoids. However, adenoid weight played a role in the persistence of OME even after surgery as majority (71.2%) of those with persistent OME post adenotonsillectomy were those who had adenoids weighing more than 2.55 grams.

Factors exist that could possibly affect the outcomes observed in this study. First, although the study's findings are promising, the lack of a control group limits the strength of the conclusions. Due to ethical constraints at the study hospital, a randomized controlled trial was not feasible, as it would have required withholding adenotonsillectomy from eligible patients. Secondly, the potential impact of post-operative antibiotics in OME resolution seen in our participants cannot be determined. Its role however may not be significant as all 95 participants received the exact same post –op antibiotics regimen, yet had different outcomes.

Additionally, the use of endoscope-assisted adenoidectomy might have yielded better resolution rates, as suggested by Cappaccio et al, who reported better resolution of OME with endoscopic assisted adenoidectomy when compared to traditional blind curettage adenoidectomy.[22] More complete surgical removal of adenoid tissue (especially in the peri tubal area) allowed by endoscopic surgery leads to better restoration of the patency of the torus tubarius, thereby facilitating middle ear drainage and ventilation.

Despite its limitations, this study's findings have significant implications for reducing morbidity and caregiver financial burden in these groups of patients with concurrent adenotonsillar enlargement and OME. By potentially eliminating the need for two separate surgeries (myringotomy with grommet insertion and adenotonsillectomy), treatment can be streamlined, resolving the condition with a single procedure.

CONCLUSION

The findings of this study suggests that adenotonsillectomy alone (without myringotomy and tympanostomy tube insertion) may resolve OME coexisting with adenotonsillar enlargement, when followed up for a minimum of 6 weeks.

Recommendations

Randomized controlled trials should be done to further ascertain if Adenotonsillectomy, without myringotomy and grommet insertion, may be recommended as a first-line surgical procedure for children having concomitant OME and adenotonsillar enlargement in our environment.

Longitudinal studies should be carried out on the children who had OME resolution following adenotonsillectomy, to determine if the resolution is temporary, or if permanent. Multivariate studies are recommended to identify the effect of possible confounders in this study (including allergy, adenoid weight, surgical technique, role of post op antibiotics and natural history of OME). Incorporating tympanometry into the preoperative evaluation of children scheduled for adenotonsillectomy may be a valuable adjunct to routine care.

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