Role of Tympanometry in the Diagnosis of Hearing Impairment in Children with Otitis Media and Effusion

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Abstract

Background: To determine if Tympanometry can be used to diagnose hearing impairment in children with otitis media with effusion.

Method: A six month prospective study of school children aged between 5 and 7 years in the selected primary schools. Techniques of data collection included otoscopy, tympanometry and screening audiometry.

Results: Showed that tympanometry correctly identified cases without hearing impairment.

Conclusion: That tympanometry may be suggested as screening tool for younger children with Otitis Media with Effusion especially in developing countries thereby reducing cost implications tor these patients.

Keywords: *Tympanometry, Otitis Media with Effusion, Hearing Impairment, Screening Tool*

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Introduction

Otitis media with effusion (OME) is characterized by a nonpurulent effusion of the middle ear that may be either mucoid or serous. Symptoms usually involve hearing loss or aural fullness but typically do not involve pain or fever.

The monitoring of children with otitis media with effusion ties up considerable resources in audiology departments, impedance audiometry is frequently used when monitoring these children. It has been shown to be very sensitive in detecting middle ear effusions, but its value indetecting those children with significant hearing impairment secondary to this is in question because of the wide range of hearing impairments possible with a type B tympanogram[1]

It would be be useful if tympanometry can be used also in monitoring hearing impairment as this will lead to a significant reduction in costs for these patients.

In this paper, a study is presented in which tympanometry was used as a screening tool for school-age children, these children also had screening audiometry done with an audiometer and a comparism was made on the

co-relation between hearing impairment and tympanometrically detected OME.

Methods

This was a prospective study conducted over a period of 6 months. Subjects included in the study were primary 1 pupils in the selected primary schools with an age range of 5 -7 years. Exclusion criteria was tympanic membrane perforation. Data collection techniques included, Personal Identification, Otoscopy, Tymanometry and Screening audiometry.

All examinations were carried out in the school premises, otoscopic findings were noted prior to pure tone audiometric findings or tympanometric recording from the pupils.

For Tympanometric recordings a Welch-allyn microtymp 2 was used with the following specifications, Probe frequency - 226Hz and a sound pressure level of 85 dB.

Pressure range of + 200 to–400 dapa. Fiellau Nikolajsen (1983) modified Jerger's (1970) nomenclature; subdividing tympanograms into 4 types was used.

Type A - Middle ear pressure + 200 to – 99mm of Water.

Type B - Flat traces without a well defined compliance.

Type C_1 - Middle ear pressure – 100 to –199mm of Water.

Type C_2 - Middle ear pressure – 200 to 400 mm of Water

Types C_1 and C_2 associated with a negative middle ear pressure as in Eustachian tube dysfunction and which is also associated with middle ear effusion as well as the type B flat curve which is highly associated with middle ear effusion were used as indicators of OME.

For Screening Audiometry, a Peters AP 6 portable audiometer was used, with a noise exclusion head set. A screening level of 25dB was used in 4 test frequencies of 500, 1000, 2000 and 4000 Hz.

The screening criteria for pass were response at all test frequencies. The child was said to have failed if he or she did not respond to any 1 or more of the 4 test frequencies at 25dB (hearing threshold) level.

The Data obtained were then recoded in a pre-coded Questionnaire and were later analyzed statistically and presented in pictorial and graphical or tabular form.

The various measures of diagnostic accuracy i.e. sensitivity, specificity, false positive and false negative rates were computed.

The School Authorities and Parents teachers association were informed and their consent sought before the study commenced.

Tympanometric results for ears with hearing impairment: 270 children were screened of these, 59 had hearing impairment (21.9%). 60 children had one or both ears tympanometrically diagnosed with OME yielding a total of 86 ears, of these, 32 children had normal hearing (53.3%) while 28 had impaired hearing (46.7%).

Tympanometric diagnosis of OME associated hearing impairment.

$$\text{Sensitivity} = \frac{a}{a + c}$$

$$\text{Specificity} = \frac{d}{b + d}$$

Where

a = impairment present, test positive

b = impairment absent, test positive

c = impairment present, test negative

d = impairment absent, test negative

Using the same notation

The false negative proportion = $\frac{c}{a+c}$

And the false positive = $\frac{b}{b+d}$

The positive predictive value is the proportion of patients with a positive result who actually have the disease.

PPV = $\frac{a}{a+b}$

a = 28

b = 32

c = 31

d = 179

Sensitivity *sensitivexcaa*%5.47%1005928312828==+=+

Specificity *specificxdbd*%8.84%10021117917932179==+=+

False negative proportion %5.521005931312831==+*x*

False positive rate = %2.15100211321793232==+*x*

Positive predictive value

= *baa*+

= %1006028322828*x*=+ = 46.7%

That is 53% of patients with this type of tympanogram had hearing within normal limits.

Discussion

About 46% of the subjects with tympanometric diagnosed OME had impaired hearing; this was close to that obtained by Ogisi who noted that 48% of the subjects used in his study with abnormal tympanograms had significant hearing threshold elevations[2].

The specificity of tympanometry in detecting hearing impairment associated with OME from this study was very high, 84.8%, thus the false positive rate was relatively low (15.2%).

The high degree of specificity implies that tympanometry correctly identified cases without hearing impairment, this is in agreement with a similar study by Kazanas and Maw[3] where their results showed that a type B tympanogram was accurate in detecting hearing impairment, thus a type A tympanogram implies no hearing impairment. The percentage of patients (11.6%) with normal appearance of the tympanic membrane but who however had tympanometric diagnosed OME could be as a result of false positive results.

Another advantage of tympanometry over conventional pure tone audiometry is that most pre-school children will co-operate better with tympanometry[4]

We can therefore suggest from our study that

in smaller children who might not be able to undergo screening audiometry, when the cost is usually unaffordable as in a developing country like ours or in a very busy otolaryngological department, tympanometry may be used as a screening tool for OME associated hearing impairment thereby avoiding the need and cost implication of further audiological testing.

Conclusion:

In this study Tympanometry was found to be highly specific in diagnosing OME associated hearing impairment, thus we suggest that it may have a role in the diagnosis of hearing impairment associated with OME.

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