Comparison of endoscopic and microscopic management of attic cholesteatoma: A randomized controlled trial

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February 21, 2021

Abstract

Objectives: To compare the endoscopic approach to manage attic cholesteatoma with conventional microscopic technique. Design: Randomized controlled trial. Participants: A total of 190 patients (192 ears) diagnosed with attic cholesteatoma extending to the antrum area (stages Ib and II) were randomly assigned into two groups: one undergoing endoscopic approach and the other undergoing the microscopic technique. Main outcome measures: The two groups were compared in terms of preoperative and intraoperative findings, access to hidden areas expressed in terms of the Middle Ear Structural Visibility Index (MESVI), mean operative time, and postoperative findings. Results: No difference in the parameters of the preoperative and intraoperative findings analyzed (patient age, computed tomography findings, disease stage, and intraoperative cholesteatoma characteristics) was observed between the endoscopic and microscopic groups. The median MESVI for the endoscopic group was better than that for the microscopic group ($P<0.05$). The mean operating time using the endoscopic approach was less than that using the microscopic approach ($P<0.05$). The median postoperative pain score in the endoscopic group was lower than that in the microscopic group ($P<0.05$). No significant difference was found between the two groups in terms of taste sensation, air-bone gap closure at the end of 4 weeks, and vertigo experienced at the end of the first week. When long-term surgical outcomes were assessed 1 year postoperatively, five patients in the microscopic group had recurrence, four had cartilage displacement, three had perforation, and five had retraction pocket formation. In the endoscopic group, four patients had disease recurrence, three had cartilage displacement, two had perforation, and four had retraction pocket formation. Conclusion: Endoscopic management of limited attic cholesteatoma showed definite advantages over the conventional microscopic approach, such as providing better visualization, requiring less postoperative time, subjecting the patients to less pain, and decreasing the incidence of complications.

INTRODUCTION

An attic cholesteatoma is a common disease encountered by otologists because it typically destroys the ossicles, causing several complications.The traditional treatment method for attic cholesteatoma is the transoral or retroauricular approach with microscope.

In 1997, after first reporting 36 successful cases of cholesteatoma removed by endoscope, [1] Tarabichi et al. found an endoscopic case in which the otology department correctly found its own position. The main advantage of endoscope widely used in the world is that it can have a wider and clearer field of vision and destroy less normal tissues, but its disadvantage is localized attic disease, because it has not been investigated and studied whether it can replace microscope treatment in other treatments.[2]

When studying the subjects in different stages of diseases, the results of comparative experiments under microscope and endoscope are inaccurate, and the correctness of the results cannot be guaranteed. The degree

of cholesteatoma can be classified into cholesteatoma of upper tympanum.[3] By comparing the traditional microscope treatment with endoscopic treatment for cholesteatoma in different stages, we can evaluate and compare the efficacy of endoscopic ear surgery (EES).[4]

MATERIALS AND METHODS

Patient selection and inclusion/exclusion criteria

204 patients with middle ear cholesteatoma diagnosed by me from January 2018 to October 2019 were all the subjects of this study. The research scheme approved by the appropriate institutional review committee is taken as the scheme for this experiment. The criteria of this study are mainly confirmed patients with chronic otitis media with cholesteatoma in the upper tympanic cavity, aged 6-80 years, without maxillary sinus or mastoid involvement. To confirm the disease, it is necessary to pass preoperative high-resolution computed tomography (HRCT) of temporal bone and otoendoscopy, and general anesthesia is necessary during operation. We have followed the "Specifying the target difference in the primary outcome for a randomised controlled trial: guidance for researchers" reporting guidelines for the preparation of this paper.

All patients underwent pure tone audiometry, tympanometry, and preoperative HRCT scans of temporal bone before surgery (Figure 1). Thirteen patients with mastoid dilatation need to be thoroughly cleared of diseases, and must be thoroughly treated by undergoing surgery under the tube wall. In addition, the patients excluded from the research and analysis were one case of lateral semicircular canal fistula found during operation.

Patients who received EES and micro-otosurgery (MES) were randomly divided into two groups by random number table. One of the randomized sequences generated by a random number table is used to hide and distribute sealed opaque envelopes. Among them, the author will perform all cases of surgery to ensure the consistency of the study.

Surgery

All the operations in this study were performed under local infiltration under general anesthesia with 2% lidocaine and epinephrine (1: 100,000), in which Karl Storz (4 mm diameter, 18 cm long) rigid endoscope (0, 30, 45) and Zeiss operating microscope were used to study each group.

Penetration of postaural and canal, dissection of postaural sulcus of arched postaural incision flap, cutting of musculoperiosteal flap and bone canal in the latter half of contact, exposure and standard harvest of fascia of temporal muscle, detached skin canal measured from 12 o'clock to 6 o'clock position, and a front extended open attic area are all surgical technical contents of MES group. The whole range of cholesteatoma can be observed by gastrostomy with drill bit. To observe whether there is residual cholesteatoma matrix in attic area after cholesteatoma resection, we can observe it directly with or without a mirror. Relocation of the tympanic membrane flap can be performed with the support of the perichondrium, provided that the cartilage removed from the tragus reconstructs the attic (Figure 2). Osteoplasty can be performed with prosthesis when the ossicles are destroyed.

The technique of holding the endoscope in the left hand and cutting the skin along the tympanic membrane ring at 6 o'clock and 12 o'clock for EES group operation; The symptoms of bleeding can be controlled by cotton gauze. A pubic facetomy can be performed. Scrapers or gouges and mallets. Check the upper attic area after cholesteatoma resection, and use 0 and 30 endoscopy. The tympanic membrane flap was repositioned after rebuilding the attic through cartilage (Figure 3). Osteoplasty can be performed with prosthesis when the ossicles are destroyed.

Staging system for attic cholesteatoma

According to the EAONO/JOS 2015,[4] the attic cholesteatoma was classified as follows:

Cholesteatoma in attic (stage I), epithelial shrink bag self-cleaning function (stage Ia), continuous accumulation of shrink bag keratin-debris (stage Ib), cholesteatoma involving two or more websites (stage II),

intratemporal complications and/or pathological conditions of cholesteatoma (stage III), and intracranial cholesteatoma complications (stage IV).

Middle Ear Structural Visibility Index

The exposure degree of some key structures in the complete resection of attic cholesteatoma was expressed by the middle ear structure visibility index (MESVI) (supplementary figure 1).[5] The higher the MESVI, the higher the extent of surgical exposure.

Study parameters and result analysis

The average operation time from the first incision to earplug, as well as entering the hidden area of MESVI expression, the results of preoperative, intraoperative and postoperative examination are all the results of the above study.

The above experimental results were statistically analyzed by SPSS (version 24.0; SPSS Inc, Chicago, Illinois, USA). The average and standard deviation of digital variables, and the numbers and percentages of classified variables are used as the summary data of this time. Use paired t to test paired samples. Chi-square test or Fischer test was used to accurately check the unpaired proportion comparison. The experimental standard with statistical significance allows the difference of P[?]0.05.

RESULTS

Demographic distribution

There are 190 cases (192 ears) of chronic suppurative otitis media with cholesteatoma of upper tympanum, aged 6-75 years, including 92 females and 98 males. The average age of patients in the microscopic examination group was 45.67 years, and the average age of patients in the microscopic examination group was 45.06 years (P=0.065).

Preoperative and intraoperative findings

Facial nerve dehiscence

Among the 20 patients (10.42%) with suspected facial fissure, 12 were EES group and 8 were MES group. Intraoperatively, the incidence of facial nerve dehiscence (26 cases) caused by the cholesteatoma matrix was 13.54%. There was no significant difference between EES group with 14 facial nerve defects and MES group with 12 facial nerve defects (P=0.673). Among them, the symptoms of all cases with suspected facial nerve fissure on CT were confirmed during operation.

Semicircular canal fistula

Preoperative CT images showed no semicircular canal fistulas detected in any group. However, one case of lateral semicircular canal fistula in EES group was also found during operation. To keep the study groups homogeneous, these patients were excluded.

Staging system for attic cholesteatoma

According to the preoperative CT results and intraoperative findings, cholesteatoma spread in sinus cavity in stage Ib and II, 62 cases in stage Ib and 62 cases in stage II in EES group; 60 cases were in stage Ib and the rest were in stage II in MES group.

Parameters analyzed

The selected patients were the same, but there was no difference in preoperative and intraoperative parameters between endoscopic group and microscopic examination group.

MESVI

The median MESVI was 8 (range, 3–10) and 4 (range, 3–8) for the endoscopic and microscopic approach groups, the experiment produced a statistically significant difference

(P <0.05, Figure 4).

Operating time

The mean operating time was 93.75 ± 9.97 minutes and 105.833 ±14.19 minutes for the endoscopic and the microscopic approach groups, there was a statistically significant experimental difference (P <0.05).

Postoperative findings

Postoperative pain

Patient reports of endoscopic group with "almost no pain" or "slight pain" are all patient reports, and all patients do not need painkillers. Among them, 25% of patients who have experienced pain in need of painkillers have undergone microsurgery. 6 hours after operation, the pain was calculated by the numerical rating scale. The average pain score of microscopic examination group was 5.80(4-8) and that of endoscopic group was 3.45(1-6), which was statistically significant (P<0.05, Figure 5A).

Taste sensation

Facial nerves and chorda tympani nerves were kept intact during the operation for all patients. The rate of transient taste abnormality in microscopic examination group was 10.42%(10/96), and that in endoscopic group was 12.50%(12/96), which was not statistically significant*(*P =0.650, Figure 5B).

Air-bone gap and vertigo

During the 4-week follow-up, the air-bone gap closure was 17.55 dB in the endoscopic group and 17.69 dB in the endoscopic group (preoperative-postoperative ABG). There was no difference in hearing improvement between the endoscopic group and the endoscopic group (P=0.564, Figure 5C).

The rate of vertigo at the first weekend after operation was 8.33% in EES group and 10.42% in MES group. The experimental data of both groups were similar (Figure 6D).

Average healing time

The average healing time was 43.72 days (range, 20–60 days, standard deviation = 10.99) in the endoscopic subgroup and in the microscopic subgroup,43.99 days (range, 21–56 days, standard deviation = 10.27). However, there is no obvious difference in the experimental data. The comparative data is the healing time of the two methods. (P =0.262).

Long-term outcomes

Disease recurrence, cartilage displacement, perforation and re-contraction/re-contraction pocket formation, etc. were measured as long-term postoperative results one year after operation (Figure 6). Graft dislocation in osteoplasty occurred in this patient. There was no significant difference in the long-term results measured one year after operation between the two groups.

DISCUSSION

Attic cholesteatoma from Prussian cavity, through superior membrane and superior sinus to mastoid process. Among them, the endoscope with curette has a wider field of operation for attic cholesteatoma extending to maxillary sinus. Cholesteatoma undergoing mastoidectomy extends to mastoid cavity, so ventilation should be ensured during the operation, so that the lesion can be completely removed and the possibility of recurrence of attic cholesteatoma can be completely solved.

Extent of surgical exposure

The main purpose of cholesteatoma surgery is to reveal the new systematicness of the key parts of attic.[7] The exposure degree of each case in middle and middle ear surgery can be measured by a special grading system. MESVI, as the only grading system of middle ear surgical exposure, is the main content of our research. The median MESVI of microscopic approach is not as good as that of endoscopic approach. The median MESVI

of the microscopic approach is lower than that of the endoscopic approach under an approximately equal exposure area. At this time, the perspective of endoscopic surgery was broadened. The angle endoscope with appropriate instruments can be used to check the corner of the upper membrane cavity, which can better and more completely solve the disease without sacrificing extra bones.

Management of attic cholesteatoma

In the treatment of cholesteatoma in upper attic, endoscopic approach and microscopic approach have the same therapeutic effect in this study. Endoscopic approach and microscopic approach have the same operation time. Microscopic surgery takes less time than endoscopic surgery in a study by Magliulo et al.[3] In order to ensure that the surgical field of vision is wide enough in one-handed endoscopic surgery, it takes more time to stop bleeding, which will lead to an increase in the chance of leaving residual lesions when the surgical field of vision is low, and the critical structures are in danger. The operation time of endoscopic approach will be shorter in other studies, which is due to better understanding and familiarity with surgical anatomy and techniques.[5]

[8] In the early systematic review of EES and MES patients, the success rate and hearing results of 8 tympanic transplants can be compared experimentally. The taste, postoperative vertigo, air-bone space, average healing time and long-term prognosis have been proved to have no significant difference. Magliulo et al. have made a similar research conclusion on the statistical difference between the two surgical techniques in terms of postoperative pain and healing time.[3,5]

Complications

In this study, there were 4 patients with recurrence and 3 patients with recurrence. No complications related to facial nerve occurred in all patients. Among 36 patients in the endoscopic technique group, a study by Arindam et al. found that only one patient had residual lesions. In another study, Marchioni et al. found that 0.4% of patients had bone dislocation and 0.6% had persistent tympanic membrane perforation.[9,10] Cochlear/auricle cartilage displacement and subsequent retraction pocket formation are other important complications. Minimization of other important complications can be controlled by reducing excessive bone removal. Cholesteatoma can be removed to ensure easier and more stable reconstruction when it extends below the front buttress.

In our study, for similar diseases, the value of MESVI in the endoscopic group was higher, which caused the bone defect to be lesser; therefore, we concluded that it would result in fewer cartilage displacement and retraction pocket formation. Because we followed up the patients for only 1 year, there is no statistical difference between the two groups.

Endoscopic approach: advantages and disadvantages

Compared with surgical microscope, surgical endoscope provides a closer surgical field of vision, which makes it easier to expose the hidden lesions of the middle ear. The visualization of middle ear can be better realized by EES, especially when it is used for educational purposes. Endoscopic approach is the primary surgical approach for middle ear cholesteatoma, and Marchioni et al. It is easier to retain small bones and completely remove cholesteat[11] tumor in endoscopic surgery. The scope of endoscopic surgery is obviously reduced, and there is no obvious difference between the recurrence rate of cholesteatoma and endoscopic surgery, according to the conclusion of Ayache et al.[12] Compared with endoscopic approach, postoperative pain is higher and healing is slower. [13]In the endoscopic group, the arch incision behind the ear was not used after operation, and scars would not appear. These advantages were also confirmed in our study.

The one-handed technique of EES is perceived as one of its major limitations. The main function of non-dominant hand in MES is to attract the blood from the operation field, and it is the dominant hand to perform important surgical stripping. In EES, only one hand can perform the surgeries while the other hand controls the endoscopy, and a little bleeding may interfere with the surgical field at this time. Therefore, in the setting of one-handed surgical technique, hemostasis is essential.

Depth perception is limited in EES due to the two-dimensional nature of operation image, which is another obvious disadvantage in EES, so operators are always faced with lack of stereoscopic vision. Therefore, the surgeon has to achieve depth perception through haptic and visual. Recently years, inquire depth perception has been overcome in functional endoscopic sinus surgery; thus, we can learn from the experiences of sinus surgeons and accommodate for the lack of perception of depth.

CONCLUSION

In the treatment of attic cholesteatoma, under limited exposure conditions, endoscopic approach can avoid extra bone resection, find important middle ear markers, shorten postoperative time, reduce patients' pain and reduce the incidence of postoperative complications. Therefore, compared with the traditional microscopic approach, experienced surgeons will choose endoscopic approach for treatment.

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FIGURE LEGENDS

Figure 1 . Preoperative findings. (A) The damage of attic was observed by otoscope. There is a deep pocket in the right ear slack (arrow). White cholesteatoma in the left ear in front of the malleus (arrow). (B) In the coronal HRCT temporal bone scan (arrow), the Prussian space has lobulated soft tissue, and the middle small bone is displaced, which erodes the attic of scutum (*) (arrow). (C)Pure tone audiogram. 90% of patients with cholesteatoma have symptoms of conductive hearing loss caused by erosion of auditory bone.

Figure 2. A patient with intermittent otorrhea and earache was treated by microsurgery. (A) attic damage

occurs when the left tympanic membrane is examined before operation. (B) The tympanic membrane became clear in the attic area after postoperative examination. (C) cholesteatoma matrix (f, facial nerve; P, Cape; In the 1980 s, stapes were completely removed. (d) Implant cartilage (arrow) when rebuilding attic area.

Figure 3. One patient experienced hearing loss and intermittent otorrhea. Endoscope was used to treat attic cholesteatoma. (A) The attic was found damaged during the preoperative examination. (B) The attic was found to be clean after the operation. (C) After gastrectomy, white cholesteatoma was found by endoscope (arrow). (D) Reconstruction of attic with cartilage after removal of cholesteatoma (arrow).

Figure 4. The visibility index of middle ear structure (MESVI) after endoscopic and microscopic gastric wall incision

Figure 5. Postoperative manifestations-after endoscopic and microscopic pubic symptomy.

Figure 6. Long-term results of 1-year postoperative follow-up

Supplement figure 1. Middle ear structure visibility index (MESVI). (A) Observation results of middle ear structure under 0 endoscope. (B)With some important anatomical signs (public relations: Cape, Jacobson nerve, hy: hypotympanum, fi: finiculus, SST: SUPTYMPANICSE: styloid process bulge, pe: pyramidal bulge, saint: stapes tendon, isj: incudostapedial joint, fn: face) Sp: short process, nurse: malleus neck, ttm: tensor timulus muscle, ttf: tensor timulus fold, ica: internal carotid artery, cp: cochleariform process, lsc: lateral semicircular canal, safety factor: stapes foot) was used as the MESVI 10-point scoring system.