COMPARISON BETWEEN PNEUMATIC OTOSCOPY AND TYMPANOMETRY IN DIAGNOSING MIDDLE EAR EFFUSION

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ABSTRACT

Background: *Otitis media with effusion (OME) is a common condition of the middle ear in children characterized by accumulation of fluid without acute symptoms or signs of infection causing hearing impairment. Tympanometry is a reliable diagnostic tool that has the capability of indirectly detecting fluid collection in the middle ear. Pneumatic otoscopy similarly has this capability to a lesser degree. Both tools have been demonstrated to be reliable.*

Aim and Objective: *To compare pneumatic otoscopy and tympanometry in the diagnosis of OME.*

Subjects and Methods: *This was a cross-sectional community-based study. Ten schools from the two Local Government Areas of Sokoto metropolis were randomly selected comprising Private and Public nursery and primary school pupils between the ages of four and seven years. Pneumatic otoscopy was done in each ear followed by tympanometry. The data was collated and analyzed using a statistical package for Social Sciences (SPSS) version 20.*

Results: *Pneumatic otoscopy correctly predicted normal mobility in 394 out of 399 ears identified to have type A or C1 tympanogram and impaired mobility in 52 out of 61 ears with either B or C2 with sensitivity of 85.3% and specificity of 98.3%.*

Conclusion: *When compared with Tympanometry, Pneumatic Otoscopy has a sensitivity of 85.3% and specificity of 98.7% in predicting the Tympanogram Type. This represents a fairly good agreement between tympanometry and pneumatic otoscopy in the diagnosis of OME.*

Keywords: *Otitis media with effusion, Tympanometry, Pneumatic otoscopy*

INTRODUCTION

Pneumatic Otoscopy is a well-known method used to assess the presence or absence of a middle ear effusion. [1] The purpose of pneumatic otoscopy is to determine the mobility and appearance of the tympanic membrane. Normal tympanic membrane mobility indicates the absence of middle ear effusion while the absence of or decreased mobility of tympanic membrane is indicative of middle ear effusion. Pneumatic otoscopy has been found to be effective in assessing middle ear conditions.[1] It is cheap and easy to use. Recent clinical practice guidelines for otitis media with effusion recommend that clinicians use pneumatic otoscopy as the primary diagnostic method for middle ear effusion.[2] The accuracy of identifying middle ear effusions using pneumatic otoscopy improves with clinical experience.[2] Pneumatic otoscopy may be used to diagnose OME in low resource settings where tympanometers are not affordable.

The use of acoustic immittance tests, such as tympanometry, is a powerful adjunct to the use of behavioral tests in providing data about the middle ear system.[3] Tympanometry is an objective measure of middle ear status that is commonly used in diagnosing otitis media with effusion (OME) in clinical setting.[3]

Specifically, tympanometry provides an estimation of intra tympanic pressure, eustachian tube function, tympanic membrane integrity and mobility, and continuity of the ossicular chain.[4] It is commonly employed for diagnostic and research purposes. It is non-invasive and easy to perform; and has a high accuracy rate with a sensitivity of between 73 and 99 percent and specificity of between 40 and 74 percent in detecting middle ear effusion.[5]

In tympanometry, a probe tone usually at 220Hz is introduced into the external auditory canal and the amount of sound reflected back from the tympanic membrane is measured as the pressure in the ear canal is varied from positive to negative, from +200 to -400mmH_2O. The tympanogram is a graph that plots the variation in air pressure (dapa) on X-axis to immittance (mmH_2O) on Y-axis. It was first described by Jerger in 1970 and modified by Fiellau Nikolajsen in 1983 according to which four main types of graphs were reported.[6,7] Type A graph is the one found when the middle ear pressure is from +200 to -99 mmH_2O. It is found in normal ear when the peak occurs at atmospheric pressure (0), because the Eustachian tube is functioning normally and, periodically ventilating the middle ear with normal TM and middle ear compliance. Type B graph depicts flat traces without a well-defined compliance. It is found that when there is fluid in the middle ear or canal, it is occluded by cerumen or tympanic membrane (TM) perforation. Type C graph is of two types. A type C_1 is found in middle ear negative pressure from -100 to -199mmH_2O and it points towards mild ET dysfunction while type C_2 graph is found in negative middle ear pressure from -200mmH_2O to -400mmH_2O and it indicates moderate to severe ET dysfunction.

Type A graph is further classified into As in which the peak occurs at 0 but with reduced height. It occurs in conditions like otosclerosis or scarred TM. A type Ad graph is found when the middle ear system is hyper mobile as in flaccid TM or ossicular discontinuity.

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METHODOLOGY

This study was a prospective cross-sectional study carried out among nursery and primary school pupils within the Sokoto metropolis. It included pupils in both public and private schools within the ages of 4 to 7 years. It was conducted between July 2017 and December 2018. It excluded those children with a history of ear discharge, tympanic membrane perforation, previous ear surgery and congenital external and middle ear anomalies. The estimated minimum sample size was 226.

A multi-staged sampling technique was employed among four Local Government Areas of Sokoto metropolis with a total of 299 schools; two local government areas were selected using simple random sampling; proportionate allocation was used to allocate number of schools to each local government area, where 10 schools were selected; population proportion to size was used to allocate number of pupils to each school; and systematic random sampling was used to select the pupils. The minimum sample size for this study was determined using the Leslie and Kish formula for sample size determination: $n= z^2 pq/ d^2$.[8] Ethical clearance was obtained from Usmanu Danfodiyo University Teaching Hospital (UDUTH) and informed consent given by the parents/ guardians of the participants. A structured questionnaire was administered and complete ENT examination was carried out for all the participants. Tympanometry was carried out using Oscilla TSM Tympanometer model, TSM300-1420-VAA (Denmark) with frequency of 220Hz, pressure range of +200 to -400mmH_2O. Types B and C2 were used as indicators of OME. Pneumatic otoscopy carried out using a pneumatic otoscope and the data collected and analyzed using SPSS version 20 and the comparison between tympanometry and pneumatic otoscopy determined.

RESULTS

Out of 371 ears with type A, pneumatic otoscopy recorded mobility in 369, 47 out of 51 with type B had TM with impaired mobility and only 3 out of 28 ears with type C1 recorded impaired mobility. Five out of 10 with C2 recorded immobile TM with pneumatic otoscopy. Pneumatic otoscopy correctly predicted normal mobility in 394 out of 399 ears identified to have type A or C1 tympanogram and impaired mobility in 52 out of 61 ears with either B or C2 with sensitivity of 85.3.0%, specificity of 98.8%, positive predictive value (PPV) of 91.2% and negative predictive value of 97.8% with kappa coefficient of 0.6. This is shown in Table 1.0.

Table 1.0: Comparing Pneumatic Otoscopy and Tympanometry
n=230

	Type B or C2	Type A or C1	Total
Impaired mobility	52 (91.2%)	5 (8.8%)	57 (100%)
Mobile	9 (2.2%)	394(97.8%)	403 (100%)
Total	61	399	460

With regards to predicting the Tympanogram type, Pneumatic Otoscopy has: -
Sensitivity = 52⁄61 x 100 = 85.3%
Specificity = 394/399 x 100 = 98.8%
Positive predictive value = 52/57 x 100 = 91.2%.
Negative predictive value = 394/403x 100 = 97.8%
A test is said to be acceptable when the sensitivity, specificity and predictive values are at least 90%.

DISCUSSION

The findings in this study showed a fairly good agreement when pneumatic otoscopy was compared with tympanometry and this suggests it can reliably be used in the absence of the tympanometer in the diagnosis of OME. The finding is similar to that by Ammar et al which also found that pneumatic otoscopy agreed with tympanometry in diagnosing OME.[9] This might be due to the fact that both studies used similar diagnostic criteria in which types B and C2 were considered diagnostic of OME. A study conducted by Sundvall also revealed that tympanometry is comparable to pneumatic otoscopy in diagnosing middle ear effusion.[1] Harris et al also found agreement between pneumatic otoscopy and tympanometry in detecting middle ear effusion.[10] Pneumatic otoscopy has also been found to have similar diagnostic accuracy with tympanometry with both having sensitivity and specificity of 70% and 90% respectively.[11] A study conducted by Rosenfeld et al also reported that the diagnostic accuracy of tympanometry was the same with that of pneumatic otoscopy in diagnosing otitis media with effusion.[12] However, a study carried out by De Melker also found tympanometry to be superior to pneumatic otoscopy [13]. Similarly, a study conducted by Watters et al found tympanometry to be superior to pneumatic otoscopy in diagnosing middle ear effusion in which type A and C tympanograms were considered as dry ear and only type B tympanogram was diagnostic of middle ear effusion.[14] Pneumatic otoscopy was, however, found to be better than tympanometry in diagnosing middle ear effusion in a study carried out by Mariza et al. [15] A similar finding was reported by the Canadian Task force in which pneumatic otoscopy was found to be better than tympanometry in diagnosing middle ear effusion.[16] Another study by Helenius et al stated that pneumatic otoscopy is more reliable than tympanometry in diagnosing middle ear effusion.[17]

CONCLUSION

Comparing pneumatic otoscopy findings with tympanometric pattern in the diagnosis of middle ear effusion in this study population found that pneumatic otoscopy has a sensitivity of 85.3% and specificity of 98.8% in predicting the tympanogram type.

Recommendations

1. The use of pneumatic otoscopes should be encouraged among practitioners working in low-resource settings where tympanometers may not be available.

2. Further research using tympanocentesis should be carried out to further confirm the validity of pneumatic otoscopy in the diagnosis of OME for research purposes.

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