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BASIC AND TRANSLATIONAL RESEARCH

Microstructure of cholesteatomas as a risk factor for bone damage based on analysis in a scanning electron microscope

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Abstract

The conducted study indicated the microstructure of cholesteatoma as a prognostic factor of the destruction of bone elements. On the one hand, this can lead to hearing impairment, but on the other hand it can also open the way for the development of complications of chronic otitis media. The most aggressive course of cholesteatoma with the development of ear-related complications was correlated with the presence of an irregular, chaotic structure combined with a short medical history. The above observation is very important in clinical practice because it justifies the earliest possible initiation of surgical treatment after the diagnosis of chronic cholesteatoma otitis media.

The long-term course of cholesteatoma was reflected in the evolution of its microstructure observed under SEM to a regular pattern in the majority of patients, with less aggressiveness towards bone tissue.

Objectives

The aim of the analysis is to assess the relationship between the microstructure of cholesteatoma and the degree of damage to adjacent bone structures. The specific goal is to identify variants of the cholesteatoma characterized by a tendency towards aggressive osteolysis of bone tissue and consequently, causing damage to the elements of the auditory ossicle chain as well as the bones of the middle ear, which opens the way for the development of ear-related complications.

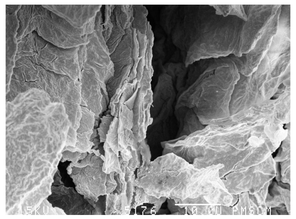
Material and Methods

Between 2016 and 2019, 440 operations were performed on patients due to chronic otitis media. Cholesteatoma was found in 130 cases. Destruction of the bone walls of the middle ear was present in 58 patients with cholesteatoma, which constitutes about 10% of all patients operated on due to chronic otitis media. These patients were further analysed.
The research group included 27 women and 31 men. The youngest patient was 27 years old, and the oldest was 70.
An analysis of the prepared samples was performed with the use of the JEOL JSM35CF scanning microscope at the Laboratory of Scanning Microscopy.
The SEM analysis took into account the following parameters and data:

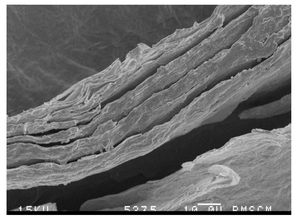
- Analysis of images at 30x, 100x, 200x, 1000x, 2000x magnification
- The structure of the cholesteatoma: matrix and perimatrix (m/p)
- Matrix structure (regular and irregular)
- Blood vessels present in cholesteatoma (matrix and perimatrix)
- Surgery I – first operation , II – subsequent operation

Results

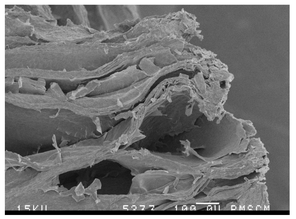
Analysis of the cholesteatomas' surface under a scanning electron microscope revealed both regular and irregular structure of the matrix, most of them being the latter. Irregular matrix structures were observed in the cases with a short disease history and in patients for whom this was the first surgical procedure. In our analysis, a cholesteatoma matrix with regular structures was associated with less bone destruction of the middle ear space.



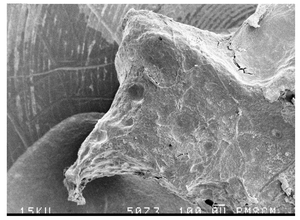
Matrix, x2000, (Focal corneocyte desquamation in the matrix. Squamous keratinocytes of the matrix, showing unordered stacking pattern and irregular microplicae on the Surface.



Matrix, x1000, (Squamous keratinocytes of the matrix, regular microplicae on the Surface.



Matrix x100, (Squamous keratinocytes of the matrix, irregular microplicae on the Surface.



Incus, x30, (Defect to the ossicle's surface

Conclusions

The microstructure of cholesteatomas that showed regular layers under SEM coincides with reduced destruction of the middle ear bone walls. An irregular structure (pathognomonic for a process with a short medical history, and in patients operated on for the first time) is characterised by a tendency towards deeper destruction of bone tissue.

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19›22 September 2024
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