Case Report

The first transcanal endoscopic ear surgery in Udayana University General Hospital

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ABSTRACT

Background: The conventional method for treating cholesteatoma involves using a microscopic approach. However, over the years, endoscopy has evolved from being a supplementary tool alongside the microscope to becoming the primary transcanal approach in different areas of ear surgery. **Purpose:** To present a case of cholesteatoma in adult which was treated by the combination of transcanal endoscopic ear surgery and mastoidectomy. **Case report:** An adult patient with malignant type of chronic suppurative otitis media underwent transcanal endoscopic ear surgery and mastoidectomy. Endoscopic surgery is a more intricate single-handed procedure that demands both experience and a comprehensive knowledge of endoscopic ear anatomy. This is essential for navigating the anatomical space, dealing with the ossicular chain, and employing transcanal drilling techniques. The primary surgical focus for endoscopic ear surgery is the middle ear. When addressing cases where cholesteatoma extends beyond the posterior epitympanum, the surgical approach relies on the surgeon's expertise in performing extensive atticotomy or mastoidectomy, either with or without microscope assistance. **Clinical question:** What is the role of transcanal endoscopic ear surgery and mastoidectomy in adult patient with cholesteatoma? **Method:** Literature searching was performed with the keywords: "cholesteatoma", AND "transcanal endoscopic ear surgery", AND "mastoidectomy" through database PubMed, Proquest, and hand searching/e-book. **Result:** There were 3 articles relevant with the subject. **Conclusion:** Transcanal endoscopic ear surgery is a minimally invasive and secure procedure characterized by its low rates of complications and recurrence.

Keywords: transcanal endoscopic ear surgery, mastoidectomy, cholesteatoma, chronic suppurative otitis media

ABSTRAK

Latar belakang: *Metode konvensional dalam tatalaksana kolesteatoma adalah dengan menggunakan pendekatan mikroskopis. Namun, selama bertahun-tahun, prosedur endoskopi telah berevolusi dari pelengkap di samping mikroskop menjadi pendekatan transkanal utama di berbagai bidang bedah telinga.* ***Tujuan:*** *Mempresentasikan kasus kolesteatoma pada orang dewasa yang ditangani dengan kombinasi bedah telinga endoskopi transkanal dan mastoidektomi.* ***Laporan kasus:*** *Seorang pasien dewasa dengan otitis media supuratif kronik tipe berbahaya yang dilakukan bedah telinga endoskopi transkanal dan mastoidektomi. Bedah telinga endoskopi adalah prosedur yang rumit, yang dilaksanakan oleh ahli otologi berpengalaman dan memiliki pengetahuan yang komprehensif tentang anatomi telinga. Hal ini penting untuk mengenali ruang anatomi, menangani rangkaian tulang-tulang pendengaran, dan menggunakan teknik pengeboran transkanal. Fokus pembedahan utama untuk bedah telinga endoskopi adalah telinga tengah. Ketika menangani kasus-kasus dengan kolesteatoma yang meluas di luar epitimpanum posterior, pendekatan pembedahan bergantung pada keahlian dokter bedah dalam melakukan atikotomi atau mastoidektomi yang ekstensif, baik dengan atau tanpa bantuan mikroskop.* ***Pertanyaan klinis:*** *Apa peran bedah telinga endoskopi transkanal dan mastoidektomi pada*

kasus pasien dewasa dengan kolesteatoma telinga? ***Metode:*** *Pencarian literatur dilakukan dengan kata kunci: "kolesteatoma", DAN "bedah telinga endoskopi transkanal", DAN "mastoidektomi" melalui* database PubMed, Proquest, *dan pencarian* manual/e-book. ***Hasil:*** *Terdapat 3 artikel yang relevan dengan topik tersebut.* ***Kesimpulan:*** *Bedah telinga endoskopi transkanal adalah prosedur invasif minimal dan aman, yang ditandai dengan rendahnya tingkat komplikasi dan kekambuhan.*

Kata kunci: *bedah telinga endoskopi transkanal, mastoidektomi, kolesteatoma, otitis media supuratif kronis*

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INTRODUCTION

Cholesteatoma is characterized by the development of keratinizing squamous epithelium accompanied by keratin debris and an inflammatory response in the surrounding tissue. It is categorized as either congenital or acquired. In cases of primary acquired cholesteatoma, a retraction pocket starts from the tympanic membrane, progresses into the tympanic cavity, and then extends towards the sinus tympani, facial recess, and attic. In more advanced instances, cholesteatoma may expand into the mastoid cavity. The main goal of surgical treatment is to eliminate the condition, ensure a healthy middle ear cavity, and, when possible, restore hearing.[1,2]

The primary objective of cholesteatoma surgery is to eliminate the disease, minimize the risk of residual cholesteatoma, and prevent recurrence, whilst striving to restore optimal hearing for the patient. Traditionally, this surgery employs a microscopic approach through canal wall-up or canal wall-down procedures. However, in recent years, the endoscopic approach has gained significant advancements due to progress in optics instrumentation, and surgeons' expertise.[3]

Initially introduced as a complement to microscopy, endoscopy has evolved into an independent transcanal approach in various aspects of ear surgery, particularly through the efforts of the International Working Group on Endoscopic Ear Surgery (IWGEES), established in 2008 by a global collaboration of otologist surgeons. The foundation of this development lies in the transcanal endoscopic approach, featuring specific indications, techniques, and limitations. Depending on the nature of cases and surgical preferences, endoscopy may be used in conjunction with microscopy, or serve as the primary technique (transcanal endoscopic ear surgery [TEES]), occasionally with the assistance of microscopy (reversed procedure).[3,4]

The objective of this case report and literature review is to provide insights into chronic suppurative otitis media, particularly the malignant type which is characterized by cholesteatoma finding, presenting a comprehensive view of current and evolving approaches of transcanal endoscopic ear surgery and mastoidectomy based on analysis of the available literatures.

CASE REPORT

A thirty-three-year-old male came to our outpatient clinic with a history of otorrhea from his right ear. The foul-smelling, blood- mixed secretion was discharged from the right ear, intermittently for 3 years. He experienced a sense of fullness and decreased hearing in the right ear. There were no cough and cold following the symptoms. Otoscopic

examination revealed perforation in attic region of the right tympanicmembrane. There was no discharge from the right tympanic membrane.

Figure 1. Otoscopic examination of the right ear

Physical examination showed no facial asymmetry. The oral cavity examination showed it was in good health. A blood test showed normal result. Computed tomography scan (CT scan) revealed a right chronic otomastoiditis accompanied by cholesteatoma in Prussak's space extending to epi-mesotympanum, additus ad antrum, eroding the ossicle, scutum, and tegmen tympanum. There was minimal deviation of the nasal septum to the right, and hypertrophy of left and right inferior nasal turbinate.

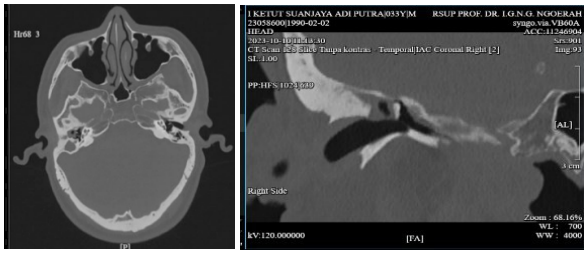

Figure 2. CT scan

The audiometric test showed right moderate severe conductive hearing loss [with air conduction (AC) 61.25 dB and bone conduction (BC) 16.25 dB], and left moderatemixed hearing loss (AC: 51.25 dB, BC: 28.75dB).

The patient underwent transcanal endoscopic ear surgery (TEES) and mastoidectomy (Figure 3). Postoperative pathology examination revealed cholesteatoma of the right tympanic and mastoid cavity. The patient receivedpostoperative antibiotic, and since then he did not have any complaint.

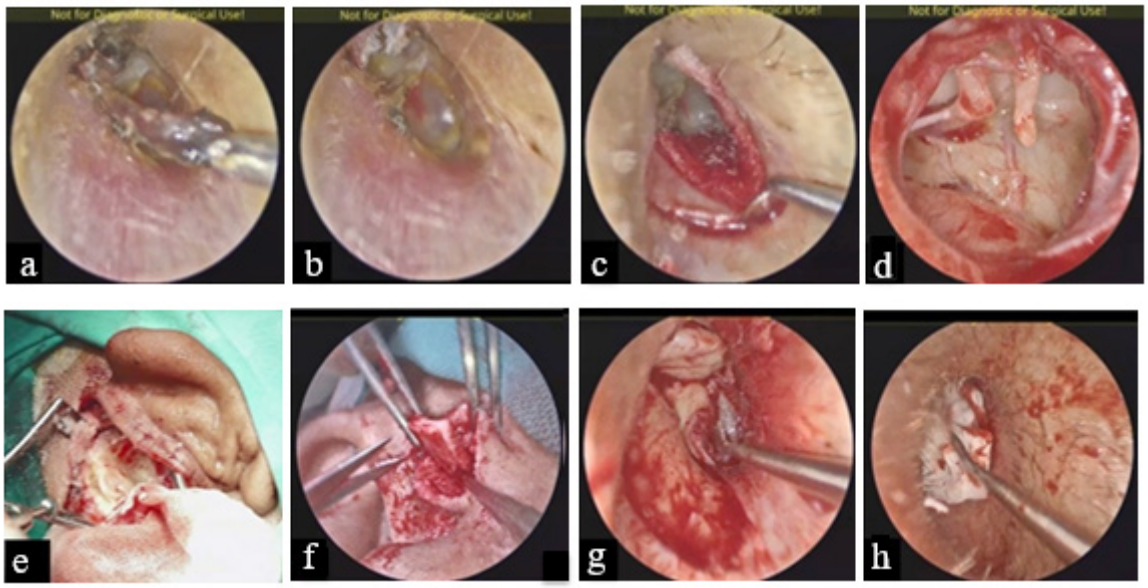

Figure 3. a. Attic perforation. b. Attic perforation with cholesteatoma. c.Tympanomeatal flap. d.Bared middle ear. e. Post auricular approach for wider view. f. Harvesting graft tissues from tragus. g. Inserting gelfoam, cartilage and perichondrium on the perofated TM. h. Gelfoam as the last cover in ear canal.

CLINICAL QUESTION

In adult patients with a cholesteatoma, what are the roles of transcanal endoscopic ear surgery and mastoidectomy?

METHOD

A literature review was conducted through a systematic literature search in electronic databases (PubMed and Proquest). The keywords used were "cholesteatoma", AND "transcanal endoscopic ear surgery", AND "mastoidectomy". Hand searching was also performed using references in the articles.

Eligible articles were all studies including randomized controlled trial (RCT), cohort studies, case series, and case reports which included the transcanal endoscopic ear surgery and mastoidectomy role in cholesteatoma surgical management. There were no limitations for publishing year. All articles published in the English-language were included. A data extraction table was created to summarize characteristics, surgical interventions, and outcome from studies selected. Qualitative characteristics and the numerical distribution of mapped evidence were used to answer the background question.

RESULT

A total of 142 articles were initially identified, 95 articles were excluded based on the screening of titles, and abstracts due to a lack of relevance to the patient, concept, and context of this article. A total of 12 full articleswere assessed for eligibility, resulting in 3 articles that met the criteria (Figure 5). The literature review included 3 articles comprising 1 randomized clinical study and 2 case series, all addressing management of cholesteatoma with endoscopic ear surgery and mastoidectomy.

Among the 3 articles, a total of 138 patients were diagnosed with chronic suppurative otitis media with cholesteatoma. Table 1 showed an overview of the randomized clinical study and case series included in this article.

Table 1. Overview of the randomized clinical study and case series included

Author	Country	Study Design	Patients (n)	Mean Age (Range)	Diagnosis/ Type of Cholesteatoma	Surgery		Conclusion
						TEES	Micro-scopic approach	
Dalgic A, 2023[1]	Turkey	CS	27	36.4 (4-67)	2 congenital cholesteatoma, 3 secondary to a tensa perforation, 15 pars flaccida cholesteatoma, 7 pars tensa cholesteatoma	27	-	TEES allows the preserva-tion of normal middle ear physiology and stands out as a good alternative for microscopic surgery in suitable cases.

Shakya D, 2023[2]	Nepal	CS	31	24 (16-39)	9 epitympanic cholesteato-maextending to the mastoid cavity, 15 mesotympanum and mastoid cavity, cholesteatoma	24	-	Endoscopic transcanal retrograde mastoidec-tomy was feasible for moderate cholesteatoma with good results. It is more functional, ideal for sclerotic mas-toid, avoids postauricular incision, allows minimal tissue/bone removal, and faster wound healing.
Hamela, 2023[3]	Egypt	CS	80	39,4±11.0 (endo-scopic surgery group) 41.3±7.7 (micro-scopic surgery group)	80 chronic suppurative otitis media with cholesteatoma	40	40	In terms of recovery time, the likelihood of residual disease, and the likelihood of recurrence, endoscopic surgery clearly outperforms microscopic surgery. The endoscope's improved lighting and picture clarity, together with its capacity to "see around the corner" allowed for minimally invasive viewing and magnifcation of anatomy. Addition-ally, a sizeble amount of functional mucosa and undamaged mastoid tissues are still present.

DISCUSSION

Chronic suppurative otitis media (CSOM) stands as a prevalent ear problem frequently seen by ear specialists (otologists). It can be categorized into cholesteatomatous or noncholesteatomatous types.

The exact cause behind the development of cholesteatoma remains unknown. Risk factors encompass low socioeconomic status, Eustachian tube dysfunction, congenital anomalies like cleft palate, malnutrition, and low birth weight.[2,3]

In clinical setting, CSOM is defined as prolonged middle ear infection characterized by the presence of purulent ear discharge through a perforated tympanic membrane for at least 2 months. Furthermore, CSOM is subdivided based on the absence or the presence of cholesteatoma as tubotympanic CSOM/safe/benign type, and atticoantral CSOM/dangerous/malignant type. The tubotympanic type is characterized by a central tympanic membrane perforation, while the atticoantral type is characterized by involvement of the postero-superior part of the middle ear (including the attic, antrum, and mastoid) with marginal or attic perforation of the tympanic membrane. The presence of cholesteatoma and erosion of the ossicles are features of atticoantral CSOM. CSOM can result in various complications, including conductive or sensorineural hearing loss, extracranial complications (e.g., facial paralysis, subperiosteal abscess, mastoiditis), and intracranial complications (e.g., meningitis, cerebral abscess).[5,6] In line with the previous literatures, our cases also presented with the main complaints of otorrhea and hearing loss. Additionally, during the otoscopic examination, a perforation was identified in the attic region of the right tympanic membrane.

Chronic Suppurative Otitis Media (CSOM) is notably widespread in developing nations. Surgical intervention remains the primary approach for managing CSOM accompanied by cholesteatoma. The microscope has long been the primary tool for mastoid surgery. Despite the passage of more than five decades, the approach to managing the posterior canal wall remains a subject of controversy.[7] The debate between canal wall-down or up techniques for mastoidectomy continues to be extensively discussed. The choice between these methods relies on various factors such as the surgeon's experience, beliefs, and confidence. These techniques, rooted in microscopic ear surgery, have been widely described.[8]

While modern microscopes offer exceptional views of the surgical area, providing 3-dimensional binocular vision and facilitating two-handed surgery, they do have limitations in visualizing deeper recesses within the middle ear. The microscope's straight-line vision and optical properties necessitate sufficient light to reach the surgical site. Consequently, surgical approaches relying on microscopes often require postauricular or endaural incisions, tissue retraction, or bone drilling to adequately visualize the targeted pathology.[7,8]

The concept of otologic surgeries has been gradually evolving since the introduction of the endoscope. Endoscopic ear surgery (EES) is a relatively recent addition to otology, and many otologists are increasingly embracing this technique.[9,10] In recent times, many surgeons have conducted cholesteatoma removal using transcanal endoscopic surgery, even in instances where the condition has spread to the mastoid, necessitating transcanal endoscopic mastoidectomy.[11]

Utilizing ear surgery endoscopes, the tympanomeatal flap is raised. Accessing the middle ear involves lifting the tympanic ring, preferably in the lower part of the canal to avoid injuring ossicles, then progressing upward to locate the chorda tympani. The removal of the bony wall from the attic section of the external auditory canal allows

identification of the ossicles, round and oval windows, tympanic segment of the Fallopian canal, cochleariform process, and horizontal semicircular canal. The degraded osseous structures housing the head of the malleus and the incus need removal, along with complete extraction of the cholesteatoma matrix. This procedure may involve performing cartilage tympanoplasty or using temporalis fascia grafting with an underlay technique, followed by accurately repositioning the tympanomeatal flap. Additionally, gel foam is tightly packed inside the external auditory canal.[3]

In our case, lidocaine 2% along with adrenaline at a ratio of 1:200,000 was administered around the ear canal and tragus. A broad posterior tympanomeatal flap was raised through an incision made from 2 o'clock to 6 o'clock position in the right ear. The cholesteatoma was detected in the middle ear under the perforated tympanic membrane (TM), the flap was lifted from the posterior annulus and positioned downwards. An assessment was made of the middle ear condition, ossicular chain, and tympanic isthmus. The cholesteatoma affecting the middle ear was carefully dissected. The removal of the malleus head was also carried out to clear any disease affecting the anterior epitympanic space.

The cholesteatoma was traced along transcanal starting from the middle ear. Drilling was conducted on the postero-superior canal wall to completely expose the lateral semicircular canal and the horizontal facial nerve. The burr speed was maintained at a low rate, specifically 30,000 rpm, which was less than the usual speed. Cutting and diamond burrs ranging from 1 to 3 mm were utilized as necessary. Drilling was performed intermittently for flushing and suctioning purposes. Once the bone was thinned, a curette was employed to eliminate the bones. These procedures were repeated until the cholesteatoma sac was completely exposed. Careful drilling was conducted with the aid of 0° and 30° endoscopes to prevent harm to vital structures such as the tympanomeatal flap, facial nerve, lateral semicircular canal, chorda tympani, and stapes. To ensure complete disease clearance, minimal removal of the posterior canal wall was attempted whenever feasible under clear vision. Potential concealed sites of cholesteatoma were thoroughly examined, including the sinus tympani, anterior epitympanum, mastoid cavity, posterior sinus, hypotympanum, and protympanum. A final inspection of the mastoid cavity and cholesteatoma clearance was conducted. Ossicular reconstruction was performed using sculptured autologous incus, if it was not extensively necrotic, or cartilaginous. Reconstruction of the TM defect and posterior canal wall was achieved with tragal cartilage reinforced by perichondrium. The ear canal was packed with gel foams. Suturing was applied to the tragus incision site and post auricular incision site, followed by bandaging. Patients were discharged the day after the surgery.

The primary objectives of tympanoplasty for CSOM involve eliminating infection, repairing the perforated tympanic membrane, and enhancing hearing ability. For years, microscopic ear surgery served as the primary method, allowing for two-handed manipulation, and providing binocular vision with an excellent stereoscopic surgical view. Over time, otologic surgeries have evolved with the introduction of the endoscope. The EES is a relatively recent advancement in otology, and many ear specialists are increasingly adopting this technique. Recently, numerous surgeons have performed cholesteatoma removal using transcanal endoscopic surgery, even in cases where the condition has extended to the mastoid, requiring transcanal endoscopic mastoidectomy.[9,10]

In conclusion, even though definitive evidence establishing the superiority of TEES over traditional approaches is lacking, the

outcomes observed thus far appear promising. TEES not only enables access to concealed areas like the sinus tympani, facial recess, and anterior epitympanic space, but also preserves the normal functioning of the middle ear. As a result, it emerges as a viable alternative to microscopic surgery in suitable cases. Proficiency and familiarity with surgical techniques are crucial in all procedures, and as proficiency grows, endoscopic surgery could be extended to more intricate cases. However, additional studies with longer observation periods and involving a large cohort of patients treated with TEES are necessary, to evaluate its efficacy and potential benefits.

DISCLOSURE

The author reports no conflicts of interest in this work.

REFERENCE

1. Dalğıç A, Yıldırım GA, Zorlu ME, Delice O, Aysel A. Total Transcanal Endoscopic Ear Surgery for Cholesteatoma. Turk Arch Otorhinolaryngol. 2023 Mar;61(1):1.
2. Shakya D, Nepal A. Transcanal endoscopic retrograde mastoidectomy for cholesteatoma: a prospective study. Ear Nose Throat J. 2023 Jun;102(6):NP269- 76.
3. Hamela MM, Abd-Elnaseer O, El-Dars MM, El-Antably A. Comparison of the outcomes of endoscopic versus microscopic approach in cholesteatoma surgery: a randomized clinical study. Egypt J Otolaryngol. 2023 Aug 22;39(1):128.
4. Bessa RG, Tsuji RK. Inside-Out Transcanal Endoscopic Mastoidectomy: Literature Revision. Int Arch Otorhinolaryngol. 2023 Apr 28;27(02):e370-6.
5. Dhingra PL, Dhingra S. Manual of Clinical Cases in Ear, Nose and Throat-E-Book. Elsevier Health Sciences; 2021 Sep 15.
6. Casselbrant ML, Mandel EM. Otitis media in the age of antimicrobial resistance. Bailey's Head and neck surgery otolaryngology. 5th ed. Philadelphia: Lippincott Williams and Wilkins. 2014:1479-506.
7. Alicandri-Ciufelli M, Marchioni D, Kakehata S, Presutti L, Villari D. Endoscopic management of attic cholesteatoma: long-term results. Otolaryngol Clin North Am. 2016;49(5): 1265-70. doi:10.1016/j.otc.2016.05.015
8. Dornhoffer JL. Retrograde mastoidectomy. Otolaryngol Clin North Am.2006;39(6):1115-27. doi:10.1016/j.otc.2006. 08.002
9. Presutti L, Gioacchini FM, Alicandri-Ciufelli M, Villari D, Marchioni D. Results of endoscopic middle ear surgery for cholesteatoma treatment: a systematic review. Acta Otorhinolaryngol Ital. 2014;34(3):153-7.
10. Kozin ED, Gulati S, Lehman A, et al. Systematic review of endoscopic middle earsurgery outcomes. Laryngoscope. 2015;125(5):1205-14. doi:10.1002/lary.25048. Systematic.
11. Nishiike S, Oshima K, Imai T, Uetsuka S. A novel endoscopic hydromastoidectomy technique for transcanal endoscopic ear surgery. J Laryngol Otol 2019;133(03):248-50.
12. Marchioni D, Villari D, Alicandri-Ciufelli M, Piccinini A, Presutti L. Endoscopic open technique in patients with middle ear cholesteatoma. Eur Arch Otorhinolaryngol. 2011;268:1557-63.