

The value of otoendoscopy in the management of middle ear cholesteatoma

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Background: The surgical management of cholesteatoma is a controversial issue, particularly regarding intact-canal-wall mastoidectomy (ICWM) versus canal-wall-down mastoidectomy (CWDM). The current experiment compared the quality of visualization in different middle ear structures using ICWM with otoendoscopy with findings of CWDM by microscopy. **Materials and Methods:** The patients diagnosed with cholesteatoma underwent tympanomastoidectomy, and then the patients selected for CWDM were included in the study (25 patients: 11 females and 14 males). After removing the cholesteatoma from the involved areas, otoendoscopic examination was done with a 4 mm, 0° endoscope by a neurootologist. All five middle ear structures (lateral epitympanum, sinus tympani, posterior crus of the stapes, round window niche, and Eustachian tube orifice) suspected of occult cholesteatoma were evaluated in terms of having or lacking the pathology. Then, CWDM was performed and all of the mentioned sites were reevaluated for diagnosing occult cholesteatoma. **Results:** The symmetric measures were 73%, 92%, 63%, 81%, and 100% for lateral epitympanum, sinus tympani, posterior crus of the stapes, round window niche, and Eustachian tube orifice, respectively. **Conclusion:** Otoendoscopy was confirmed to have a great potential to be adopted by surgeons as a less invasive procedure in the surgical management of middle ear cholesteatoma.

Key words: Canal-wall-down mastoidectomy (CWDM), cholesteatoma, otoendoscopy

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INTRODUCTION

The surgical management of cholesteatoma has still remained a controversial subject even over 100 years after the first successful mastoidectomy. Throughout the past decade, the controversy of canal-wall-up mastoidectomy (CWUM) versus canal-wall-down mastoidectomy (CWDM) in cholesteatoma was addressed.^[1-7] There seem to be inherent limitations and advantages in both CWUM and CWDM including the ease of disease removal, incidence of recurrence, and the extent of postoperative care.^[4]

If possible, intact-canal-wall mastoidectomy (ICWM) is viewed as superior to CWDM due to its better aesthetic consequences and aural hygiene. The higher rate of residual disease is the drawback of ICWM rather than

CWDM (19-47.7% vs 5-12%), which seemed to be because of the poor visualization of particular areas in middle ear during surgery.^[8] The number of criteria, published in the literature, using for choosing the technique in cholesteatoma surgery is few. It includes patient factors such as age, anatomic factors such as the degree of cellularity of the mastoid, pathologic factors that depend on the degree of extension of cholesteatoma, functional factors that involve hearing affection, and social factors regarding the accessibility of the patient for the follow-up.^[9]

According to many otologists, canal-wall-down procedures provide better visualization in the most part of middle ear than intact-canal-wall procedures. The study of Hulka and McElveen (1998) on 12 cadaveric temporal bones confirmed this idea.^[2] They suggested that CWDM showed significantly superior visualization of the lateral epitympanum, posterior crus of the stapes, and sinus tympani rather than ICWM.

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During the past 40 years, a number of techniques were suggested for getting better intraoperative visualization of middle ear cavity structures in surgeons by surgeries while keeping the posterior canal wall safe. Most of these techniques were intended to make view of the posterior tympanic cavity better particularly, the sinus tympani. The techniques included reversing the surgeon orientation, using mirrors to see around bony ridges, and temporarily removing the posterior canal wall.^[10-13] Although these methods enhance the visualization approximately, they all have some limitations and none of them has entirely been accepted.^[11,14,15] In 1967, Mer *et al.* first depicted the use of fiberoptic endoscopes for observing the middle ear cavity.^[16] However, those early otoendoscopes were short of maneuverability since they were connected to surgical microscope stands. Since then, technological advances have made preparations for handheld scopes that coming higher resolution and smaller diameters. At present, rigid otoendoscopes are used for primary cholesteatoma surgery and for second-stage organized investigative surgeries.^[17] It has been proved that the 2.7-mm 30° and 70° otoendoscopes are most practical during the primary surgery.^[18]

Several reports have been published on endoscopy-aided otologic surgery and its associated lower rate of residual cholesteatoma. For example, Yung reported a 9.4% rate of residual cholesteatoma later than ICWM aided by 0° and 30° endoscopy.^[19] Similarly on a second look, Badr-el-Dine (2002) discovered that using otoendoscopy for the primary ICWM surgery, only 8.6% of his operations displayed residual disease.^[20] Thomassin *et al.* (1993) found that the rate of residual cholesteatoma following ICWM decreased from 47.7% to 5.5% when they start using adjunctive otoendoscopy.^[14]

The rates of residual cholesteatoma using endoscopy-aided ICWM are comparable to those of CWDM using microscopy.^[19,20] While it is widely accepted and logical that this trend is due to increased visualization of the endoscopes, none of the known studies have quantitatively compared visualization through both the approaches in a randomized, blinded manner.^[21] In a study by Rehl *et al.* (2012), 30° and 70° otoendoscopy on 10 cadaveric temporal bone showed better visualization on sinus tympani and Eustachian tube while there is no significant difference among the lateral epitympanum, posterior stapes crus, and round window niche.^[8] In this study, we tried to compare the quality of visualization in different middle ear structures with otoendoscopy compared with CWDM.

MATERIALS AND METHODS

This study was conducted at Al Zahra Hospital between June 2014 and March 2015. Patients with the diagnosis of

cholesteatoma signed a written consent form after being explained about the study procedure. They underwent tympanomastoidectomy (by retroauricular approach routinely done at our institute) and then those selected for CWDM were included in the study (25 patients—11 females and 14 males). There was no exclusion criteria.

After removing the cholesteatoma from the involved areas (using otomicroscope in routine manner in all middle ear structures to the extent that was possible regarding visualization before lowering the posterior canal wall), otoendoscopic examination was done with a 4 mm, 0° endoscope by a neurootologist. In all cases, the scutum was removed for better vision to the extent that stapedius muscle could be seen. Also the incus was removed after recognizing erosion (resulting in better vision and freedom to act). All five middle ear structures suspected of occult cholesteatoma were evaluated in terms of having or lacking the pathology (cholesteatoma). These five anatomic sites were lateral epitympanum, sinus tympani, posterior crus of the stapes, round window niche, and Eustachian tube orifice. Then, CWDM was performed and all of the mentioned sites were reevaluated for the diagnosis of occult cholesteatoma. The accurate diagnosis of pathology using endoscopy in these sites was compared with that of CWDM.

Statistical analyses were performed with Statistical Package for the Social Sciences (SPSS) version 16 (SPSS-Inc., Chicago, IL). Results were reported as sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Symmetric measures were reported by Cramer's coefficient. $P < 0.05$ was considered significant for the symmetric measure.

RESULTS

Twenty-five patients (11 female and 14 male) were studied. On average, they had suffered from chronic otitis media for 16 years ($3-40 \pm 9.3$). The mean age was 46 years (range from 13 years to 70 years). Of these patients, 56% presented with granulation tissue, 24% presented with polyp, 80% presented with an ossicular chain destruction, and 28% with tympanosclerotic plaque.

Considering CWDM as a gold standard for detecting occult cholesteatoma during surgery, sensitivity, specificity, PPV, and NPV of otoendoscope is presented for each site in Table 1.

In lateral epitympanum, the otoendoscope showed 93.8% sensitivity and 77.8% specificity with a symmetric measure of 73% ($P < 0.001$), demonstrating that there is no significant difference between two techniques' visualization.

Table 1: Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and symmetric measures of otoendoscopy in different sites of middle ear, comparing CWD

Anatomic site	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Symmetric measure (%)	P-value
Lateral epitympanum	93.8	77.8	88.2	87.5	73	<0.001
Round window niche	75	100	100	89.5	81	<0.001
Posterior crus of the stapes	77.8	85.7	77.8	85.7	63	0.002
Sinus tympani	88.9	100	100	91.7	92	0.001
Eustachian tube orifice	100	100	100	100	100	0.001

All of the negative sites in sinus tympani were also detected as negative by CWDM (100% specificity). In this area, the sensitivity was 92.9%. In one case, we diagnosed cholesteatoma in sinus tympani with otoendoscope, but after the removal of canal wall, the observed pathology was tympanosclerotic plaque.

The sensitivity, specificity, and symmetric measures were 77.8%, 85.7%, and 63%, respectively. However, there were no significant statistical differences.

The specificity for round window niche (as well as sinus tympani and Eustachian tube orifice) was 100%. Its sensitivity was 75% and its symmetric measure was 81% ($P < 0.001$). In all the patients, otoendoscope detected the involved Eustachian tube correctly (sensitivity and specificity 100%) with a symmetric measure of 100%.

DISCUSSION

This study showed that otoendoscopy, compared with CWDM, would provide a good visualization of middle ear structures that are suspected for occult cholesteatoma. The anatomic sites evaluated in this study were lateral epitympanum, sinus tympani, posterior crus of the stapes, round window niche, and Eustachian tube orifice. These anatomic sites were known as areas with difficult visualization and cholesteatoma removal in ICWM. Thus, these areas are high risk for residual or recurrent diseases.^[2,14,19]

In this study, instead of largely used lateral vision endoscopes, we used only 0° endoscope. We hypothesized that in relatively shallow structures of middle ear, maneuvering 0° endoscope would replace lateral vision endoscopes. We can detect a good degree of visualization in lateral epitympanum and round window niche as CWDM. This is comparable with the previous studies using 30° and 70° otoendoscopes.^[8] Meselaty *et al.* (2003) reported that most sites of cholesteatoma remnants were seen in sinus tympani.^[22] In this study, we found the symmetric measure of this site desirable (92% with P -value less than 0.001 and specificity of 100%). Previous studies reported that otoendoscopy provided better visualization of sinus tympani than CWDM, since CWDM did not address the obstruction caused by the overlying facial canal.^[8]

The poor symmetric measure for posterior crus of the stapes may be due to conservative manipulation of this anatomic site fearing facial nerve or hearing damage. However, some researchers state that the stapedia tendon will block visualization of the posterior crus. For this reason, posterior crus of the stapes would be best visualized by placing the endoscope inferiorly in the middle ear and then viewing superiorly, seeing the posterior crus of the stapes under the stapedia tendon.

The sensitivity, specificity, and symmetric measure of Eustachian tube orifice are all 100%. However, generally, in our population the number of involved Eustachian tubes was four, and we diagnosed all of them correctly using an otoendoscope. The little amount of involvement can be due to the fact that this anatomic site is more involved in congenital cholesteatomas than acquired cholesteatomas. However, the access to Eustachian tube can theoretically be affected by the distance between umbo and promontorium.

One of the disadvantages of otoendoscope is fogging the lens of the endoscope, but this can easily be handled by using an antifog solution. Moreover, smearing of blood on the tip of an otoendoscope can significantly obstruct one's view or hinder interpretation of middle ear anatomy. For this reason, meticulous attention to hemostasis during the tympanomastoidectomy is essential.

Our results are in favor of Rehl *et al.* (2012) on 10 cadaver temporal bones which has used 30° and 70° otoendoscopes. It showed that otoendoscopy was significantly better than CWDM for sinus tympani, and there was no significant difference for lateral epitympanum, posterior crus of stapes, and round window niche.^[8]

In a prospective study comparing CWDM, CWUM with or without otoendoscopy, Meselaty *et al.* (2003) reported that after a period of 12-48 months of follow-up, all cholesteatoma residuals were from groups of patients with no otoendoscopy.^[22] It is in favor of the study of Liu *et al.* (2010) reported a recurrence rate of 6-7% for cholesteatoma in patients treated with 4.3-mm 0°, 30°, 70° otoendoscopy following 3 months to 2 years. This is comparable with that of CWDM.^[23]

Despite of these results, Saravanappa *et al.* (2003) in a survey in UK, showed that only 2-10% of surgeons use otoendoscope routinely and 7-38% use it occasionally.^[24] It should be emphasized that this method has to be used much more in the future by more surgeons, reducing CWDM in selected patients.

CONCLUSION

The results of the present study confirmed that otoendoscope could be applied in the surgical management of middle ear cholesteatoma. In fact, the otoendoscopy offers a less invasive procedure with a comparable detecting power of cholesteatoma in anatomic structure that could be hidden in otomicroscopy.

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Conflicts of interest

There are no conflicts of interest.

AUTHOR'S CONTRIBUTIONS

HRA contributed in the conception of the work, conducting the study, interpretation of data and revising the draft and approval of the final version of the manuscript. FA contributed in the conception of the work, responsible for the first draft of the manuscript, acquisition, analysis, interpretation of the data and approval of the final version of the manuscript. MR contributed in the conception of the work revising the draft and agreed for all aspects of the work. NB contributed in the conception of the work revising the draft and agreed for all aspects of the work.

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