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Comparing Pneumatic Otoscopy and Tympanometry in the Diagnosis of Otitis Media with Effusion

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Abstract

Background: Otitis media with effusion (OME) is a common condition among children with Obstructive Adenoidal enlargement. It is the most common cause of hearing loss in children. It is characterized by the presence of 'sterile' serous fluid within the middle ear, causing temporary and reversible hearing loss. It contributes to speech delays resulting from the hearing impairment. Accurate and early diagnosis is crucial for effective management. Pneumatic otoscopy and tympanometry are widely used tools to establish the diagnosis of OME. The objective of this study is to compare pneumatic otoscopy and Tympanometry in the diagnosis of Otitis media with Effusion in children with adenoidal enlargement at Jos University Teaching Hospital.

Methods: This study was a comparative cross-sectional Hospital-based study conducted at the Jos University Teaching Hospital (JUTH). Ethical clearance was obtained from the Jos University Teaching Hospital (JUTH) Ethics Committee. Consented participants had pneumatic Otoscopy and Tympanometry done in the Audiology Unit of the Jos University Teaching Hospital using HOMOTH TYMP 4000. Each ear was studied as an entity.

Results: A total of 95 patients were evaluated. Majority of the children (78.9%) were in the age group of 2-5 years (pre-school age). There were 58(61.1%) males and 37(38.9%) females with M: F=1.6:1. Prevalence of immobile Tympanic membrane from pneumatic Otoscopy was 30.52%. Prevalence of Type A, B and C tympanograms were 36.8%, 24.7% and 38.4% respectively.'

Conclusion: This study showed high prevalence of otitis media with effusion and Eustachian tube dysfunction as evidenced by significant percentage of immobile tympanic membranes, Types B and C tympanograms in patients with adenoid enlargement.

Keywords: Otitis media with effusion; Pneumatic otoscopy; Tympanometry

Abbreviations: OME: Otitis Media with Effusion; JUTH: University Teaching Hospital; SWIR: Shortwave Infrared

Introduction

Otitis media with effusion (OME) is characterized by the accumulation of serous fluid in the middle ear and is often asymptomatic, making diagnosis challenging [1]. It is a major pediatric health issue, often coexisting with adenoid hypertrophy due to Eustachian tube obstruction [2]. Enlarged adenoids, a common childhood disorder [3,4] can lead to mechanical obstruction of the Eustachian tube leading to negative intratympanic pressure due to absorption of air 5 and consequent Otitis media with effusion (OME). The adenoid constitutes the uppermost part of the ring of lymphoid tissues in the pharynx known as Waldeyer's ring. It is located in the posterior superior wall of the nasopharynx adjacent to the choanae and Eustachian tube (ET) opening [4,6]. Adenoid size varies between children, reaching maximum size between the ages 3-7 years. They regress as the nasopharynx grows, while soft tissue remains unchanged [4,6]. Chronically infected adenoids can cause upper respiratory infections, oedema, and obstruction of the Eustachian tube [5]. Studies show an increase in mast cells and inflammatory mediators in adenoids, binding Ige and releasing histamine, which affect mucociliary transport time, airway function, and mucosal cell secretion [7,8].

It has been widely demonstrated that OME has both short- and long-term impacts on audition, language, cognitive development, and quality of life in children. Globally, it is estimated that up to

90% of children experience at least one episode of OME before reaching school age, and sixty percent (60%) of the episodes occur in the first two (2) years of life. Adenoid hypertrophy is an important a etiological factor in the causation of OME [9,10]. Although there are a large number of prevalence studies on OME in the general population of children, there has been less research on its prevalence in children having adenoidal obstruction and its association with negative middle air pressure [11,12]. Pneumatic otoscopy and tympanometry are frontline tools for diagnosing OME. Pneumatic otoscopy assesses tympanic membrane mobility and is user-dependent. Tympanometry offers objective data but requires equipment and calibration [13] Despite wide use, comparative studies of these tools in African children with adenoids are limited. This study compared the diagnostic yield of pneumatic otoscopy and tympanometry in the evaluation of OME in children with adenoid hypertrophy in Jos, Nigeria.

Pneumatic otoscopy requires an airtight seal using a speculum and insufflation bulb, enabling clinicians to assess tympanic membrane mobility under varying pressures. This technique is described as essential for detecting middle ear effusion and assessing Eustachian tube function [14]. Clinically, Pneumatic Otoscopy allows physicians to assess TM color, position, and mobility simultaneously, making it both a functional and visual examination tool. It is a very sensitive and specific assessment tool when performed by trained clinicians. Despite this, its effectiveness is often limited by the operator's skill and the cooperation of pediatric patients [14]. Recent advancements have aimed to overcome these limitations. Zhong et al demonstrated the integration of artificial intelligence (AI) with otoscopic image classification, achieving a diagnostic accuracy of 97.6%, which significantly surpassed general clinical assessments [15] Similarly, Rustin et al introduced shortwave infrared (SWIR) otoscopy, which enhances the visibility of middle ear effusion and improves diagnostic confidence when used alongside pneumatic otoscopy [16].

Tympanometry is a diagnostic tool that provides quantitative information about fluid presence, middle ear system mobility, and ear canal volume. It is recommended when combined with qualitative information for evaluating otitis media with effusion. Tympanograms represent the admittance of the middle ear, with maximum mobility when air pressure equals the external auditory canal pressure. The Eustachian tube maintains middle ear pressure equal to atmospheric pressure under normal conditions. It is an objective method that measures TM mobility in response to air pressure changes. Better for screening large population and provide quantitative data. It however can be influenced by crying, ear canal size, or wax. It requires calibration of equipment for accurate measurement. Type "B" tympanograms indicate impaired compliance or increased motion impedance of the TM over the gradient, seen in OME. Type "C" tympanogram, similar to type "A", shows a peak to the left of normal pressure, indicating Eustachian tube dysfunction [17-19]. The American Academy of Pediatrics recommends tympanometry when pneumatic otoscopy is inconclusive or not feasible [20].

Rosenfeld et al compared pneumatic otoscopy and tympanometry and found their sensitivity is within similar range 87-94% (with training) and 85-95% respectively. Specificity is approximately 80% for pneumatic otoscopy and between 70-90% with tympanometry. Pneumatic otoscopy has the advantage of low cost and portability although highly operator dependence unlike tympanometry [21]. Establishing a diagnosis of OME can be challenging because symptoms of OME are neither sensitive nor specific, and some children with OME are asymptomatic. The clinical diagnosis of OME is made by history, pneumatic otoscopy and audiological evaluation that includes tympanometry and pure tone audiometry [22-24] The history may be that of a child with a hearing disorder, delayed language acquisition, difficulties at school, and behavioral and/or sleep disorders [25] To make the diagnosis of OME, the middle ear space must be assessed for fluid. This can be done using pneumatic otoscopy and which improve the accurate identification of middle ear effusion [26].

When assessing the tympanic membrane, its color should be interpreted in conjunction with symptoms and mobility. A healthy tympanic membrane typically appears pearly gray or pink. Effusions in OME may be white, amber, or bluish. A liquid film, bubbles, opacity, bluish coloration, and central retraction of the tympanic membrane may be apparent in OME [26]. Distinctly impaired mobility of the eardrum on pneumatic otoscopy is highly predictive of middle ear effusion [27] Pneumatic otoscopy might be difficult to perform in young children owing to narrow ear canals and tendency in children to squirm, but it is widely recommended as a diagnostic modality for acute otitis media and otitis media with effusion [27]. Tympanometry stands out as the most reliable objective indicator of a middle ear effusion. It provides valuable quantitative information regarding the presence of fluid in the middle ear, mobility of the middle ear system, and the ear canal volume [24,25] It is thus crucial to evaluate the impact of OME on the child's hearing, particularly because this disorder commonly occurs during the period of language acquisition.

An Etiopathogenesis of Ome

Adenoid enlargement and Eustachian tube dysfunction are recognized an etiological factor for OME. The adenoid serves as a reservoir for bacteria and also as a mechanical barrier that blocks the Eustachian tube lumen leading to the build-up of negative pressure in the middle ear resulting in middle ear effusion. Adenoid enlargement can produce Eustachian tube dysfunction by direct mechanical obstruction of ET or the obstruction of lymphatics draining the middle ear [28,29] Chronic infection of adenoids also acts as a focus of infection adjacent to ET orifice causing retrograde infection and tubal dysfunction [3]. It is hypothesized that biofilm in OME is a secondary bacterial effect following viral respiratory tract infection, contributing to inflammation and mucus production and persistence of OME [25].

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It is postulated that mucosal damage occurs due to the proteolytic activity of pepsin. However, no direct causal relationship between gastroesophageal reflux and OME has been demonstrated [25] A study conducted by Nwosu, et al shows the incidence of OME among patients with Adenoid hypertrophy was 55.9% with more type "B" 29.4% (40 ears) than type "C" 26.5% (36 ears) [1] They reported more bilateral OME than unilateral and found that the higher the grade of the adenoid the more statistically significant with OME; thus, being a risk factor for OME in children [1].

A study by Kumar et al in India found incidence of OME in patients with adenoid hypertrophy to be 55.9% (112 ears) with more of type B tympanogram 29.4% (59 ears) than type C tympanograms 26.5% (53 ears); this establishes significance of adenoid hypertrophy as a risk factor in the pathogenesis of OME [6].There was slight male preponderance (Male: Female of 1.4; 1); they also noted that there was a significant association between grade 3 adenoid hypertrophy and development of OME (P- value of 0.02), thus an important risk factor for developing OME in children [6]. A study by James et al observed more male children having higher incidence of OME than female children. They also observed 78.26% of the children had dull and retracted tympanic membrane on otoscopy, while 34.78% had classical amber colored tympanic membrane with air-fluid level; mobility of the tympanic membrane was observed in 13.04% on pneumatic otoscopy, while in the remaining 86.96% no movement was observed [30].

Tympanometry patterns

There are three major patterns of tympanograms which indirectly reflect the three degrees of tympanic membrane mobility. Type "A" pattern is a sharp peaked pattern with the peak somewhere between + 50 to -150 data. "As" (s = shallow) tympanogram pattern has a low peak amplitude of compliance suggesting stiffened middle ear system. Ad (d = deep) tympanogram pattern occurs when the TM is very flaccid or when there is disarticulation of the ossicular chain. Type "B" tympanogram reflects impaired compliance or increased impedance of the motion of the TM over the continuum of pressure gradient. Type "C" tympanogram is similar to type "A" but the peak is to the left of normal pressure or in other words more negative than – 150 data [31] A similar study by Orji et al found an incidence of 35% using only Type "B" tympanogram [32].

OME is diagnosed on Tympanometry by Type "B" Tympanogram, although there are other causes of type B tympanogram that need to be excluded like Tympanic membrane perforation which need to be excluded prior to the procedure. A study by Gunel et al suggested that adenoid hypertrophy is associated with increased negative middle ear pressure. They found type B tympanogram in 13 of the 112 ears pre-operatively [33] Another study in Kenya by Mwaniki et al in 2015 found a prevalence of 67.3% for Type B and 5.8% for type C [34].

In another study done at Howler Medical University in Erbil, Iraq, it was found that the most common type of tympanogram seen among children with OME because of adenoid enlargement is Type "B [35]. Epidemiologically, chronic Aden tonsillar hypertrophy is the most common cause of Eustachian tube dysfunction in children causing otitis media with effusion. Nwosu et al in a study conducted in Port Harcourt, Nigeria, with a sample size of 68 cases of adenoid hypertrophy (136 ears) involving both genders, found the incidence of OME among patients with Adenoid hypertrophy to be 55.9% with more type B (29.4%) than type C tympanogram (26.5%) [2]. When compared with the control, there was approximately a fourfold increase in the incidence of OME. In the study majority of the children were in the age group 2 – 4 years. There were more bilateral cases of OME than unilateral [2] Orji et al in Enugu reported OME among patients with adenoid hypertrophy to be 35% using only type B tympanogram noted a sevenfold increase in incidence of OME when compared with the control. This was significant.33Mwaniki et all's Kenya study in 2015, noted higher incidence of OME in children with adenoid hypertrophy with prevalence of type B and C tympanograms as 67.3% and 5.8% respectively [35].

Ajayan et all's study of 35 cases (70 ears) observed the most prevalent age group as 4-6years (37.2%) followed by the 7-9years age group (31.4%).36Mobility of the tympanic membrane was detected on pneumatic otoscopy in only 17.4% of cases and no movement was seen in 82.86% [36] From all these studies, type B Tympanogram was consistently higher than other types. Various increase in incidences was noted. Tympanometry (alongside history and clinical examination) is the most commonly used method in the diagnosis of OME. It has been confirmed as sensitive and fairly specific in identifying children with conductive hearing loss associated with OME. A study conducted in Pakistan by Khurshid Anwar et al in 2016 involving 63 patients with suspicion of OME, found type B tympanogram with normal canal volume to be fairly sensitive in diagnosing OME. The diagnostic value of tympanometry was; sensitivity 85.85% and specificity 72.22% and suggested a combined approach including detailed history, pneumatic otoscopy and tympanometry in diagnosing OME [24] In a similar study conducted by Daraj et al in Dubai in 2020, found specificity and sensitivity of tympanometry to be 88.2% and 85.2% respectively and suggested a comprehensive approach including detailed history, physical examination along with audiologic tests including tympanometry [22].

Comparison of pneumatic otoscopy and tympanometry

Rogers et al compared Binocular microscopy, pneumatic otoscopy and tympanometry. He found that binocular microscopy by staff pediatric otolaryngologist revealed the best sensitivity and specificity. Pneumatic otoscopy even performed by an inexperienced examiner is more sensitive and specific than tympanometry. The tympanometry is less specific in children under 1 year of age. Binocular microscopy by staff pediatric otolaryngologist was the most sensitive, 88.0% (95% CI 81.4-

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94.7), and specific, 89% (95% CI 83.1-94.9). Resident binocular microscopy revealed a sensitivity of 81.5% (95% CI 73.6-89.5) and specificity 78.9% (95% CI 71.2-86.6). Staff was more sensitive and specific than resident at pneumatic otoscopy, sensitivity 67.9% (95% CI 57.6-78.3) and specificity 81.4% (95% CI 73.8-88.9) versus 57.7% (95% CI 46.7-68.7) and 78.4% (95% CI 70.4-86.4). Tympanometry had a much lower specificity for ages 5-12 months than for older children [37].

The diagnostic accuracies of tympanometry and pneumatic otoscopy conducted by experienced uroscopists has been noted to match, as reported by Lain while referring to the study by Toner and Mains in 1990. In their study, they found that tympanometry had a sensitivity of 86% and pneumatic otoscopy had a sensitivity of 87% compared to myringotomy. Conversely, they reported a specificity of 93% for tympanometry and 89% for pneumatic otoscopy.38 Melker studied the value of pneumatic otoscopy in primary care compared to tympanometry in diagnosing OME. All pneumatic assessments on 111 children were done by one trained nurse. The sensitivity of pneumatic otoscopy was low (45%) but the specificity was high (99%) [39] In the hands of experienced uroscopists, pneumatic otoscopy is accurate [38] It has been reported that a meta-analysis by Takata et al. showed a pooled sensitivity of 94% and a specificity of 80% for trained uroscopists diagnosing OME with pneumatic otoscopy compared to myringotomy [38].

Method

The study was a comparative cross-sectional hospital-based study. It compared the diagnostic value of pneumatic otoscopy with that of tympanometry in children with obstructive adenoid enlargement seen at the JUTH.

a) Study population: Children aged 2-12 years of all gender with Obstructive Adenoid enlargement attending ENT clinic of JUTH were enrolled in this study.

b) Sample size determination: The minimum sample size (n) for the study was obtained using the following formula [40]:

c)

$$n = 2\frac{(Z_\alpha + Z_\beta)^2\ (\mathrm{p_1q_1} + p_2q_2)}{(p_2 - p_1)^2}$$

Allowing for 10% attrition rate, a calculated minimum sample size of 95 was used.

Participants eligibility criteria

a. Inclusion Criteria: Patients aged 2 – 12 years with symptoms and signs of Obstructive Adenoid enlargement and met indications for Adenoidectomy and consent to the study (by the care giver/guardian)

b. Exclusion Criteria: These included: - non consenting Patients/guardian, patients with acute upper respiratory tract infections, acute otitis media and otitis externa, tympanic membrane perforation, children with cleft palate, syndromic children and children who have had otologic surgeries like previous tympanoplasty.

Sampling technique and research instrument

A consecutive sampling technique (total enumerative sampling) was used for selection of study participants.

a) All children with diagnosis of Adenoid enlargement that met the inclusion criteria (which include recurrent rhinorrhea, snoring, nasal blockage, mouth breathing, sleep apnea, hyperactivity, daytime hypersomnolence and adenoid nasopharyngeal ratio of ≥0.5 calculated using Fujioka et al method from x-ray post-nasal space) [41] were interviewed. If the respondent does not consent to participate in the study, the next respondent was selected (consecutive sampling method). This method was used until the sample size was met.

b) The data collection was done over a period of one (1) year.

Research Instruments

A standard protocol was used for clinical assessment of the patients, and filling of interviewer assisted questionnaire. Physical examination shall be carried out using:

Good light source: LED headlight®, head lamp.

Wooden tongue depressor

I. Face mask

II. Surgical Gloves

III. Heine's Mini 3000 Fiber optic Otoscope with a pneumatic cuff

IV. HOMOTH Timp 4000 Tympanometry

V. Umbrella and mushroom probe tips (226Hz)

VI. Cotton wool

VII. Methylated spirit

The Pneumatic Otoscopy was performed at the ENT Clinic, while tympanometry was performed at the Audiology Laboratory in Jos University Teaching Hospital by the Principal investigator.

Precautions Taken Include

a) Participant preparation was done which includes making sure there was no ear discomfort through questioning e.g. ear discharge, pain or had surgery involving the ears.

b) Participants were instructed not to swallow or speak while test is on

c) During the Pneumatic otoscopy, appropriately sized speculum for age and canal size was used.

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d) The Tympanometry and probe tip was cleaned with methylated spirit (i.e. free from dust and dirt and in compliance with local infection control standards)

e) The calibration of the Tympanometry was checked.

f) Appropriate size Tympanometry probe for age and canal size was used and properly fitted.

Procedure and Data Collection

Questionnaire was administered (for those that cannot speak English, it was translated to them) in the language they understood. All participants satisfying the inclusion criteria were identified, their biodata and history was obtained by interviewing them. Thereafter, a physical examination including ear, nose and throat examination, Pneumatic otoscopy was done using Heine's Mini 3000 Fiber optic Otoscope with a pneumatic cuff and tympanometry was performed using HOMOTH Timp 4000 Tympanometry and the findings noted.

Pneumatic otoscopy

Otoscopy was performed to make sure there was no ear wax or foreign body obstructing the external auditory canal. Patient was counselled to reduce movement and also not to speak during the procedure.

a. The tip of the otoscope was inserted into the ear canal, ensuring that a strong seal is made with the canal.

b. The color, translucency, and position of the tympanic membrane were assessed. Visualization of the tympanic membrane landmarks, such as the 4 quadrants including the cone light reflex, malleus, and umbo was done.

c. Retraction of the tympanic membrane by noting the position of the lateral process of the malleus was noted as well as any foreshortening of the long process of the malleus.

d. The Tympanic membrane mobility by application of positive pressure (gently squeezing the rubber bulb and then releasing) and negative pressure (squeezing the bulb before insertion and release it once the seal is made) was done.

Tympanometry procedure

An appropriately sized probe with a soft rubber cuff (umbrella-shaped tip) was positioned at the entrance of the external auditory canal and the Tympanometry switched on; this changes the air pressure in the ear canal. Tracing of compliance and pressure was recorded in a tympanogram. The procedure lasted between 5 – 10 mins for both ears. Data collected from the questionnaire was imported into IBM – Statistical Product and Service Solution (SPSS) version 26.0 for analysis. Basic univariate descriptive statistics of the sociodemographic characteristic were presented in frequencies and percentages. Bivariate analysis was done using Chi-square test and student t-test to compare pneumatic otoscopy and tympanometry findings. Level of statistical significance was set at P value of < 0.05 (i.e. 95% confidence interval). An informed written consent was obtained from participants' parents/guardians prior to recruitment into the study with assurance of anonymity and confidentiality of information provided by them. Participants were allowed to opt out of the study at any stage of the study. Ethical clearance was obtained from the research and Ethics Committee of JUTH, Plateau State with reference number JUTH/DCS/IREC/127/XXIX/1779.

Limitation of the Study

It is possible that obstructive Aden tonsillar enlargement and OME may be caused by same a etiological factor/agent and so may be difficult to identify the particular an etiological factor.

Results

A total of 190 ears (95 patients) were evaluated, the age of the patients ranged from 2-12 years with a median age of 4 years (interquartile range 3.0- 5.0); the most prevalent age group was 2-5 years (78.9%) followed by the 6-9 years group (15.8%) (Table 1).There were 58(61.1%%) males and 37(38.9%) females (Table 1).Right otoscopy revealed normal tympanic membrane in 45 ears (47.4%), bulging tympanic membrane in 16 ears (16.8%), retracted tympanic membrane in 19 ears (20.0%) and air-bubbles in 15 ears (15.8%) while left otoscopy findings are as indicated on Table 2. Right Pneumatic otoscopy findings showed Tympanic membrane mobility in about 63 ears (66.3%) and 69 ears (72.6%) on the left Pre-operatively, Percentage of normal tympanogram (Type A) in 190 ears was 38.4%. Percentage of type B tympanogram in 190 ears was 24.7% and percentage of type C tympanogram in 190 ears was 36.8% (Table 3 & 4).

Table 1: Age and Sex Distribution of Patients.

Parameter	Frequency	Percentage (%)
Age (Years)		
02-May	75	78.9
06-Sep	15	815.
10-Dec	5	5.3
Sex		
Male	58	61.1
Female	37	38.9

Median= 4.0 years (IQR 3.0-5.0) n=95.

Table 2: Otoscopy Findings.

Otoscopy Findings	Frequency		Percentage (%)	
	Right	Left	Right	Left
Normal	45	51	47.4	53.7
Bulging	16	17	16.8	17.9
Retracted	19	18	20	18.9
Air Bubbles	15	9	15.8	9.50%
Total	95	95	100	100

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Table 3: Pneumatic Otoscopy Findings.

Pneumatic Otoscopy	Frequency		Percentage (%)	
	Right	Left	Right	Left
Mobile	63	69	66.3	72.6
Not Mobile	32	26	33.7	27.4
Total	95	95	100	100

Table 4: Tympanometry Findings.

Right		
Tympanometry	**Frequency**	**Percent**
Type A	33	34.7
Type B	28	29.5
Type C	34	35.8
Total	95	100
Left		
Tympanometry	**Frequency**	**Percent**
Type A	40	42.1
Type B	19	20
Type C	36	37.9
Total	95	100

Table 5: Comparison Between Pneumatic Otoscopy and Tympanometry.

Tympanometry Finding							
Pneumatic Finding	**Type A**	**Type B**	**Type C**	**Total**	**Do**	**X^2**	**p-Value**
Right							
Mobile	33 (52.4%)	0 (0.0%)	30 (47.6%)	63 (100%)	2	79.2	<0.001
Non-Mobile	0 (0.0%)	28 (87.5%)	4 (12.5%)	32 (100%)			
Total	33 (34.7%)	28 (19.5%)	34 (35.8%)	95 (100%)			
Left							
Mobile	40 (58.0%)	0 (0.0%)	29 (42.0%)	69 (100%)	2	66.633	<0.001
Non-Mobile	0 (0.0%)	19 (73.1%)	7 (26.9%)	26 (100%)			
Total	40 (42.1%)	19 (20.0%)	36 (37.9%)	95 (100%)			

Post-operatively in 190 ears, the percentage of type A tympanogram was 79.5%, type B was 11.1% and type C was 9.5%. Right pre-operative tympanometry showed 33(34,7%) ears have type A' tympanogram, type B 28 (29.5%) ears and type C 34(35.8%) ears and left pre-operative tympanometry showed 40 (42.1%) ears have type A tympanogram, type B tympanogram 19(20.0%) ears and type C tympanogram 36(37.9%) ears (Table 4 & 5). Pneumatic otoscopy findings with their corresponding tympanometry findings revealed 63 ears on the right were mobile with 33(52.4%), 0(0.0%) and 30(47.6%) types A, B and C respectively and 32 ears were non-mobile with 0(0.0%), 28(87.5%) and 4(12.5%) types A, B and C respectively while on the left 69 ears were mobile with 40(58.0%), 0(0.0) and 29(42.0%) types A, B and C tympanograms respectively while 32 ears were non-mobile with 0(0.0%), 19(73.1%) and 7(26.9%) types A, B and C tympanograms respectively.

Discussion and Conclusion

In this study majority of the children (78.9%) were in the age group of 2-5 years or the preschool age group followed by age group 6-9 years (15.8%) and 10-12 years (5.3%) age group. This finding concurred with a study in Nigeria by Nwosu et al, in which the pre-school age group of 2-4 years was predominant but with a relatively lower percentage of 52.9% than the 78.9% of the present study. However, in the school age group, this study contrasted sharply in both the age group and percentage composition of 15.8% as against the 23.5% obtained by Nwosu et al in the school age group of 5-7 years. James et al in India found majority of the

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children (34.8%) to be within the age group of 5-7 years;30 this is at variance in both percentage and composition with the present study where majority (78.9%) were in the pre-school age group of 2-4 years. The median age of 4.0 years (interquartile range of 3-5 years) as found in this study concurred with the findings of both Nwosu and Orji et al in Nigeria who reported a mean age of 4.0 years.3,32 This is at variance with the works of James et al where they reported a mean age of 5.3 years.30.

There were 58(61.1%) males and 37(38.9%) females giving a male: female ratio of 1.6:1. This slight male preponderance is similar to the findings by Nwosu et al and studies conducted by other researchers.32,30

Otoscopic findings in this study revealed normal tympanic membranes in majority of the patients with 96(50.5%) ears out of the 190 ears, 33(17.4%) ears had bulging tympanic membrane, 37(19.5%) ears had retracted and dull tympanic membrane and 24(12.6%) ears had air bubbles in the middle ears behind the tympanic membranes. This sharply contrast the findings by Ajayan et al where they found majority (78.5%) of the patient's ears with dull and retracted tympanic membranes.36 This could be explained by the fact that all patients had features of OME as inclusion criteria resulting in high percentage of type B tympanogram pre adenoidectomy.

Mobility of the tympanic membranes was observed on pneumatic otoscopy in 132(69.5%) ears of the 190 ears while in the remaining 58(30.5%) ears, no movement was appreciated (which is a reliable sign of OME). This is in disparity to the findings in a study by James et al where they found immobile tympanic membranes in 86.95% of the ears. This could be explained by their inclusion criteria where all the patients had clinical features suggestive of OME which contrasts with this study in which patients with adenoid enlargement and ANR > 50% were included. [13,30]. According to the Agency for Health Care Research and Quality, otoscopic appearance is reliable in two-third of cases.42 Type A, B and C were 36.8%, 24.7% and 38.4% respectively. This showed type A and C tympanograms to be the most common findings followed by type B. This contrasts with the study by Nwosu et al in Port Harcourt, where they found type A tympanogram to be the most common in 44.1%, type B tympanogram in 29.4% and type C tympanogram in 26.5%.3 Kumar et al, James et al in India and many others found type B tympanogram to be the most prevalent.[3, 13,30,32] This could be attributed to the inclusion criteria of only type B tympanogram or patients with clinical features of OME pre-adenoidectomy in their studies.

Comparison Of Pneumatic Otoscopy and Tympanometry Findings

In this study pre-adenoidectomy pneumatic otoscopy revealed 132(69.5%) of the tympanic membranes were mobile out of which 55.3% and 44.7 were type A and C tympanograms respectively. None of the ears had type B tympanogram while 58(30.5%) of the tympanic membranes were non-mobile out of which 81.0% and 19% were type B and C tympanograms respectively. None of the ears had type A tympanogram. This is in contrast with the findings of Nwosu et al, Rajashekar, Ajayan et al and James et al where they found most of the tympanic membranes to be non-mobile. [3,4,30,36].

Conclusion

This study showed high prevalence of otitis media with effusion and Eustachian tube dysfunction evident by type B and C tympanograms respectively in patients with adenoid enlargement pre-adenoidectomy which was confirmed by the pre-adenoidectomy tympanogram with a significant Pneumatic otoscopy in 58(30.5%) ears, with no movement appreciated which is in keeping with Mathis study showed significant agreement between pneumatic otoscopy and tympanometry in the diagnosis of OME; combination of both would improve outcome of diagnosis. Early diagnosis of OME using simple investigation like tympanometry in combination with pneumatic otoscopy would aid in early identification of at-risk and established cases of OME and its sequalae thereby allowing early surgical intervention (adenoidectomy) if medical treatment failed. This study has assessed the role of pneumatic otoscopy and tympanometry in investigating adenoid enlargement patients with OME.

I. Therefore, pneumatic otoscopy and tympanometry are highly recommended in children with obstructive adenoid enlargement for early detection of eustachian tube dysfunction and OME.

II. Parents and care givers especially kindergarten and primary school teachers should be sensitized on the significance of early detection using pneumatic otoscopy and tympanometry as a screening tool and proper treatment instituted to prevent sequalae of OME and improving hearing, language and speech development thus improving academic performance of affected children.

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