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ORIGINAL RESEARCH

Evaluation of Transiently Evoked Oto-Acoustic Emissions in Children with Otitis Media Effusion: An Institutional Based Study

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ABSTRACT

Background: Otitis media with effusion (OME) is one of the most common childhood diseases and can affect about 2/3 of children in the first 5 years of life. The present study was conducted to evaluate transiently evoked oto-acoustic emissions in children with otitis media effusion.

Material and methods: The present study was conducted to evaluate transiently evoked oto-acoustic emissions in children with otitis media effusion. A group of 50 children with bilateral otitis media with effusion was included in the study. 50 normal children of similar age and sex were used as controls. Both patients and controls underwent clinical otologic and audiological evaluation.

Results: The results showed thatin 68 ears of the patients (68%) otoacoustic emissions were absent. In the remaining 32 ears (32%) the mean emission amplitude was reduced, compared to the mean value of the control group. In 79 of the 100 ears of controls clear TEOAEs were recorded. Comparison of signal-to-noise ratios by independent sample t-test between the two groups showed statistically significant differences. In all cases the values of the patients were lower than the mean value of the controls.

Conclusion: The present study concluded that TEOAEs should be included in the diagnostic workup of otitis media with effusion.

Keywords: Otoacoustic Emissions, Transiently Evoked Otoacoustic Emissions, Mean Emission Amplitude.

INTRODUCTION

Otitis media with effusion (OME) is an inflammation of the middle ear with the presence of serous or mucous secretion, an intact tympanic membrane, but with no clinical manifestations of acute infection.[1] The secretions in middle ear interfere with the transmission of sound through the ossicle/tympanic system, often leading to mild to moderate conductive hearing loss.[2-5] Otitis media with effusion is a common pediatric disease and is considered the most common cause of hearing impairment among children.[6] OME is a risk factor for acute otitis media and for sleep disorders, loss of appetite and ear pain and has psychosocial impacts, which, in the long term, may result in behavioral,[7] speech and language development disorders.[8] It is characterized by middle ear inflammation, which is filled with a fluid (effusion) and with no clinical signs of infection.[9] Diagnosis is mainly based on pneumatic

otoscopy, pure-tone audiometry, and tympanometry. Tympanometry is an objective technique that can detect abnormal middle-ear function consistent with the presence of fluid in the middle-ear cavity.[10] Transiently evoked otoacoustic emissions (TEOAEs) are a diagnostic method widely used during the past decade to study cochlear function, in a noninvasive and objective manner. Usually, TEOAEs are present in people who have normal cochlear function and a healthy middle ear.[11] The present study was conducted to evaluate transiently evoked oto-acoustic emissions in children with otitis media effusion.

MATERIALS AND METHODS

The present study was conducted to evaluate transiently evoked oto-acoustic emissions in children with otitis media effusion. A group of 50 children with bilateral otitis media with effusion was included in the study. 50 normal children of similar age and sex were used as controls. Both patients and controls underwent clinical otologic and audiological evaluation including medical history, pneumatic otoscopy, tympanometry, and standard pure-tone audiometry. The diagnosis of otitis media with effusion was established when findings in at least three of them were positive. Conventional pure-tone audiometry was conducted in a standard soundproof booth, using a two-channel ALPS audiometer and earphones. Standard audiometric procedures were applied and the pure-tone thresholds of each ear at frequencies of 0.25, 0.5, 1, 2, 3, 4, and 8 kHz were measured. Subjects were considered to have a hearing loss if any threshold between 250 and 8000 Hz exceeded 20 dB HL. When air conduction thresholds were out of normal hearing range, bone conduction thresholds were obtained. Standard single-frequency tympanometry was performed with an AUDIO-SMART, NEUROSOFT portable Tympanometer, using a single frequency 85 dB SPL (sound pressure level) tone set at 226 Hz. The range of ear canal pressure was +400 to −600 daPa. The American Speech-Language-Hearing Association guidelines were used to determine if a tympanogram was considered abnormal[11]:

1. Static admittance less than 0.3 mmho;
2. An equivalent ear canal volume greater than 1.0 cm3 when accompanied by a flat tympanogram;
3. Tympanometric width greater than 200 daPa.

TEOAEs were further performed in all patients and controls, using a AUDIO SMART, Neurosoft Portable OAE. The acoustical stimulation, the data recording, and the data analysis were produced automatically with the aid of this system. Testing was performed in a sound proof room using a standard probe with disposable tips. The noise rejection level at the probe tip was set to 47 dBand fitting of the probe was inspected prior to each recording. Stimuli were half-sinusoidal clicks of 100 μsec duration. The nonlinear method of recording was used, allowing the phase-locked cochlear component of the response to be measured. The recording bandwidth was set between 0.75 to 5 kHz, stimulus intensity was approximately 80 dB, and repetition rate was 50 stimuli/sec. The numbers of responses accepted and rejected by artefact rejection were displayed and updated during averaging. The test was concluded after 260 total sweeps had been recorded. The “pass” criteria were signal-tonoise ratio ≥6 dB, in four of five 1/2 octave frequency bands at 1, 1.5, 2, 3, and 4 kHz.[12]

RESULTS

A group of 50 children with bilateral otitis media with effusion was included in the study. 50 normal children of similar age and sex were used as controls. Mean pure-tone thresholds exceeded 20 dB HL for the lower and middle frequencies in the group of children with otitis media with effusion, whereas mean values lower than 20 dB HL were found in the control group across all the examined frequencies. In 68 ears of the patients (68%) otoacoustic emissions were absent. In the remaining 32 ears (32%) the mean emission amplitude was

reduced, compared to the mean value of the control group. In 79 of the 100 ears of controls clear TEOAEs were recorded. Comparison of signal-to-noise ratios by independent sample t-test between the two groups showed statistically significant differences. In all cases the values of the patients were lower than the mean value of the controls.

Table 1: Means and levels of statistical significance (P) of pure-tone thresholds and signal-to-noise ratios of transiently evoked otoacoustic emissions (TEOAEs), comparing the ears of patients and the ears of controls.

	Pure-tone thresholds			Signal-to-noise ratios (TEOAEs)		
Frequencies (kHz)	**Patient ears N=100**	**Control ears N=100**	**p-value**	**Patient ears N=100**	**Control ears N=100**	**p-value**
0.25	31.2	12.8	<0.001	Not measured	Not measured	Not measured
0.5	29.5	10.3	<0.001	Not measured	Not measured	Not measured
1.0	24.6	9.8	<0.001	6.0	4.9	<0.01
1.5	Not measured	Not measured	Not measured	12.1	7.1	<0.001
2.0	25.4	13.0	<0.001	18.5	7.9	<0.001
3.0	20.9	15.6	<0.01	17.2	8.8	<0.001
4.0	18.3	16.3	Not significant	17.9	9.3	<0.001
8.0	14.5	15.4	Not significant			Not significant

DISCUSSION

Otitis media with effusion is the most common cause of hearing loss in childhood; it occurs more often during the period of language development and can affect it.[13]The secretions in the middle ear interfere with the transmission of sound through the ossicle/tympanic system, often leading to mild to moderate conductive hearing loss.TEOAEs are signals produced by the cochlea upon stimulation by a short acoustic click in the external ear canal.[14]Otoacoustic emissions aredivided into spontaneous and evoked otoacoustic emissions. Spontaneous otoacoustic emissions are present in half of the normal individuals while evoked otoacoustic emissions are detected in almost all normal hearing individuals. TEOAEs are a valuable screening tool for hearing impairment, although neither information about the degree or configuration of hearing loss is provided, nor is differential diagnosis between sensorineural and conductive hearing loss possible.[15]

In 68 ears of the patients (68%) otoacoustic emissions were absent. In the remaining 32 ears (32%) the mean emission amplitude was reduced, compared to the mean value of the control group. In 79 of the 100 ears of controls clear TEOAEs were recorded. Comparison of signal-to-noise ratios by independent sample t-test between the two groups showed statistically significant differences. In all cases the values of the patients were lower than the mean value of the controls.

In 1996, Schmuziger et al., examined TEOAE and found uniformly distributed values in the whole frequency spectrum in patients with damaged middle ear ventilation.[16]

Driscoll et al. found absent TEOAEs in 20.3 per cent of children.[17] In children studying in special schools, the same authors found absent OAEs in 40 per cent.[18]

Koike and Wetmore found that the status of the middle ear greatly affected transiently evoked otoacoustic emission measures, which was most significant with flat tympanograms, mainly indicative of reduced tympanic membrane mobility and the presence of middle-ear effusion.

These authors too encouraged the routine use of transiently evoked otoacoustic emission testing.[19]

According to Pienkowski, OME might be the cause of hidden hearing loss, since even though audiometric measures may remain normal, hidden damage could impair sound localization and alter the processing of auditory information. It is therefore highly recommended that patients with OME who have normal audiograms be monitored electroacoustically and electrophysiologicallyin order to be sure that the best audiological monitoring and intervention is provided. The high sensitivity of the OAE test probably explains why, in this study, OAE abnormalities could be detected even though other tests, such as psychoacoustic threshold and immittance audiometry, were normal.[20]

CONCLUSION

The present study concluded that TEOAEs should be included in the diagnostic workup of otitis media with effusion.

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