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WILEY
INTRODUCTION

Adhesive otitis media (AdOM) is an entity, in which the pars tensa of the tympanic membrane (TM) is retracted and adheres to the medial wall of the tympanic cavity. Subsequent adhesions and fibrosis of the middle ear acoustic system would lead to conductive hearing loss, called the sequelae of chronic otitis media, which accounts for approximately 3% of chronic inflammatory lesions in the middle ear, and can develop into cholesteatoma. The diagnosis is mainly based on the morphologic observations of the TM, and is validated using the Valsalva maneuver. A tympanogram may also be helpful for the diagnosis. At present, there is no consensus on the best treatment strategy for AdOM. Most doctors tend to choose conservative treatment, and surgical intervention is considered when middle ear cholesteatoma or serious hearing loss develops. The effectiveness of surgical treatment may be poor in AdOM, when compared to other types of otitis media, because eustachian tube dysfunction (ETD) is difficult to solve. It has generally been considered that surgery for improving hearing can be considered only when eustachian tube (ET) function becomes normal. Therefore, most doctors recommend that it is better to primarily resolve ETD due to nasal and nasopharyngeal diseases before a second-stage surgery of tympanoplasty. However, the assessment of ET function is another problem, because there is no widely accepted gold standard for the diagnosis of ETD at this stage.

In recent years, great progress has been made in the diagnosis and treatment of ETD. The Eustachian Tube Dysfunction Questionnaire has been considered as the only patient-reported outcomes tool to have undergone initial validation studies. Among objective tests, tubomanometry (TMM) is reliable, and can be routinely used to support the diagnosis of chronic obstructive ETD. The most important advance in treatment is the application of ET balloon dilatation (ETBD). Schroeder et al. reported the surgery outcomes of 622 cases (1,076 ears) of ETBD, which were followed up for 5 years. The subjective satisfaction rate was close to 80%, and ET scores (ETS) improved postoperatively in 82% of patients. This technology has been gradually promoted throughout the world.
ETBD is more appropriate for the treatment of AdOM. Whether cartilage tympanoplasty (CT) combined with ETD can be simultaneously conducted after removing the adhesions in the middle ear. Therefore, the aim of the present study was to determine whether cartilage tympanoplasty (CT) combined with ETBD is more appropriate for the treatment of AdOM.

MATERIALS AND METHODS

Study Design

This trial was a multicenter, prospective, double-blind, randomized, controlled clinical trial approved by the hospital ethics committee. Informed consent was obtained from the patient or guardian. The inclusion criteria were as follows: 1) adherence of the TM to the promontory; 2) symptoms of hearing loss, ear stuffiness, and tinnitus; 3) pure-tone audiometry suggesting conductive hearing loss; 4) the acoustic impedance suggesting a type B or C tympanometry; 5) the high-resolution CT excluded middle ear cholesteatoma. A total of 120 patients, who were admitted in three tertiary hospitals from January 2014 to May 2015, were included into the study. Among these patients, 63 patients were male and 57 patients were female, and the average age of these patients was 43 years old (range, 15–75 years old). Furthermore, among these patients, 66 were left-ear cases and 54 were right-ear cases. These patients were randomly divided into four groups: conservative treatment group (control group), ETBD group, CT group, and ETBD+CT group. An online randomization (http://www.randomization.com) was used to generate a randomization plan for the treatment assignments of patients, which was documented by a statistician. When an eligible patient was obtained, the sequence number of the patient would be sent to the statistician to exchange this for the assigned treatment-allocation plan for the treatment assignments of patients, which was documented by a statistician. When an eligible patient was obtained, the sequence number of the patient would be sent to the statistician to exchange this for the assigned treatment-allocation to the patient.

Treatments

Control Group. Patients were provided with nasal topical steroids and instructed to perform autoinflation using the Val-salva maneuver to improve ET function.

CT Group. After making a postauricular incision, the tympanomeatal flap was elevated, and the adherent TM was carefully removed off the medial wall of the tympanic cavity. An epitympanotomy or posterior tympanotomy was performed, when necessary, to clear adhesion tissues in these regions and around the ossicles, together with those in the tympanic opening of the ET. The ipsilateral tragus cartilage was harvested and the perichondrium was left attached to only one side to establish a cartilage/perichondrium island flap (Fig. 1A). This was subsequently thinned to approximately 0.5 mm. Then, myringoplasty was conducted in an underlay fashion. If the ossicular chain was eroded or unable to be separated from the adhesions, an ossiculoplasty was performed. When the stapes superstructure was present, a titanium partial ossicular replacement prosthesis (Heinz Kurz GmbH Medical Technology, Dusslingen, Germany) was used, whereas when the stapes superstructure was absent, a total ossicular replacement prosthesis was used (Fig. 1B).

ETBD Group. An ET balloon dilation system (Spiggle & Theis, Overath, Germany) was used, as previously reported.5 Assisted by a nasal endoscope, the balloon was introduced through the ET pharyngeal opening, and slowly dilated under a pressure of 10 bars for 2 minutes.

Outcome Measures

All patients were regularly followed up postoperatively and assessed using a variety of measurements at 3 months, 6 months, 1 year, and 2 years after the treatments.

Healing of TM. Otoendoscopy was performed to determine whether the TM graft survived or remained perforated.

Hearing Test. The mean air-bone gap (ABG) at frequencies of 500 Hz, 1 kHz, 2 kHz, and 4 kHz was measured in a double-layer soundproof room using a Madsen OB922 pure-tone audiometer (Otometrics, Taastrup, Denmark).

TMM and ETS. The calculations included three R values detected by ET manometry under pressures of 30, 40, and 50 mbars, and two subjective symptom scores.7 ETS was the sum of these five scores, which ranged from 0 to 10, suggesting a condition of ETD when it was <5.

Tinnitus Handicap Inventory. The Tinnitus Handicap Inventory (THI) questionnaire consisted of 25 questions, with a total score of 100.8 This divided the extent of tinnitus into six levels: level 1 (0–16, no disability), level 2 (18–36, mild disability), level 3 (38–56, moderate disability), level 4 (58–76, severe...
disability), and level 5 (78–100, extremely severe disability). The higher the score, the more serious the tinnitus was.

**Ear Stiffness Visual Analog Scale.** A score of zero meant no discomfort, whereas a score of 10 indicated severe discomfort. The visual analog scale (VAS) was divided into three degrees: a scale of 0 to 3 was defined as mild, a scale of 3 to 7 was defined as moderate, and a scale of 7 to 10 was defined as severe. The higher the score, the more severe the stiffness feeling was.

**Chronic Otitis Media Outcome Test–15.** Baumann et al.9 proposed the use of Chronic Otitis Media Outcome Test–15 (COMOT-15) to assess the quality of life in patients with chronic otitis media (COM). In this test, a total of 15 items with a total score of 75 was used to investigate the common single symptom and related symptoms in patients with COM. The lower the score, the less influence COM had on quality of life.

**Statistical Analysis.** Descriptive statistics were presented as mean ± standard deviation, whereas categorical variables were expressed using counts and percentages. Variance analysis ($F$ analysis) was used to test the homogeneity of each group, preoperatively. A $\chi^2$ test was used to determine the difference in TM healing rate between the CT group and ETBD+CT group at each follow-up time point. A paired $t$ test was used to determine the significant difference of each observation before and after treatment in the same group. Repeated $F$ analysis was used to test the differences of each observation among the four groups at each follow-up time after surgery. All statistical analyses were performed using SPSS 17.0 (IBM, Armonk, NY). $P < .05$ was considered statistically significant.

**RESULTS**

There was no statistical difference in preoperative ABG, ETS, THI, VAS and COMOT-15 among the four groups (Table I).

**Postoperative Healing Rate of TM**

The gelatin sponge was detached from the external ear canal at 4 weeks after the tympanoplasty. Three patients in the CT group and three patients in the ETBD+CT group presented with swelling of the TM at 3 months postoperatively accompanied by small secretions. In addition, one patient in the ETBD+CT group had a small perforation. All patients were treated with oral cephalosporin antibiotics and ofloxacin ear drops. Two patients in the CT group and one patient in the ETBD+CT group presented with dry ear at 6 months. One patient in each group had repeated ear drainage and finally recovered after 2 years of follow-up. The patient who had a small perforation in the ETBD+CT group could not spontaneously heal during the follow-up period. Two ears of patients in the CT group had retraction in the anterior and inferior region of the TM at 3 months after surgery. No significant deterioration was observed for 2 years, and no treatment was performed. The remaining ears recovered well for the duration of the follow-up period (Fig. 1C). There was no significant difference in the postoperative TM healing rate between these two groups ($P > .05$) (Table II). Furthermore, adhesion of the TM in the control group and ETBD group could not spontaneously heal. Two patients in the control group progressed to middle ear cholesteatoma.

**Pure-Tone Audiometry**

Postoperative ABG was significantly reduced in the CT group and ETBD+CT group ($P < .05$) (Table III). The difference in reduction magnitude in these two groups was not statistically significant ($P > .05$). However, this was significantly larger, when compared with that in the control group after 3 months, 6 months, 1 year, and 2 years of follow-up ($P < .01$).

**THI Score**

Postoperative THI scores significantly decreased in these three surgical groups ($P < .05$), whereas scores in the control group had no significant change (Table IV). The reduction in THI score in the ETBD+CT group was significantly larger than that in the CT group after a follow-up period of 1 and 2 years ($P < .05$). One patient in the ETBD+CT group developed tinnitus postoperatively.

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**TABLE I.**

Preoperative Data of the Four Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>No.</th>
<th>ABG (dB)</th>
<th>ETS</th>
<th>THI</th>
<th>VAS</th>
<th>COMOT-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>30</td>
<td>32.68 ± 8.04</td>
<td>3.93 ± 1.97</td>
<td>41.64 ± 25.91</td>
<td>4.03 ± 2.13</td>
<td>31.84 ± 11.35</td>
</tr>
<tr>
<td>ETBD</td>
<td>30</td>
<td>31.67 ± 7.78</td>
<td>2.84 ± 1.68</td>
<td>42.13 ± 27.99</td>
<td>4.80 ± 2.78</td>
<td>36.13 ± 12.17</td>
</tr>
<tr>
<td>CT</td>
<td>30</td>
<td>33.19 ± 9.69</td>
<td>3.33 ± 1.91</td>
<td>45.14 ± 28.78</td>
<td>4.33 ± 2.41</td>
<td>32.87 ± 8.94</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>30</td>
<td>35.59 ± 9.48</td>
<td>2.57 ± 1.35</td>
<td>47.23 ± 28.83</td>
<td>4.40 ± 2.35</td>
<td>37.67 ± 10.05</td>
</tr>
<tr>
<td>$P$</td>
<td></td>
<td>&gt;.05</td>
<td>&gt;.05</td>
<td>&gt;.05</td>
<td>&gt;.05</td>
<td>&gt;.05</td>
</tr>
</tbody>
</table>

Data are presented as value ± standard deviation.

ABG = air-bone gap; COMOT-15 = chronic otitis media outcome test; CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation; ETS = eustachian tube scores; THI = tinnitus handicap inventory; VAS = visual analog scale.

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**TABLE II.**

Healing Rates of the Rebuilt Tympanic Membrane at Each Follow-up Time Point

<table>
<thead>
<tr>
<th>Groups</th>
<th>3 Months</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>25 (83.33%)</td>
<td>27 (90.00%)</td>
<td>27 (90.00%)</td>
<td>28 (93.33%)</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>27 (90.00%)</td>
<td>28 (93.33%)</td>
<td>28 (93.33%)</td>
<td>29 (96.67%)</td>
</tr>
<tr>
<td>$P^*$</td>
<td>.448</td>
<td>.640</td>
<td>.640</td>
<td>.554</td>
</tr>
</tbody>
</table>

$\chi^2$ test. CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation.
which was considered to be induced by the perforation of the TM.

**Ear Stufness VAS**

Postoperative VAS scores significantly decreased in the three surgical groups ($P < .05$), whereas scores in the control group had no significant change (Table V). The reduction in VAS scores in the ETBD+CT group was significantly larger than that in the CT group after 6 months, 1 year, and 2 years of follow-up ($P < .05$).

**COMOT-15 Score**

Postoperative COMOT-15 scores significantly decreased in these three surgical groups after 3 months, 6 months, 1 year, and 2 years of follow-up ($P < .05$), whereas scores in the control group had no significant change (Table VI). The postoperative quality of life of patients in the ETBD+CT group was significantly higher than that in the CT group ($P < .05$).

**ETS**

The postoperative ET function significantly improved in the ETBD and ETBD+CT groups, according to the changes in ETS ($P < .05$) (Table VII). However, there was no significant improvement in the CT group ($P > .05$). Furthermore, improvements in ETS in the ETBD and ETBD+CT groups at 3 months, 6 months, 1 year, and 2 years after surgery was larger than that in the control group and CT group ($P < .05$).

**Security Analysis**

No facial paralysis, dizziness, sensorineural hearing loss, or other serious adverse reactions occurred in patients after cartilage tympanoplasty. Furthermore, the tragus maintained its normal appearance after surgery. There were no complications, such as internal carotid artery injury, after ETBD. Two patients with ETBD exhibited short-term symptoms of patulous ET, such as autophony, which spontaneously relieved within 1 year.

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**TABLE III.**

Postoperative Air-Bone Gap in the Four Groups at Each Follow-up Time Point

<table>
<thead>
<tr>
<th>Groups</th>
<th>3 Months</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>33.88 ± 7.97</td>
<td>34.97 ± 8.32</td>
<td>34.50 ± 9.06</td>
<td>34.67 ± 8.95</td>
</tr>
<tr>
<td>ETBD</td>
<td>30.36 ± 9.11</td>
<td>29.42 ± 7.47</td>
<td>29.89 ± 8.76</td>
<td>28.67 ± 7.79</td>
</tr>
<tr>
<td>CT</td>
<td>22.47 ± 12.54†</td>
<td>20.07 ± 11.99†</td>
<td>18.87 ± 9.75†</td>
<td>17.37 ± 10.37†</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>21.12 ± 11.60†</td>
<td>19.24 ± 11.74†</td>
<td>17.63 ± 9.09†</td>
<td>16.16 ± 9.89†</td>
</tr>
</tbody>
</table>

Data are presented as value in decibels ± standard deviation.

*Significantly different compared with data in the control group, $P < .01$.
†Significantly different compared with preoperative data, $P < .05$.

CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation.

**TABLE IV.**

Tinnitus Handicap Inventory Scores After Treatment in the Four Groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>3 Months</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>42.27 ± 26.40</td>
<td>41.93 ± 27.63</td>
<td>43.20 ± 28.04</td>
<td>42.46 ± 28.54</td>
</tr>
<tr>
<td>ETBD</td>
<td>30.67 ± 25.84*</td>
<td>27.13 ± 25.40*</td>
<td>25.07 ± 26.07*</td>
<td>23.13 ± 24.39*</td>
</tr>
<tr>
<td>CT</td>
<td>32.80 ± 19.90*</td>
<td>32.93 ± 19.11*</td>
<td>33.20 ± 19.64*</td>
<td>32.40 ± 19.66*</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>32.92 ± 26.80*</td>
<td>30.08 ± 25.63*</td>
<td>25.85 ± 26.86†</td>
<td>24.23 ± 25.33†</td>
</tr>
</tbody>
</table>

Data are presented as value ± standard deviation.

*Significantly different compared with the preoperative data, $P < .05$.
†Significantly different compared with data in the CT group, $P < .05$.

CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation.

**TABLE V.**

Visual Analog Scale of Ear Stufness After Treatment in the Four Groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>3 Months</th>
<th>6 Months</th>
<th>1 Year</th>
<th>2 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>4.21 ± 2.09</td>
<td>3.94 ± 1.87</td>
<td>4.16 ± 2.24</td>
<td>4.21 ± 2.37</td>
</tr>
<tr>
<td>ETBD</td>
<td>2.13 ± 1.47*</td>
<td>1.47 ± 1.20*</td>
<td>1.40 ± 1.23*</td>
<td>1.27 ± 1.01*</td>
</tr>
<tr>
<td>CT</td>
<td>2.67 ± 1.40*</td>
<td>2.59 ± 1.36*</td>
<td>2.51 ± 1.55*</td>
<td>2.47 ± 1.25*</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>1.67 ± 1.29*</td>
<td>1.13 ± 1.25†</td>
<td>1.00 ± 1.13†</td>
<td>1.07 ± 1.10†</td>
</tr>
</tbody>
</table>

Data are presented as value ± standard deviation.

*Significantly different compared with the preoperative data, $P < .05$.
†Significantly different compared with data in the CT group, $P < .05$.

CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation.
DISECUSSION

Sade and Berco\textsuperscript{10} classified an atelectatic ear into four stages. The extent of TM retraction was determined by ET function, the elasticity of the TM, and the condition of the middle ear mucosa. In stage IV, TM atelectasis often leads to irreversible adhesions to the middle ear and damage of the acoustic structure, causing hearing loss, tinnitus, ear fullness, and an impact on quality of life. Otorrhea is another complaint of some patients, although this was not the main inclusion criteria in the present study.

AdOM remains a challenge for otologists. The choice of treatment for otorrhea is likely to be surgery, which usually indicates a secondary infection, granulation, or cholesteatoma formation. However, treatments for patients without otorrhea remains controversial, including conservative medical management, ventilation tube insertion, reconstruction of the TM, ETBD, and hearing aids. Clinical observations have revealed that the efficiency of conservative treatments, such as medication, inflation of the ET, and tympanostomy tube insertion, remains uncertain. In the present study, it was ensured that treatment patterns in the control group (drug treatment) and ETBD group were unable to relieve symptoms, such as tinnitus and ear stuffiness, nor improve the healing rate of the TM, hearing, and quality of life. Moreover, a long-term wait-and-see may increase the risk of cholesteatoma formation. Therefore, surgery may be a better decision. The surgical indications that were chosen included moderate conductive hearing impairment, suspected ossicular chain erosion, and infection of the TM with granulation tissue formation. The surgical goals of AdOM\textsuperscript{11} were as follows: 1) to completely remove adhesions, including the atrophy TM, granulation, and adhesive middle ear structure; 2) to rebuild the TM and ossicular chain; and 3) to improve the ventilation and make the middle ear a gas-containing cavity.

Better ET function is the premise of successful surgical treatment of AdOM. In addition to the intraoperative exploration of the larynx and tympanic opening of the ET, ETBD, which is a new technique that had been rapidly developed in recent years, was also used. Literature reports have consistently demonstrated good results of ETBD in the treatment of ETD-related diseases, with advantages of less trauma, high safety, and ease of use. By observing 622 cases undergoing ETBD during the 5-year follow-up period, Schröder et al.\textsuperscript{5} concluded the following surgical indications: 1) symptoms of ETD, 2) chronic secretory otitis media, 3) AdOM, and 4) TM retraction after middle ear surgery. However, there is presently no standard for applied pressure and duration in ETBD, and the length and diameter of the balloon, which may influence surgical efficacy.

The use of stiff materials, which can better resist negative middle ear pressure and prevent recurrent retraction, is the key to avoid the relapse of AdOM. Cartilage is a widely used material, and more suitable for the treatment of AdOM than temporal fascia, due to its long-term resistance to negative pressure in the middle ear.\textsuperscript{12,13} Furthermore, it carries better sound-conducting capability at a thickness of 500 μm.\textsuperscript{14} Therefore, a thinned tragus cartilage/perichondrium island flap was used during the tympanoplasty in the present study, with the cartilage surface facing the promontory to prevent recurrent adhesion.

In the present study, the investigators attempted to determine whether the sole application of ETBD or

<table>
<thead>
<tr>
<th>TABLE VI.</th>
<th>Chronic Otitis Media Outcome Test–15 Scores After Treatment in the Four Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>3 Months</td>
</tr>
<tr>
<td>Control</td>
<td>32.39 ± 10.51</td>
</tr>
<tr>
<td>ETBD</td>
<td>22.40 ± 11.08*</td>
</tr>
<tr>
<td>CT</td>
<td>26.33 ± 8.25*</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>18.87 ± 7.11†</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE VII.</th>
<th>Eustachian Tube Scores After Treatment in the Four Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>3 Months</td>
</tr>
<tr>
<td>Control</td>
<td>3.84 ± 1.87</td>
</tr>
<tr>
<td>ETBD</td>
<td>6.13 ± 1.47†</td>
</tr>
<tr>
<td>CT</td>
<td>3.69 ± 2.04</td>
</tr>
<tr>
<td>ETBD + CT</td>
<td>6.67 ± 1.29†</td>
</tr>
</tbody>
</table>

Data are presented as value ± standard deviation.
*Significantly different compared with the preoperative data, \( P < .05 \).
†Significantly different compared with data in CT group, \( P < .05 \).
CT = cartilage tympanoplasty; ETBD = eustachian tube balloon dilatation.
cartilage tympanoplasty is effective, which one is more important, and whether the combination of these two could have more benefit for the recovery of AdOM. Relevant reports are rare in the present literature. Because there is no gold standard for the assessment of ET function, the manner of evaluating the effect of ETBD is controversial. Therefore, the present study attempted to evaluate its surgical effect by multiple comparison of TM morphology, hearing results, ETS, THI, VAS, and quality of life. As observed from the results in the ETBD group, TM morphology and hearing did not improve during the follow-up period, although symptoms such as ear stuffiness and tinnitus softened postoperatively. This indicates that ETBD alone could not address the problem of irreversible adhesion in the TM and middle ear acoustic structures. Conversely, the TM morphology was improved, and the middle ear pneumatization was restored in more than 90% of patients in the CT group, resulting in the reduction in the postoperative ABG. This implies that cartilage tympanoplasty plays a key role in the recovery of the disease, with a long-term resistance to pressure changes across the ear drum.

The combination of ETBD and cartilage tympanoplasty improved postoperative ET function, which helped to soften possible changes in atmospheric pressure across the rebuilt TM. Despite the postoperative occurrence of one case of small perforation in the ETBD+CT group and two cases of TM retraction in the CT group, the postoperative healing rate and reduction of ABG were not significantly different between these two. However, CT alone could not solve ETD. Furthermore, negative middle ear pressure might still occur postoperatively, causing discomfort. As observed from the ET score, THI, VAS for ear stuffiness, and COMOT-15 results, improvements in the ETBD+CT group were superior to that in the CT group, and the difference was statistically significant. Some doctors have proposed grommet tube insertion during or after cartilage tympanoplasty in patients with ETD for the purpose of ventilation and observation of possible cholesteatoma formation. However, the benefit was short term. In addition, secondary TM perforation and middle ear infection might occur. Therefore, the combined ETBD had an advantage in the recovery of patients under tympanoplasty. No complications occurred in cases with combined ETBD, such as hemorrhage, tear of the nasopharyngeal mucosa, or internal carotid artery injury, indicating that it had the advantages of hardly any injury and low risk. In addition, it had no influence on postoperative hearing level (no statistical difference with that in the CT group).

Thus, it was considered that ETBD+CT can be used as an appropriate approach for the treatment of AdOM with severe ETD. Furthermore, this surgical method provides resistance against pressure changes in the middle ear, and avoids the additional insertion of a ventilation tube. Moreover, the primary results support its advantages in preventing re-adhesion of the TM and relieving related symptoms. However, long-term clinical observations are still needed. In addition, it is better to perform routine postoperative CT scans to help reveal the iatrogenic cholesteatoma in future studies.

CONCLUSION

Cartilage tympanoplasty combined with ET balloon dilatation could be used as an appropriate surgical technique for AdOM, which could relieve the symptoms of tinnitus and ear stuffiness, and improve postoperative TM morphology, hearing level, ET function, and quality of life with a low incidence of complications.

BIBLIOGRAPHY