Introduction

Eustachian Tube (ET) dysfunction plays a significant role in the pathogenesis of middle ear diseases. Therefore, an adequate evaluation of the ET function is an important factor in the diagnostic and therapeutic process of middle ear diseases.

Sonotubometry is a non-invasive clinical method that allows an assessment of the tube function under physiologic conditions (Fig. 1). The use of Perfect Sequences (PSEQ) as a test signal is novel approach in this field. Successfully performed on healthy individuals in the past, the application of PSEQ has proven to be an effective method of detecting ET openings in normal ears. This study investigates the function of the ET in pathologic ears using PSEQ.

Patients and Methods

Sonotubometry with PSEQ was performed on a total of 40 patients (n=65 ears) divided in the following groups:

- **Group I** – 20 healthy individuals (n=40 ears) as a control group;
- **Group II** – 11 patients (n=16 ears) with middle ear effusion with acute/subacute ET dysfunction;
- **Group III** – 9 patients (n=9 ears) with chronic ET dysfunction, requiring tympanoplasty.

Sonotubometric measurement was performed using a fixed setting with four different maneuvers to provoke a ET opening: yawning, dry swallowing, swallowing with water and Toynbee (Fig.2). The resulting sonotubograms were quantitatively and qualitatively analyzed and percentage of openings with regard to maneuvers as well as average amplitude (A) and duration (D) of the opening were calculated for each patient. Group II was examined before and 6 days after operation (myringotomy or tympanoplasty).

Results

The results are summarized in Table 1 and Graph 1.

- Dry and water swallowing produced best results for provoking a tube opening both in normal and diseased ears.
- Both acute and chronic ET dysfunction demonstrated lower amplitudes and fewer ET openings as opposed to healthy ears.
- Opening amplitude and frequency was very similar in both acute and chronic ET dysfunction.
- Normal and recovered ears showed a longer opening duration but this difference was not of statistic significance between any of the groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Detected-openings (%)</th>
<th>Average-amplitude (dB)</th>
<th>Average duration (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>76.9</td>
<td>18.2</td>
<td>424</td>
</tr>
<tr>
<td>Group IIa</td>
<td>10.1</td>
<td>27.3</td>
<td>312</td>
</tr>
<tr>
<td>Group IIb</td>
<td>17.5</td>
<td>16.3</td>
<td>438</td>
</tr>
<tr>
<td>Group III</td>
<td>40.5</td>
<td>9.8</td>
<td>391</td>
</tr>
</tbody>
</table>

**Table 1**

Discussion

In ears with ET dysfunction openings could be registered in almost all patients, however, no significant difference was demonstrated for their number and amplitude in comparison to healthy ears. This suggests that besides the decreased number of ET openings, these are also less efficient in diseased ears. An examination after a surgical intervention in ears with acute ET dysfunction showed a recovery of the normal function within a week for most of the ears. These results demonstrate that after taking appropriate measures for ventilating the middle ear a recovery of the ET also occurs. This suggests that the dysfunction in acute cases is caused by an inflammatory swelling.

In some patients an improvement could not be registered by sonotubometry. This may hint at a chronic disorder in these cases.

Conclusion

Sonotubometry with PSEQ is a feasible novel method for assessment of ET physiology and pathology. Many diseased ears show openings. Opening frequency and amplitude seem to be more important for middle ear ventilation than the duration. The method has the potential to open new perspectives on ET physiology and its monitoring.

References: