

Glomus tympanicum removal using transcanal endoscopic assisted surgery: An experience with six cases

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Abstract

Objective: To evaluate an endoscopic approach in the management of glomus tumor, and also to investigate and evaluate its appropriateness and feasibility.

Methods: Glomus tumors, also known as paragangliomas, are benign primary tumors of the middle ear. The advent of endoscopic ear surgery has provided new dimensions to the management of this highly vascular tumor. Retrospective analysis of six patients of glomus tympanicum, operated between July 2014 and June 2019, with modified Fisch classification Type A and B1, who were managed by a retroauricular transcanal endoscopic approach. Preoperative and post-operative analysis was done for these patients.

Results: The chief complaint was pulsatile tinnitus, which disappeared in five cases and reduced in severity in one of them. Hearing was improved with reduction in air-bone gap in all the cases. No major complications or recurrence were observed in any of the patients after 12 months of follow-up.

Conclusion: This endoscopic approach serves as a safe and reliable technique for tumor removal. It thus provides postoperative comfort for most of the patients.

KEYWORDS

glomus tumor, glomus tympanicum, pulsatile tinnitus, transcanal endoscopic, tympanic paraganglioma

Key points

- Significant findings of the study: With the transcanal endoscopic approach, hearing was improved with reduction in air-bone gap in all the cases. No major complications or recurrence were observed in any of the patients after 12 months of follow-up.
- What this study adds: It highlights that the use of the endoscopic transcanal approach for the removal of glomus tumor is quite feasible. This endoscopic approach thus serves as a safe and reliable technique for complete tumor removal by dissection. It provides postoperative comfort for most patients.

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INTRODUCTION

Glomus tumors, also known as paragangliomas, are benign, slow-growing tumors, originating from neuroectodermal tissues. They comprise the second most common neoplasm of temporal bone and the most common lesion of the middle ear and jugular foramen.¹ Paragangliomas can occur at any site along sympathetic paraganglial chains, extending from the neck to the pelvis. In the head and neck region, paraganglia are located in the adventitia of the jugular bulb, along the IXth and Xth cranial nerves, and in the middle ear in association with the Jacobson's plexus.¹ In this region, two anatomically diverse groups of paragangliomas have been described, namely, the cervical paragangliomas and the temporal bone (jugulotympanic) paragangliomas. The cervical paragangliomas include carotid body tumors and glomus vagale tumors, whereas the jugulotympanic tumors comprise of glomus tympanicum and glomus jugulare. Glomus tympanicum tumors originate from paraganglionic cells that lie along the Jacobson's nerve and Arnolds nerve. Two different classification systems of glomus tumors are commonly used, one proposed by Fisch and Mattox, and the other by Glasscock and Jackson. The classification proposed by Fisch is most frequently used.¹ The Fisch classification was further modified by Mario Sanna, giving a detailed description of tumor and its involvement, thus helping in surgical planning, known as the Modified Fisch classification, depicted in Table 1.²

Glomus tympanicum continues to be the most common tumor of the middle ear. These tumors are slow growing, benign, and highly vascular. It arises from the capillary and precapillary blood vessels, located along the tympanic branch of glossopharyngeal nerve (Jacobson's nerve). The tumor derives its blood supply mainly from the inferior tympanic branch of the ascending pharyngeal artery. Glomus tympanicum most commonly presents as pulsatile tinnitus followed by conductive hearing loss, otalgia, and aural fullness. The characteristic location of the glomus tympanicum is lateral to the cochlear promontory. Radiological diagnostic modalities including computed tomography (CT) and magnetic resonance play a significant role in making an early diagnosis. CT scan of temporal bone showing intact jugular bulb and intact carotico-tympanic spine is very characteristic.

Surgical excision of the tumor, by either transcanal or postaural approach, is the mainstay of treatment. Mostly, the surgery is performed using a microscope, but the use of endoscope provides

certain advantages over the former. The advantages include a wider surgical view with excellent visualization, and being able to negotiate the instruments into different spaces of middle ear, which are usually difficult to visualize with microscope.

MATERIALS AND METHODS

This study was conducted in a tertiary care center from July 2014 to June 2019. Six cases of glomus tympanicum, managed by tumor removal using a retroauricular transcanal endoscopic approach, were included.

Data collection

The study was conducted after obtaining the permission of the Institutional Ethical Committee. The clinical records of the patients presenting with glomus tympanicum, during the stipulated study period, were reviewed. Tumor removal was done through a transcanal endoscopic approach in all of these patients.

Inclusion criteria

1. Tumor confined to middle ear and hypotympanum without mastoid involvement—Modified Fisch classification stage—A and B1.
2. Patients with a minimum of 12 months postoperative follow-up.

Exclusion criteria

1. Patients with tumors involving mastoid, and those involving erosion of the carotid canal—Modified Fisch classification stage—B2 and B3.
2. Patients lost to follow-up (<12 months postoperatively).

Clinical records

The demographic profile of the patients was noted. A complete history-taking and detailed clinical examination was conducted.

TABLE 1 Modified Fisch classification of the middle ear and mastoid glomus tumors.

Class	Description
A	Tumors limited to the middle ear cleft without invasion of the hypotympanum
A1	Tumors completely visible on otoscopic examination
A2	Tumor margins are not visible on otoscopy. Tumor may extend anteriorly to the eustachian tube and/or to the posterior mesotympanum
B	Tumors limited to the tympanomastoid compartment of the temporal bone without erosion of the jugular bulb
B1	Tumors confined to the middle ear cleft with extension to the hypotympanum
B2	Tumors involving the middle ear cleft with extension to mastoid
B3	Tumors involving middle ear cleft with erosion of carotid canal

Preoperative evaluation

The tumor was graded according to the modified Fisch classification. Otoscopic examination revealed a red mass behind the tympanic membrane in all the cases as in Figure 1.

A detailed record of clinical examination was done, which included otoscopic findings, tuning fork tests, pure tone audiometry, tympanometry for assessment of hearing and middle ear functional status.

Radiological imaging

Contrast-enhanced CT scan of the temporal bone was done in all patients as shown in Figure 2. Magnetic resonance imaging (MRI) was done in one patient to rule out jugular bulb involvement.

Surgical technique

All the six patients were operated under general anesthesia using endoscope (0° and 30°, 4 mm diameter, 18 cm length Hopkins rod)



FIGURE 1 Endoscopic view of left ear showing a red mass behind the intact tympanic membrane.

with Karl Storz 3-chip HD camera and monitor. The three-handed technique was used for the surgeries, with an endoscope and operative instrument held by the main surgeon and suction by the assistant. A microscope was kept ready in the theater as a stand-by, in case of immediate requirement. The patient was in supine position with head extended at about 30° and turned 45° toward the opposite side of the involved ear. After ear canal and retroauricular infiltration, an incision was given in the posterior canal wall from 12 to 6 O'clock position approximately 1 cm lateral to fibrous annulus using a circular knife and 0° endoscope. Retroauricular incision was given and posterior canal skin was elevated. Then, through retroauricular transcanal approach, tympanomeatal flap was elevated using suction elevator and 0° endoscope.

In one of the cases, the tumor occupied the whole middle ear cavity, hence the tympanomeatal flap was elevated further anteriorly by extending the canal incision superiorly upto 1 O'clock and inferiorly upto 5 O'clock as depicted in Figure 3A. The dissection continued by detaching the posterior malleolar ligament and dissecting the ear drum from the short process of malleus and anterior malleolar ligament. Entire malleus was skeletonized from the tympanic membrane for exposure of anterior margin of the tumor. Posterior canalplasty and atticotomy were done by bone drilling and curetting for a good exposure and aiding in instrumentation. Tumor margins were well visualized after drilling of the external auditory canal and edges of bony annulus. Saline irrigation was used intermittently to avoid thermal damage by endoscope. The middle ear structures were completely obscured by the tumor mass. Cotton ball (soaked with adrenaline) was used for the dissection of tumor mass from the Eustachian tube orifice, ossicular chain, oval, and round window area. Dissection was done from superior to inferior aspect of middle ear. As the tumor mass was not adherent to the ossicular chain, by careful dissection, the ossicular chain was preserved completely.

In two cases, both malleus and incus were removed for complete tumor removal and ossiculoplasty was done.

The size and vascularity of the tumor were reduced by using bipolar cautery and adrenaline-soaked cotton ball. After careful dissection of antero-inferior aspect of the middle ear, the feeding vessel of the tumor, the inferior tympanic artery, was cauterized. Then, the tumor was removed using cup forceps and sent for histopathological examination. After hemostasis, a thorough inspection of middle ear was done using

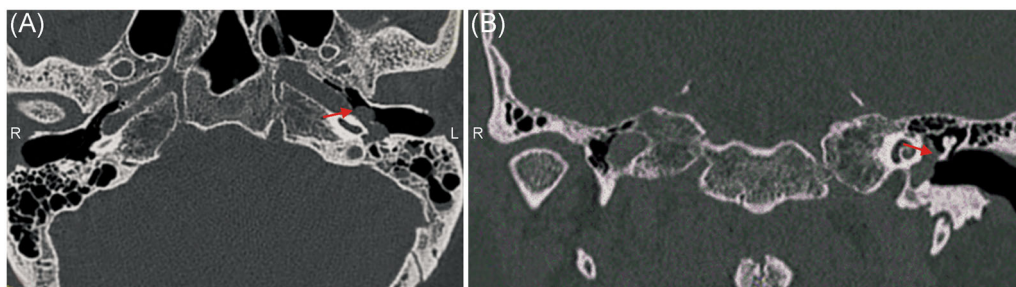


FIGURE 2 Computed tomography (CT) scan of temporal bone showing glomus tympanicum involving hypotympanum. (A) In axial section, showing the mass occupying left middle ear (indicated by red arrow); (B) In coronal section showing mass medial to the malleus handle and involving the hypotympanum of left ear (indicated by red arrow).

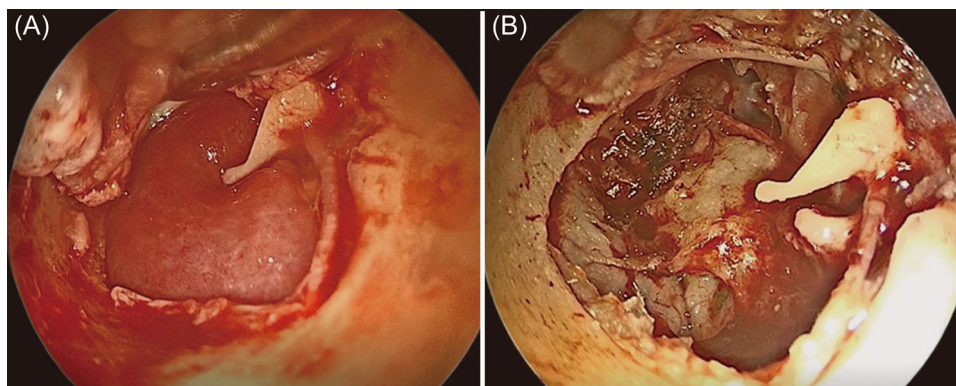


FIGURE 3 Intraoperative and postoperative endoscopic view of the glomus tumor. (A) Intraoperative endoscopic view of the glomus tumor (after elevating tympanomeatal flap) occupying whole tympanic cavity including hypotympanum. (B) Postoperative endoscopic view showing complete removal of the tumor from middle ear and hypotympanum.

30° endoscope, to check for any residual tumor as in Figure 3B. In one case, there was a residual tumor in the attic which was removed by a ball probe and angled suction tip.³

RESULTS

A retrospective detailed chart review, patient interviews, and the patient's clinical examination findings were documented. All the patients were operated by retroauricular transcanal endoscopic approach and the results were analyzed. All of them were followed up for a minimum period of 12 months. According to modified Fisch classification, five tumors fell into Group A and one was in Group B1. The age of presentation ranged from 45 to 60 years. Out of the six cases, two were male, and four were female. Patients in our study presented with pulsatile tinnitus and hearing loss, aural fullness, and otalgia. Tinnitus disappeared in five patients after the operation. In one patient, tinnitus reduced but is still persisting at 18 months of follow-up. Of the six patients with hearing loss, four presented with conductive hearing loss, and two had mixed hearing loss. Air-bone gap improved in all the patients postoperatively. Ossiculoplasty was done in two cases, as the incus was removed for complete tumor removal owing to the large size of the tumor. In rest of the four cases, tumor removal was done meticulously without disturbing the integrity of the ossicular chain. Two of the patients had a tumor almost completely occupying the middle ear which took long time for removal. Endoscopic view, intraoperative, and postoperative images are depicted in Figures 1 and 3.

DISCUSSION

This study is a retrospective analysis of six selected cases of glomus tympanicum, managed endoscopically, over a period of 5 years and a follow-up of 1 year, at a tertiary referral center. The main aim of the study was to evaluate the role of endoscopy and its utility for the management of glomus tumor, and also analyze the complications, morbidity, and hearing status of the patients following therapy. All six

cases were investigated and demographic and imaging data were collected. Evaluation of the glomus tumor included a detailed chart review and clinical assessment.

The patients' ages ranged from 45 to 60 years, with a mean of 53 years. There were four females and two males, which was similar to the previous studies,³ but differs from that reported by Carlson et al., which showed a ratio of 9/1 female-to-male ratio.^{4,5}

The use of endoscope in ear surgery has added new heights to the standard of surgery. It provides excellent visualization of inaccessible areas of the middle ear, without requiring much bone drilling and also reduces the residual and recurrence of disease. The technique of endoscopic ear surgery was introduced years ago and was popularized by Tarabichi, Thomassin, Daneshi, Presutti, and Marchioni for different ear and lateral skull base surgeries.⁶⁻⁹

Marchioni et al.¹⁰ first reported the use of endoscopes in middle ear tumor removal in 2013. The most common middle ear tumors for which endoscopic removal was used included paragangliomas, adenomas, carcinoid tumors, osteomas, hemangiomas, and facial nerve neuromas.¹⁰ The most important differential diagnoses of middle ear tumors are aural polyps, high jugular bulbs, aberrant carotid artery, and malignant neoplasms.^{11,12} Glomus tumors are slow-growing vascular, benign tumors that usually present clinically as pulsating tinnitus, hearing loss, otalgia.

Access through the ear canal can be used for the removal of many glomus tumors. In the 115 cases reported by Carlson et al.,⁵ 32% of the tumors were removed via the transcanal route. In all patients included in our study, surgery was performed by retroauricular transcanal approach. The advantages of this approach are wide exposure, better bone drilling, reduced frequent fogging of lens, and allows two surgeons to operate simultaneously. It also prevents meatal skin injury while using bipolar cautery.

Tinnitus persisted in one patient though the severity of tinnitus reduced. In the study conducted by Daneshi and Jahandideh⁶ out of the 13 cases of glomus tumor, 1 case had persistence tinnitus.

Temporalis fascia grafting was performed in all patients, as there was shortening of tympanomeatal flap due to bony canal drilling for a wide exposure.

TABLE 2 Pre- and postoperative findings and symptoms in six cases of glomus tympanicum tumors.

No.	Sex	Modified Fisch Class	Average A-B gap between pre- and postoperative (dB) ^a		Type of hearing loss	Symptoms
			Pre-	Post-		
1	F	A2	30	16	Conductive	Tinnitus, Hearing loss
2	F	A1	24	14	Conductive	Tinnitus, Aural fullness
3	M	A2	20	12	Mixed	Tinnitus, Otagia
4	F	B1	28	18	Conductive	Tinnitus, Hearing loss
5	F	A1	22	16	Mixed	Tinnitus, Aural fullness
6	M	A1	26	14	Conductive	Tinnitus, Hearing loss

^aAt 500, 1000 and 2000 Hz.

Canalplasty was done in all cases for adequate tumor exposure and proper instrumentation. Intraoperative bleeding was not significant. Bipolar cautery and adrenaline-soaked cotton balls were used to control bleeding and to reduce tumor mass. Other studies showed similar results of less intraoperative bleeding, except for O' Leary et al., who reported significant intraoperative bleeding in their series.¹³

All the patients included in our study presented with tinnitus and hearing loss. Of the six patients, four had conductive hearing loss, and two had mixed hearing loss. Hearing assessment was done before and after surgery. Closure of AB gap was observed in all the patients included in our study as depicted in Table 2. Our findings were similar to the study of Sanna and colleagues.^{2,14,15}

Proper visualization obtained by the use of endoscopes helps in meticulous dissection of tumors without disturbing the ossicular chain in four cases. Two of the patients required ossiculoplasty, as the incus had to be removed to achieve complete tumor removal.

Major disadvantages associated with endoscopic ear surgery include surgeon has to work in one hand which makes it difficult during the bleeding situation and frequent fogging of the endoscope. Intraoperative bleeding reduces the ability of the surgeon to dissect during bleeding. This situation can be overcome by three handed technique, frequent use of adrenaline-soaked multiple cotton balls, patient positioning (30° head elevation in reverse Trendelenburg position to facilitate venous return). Intraoperative inconvenience can be overcome by performing regular endoscopic ear surgeries. Fogging can be reduced by obtaining wide exposure, which can be achieved by retroauricular transcanal approach and posterior canalplasty.

CONCLUSION

Endoscopic-assisted transcanal approach for the removal of glomus tumor is quite feasible. The endoscope proves very useful in visualizing the nooks and the corner of middle ear, thus helping in proper and complete tumor dissection. The endoscopic approach thus serves as a

safe and reliable technique for tumor removal. It provides postoperative comfort for most of the patients.

AUTHOR CONTRIBUTIONS

Pradipt Ranjan Sahoo, Imran Wasfi Khan, and Kabikanta Samantaray were involved in the management of patients. Monalisa Sahu, Imran Wasfi Khan was involved in collection of data. Pradipt Ranjan Sahoo was involved in analyzing the data. Pradipt Ranjan Sahoo, Monalisa Sahu, and Kabikanta Samantaray contributed in the writing the paper.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS STATEMENT

The study was approved by the Institutional Ethics Committee of the Kalinga Institute of Medical Sciences, KIIT-Deemed to be University (KIIT/KIMS/IEC/371/2020) and conducted in accordance with the Declaration of Helsinki. As this study is retrospective, the requirement for informed consent by the ethics committee was waived. All data on the patients was anonymized or maintained with confidentiality.

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