Value of Ear Endoscopy in Cholesteatoma Surgery

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Objective: The purpose of this study was to assess the value of ear endoscopy in cholesteatoma surgery and to demonstrate its consequence in improving surgical outcome.

Materials and Methods: A total of 92 ears with acquired cholesteatoma (primary or secondary) were operated on. In this prospective study, 82 cases were operated on by using canal wall up (CWU) technique, and 10 cases were operated on by using canal wall down (CWD) procedure. Endoscopically guided ear surgery was incorporated complementary to the microscope as a principal part in the procedure. Second-look endoscopic exploration was performed on some selected cases, depending on the finding during the primary surgery and the postoperative findings of clinical and computed tomographic studies.

Results: In the primary surgery after completion of microscopic cleaning, the overall incidence of intraoperative residuals detected with the endoscope was 22.8%. Sinus tympani was the most common site of intraoperative residuals in both CWU and CWD groups, followed by the facial recess and the under-surface of the scutum in the CWU cases. Reconstruction of the hearing mechanism was performed in the primary surgery in 86 cases (93.5%) and postponed to the second stage in only six cases (6.5%). Out of the 82 CWU cases, 35 second-look endoscopic explorations (42.7%) were performed. Three recurrences (8.6%) were identified. Two cases showed a tiny residual cholesteatoma pearl, and the third showed a larger open residual cholesteatoma filling the sinus tympani and extending to the aditus. In this series, no morbidity or complication was encountered secondary to the use of endoscopes in the mastoid or middle ear.

Conclusion: Incorporating the endoscope into the surgical armamentarium in otology contributes much to the concept of minimally invasive surgery. Minimally invasive endoscopic ear surgery should be accepted as a new horizon in ear surgery. In this study, it became obvious that despite the use of the endoscope in conjunction with the operating microscope, 100% eradication of the disease still could not be achieved; however, the use of endoscopes did reduce the residual cholesteatoma rate. Key Words: Endoscopic ear surgery—Residual cholesteatoma—Surgery of cholesteatoma.


Since the beginning of the tympanoplasty era, considerable effort has been devoted to the development of techniques designed to ensure enduring anatomic stability for cholesteatomatous ears. Residual cholesteatoma occurs as a consequence of growth of a fragmental remnant of the matrix inadvertently remaining in the middle ear at the time of primary cholesteatoma surgery. This happens even after meticulous removal of the matrix under an operating microscope, regardless of the surgical technique used (1,2). Poor access is considered the major reason for this failure (3). Microsurgery of the middle ear is traditionally performed under the operating microscope. Despite the illumination and magnification offered by the operating microscope, it has proved to have distinct limitations. The surgeon can visualize structures only directly ahead and is unable to see around objects. This straight-line view offered by the microscope resulted in certain blind pockets during middle ear surgery. These limitations can be overcome with the complementary help of an endoscope, which allows “looking around the corner” (4). During the past few years, middle ear surgery has increasingly relied on the endoscope. Yung (5) and Thomassin et al. (6) studied the use of rigid endoscopes in cholesteatoma surgery, particularly to visualize and assist in removal of residual disease from blind pockets (e.g., sinus tympani and anterior epitympanic recess). Second-stage endoscopic exploration with limited postauricular incision for detection of residual cholesteatoma was first described by McKennan (7). The purpose of this study was to assess the value of ear endoscopy in cholesteatoma surgery and to demonstrate its effect in improving surgical outcome.

MATERIALS AND METHODS

A total of 92 ears with acquired cholesteatoma (primary or secondary) were operated on in the Ear, Nose, and Throat Department of Alexandria University Hospital, Alexandria, Egypt. In this prospective study, these cases were operated on by using
either canal wall up (CWU, 82 cases) or canal wall down (CWD, 10 cases) technique, incorporating endoscopically guided ear surgery as a principal part of the procedure.

The operation was performed by using a Zeiss microscope and standard microsurgical instruments under continuous suction irrigation. The optic equipment used consisted of 0-, 30-, and 70-degree rigid Hopkins rod telescopes with an outside diameter of 2.7 mm (Karl Storz GmbH & Co., Tuttingen, Germany). A three-chip videocamera (Karl Storz) and 20-inch high-resolution monitor (Sony, Tokyo, Japan) were used, and all of the procedures were performed by working from the images on the monitor and were recorded with a videocassette recorder. Illumination was provided either by halogen or, preferably, xenon cold light source connected with a fiberoptic light cable. The endoscopic ear surgery was performed with a special set of microendoscopic instruments (Karl-Storz). The endoscopes and light cable were immersed completely in 2% glutaraldehyde (Cidex, Johnson & Johnson, Raynham, MA, U.S.A.), for 20 minutes, followed by thorough washing with sterile water. The video camera was wrapped with an autoclave cover.

CWU was the standard technique used, whereas CWD was chosen only in cases with severely contracted and sclerosed mastoid cavities. The endoscope was used, in this study, as a complementary tool to the microscope in an attempt to evaluate its role in controlling the disease. Second-look endoscopic exploration was performed on some selected cases, depending on the finding during the primary surgery and the results of post-operative clinical and computed tomographic (CT) follow-up studies. A second-look procedure was performed usually within 9 to 12 months after the primary operation. A limited 2-cm postauricular incision and a tympanomeatal flap was elevated in all cases. The mastoid cavity was entered by using sharp dissection and bipolar hemostasis. These steps could be performed either with the help of the 0-degree endoscope or the microscope. Examination of the epitympanum, mastoid air pocket, facial recess, and posterior aspect of the middle ear was performed until residual cholesteatoma had been ruled out. Tiny residual cholesteatoma pearls could be removed endoscopically by using micro-instruments designed for the endoscope. Larger cholesteatoma residuals required opening the postauricular incision, as is usually performed in a conventional second-look procedure. Large residuals needed to be excised either by taking the CWD or by repeating the intact canal wall procedure, at the discretion of the surgeon. In this case, a thirdlook procedure was planned.

RESULTS

This study presents results of 92 cholesteatomatous ears operated on since 1995 that incorporated endoscopically guided ear surgery as a principal part of the procedure. CWU was the standard technique and was used in 82 cases, whereas CWD was used only in 10 cases with severely contracted, sclerosed mastoid cavities. All cases were approached through standard postauricular incision. Conchomeatoplasty was performed in all 10 cases in the CWD group.

Endoscopy was used intraoperatively, after completion of the microscopic work and before starting the middle ear reconstruction, looking for remnant or residual epithelial matrix in hidden areas of the middle ear. These areas included sinus tympani, anterior epitympanic recess, facial recess, and the medial (under) surface of the scutum. In the primary surgery, the overall incidence of intraoperative residuals detected by the endoscope was 22.8%. Sinus tympani was the most common site (42.9%) of intraoperative residuals in both CWU and CWD groups, followed by the facial recess (23.8%) and the under surface of the scutum (14.2%) in the CWU cases (Table 1).

Reconstruction of the hearing mechanism was performed in the primary surgery in 86 cases (93.5%) and postponed to the second stage in only six cases (6.5%). This was mainly because of the bad condition of the mucosa lining of the middle ear cavity or the questionable total removal of the cholesteatoma. Thin silastic sheets were used in 28 cases (30.4%). Autograft ossicles, after meticulous cleaning for any abnormalities, were mostly used in reconstruction mechanism (53 cases, 57.6%), followed by cartilage (30 cases, 32.6%) and ceramic total or partial ossicular replacement prostheses (9 cases, 9.8%).

Of the 82 CWU cases, 35 second-look endoscopic explorations (42.7%) were performed 9 to 12 months after the primary surgery. Three recurrences were identified (8.6%). Two cases showed tiny residual cholesteatoma pearls: one in the mastoid cavity and the other in the sinus tympani (Fig. 1). Both residual pearls were endoscopically removed. The third case showed larger residual material filling the sinus tympani and extending medial to the interposed incus toward the aditus and attic. This case was converted into a CWD procedure, and the cholesteatoma was successfully removed by using both microscopic and endoscopic techniques. In this series, there was no morbidity or complication secondary to the use of the endoscope in the mastoid or middle ear.

DISCUSSION

Surgical treatment of cholesteatoma remains one of the most controversial issues in the field of otology. Residual cholesteatoma is among the major causes of failure in surgical treatment of cholesteatoma. In the present work, the endoscope was used only at the end of the microscopic procedure when it was thought that complete eradication of disease had been achieved. Verifica-
tion of complete cholesteatoma removal proved possible through the magnified panoramic views obtained by the endoscopes. On detection of any cholesteatoma remnants, precise excision could be performed by using fine endoscopic micro-instruments under video-endoscopic control. Regarding the second-look operations, they were performed with a limited postauricular approach and endoscopic technique. We could rule out residual disease also from middle ear recesses in addition to the epitympanum and mastoid. This was accomplished by the addition of a limited tympanomeatal flap and by passing the endoscope transtympanically to ensure complete eradication of disease that may not be visible via an endoscopic mastoid exploration. This required 2-cm incision and placement of a small retractor. McKennan (7) and Youssef and Poe (8) found that the use of the endoscopic technique significantly decreased the morbidity of the second-look procedure, enhanced visualization of residual disease, and reduced operating time.

In CWD procedures, a second-look operation was considered mandatory if complete removal of cholesteatoma in the primary surgery was questionable or if the postoperative CT scan showed an abnormal soft-tissue shadow. However, if the clinical condition of the patient was very satisfactory and the 1-year postoperative CT scan showed good aeration with no abnormal findings, then the second-look operation could be postponed in consideration of the results of a yearly CT scan. In this study, out of the 82 CWU cases, 35 second-look endoscopic explorations (42.7%) were performed 9 to 12 months after the primary surgery.

It has been shown that with closed operations the rate of residual cholesteatoma detected at the second-look operation varies from 10 to 43% (2). Thomassin et al. (6) found that by using intraoperative endoscopy the quality of disease eradication significantly improved and resulted in the dropping of the incidence of residual cholesteatoma from 47% to 6%. They attribute this considerable reduction in residual cholesteatoma to the endoscope, which eliminates blind surgery. In this study, of the 35 second-look endoscopic explorations performed, three residuals (8.6%) were identified. Despite this close similarity between these two residual rates, it should be noted that the remaining patients who have yet to be subjected to second-look endoscopic exploration are scheduled for close follow-up and eventual endoscopic reexploration. In 15 second-look procedures, Haberkamp and Tanyeri (9) found one residual cholesteatoma in their endoscopic cases series. Also, in Yung’s (5) series, despite endoscopic control, one patient still experienced residual cholesteatoma in the middle ear. Yung concluded that it is possible that the operating microscope and the rigid endoscopes could not identify small areas of squamous epithelium in the middle ear cavity. We agree with Youssef and Poe (8), who recommend further long-term follow up studies to report the actual recurrence rate in cases in which endoscopic removal of cholesteatoma is judged to be successful at the primary operation.

Residual cholesteatoma occurs as a consequence of growth of a fragmental remnant of the matrix inadvertently remaining in the middle ear at the time of cholesteatoma surgery. Poor access was one of the major reasons for residual disease, particularly in the sinus tympani, anterior epitympanic recess, and eustachian tube. Hence, these areas were considered the main sites.

**FIG. 1.** Second-look operation 1 year after the primary surgery (left ear). A, Microscopic view after slight elevation of the TMF; only the interposed incus could be visualized. B, 30-degree endoscopic view showing a cholesteatoma pearl in the sinus tympani. C, Endoscopic dissection of the pearl. D, Endoscopic view showing clean sinus tympani. I, incus; TMF, tympanomeatal flap; Chole, cholesteatoma; RW, round window.
of recurrence (6). Microsurgery of the middle ear is traditionally performed under the operating microscope. With the operating microscope, the surgeon can visualize structures only directly ahead and is unable to see around objects. This straight-line view offered by the microscope resulted in certain blind pockets during middle ear surgery. In this study, during the primary surgery and after meticulous cleaning of the matrix under the microscope, the overall incidence of intraoperative residuals detected by the endoscope was 22.8%. In this study, similarly to Pratt (10), Magnan et al. (4), and Gonzalez and Bluestone (11), the sinus tympani alone was found to be the most common site (42.9%) of intraoperative residuals in both CWU and CWD groups, followed by the facial recess (23.8%) and the undersurface of the scutum (14.2%) for the CWU cases. We agree with Magnan et al. (4), who stated that the limitations of access to the sinus tympani can be overcome with the complementary help of an endoscope, which allows looking around the corner.

The shape of the residual cholesteatoma is considered to represent the state of the cholesteatoma (12). From the surgical point of view, the squamous pearl is regarded as an end stage and it is easily removed, whereas an open-type residue retains its potential for further growth. From observations at second-look operations in the current study, squamous pearls were found in two cases and open-type residual was found in one case. In our opinion, removal of an intact cholesteatoma pearl could be considered the end of follow-up. However, if an open cholesteatoma is detected, this necessitates either removal through CWD or CWU technique, with a planned third-look operation. Schuring et al. (12) reported detection of residual disease in 35% of their cases, of which 21% were of squamous pearls and 14% were of the open type. Gyo et al. (13) reported that the incidence of open-type residues was remarkable in pars tensa cholesteatoma and in severe primary disease, occurring predominantly around the stapes and in the sinus tympani. However, no firm conclusion concerning the factors responsible for the shapes of residue can be drawn from the current study.

According to our experience, we found that the 30-degree endoscope was more frequently used in all cases and gave the best overall exposure of the middle ear recesses. Similarly, Yung (5), McKennan (7), Youssef and Poe (8), and Bottrill and Poe (14) preferred the 30-degree endoscope to the 70-degree endoscope because of its better forward view capabilities that facilitate introduction into the wound. In this study, the 70-degree endoscope was occasionally used only to visualize the superior aspect of mastoid cavity and the undersurface of the scutum as mentioned by McKennan (7). Youssef and Poe (8) and Tarabichi (15) used a 4-mm-diameter endoscope and found that it yielded wider views and much better resolution than the 2.7-mm endoscopes. In the present work, we considered a 2.7-mm endoscope a good compromise between diameter and image size and resolution, as mentioned by many authors (5,6,14). However, Yung (5) stated that if space permitted, a 4-mm endoscope yielded a larger image with which it is easier to work.

Youssef and Poe (8) and Bottrill and Poe (14) mentioned that the surgeon can greatly benefit initially from using both endoscope and microscope until becoming familiar with endoscopic techniques. Many of the cases in this study, whether during the primary surgery or the second-look operation, needed alternation between microscopic and endoscopic technique. An operating microscope was used for reorientation and bimanual dissection when endoscopy became difficult, particularly if ossicular reconstruction was staged in the primary operation or if residual disease was so extensive that it necessitated conversion to an open second-look operation. Although endoscopy cannot be viewed as a replacement for conventional mastoid surgery, it does offer the surgeon a less invasive option. In contrast to Tarabichi (15), who thought it quite difficult to use the endoscope and microscope to perform different tasks in the same procedure, we found that alternating between the microscope and endoscope is a useful option and essential to advancing one’s endoscopic skills.

There was neither morbidity nor complication secondary to the use of endoscopes in the current study. However, the risk of damage to the ossicular chain should not be underestimated. Thomassin et al. (6) reported two cases of total sensorineural hearing loss as a result of trauma to the intact stapes.

We agree with Tarabichi (15) that endoscopes have many proven advantages over the microscope, including wider angle of view, better visualization of structures that are parallel to the axis of the microscope, visualization of hidden structures such as the sinus tympani and anterior epitympanic recess, and the ability to visualize beyond the shaft of larger surgical instruments. On the other hand, several disadvantages of endoscopes include loss of depth of perception and binocular vision, the inevitable one-handed surgical technique involved, the need of a bloodless field (hence meticulous attention to hemostasis is essential), fogging and smearing of the tip of the endoscope, the mandatory need for reliable physician training, and the cost of equipment involved.

CONCLUSIONS

Incorporating the endoscope into the surgical methods in otology contributes much to the concept of minimally invasive surgery. The goal of the minimally invasive endoscopic ear surgery should be accepted as a new horizon in ear surgery. Combining the attributes of the binocular microscope and the endoscope during surgery proved to have improved efficacy compared with standard techniques. The technique can be considered technically feasible for the majority of surgeons in terms of both levels of required surgical skill and accessibility to new equipment. In this study, it became obvious that despite the use of the endoscope in combination with the operating microscope, we still could not achieve a 100%
eradication of the disease. However, the use of endoscopes did reduce the residual cholesteatoma rate.

REFERENCES


