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Risk factors for sensorineural hearing loss in pediatric chronic otitis media

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ABSTRACT

Objectives: To assess the clinical significance of sensorineural hearing loss (SNHL) in a group of pediatric patients suffering from unilateral chronic otitis media (COM) with or without cholesteatoma, using the contralateral healthy ear as a control, and to define risk factors for the development of SNHL in such patients.

Methods: The subjects of this retrospective study were 124 pediatric patients with unilateral COM admitted for surgery. Mean age at surgery was 13.3 ± 3.2 years (range, 7–18) and mean duration of the disease was 88.4 ± 45.0 months (range, 6–192 months). The preoperative pure-tone average value (PTA) for bone conduction (BC) was calculated in each ear (BC-PTA) as the average of BC thresholds at 500, 1000, 2000, and 4000 Hz. Potential risk factors for SNHL that we evaluated were demographics, duration of disease, presence of cholesteatoma, and previous otologic history.

Results: Mean BC-PTA values in the diseased ears prior to surgery differed significantly from those in the healthy ears (12.74 ± 8.75 dB and 9.36 ± 6.33 dB, respectively; $P < 0.01$). The degree of SNHL in the diseased ear at 2000 Hz was found to be significantly correlated with the presence of cholesteatoma and with age above 10 years.

Conclusions: One of the complications of COM, with or without cholesteatoma, in addition to the conductive hearing loss, is the development of clinically significant SNHL. It is therefore imperative to actively treat pediatric patients diagnosed with COM, with the aim of preventing the possible development of SNHL.

1. Introduction

Hearing loss is considered a common sequela or complication of chronic otitis media (COM) both in adults and in children [1]. Hearing loss in patients with COM is typically conductive, but sensorineural hearing loss (SNHL) may also occur [2]. Conductive hearing loss results from perforation of the tympanic membrane, discontinuity or fixation of the ossicular chain, middle ear effusion, atelectasis of the tympanic membrane, and the presence of cholesteatoma or granulation tissue in the middle ear. SNHL reportedly results from direct insults to the inner ear such as penetration of toxic agents via the round-window membrane [3], disease-related destruction of the bony framework [4], or intra-operative trauma [5]. Alternatively, it may occur indirectly, via an increase in the functional mass of the ossicular chain, resulting in changes in the resonant frequency and raising of the bone conduction (BC) thresholds, similar to the Carhart effect [6,7].

Clinically significant SNHL has been reported in patients with COM [8,9]. However, the incidence and clinical significance of SNLH, and its risk factors in pediatric patients with COM, are still unclear, and contradictory findings have been reported [10–12]. It is well known that non-rehabilitated hearing loss in children, even if unilateral, can have major negative implications for language development, and scholastic progress [13]. Thus, it is essential that hearing loss in pediatric patients with COM be characterized and appropriately treated as soon as possible.

The aims of this retrospective case study were to evaluate the clinical significance of SNHL and define its risk factors in pediatric patients with COM.

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2. Materials and methods

2.1. Subjects

Data were collected from the medical files of 124 pediatric patients who were admitted between December 1997 and June 2012 to our tertiary-referral otologic center for surgical management of unilateral COM with or without cholesteatoma. Their mean age on admission was 13.3 ± 3.2 years (range, 7–18 years) and the mean duration of disease prior to admission was 88.4 ± 45 months (range, 6–192 months). In each case the contralateral healthy ear was used as a control, thus eliminating possible environmental effects. Excluded from the study were patients with bilateral disease, additional otologic pathology, congenital inner ear malformation, or congenital cholesteatoma. The study was approved by the Institutional Review Board of our medical Center (BNZ-0046-11).

2.2. Audiometric evaluation

Prior to surgery, each patient had undergone an audiometric evaluation according to the recommendations of the American Academy of Otolaryngology—Head and Neck Surgery Committee for reporting hearing thresholds in conductive hearing loss. In accordance with these guidelines, recorded data at 4000 Hz replace non-existing data at 3000 Hz [14]. Hearing thresholds had been measured with a GSI-16 audiometer (Grason-Stadler, Eden Prairie, MN, USA). The collected data included air conduction (AC) and BC thresholds in each ear at frequencies of 500, 1000, 2000 and 4000 Hz. The pure-tone average (PTA) for BC (BC-PTA) in each ear was calculated for each patient] as the average of BC thresholds at 500, 1000, 2000 and 4000 Hz, and the difference in BC thresholds (ΔBC) between the ear with COM and the healthy ear was calculated. The air-bone gap (ABG) in the affected ear was calculated as the difference between AC and BC thresholds at 500, 1000, 2000 and 4000 Hz.

2.3. Statistics and risk factors for SNHL

To assess the clinical significance of SNHL in this patient cohort, data were analyzed using SPSS 18.0 (SPSS, Chicago, IL, USA). A paired *t*-test was used to examine the differences in AC and BC thresholds between the healthy and the affected ear at each frequency. A *t*-test and ANOVA were used to determine the relationship between the ΔBC at each frequency and the categorical variables (age, gender, side, disease type, recurrent AOM, and number of previous ear surgeries). Pearson's correlation coefficient was used to determine the relationships between the ΔBC at each frequency and the disease duration, between the ΔBC at each frequency and the patient's age, and between the BC at each frequency and the ABG. Stepwise multiple linear regression analysis was used to predict the relationships between ΔBC and these predictor (independent) variables. A *P* value of 0.05 was considered statistically significant.

3. Results

3.1. AC and BC thresholds

Pure-tone AC and BC thresholds at 500, 1000, 2000 and 4000 Hz in the affected ear and the normal ear are presented in Fig. 1. Statistically significant differences between AC thresholds and between BC thresholds in the two ears were found across the range of tested frequencies, and was maximal at 4000 Hz (27.46 ± 16.27 dB and 7.17 ± 8.81 dB, respectively; Table 1).

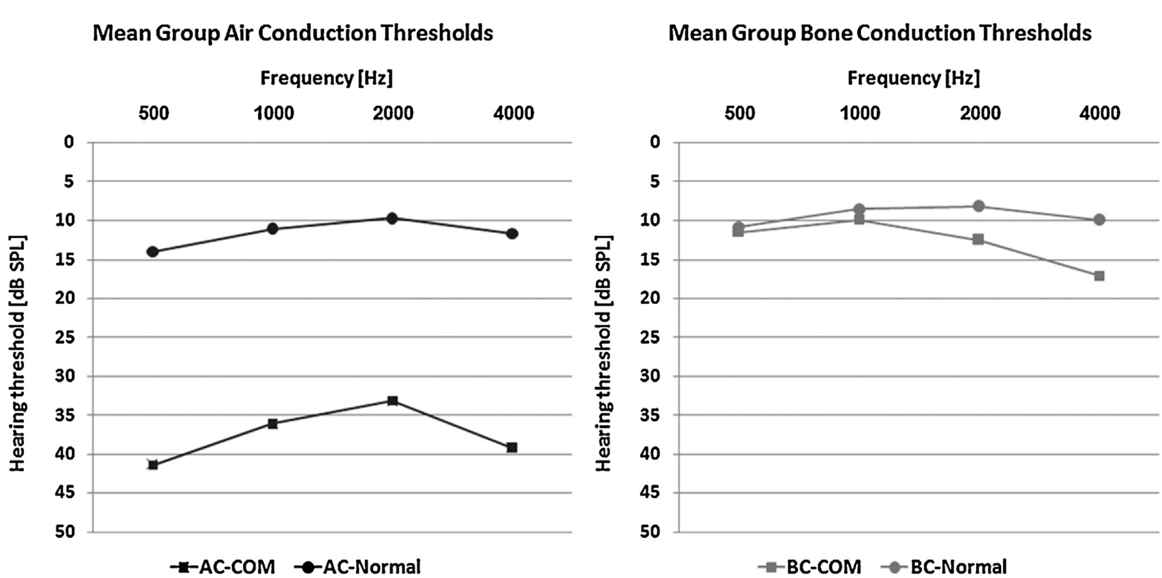

Fig. 1. Pure-tone air conduction thresholds and bone conduction thresholds at 500, 1000, 2000 and 4000 Hz in the affected ear and in the normal ear. AC: air conduction; BC: bone conduction; SPL: sound pressure level; SNHL: sensorineural hearing loss.

Table 1
Differences in air conduction thresholds (ΔAC) and in bone conduction thresholds (ΔBC) between the affected ear and the normal ear at 500, 1000, 2000 and 4000 Hz.

	500 Hz		1000 Hz		2000 Hz		4000 Hz	
	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*
ΔAC (dB)	27.38 ± 17.39	0.0001	25.04 ± 15.24	0.0001	23.47 ± 16.44	0.0001	27.46 ± 16.27	0.0001
ΔBC (dB)	0.65 ± 7.04	0.31	1.33 ± 6.6	0.024	4.36 ± 7.27	0.0001	7.17 ± 8.81	0.0001