



ORIGINAL ARTICLE

## Middle ear impedance studies in elderly patients implications on age-related hearing loss<sup>☆</sup>



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### KEYWORDS

Acoustic impedance tests;  
Pure-tone audiometry;  
Aged;  
Presbycusis;  
Acoustic reflex

### Abstract

*Introduction:* Controversies arise with respect to functioning of the middle ear over time.

*Objective:* To assess changes in middle ear impedance that may be related to aging, and/or if there was an association of these changes with those of the inner ear in the elderly patients.

*Methods:* Cross-sectional, comparative study of elderly patients managed in ear, nose and throat clinics. A structured questionnaire was administered to obtain clinical information. Pure tone audiometry, tympanometry, and acoustic reflexes were performed. Comparative analyses were performed to detect intergroup differences between clinico-audiometric findings and middle ear measures, viz. tympanograms and acoustic reflexes.

*Results:* One hundred and three elderly patients participated in the study; 52.4% were male, averagely  $70.0 \pm 6.3$  years old, age-related hearing loss in 59.2%, abnormal tympanograms in 39.3%, absent acoustic reflex in 37.9%. There was no association between age and gender in patients with abnormal tympanograms and absent acoustic reflex. Significantly more patients with different forms and grades of age-related hearing loss had abnormal tympanometry and absent acoustic reflex.

*Conclusion:* Some abnormalities were observed in the impedance audiometric measures of elderly patients, which were significantly associated with parameters connected to age-related hearing loss.

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**PALAVRAS-CHAVE**

Impedância elétrica;  
Audiometria de tons puros;  
Idoso;  
Presbiacusia;  
Reflexos acústicos

## Estudos de impedância da orelha média em pacientes idosos; implicações na perda auditiva relacionada à idade

**Resumo**

*Introdução:* Existem controvérsias no que se refere às alterações funcionais da orelha média com o passar dos anos.

*Objetivo:* Avaliar as mudanças na impedância da orelha média que podem estar relacionadas ao envelhecimento, bem como qualquer associação dessas alterações com as que ocorrem na orelha interna.

*Método:* Estudo prospectivo comparativo de pacientes idosos atendidos em ambulatórios especializados em otorrinolaringologia e aplicação de questionário estruturado para obtenção de informações clínicas. Foram realizadas audiometria de tons puros, timpanometria e reflexos acústicos e análise comparativa para detectar as diferenças intergrupos entre os achados clínico-audiométricos.

*Resultados:* Participaram do estudo 103 pacientes idosos: 52,4% do gênero masculino; idade de  $70 \pm 63$  anos; perda auditiva relacionada à idade detectada em 59,2%; timpanograma anormal em 39,3%; e reflexo acústico ausente em 37,9%. Não foi encontrada associação entre idade e gênero em pacientes com timpanograma anormal e reflexo acústico ausente. Um número significativamente maior de pacientes com diferentes graus e configurações de perda auditiva relacionada à idade apresentou timpanometria anormal e reflexo acústico ausente.

*Conclusão:* Algumas anormalidades foram observadas em medidas de impedância audiométrica em pacientes idosos, que foram significativamente associados com os parâmetros ligados à perda auditiva relacionada à idade.

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**Introduction**

Hearing involves a complex interplay and integration of several mechanisms, including conduction of sound waves from the environment through the external auditory canal, vibrations of the tympanic membrane, stimulation of the transformer mechanism in the middle ear, as well as the sensory hair cells of the cochlea the central neuronal connections with termination at the primary auditory cortex. The functions of some of these mechanisms are affected by aging and tend to manifest as hearing impairment, which is particularly common in the elderly.

A deficit in hearing acuity is the most common sensory disorder that has been associated with aging.<sup>1</sup> In fact, studies have shown that approximately one-third of adults aged between 61 and 70 years, and over 80% of those older than 85 years have clinically obvious difficulty understanding speech and following conversations in the presence of background noise.<sup>2,3</sup> On the average, hearing threshold increases by approximately 1 dB per year for subjects aged 60 years and above, with a tendency to further deterioration with increasing age.<sup>4</sup> At audiometry, up to 35% of elderly subjects above 60 years had pure tone average threshold of 25 dB HL or more at frequencies between 0.5 and 4kHz, which increased further to 50% in the age group between 70 and 80 years.<sup>5</sup> While the reported prevalence of hearing loss among elderly subjects vary in different locations, it is an established fact that it increases with age.<sup>6</sup>

Traditionally, hearing loss is classified as conductive, sensory, neural, or mixed-type. Age-related changes in the inner ear and its central connections have been well documented

among elderly subjects. These include loss of sensory hair cells of the cochlea consequent upon generalized degenerative processes, dysfunction of the stria vascularis (the main blood supply to the organ of Corti), and degeneration of the neurons of the cochlear nerve or its central connections.<sup>7</sup> In the external ear, wax impaction in the external auditory meatus has been reported to be disproportionately more common in the elderly patients than in other groups of patients, causing conductive hearing loss.<sup>8</sup> This is a consequence of the generalized degeneration of epithelia, including those of the microcilia, affecting the external auditory canal without an accompanying reduction in the rate of wax production. Other causes of conductive hearing loss are often related to the functioning of the middle ear.

Compared with other categories of patients, little attention has been paid to the conductive middle ear components in elderly patients. Controversies arise concerning the functioning of the middle ear as age advances. While some studies concluded that the conducting mechanisms of the middle ear remain normal and functional, or that they may play no serious role in the hearing impairment associated with aging,<sup>9,10</sup> others observed some changes in the dynamic characteristics of the middle ear that may be related to aging.<sup>11,12</sup> This might have resulted from different types of instruments used for assessing the middle ear functions. As part of the study on the epidemiology of hearing impairment among elderly patients, the author performed both pure-tone and impedance audiometries (tympometry) to assess the functions of the inner and middle ear, respectively.<sup>13</sup> The observation of certain abnormal tympanometric tracings in some patients with normal audiograms and in patients with

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