ORIGINAL ARTICLE

OTOSCOPY COMPARED WITH TYMPANOMETRY: An evaluation of the accuracy of simple otoscopy.

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Abstract

Background: *Although otoscopy has been shown to compare favourably with results of tympanometry, the actual diagnostic value of otoscopy for otitis media with effusion (OME) has not been evaluated in Nigeria. The study was aimed at evaluating the sensitivity, specificity and predictive value of otoscopy in the diagnosis of OME as compared with tympanometry.*

Method: *It was a prospective hospital-based, descriptive cross-sectional study in which the results of simple otoscopy were compared with results of the tympanometry of 82 ears of children aged between 6 months and 12 years, who presented to the Otolaryngology clinics of the UNTH Enugu with symptoms of obstructive adenoid enlargement.*

Results: *Simple otoscopy produced 84.4% agreement with tympanometry in detecting OME. The agreement was better in older children than the younger ones (P <0.05). Simple otoscopy was more specific in detecting ears considered normal than abnormal ears. Among the abnormal ears, otoscopy was more sensitive in its detection of OME than negative middle ear pressure. Retraction of the tympanic membrane was the most specific otologic finding in detection of OME.*

Conclusion: *Simple otoscopy is comparable to the accuracy of tympanometry in the diagnosis of OME.*

Keywords: *Otoscopy, tympanometry, validity, otitis media with effusion.*

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Introduction

Although tympanometry is generally accepted as a reliable diagnostic method for otitis media with effusion[1-3], otoscopy has been shown to compare favourably with results of tympanometry [3-6]. Otoscopy is therefore still an important diagnostic tool in the evaluation of otitis media with effusion (OME). Only one study evaluated the degree of agreement between otoscopy and tympanometry in Nigerian children[4].The actual diagnostic value (sensitivity, specificity and predictive value) of otoscopy for OME has not been evaluated in Nigeria. This present study was therefore aimed at determining the sensitivity, specificity and predictive values of otoscopy in the diagnosis of OME using tympanometry as the reference test.

Method

This present work was a prospective hospital-based, descriptive cross-sectional study. The study population consisted of consecutive children aged 6 months to 12 years with obstructive adenoid disease that presented to the authors over a period of 13 months between March, 2004 and April, 2005. In the course of their evaluation prior to treatment, the otologic complications (which included acute otitis media and OME) were evaluated for each child using both simple otoscopy and tympanometry.

The study protocol was explained to the patients and parents or guardian in a language they understood and written informed consent obtained from the parents or guardian.

The research protocol was reviewed and approved by the UNTH hospital ethical review committee.

The otoscopy was carried out using a battery-powered 'Keeler' otoscope after the external auditory canals were first cleaned out of any cerumen or debris. The appearances of the tympanic membranes were categorized into two groups as follows: (i) “Normal”; representing the tympanic membranes that had normal architecture and light reflex at the pars tensa. (ii) “Abnormal”; representing tympanic membranes that had appearances consistent with OME dullness, retraction, dull red discoloration.

The tympanometry was carried out using “SAT 12; Audio Med” impedance meter. The impedance meter 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 226 Hz was used to test both ears of each patient. The

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tympanograms obtained were analyzed using the modified Jager's classification [7] as follows:

- Type A = normal middle ear function. (The maximal compliance ranged from 0.39 ml to 1.30 ml. While middle ear pressure range from +200 mm of water 99mm of water)

- Also included here are subtypes A_s (low maximum compliance at normal pressure), and A_d (very high compliance at normal pressure).

- Type C = Eustachian tube dysfunction (Point of maximal compliance occurring below 100 mm of water)

  C_1 = middle ear pressure of 100 to 199mm of water C_2 = middle ear pressure of 200 to - 400 mm of water

- Type B = presence of middle ear effusion. (Flat curve of the compliance tracing).

The various tympanograms obtained were categorized into: type B (indicating presence of middle ear effusion), type A (normal), and, type C. Both types A and type C represented ears without middle ear effusion. The exclusion criteria for tympanometry included: those that had active ear discharge, and/or tympanic membrane perforation, otitis externa, and acute otitis media.

Otoscopy was carried out before tympanometry on each ear. The reason was to prevent otoscopic evaluation from being influenced by the result of tympanometry; and to select those that were eligible for tympanometry. The appearances of the tympanic membranes were compared with the results of tympanometry. By using tympanometry as a reference test, sensitivity, specificity and predictive values of otoscopy were determined.

Results

Out of a total of 128 ears that were initially examined otoscopically, 82 ears met the criteria for inclusion and analysis. 46 ears that were initially evaluated by otoscopy were excluded from tympanometry on account of either an active ear discharge or perforation of the ear drum or otitis externa, or acute otitis media.

The result of simple otoscopy showed the appearance of the tympanic membranes considered as normal in a total of 43 (52.4%) ears, and abnormal appearances of the tympanic membranes in 39 (47.6%) ears. Of the abnormal otoscopic findings, dullness of tympanic membranes accounted fo 12.8% (5 years) and 15.4% (6 ears) respectively.

Table I shows the distribution of the various tympanic membrane appearances among the tympanogram types.

Of the 82 tympanograms obtained, type A tympanogram was found in 32 ears (39.0%) and no ear had type A_s or type A_d. Type C was obtained in a total of 18 ears (22.0%). 32 ears (39.0%) had type B tympanogram.

Table I: **Otoscopic Findings Vs Tympanometry Results. n = 82 ears.**

Otoscopic Findings	Tympanogram Types			No of ears
	A	B	C	
Normal	27	5	11	43
Dullness	3	19	6	28
Red Discoloration	2	2	1	5
Retraction	_	6	_	6
Total	**32**	**32**	**18**	**82**

The highest proportions of abnormal tympanic membrane appearances were associated with types B (84.4%) and C (38.9%) tympanograms. 15.6% of the total type A tympanogram was associated with abnormal ear drums and 84.4% of them had normal ear drums. Comparison of the tympanogram types with clinical otoscopic appearances was shown in Table 2.

Table II: **Tympanogram Types Compared With Clinical Otoscopic Findings. n=82 ears.**

Tympanogram Types	Otoscopic Appearances			
	Normal	(Proportions)	Abnormal	(Proportions)
A	27	(84.4%)	5	(15.6%)
B	5	(15.6%)	27	(84.4%)
C	11	(61.1%)	7	(38.9%)
Total	43	(52.4%	39	(47.6%)

Using the result of the tympanometry as a reference, the validity of otoscopic result was tested. Thus, the sensitivity of abnormal otoscopy for OME (type B tympanogram) was 84.4% and its specificity was 76.0%. The predictive values of otoscopy for OME and

normal middle ears were 69.2% and 88.4% respectively. On the other hand, the sensitivity and specificity of abnormal otoscopic appearances of tympanic membranes for type C tympanogram were 38.9% and 50% respectively.

The sensitivity of abnormal otoscopy for OME in children below the age 4 years was 82.2% and was 91.9% in children aged 4-12 years. The difference was statistically significant ($p < 0.05$) .

The sensitivities of red discoloration, retraction, and dullness of the tympanic membranes for diagnosis of OME (type B tympanogram) were 6.3%, 18.8%, and 59.4% respectively; while the specificities of dullness and retraction of the tympanic membranes in the diagnosis of OME were 82% and 100% respectively.

Discussion

The results of otoscopy have been reported to be examiner dependent with an inter-examiner agreement of 50%-85% depending on the parameters studied [8]. Several factors related to the examiner vary among the examiners, of which the skills and experience are among the most important. However, the degree of agreement between the result of otoscopy and that of tympanometry is a measure of the examiners accuracy with otoscopy. Tympanometry is a generally accepted - reliable diagnostic and screening device for middle ear effusion[1-3] with sensitivity values of 93% - 97%[6, 9]. A number of studies have compared otoscopy with tympanometry but the tympanometric indices as well as the age range of the children examined varied[3,4,5,6,9] and these have made the comparison of results among researchers difficult.

In the present study, the highest proportion of abnormal ear drums (84.4%) was associated with type B tympanogram. With reference to the result of tympanometry, the sensitivity of the abnormal tympanic membrane appearances in the detection of OME was also calculated to be 84.4%. Therefore the degree of agreement or correspondence between otoscopy and tympanometry with respect to the diagnosis of OME was 84.4%. However the specificity of otoscopy was relatively lower (76%) showing that the accuracy of otoscopy was 24% poorer than tympanometry in the diagnosis of OME. It was also observed that not all abnormal ear drums were associated with OME as significant proportion of normal ears with normal type A tympanogram were found to have abnormal ear drums appearances on otoscopy (15.6%).

Similarly, Ogisi reported that the highest proportions of abnormal ear drums on otoscopy in his series were associated with type B tympanogram (60%)[4]. In another study comparing the results of simple otoscopy with tympanometry among 785 unselected ears, 83% agreement was found between the two methods[5].

In the present study, the predictive value of otoscopy was better in normal ears than ears with OME, thus indicating that otoscopy was more accurate in detecting normal ears free of OME than pathological ears having OME. Gimsing et al similarly reported better agreement between the results of simple otoscopy and tympanometry in evaluating ears that were normal (96%) than pathological ears (72%) [5].

The sensitivity of the otoscopy for OME was significantly better in older children than in the younger age group which is similar to the report of Gimsing et al [5]. Other researchers also reported better sensitivity of otoscopy in older than younger children [1,3]. These findings may be due to the fact that the tympanic membranes of older children are likely to be seen more clearly than that of the younger children. The external auditory canals in younger children are relatively narrower thus minimizing the accuracy of their tympanic membrane appearance on otoscopy.

Otoscopy was more sensitive in detecting ears with OME (84.4%) than those having only negative middle ear pressure of -100mmHg and above (38.9%). This is because OME is more likely to impact obvious observable changes on the tympanic membrane than mere negative middle ear pressure.

It is observed that dullness of the tympanic membrane was the most frequent abnormal otoscopic finding (71.8%), while redness and retraction were less frequently observed. Correspondingly, dullness was the most sensitive abnormal otoscopic finding in detecting OME. However, retraction of the tympanic membrane proved to be the most specific otoscopic finding in detecting OME. These findings therefore signify that retraction of tympanic membrane is the most reliable otoscopic finding for the diagnosis of OME. This is similar to the reported findings by other researchers[3].

Conclusion

In the present evaluation, the following conclusions can be extracted;

Simple otoscopy produced 84.4% agreement with tympanometry in detecting OME. The agreement was better in older children than the younger ones.

Simple otoscopy was also more accurate in detecting ears considered normal than abnormal ears as confirmed by tympanometry.

Among the abnormal ears, otoscopy was more sensitive in its detection of OME than mere negative middle ear pressure. Retraction of the tympanic membrane was the most specific otologic finding in the detection of OME.

Finally, it should be stated that the conclusions reached here are in no way advocacy for choosing otoscopy over tympanometry as otoscopy was 24% less specific than tympanometry in detecting OME. Rather, the evaluation is only a simple guide to the accuracy and limitations of simple otoscopy.

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