Original Study

Endoscopic Management of Early Stage Middle Ear Paragangliomas – An Australian Case Series

AQ2 *Mark E. Quick, *Aanand Acharya, †‡§Peter Friedland, ¶||**††Jonathan H.K. Kong, ¶Alexander J. Saxby, ¶||**Nirmal P. Patel, and *Latif Kadhim

*Department of Otolaryngology-Head & Neck Surgery, Fiona Stanley Hospital, Murdoch; †Joondalup Health Campus, Joondalup; ‡University of Western Australia; §Notre Dame University, WA, Australia; ¶Sydney Endoscopic Ear Surgery Research Group; ||Discipline of Surgery, Sydney Medical School, University of Sydney; **Department of Otolaryngology-Head & Neck Surgery, Faculty of Medicine and Health Sciences, Macquarie University, Sydney; and ††Department of Otolaryngology-Head & Neck Surgery, Royal Prince Alfred Hospital, Sydney, NSW, Australia
AQ3

Objective: To analyze the outcomes of the endoscopic transcanal approach for removal of early stage middle ear paraganglioma tumors (MEPT).
Study design: Cases series with chart review.
Setting: Two tertiary Australian Otology centers.
Patients: Adult patients with middle ear paraganglioma tumors treated with transcanal endoscopic approach from 2/2016 to 12/2019. Tumor staging was described using the Modified Fisch-Mattox (MFM). Inclusion criteria included patients with an MFM Class A or B. Exclusion criteria included higher staged or syndromic disease.
Intervention: All tumors were managed with transcanal endoscopic approach.
Main outcome measures: Primary outcome measures included disease clearance and hearing measured according to the AAO-HNS guidelines. Secondary outcomes included complications, duration of surgery, and length of stay.
Results: Ten patients underwent totally endoscopic transcanal resection of MEPT (9 female, mean age of 45.5 years, 70% were left sided). Mean tumor size was 6.1 mm (SD 3.4 mm). Five cases (50%) were classified using the MFM system as class A1, two cases were class A2, and three cases were class B1. Three cases required canalplasty for access but were completed entirely endoscopically. Nine of the 10 cases had complete audiometric data. Pre- and postoperative mean air conduction remained stable with a decrease in mean air-bone gap of 2.84 dB. Postoperative complications include one pinhole perforation. There were no facial nerve complications. Mean follow-up period was 10 months (range 4–25 mo) with all cases having resolution of pulsatile tinnitus and no tumor recurrence.
Conclusion: The transcanal endoscopic approach for early stage MEPT offers excellent visualization and permits safe and effective removal of disease with the advantages of a minimally invasive technique for patient recovery. **Key Words:** Endoscopy—Middle ear tumor—Paraganglioma—Transcanal endoscopic ear surgery.

Otol Neurotol **42:**xxx–xxx, 2021.

INTRODUCTION

Traditionally middle ear paraganglioma tumors (MEPT) have been managed with surgical excision, frequently requiring an endaural or post auricular approach (1). The approach is dependent on the extent of the tumor within the middle ear, tympanic sinus, and mastoid cavity. Centred on the middle ear cleft, early stage paragangliomas may still extend into the recesses of the middle ear making resection challenging given their vascular nature. Although endoscopic ear surgery has been applied to a number of otology operations including tympanoplasty, cholesteatoma surgery, and ossicular chain reconstruction; few authors have described its use and outcome in middle ear tumor surgery (2–4).

Compared to the standard microscope view transcanal endoscopic access to the middle ear offers superior visualization in specific areas such as the hypotympanum, protympanum, and retrotympanum (5–9). Transcanal endoscopic ear surgery (TEES) eliminates the need for a post-auricular incision therefore eliminating the risk of pinna misalignment and changes in the auriculomastoid angle post surgery. Resection of MEPT with laser and bipolar cautery has been described; however, no previous papers have directly compared each technique (8,10,11). The primary objective of this study is to

Address correspondence and reprint requests to Mark E. Quick, BSc, MBBS, MEng, Department of Otolaryngology-Head & Neck Surgery, Fiona Stanley Hospital, Murdoch, WA, Australia. E-mail: mark.quick@health.wa.gov.au
AQ4
The authors disclose no funding and conflicts of interest.
Meeting information: World Congress on Endoscopic Ear Surgery 3.0, Boston, MA, US. 13–15th June 2019.
AQ5
DOI: 10.1097/MAO.0000000000003234

FIG. 1. (A) Axial and (B) coronal non-contrast computed tomography scans of the left temporal bone in a patient with left class B1 (MFM classification) paraganglioma demonstrating extension into the hypotympanum. (C) Endoscopic view showing red retrotympanic vascular mass.

describe the disease clearance and hearing outcomes of transcanal endoscopic ear surgery in treatment of early stage middle ear paragangliomas. Secondary outcomes were measured including intra-operative complications, duration of surgery, and length of stay for both CO_2 laser and bipolar resection of these vascular tumors.

METHODS

Patient Cohort

Six senior otologists retrospectively reviewed all adult patients over the age of 18 with MEPT in which an endoscopic resection was performed or attempted from February 2016 to December 2019 (Fig. 1). Pre-operatively each patient underwent a history, physical examination, pure tone audiometry including speech recognition and pre-operative imaging with MRI (n = 8), CT (n = 10), or both.

Collected data for Analysis and Statistical Framework

The pre-operative aspects collected included demographic data (age, sex), tumor characteristics (size, side, location, and classification utilizing the GJ and or Modified Fisch-Mattox [MFM] classification), patient presenting symptoms, signs, and audiological data. Surgical approach, intra-operative findings, and postoperative surgical outcomes consisting of completeness of tumor resection, symptom resolution, facial nerve function, and postoperative audiology analysis were recorded. Air and bone conduction pure tone average (0.5, 1, 2, and 3 kHz) as well as closure of the air-bone gap were calculated utilizing the standardized otology method and report as described by Gurgel et al. (12) Statistical analysis comprised of calculating the mean and standard deviation (Excel, Microsoft, Redmond, WA) and combined audiological data displayed using standard formatting.

Surgical Technique

All operations were performed under general anesthesia and completed entirely via a transcanal endoscopic approach (Class 3 endoscopic ear surgery under the Massachusetts Eye and Ear Infirmary ESS Classification system, MEEI) (13). The external ear canal was infiltrated with local anesthesia (either xylocaine 1% or ropivacaine 1%) with adrenaline 1:100,000. A 3.0-mm diameter 14 cm length Hopkins endoscope with varying degree of angulation including 0°, 30°, and 45° with a high definition camera head and display were utilized. The light intensity was set no higher than 50% intensity. Excess hair in the hair bearing area of the external ear canal was trimmed. Standard radial canal incisions were made, positioned to facilitate access to the tumor location. A tympanomeatal flap was elevated to ensure adequate exposure and visualization of the middle ear. Where necessary, an access canalplasty (n = 3) was performed using curette, protected tip burs (Medtronic, MN) or a piezosurgery device (Mectron, Carasco, Italy). This enabled greater tumor exposure, cautery instrument access and improved visualization during postoperative follow-up. In some cases a more superiorly based flap (preserving the anterior tympanomeatal annulus) to inspect and access the protympanum and anterior mesotympanum was also used (Fig. 2). The entire middle

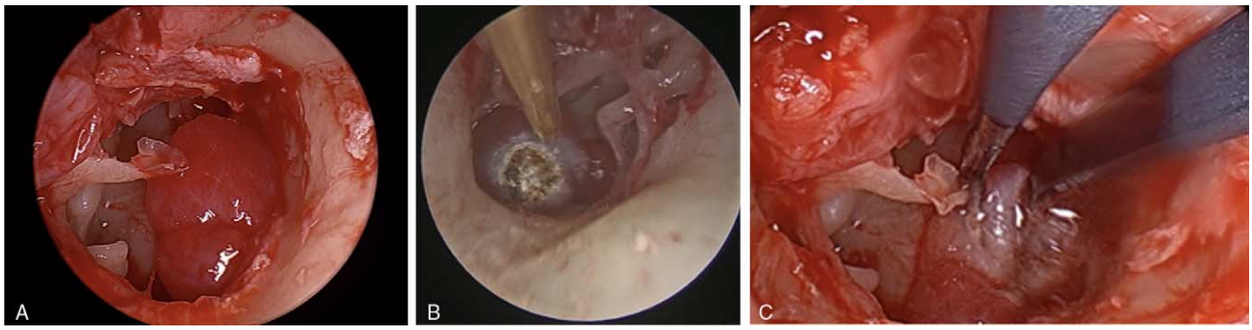

FIG. 2. (A) Transcanal endoscopic approach and visualization of paraganglioma tumor extending from the mesotympanum into the protympanum. (B) CO_2 laser ablation of feeding vessel and tumor mass. (C) Neurosurgical curved insulated bipolar forcep ablation of tumor mass.

ear was inspected with the endoscope noting the size, position of the tumor, and involvement of surrounding middle ear structures. Incudostapedial joint disarticulation was performed in one case to manage disease significantly abutting the ossicles. Tumor resection was performed utilizing either a CO_2 laser with hand-held microfibre (ACU pulse DUO^{TM} Lumenis, San Jose or Omni-Guide Katlenburg-Lindau, Germany) set between 4 and 8 W with gas pressure of 50 to 70 PSI (Fig. 2B) or a micro-ophthalmic bipolar forceps set at 8 to 10 W, or curved insulated neurosurgical bipolar forceps (Fig. 2C). Particular attention was paid to the inferior tympanic artery, which was cauterized early to aid in hemostasis. Neuropatties soaked in 1:1,000 adrenaline were applied to reduce additional bleeding during tumor resection. Frequent irrigation of the middle ear with warm water to avoid thermal injury and reduce bleeding was performed. Inline suction performed by a surgical assistant enabled smoke evacuation. Use of angled endoscopes (30° or 45°) enabled entire middle ear visualization and ensured complete excision under direct vision. The tympanomeatal flap was replaced, and the canal packed with dissolvable gelatin sponge soaked with ciprofloxacin. All patients were discharged home on the day of surgery.

RESULTS

Patient Characteristics

Of the 10 cases, seven underwent surgery in Western Australia and three in New South Wales, Australia. The average age was 45.5 years (SD 16.1 yrs) with a range between 25 to 69 years. 90% were female. All patients presented with pulsatile tinnitus and normal facial function. Pre-operatively seven patients had hearing within normal limits, two patients had a mild conductive hearing loss (15 dB), and one patient had a mixed hearing loss. One patient underwent laboratory investigations for hereditary paraganglioma syndrome, with a negative result.

Tumor Characteristics

Seven of the 10 tumors were left sided. The mean tumor size was 6.1 mm (SD 3.4 mm). Five of the 10 tumors were located entirely in the mesotympanum over the cochlear promontory and completely visible on otoscopy. They were classified as GJ grade 1 and MFM class A1. The other five tumors were classified as GJ grade 2 involving additional middle ear regions including the retrotympanum, protympanum, and hypotympanum. Two cases were classified as MFM class A2 and three as class B1. In each case, the glomus tympanicum was located entirely within the middle ear and did not extend to the mastoid antrum or mastoid cavity. Patient and tumor details are listed in Table 1.

TABLE 2. *Surgical details*

Detail	n (%) or mean (range)
Surgical approach	
Endoscopic transcanal	10 (100%)
Operative time	
Overall (min)	98 (60–160)
CO_2 laser: bipolar (min)	90: 110
EBL	
Overall across 10 cases (ml)	16 (10–50)
Extent of resection – complete	10 (100%)
Postoperative follow-up (mo)	10 (4–25)

EBL indicates estimated blood loss; min, minute; ml, milliliters.

Surgical Results and Complications

An entirely endoscopic technique (Class III) was used to remove the tumor in all 10 cases (13). Six cases utilized CO_2 laser entirely for tumor resection and bleeding management, three cases managed tumor resection with bipolar cauterization, and one case utilized a combination of both. Operating time varied from 60 to 160 minutes with a mean of 98 minutes (SD 32 min). Longer operative times were recorded in patients with greater disease extension and the three patients who required canalplasty. Average operating time was not affected by use of CO_2 laser versus bipolar (90 and 110 mins respectively [NS]). Average blood loss was 16 ml (range 10–50 ml). In nine cases, the tumor did not involve the ossicular chain; however, in one case the tumor abutted the tensor tympani tendon and the anterior crus of the stapes. Surgical details are displayed in Table 2. Postoperatively all patients recovered well

TABLE 1. *Baseline patient demographics and glomus tympanicum tumor details*

Characteristic	Mean (Range) or n (%)	
Age at diagnosis (yrs)	45.5 (range 25–69)	
Female sex	9 (90%)	
Primary disease	10 (100%)	
Left sided tumor	7 (70%)	
Tumor size (mm)	6.1 (3–14)	
Tumor location	Mesotympanum 5 (50%)	
	Mesotypanum + protympanum 2 (20%)	
	Mesotympanum + hypotympanum 3 (30%)	
Classification	MFM	GJ
	5 (class A1) (50%)	5 (stage I) (50%)
	2 (class A2) (20%)	5 (stage II) (50%)
	3 (class B1) (30%)	

MFM, Modified Fisch-Mattox classification.

TABLE 3. *Audiometric results pre- and postoperative*

		AC (0.5, 1, 2, 3 kHz)			ABG (0.5, 1, 2, 3 kHz)			ABG closure			BC (0.5, 1, 2, 3 kHz)		
	n	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Pre-operative	9	13.1	9.2	0–23.8	7.6	5.5	0–16.9	NA	NA	NA	5.6	8.1	0–20.6
Postoperative	9	13.9	6.9	0–18.8	5.7	3.4	0–10	2.4	7.5	−5.6 to 14.4	8.8	6.4	0–18.8

AC indicates air conduction; ABG, air-bone gap; BC, bone conduction; NA, not applicable.

following general anesthetic and were discharged the same day. One patient had a small pinhole tympanic membrane perforation noted at follow-up. There is ongoing close monitoring of this small perforation that is dry and not infected. Mean follow-up duration was 10 months (range 3–25 mo). There were no chorda tympani or facial nerve injuries. Postoperatively all patients had resolution of pulsatile tinnitus and subjectively minimal pain with no narcotic use required upon discharge.

Audiological Findings

Pre-operatively, seven patients had normal hearing thresholds, two had a mild conductive hearing loss, and one had a mixed hearing loss. Nine of the 10 cases had complete pre- and postoperative audiology results. One of the patients with mild conductive hearing loss preoperatively was excluded with incomplete postoperative audiological data.

Postoperatively the hearing remained stable in the patient with mixed hearing loss and improved to normal in the patient with a mild conductive hearing loss. Of the seven patients with normal pre-operative hearing, postoperatively one had a mild conductive hearing loss, one had mild sensorineural hearing loss, and five had normal hearing. The mean air conduction (AC) thresholds remained stable with a pre-operative and postoperative mean AC of 14.6 dB (SD, 8.5) and 15.4 dB (SD, 5.2) respectively. The mean air-bone gap closure was 2.84 dB (SD, 8.0) (Table 3).

DISCUSSION

The use of transcanal endoscopic ear surgery to manage middle ear pathology has several advantages including enhanced visualization, facilitating direct vision dissection, and enabling a minimally invasive approach avoiding the cosmetic complications of the post auricular or endaural incisions. Difficult to reach regions including the sinus tympani, facial recess, hypotympanum, and protympanum may not be easily accessible with the classic line-of-sight transcanal microscopic view (14). Several studies have reported on the use of TEES to manage middle ear neoplasms (3,5,15). Middle ear paraganglioma tumors represent an important subset of middle ear neoplasms that generally have an indolent nature. A recent large retrospective series reported otic capsule invasion and facial palsy in 7 out of 115 cases (6%) (1). This series reported that a significantly higher proportion of patients are female (90%) with a bimodal spread of disease presentation in age groups 30 and 60 years old (1). These trends were similar to those seen in the current presented series of early stage middle ear paragangliomas treated by TEES.

Comparison with Other Studies

Several published papers support the use of transcanal approach in safely managing small MEPT localised in the mesotympanum (class A1) with the use of the microscope (11,16,17). Tumor extension into the posterior mesotympanum (class A2) and sinus tympani or hypotympanum (class B1), required more extensive surgical microscope assisted approaches in these published works. The larger approaches included post-auricular, superficial soft tissue dissection, posterior tympanotomy (class A2), and transmastoid approach (class B1) to enable adequate visualization and safe tumor dissection (11,16,17).

The exclusive use of TEES to manage middle ear neoplasms, in particular paragangliomas, was first reported in 2013 (8). This small case series of three patients, with a moderate follow-up period, mainly highlighted the advantages of TEES in managing disease confined to the middle ear space. The series included one case with MFM classification class A1 and two cases with MFM classification class B1. Complete tumor resection with exclusive endoscopic use was achieved in 4 out of 5 patients in a study by Noel and Sajjadi (18). Disease extension involving the tympanomastoid complex (Fisch type B) required a combined transcanal endoscopic and post auricular incision approach (18).

A larger series presented 11 out of 14 cases (79%) that were managed exclusively by an endoscopic approach, with complete tumor resection utilizing either KTP or CO_2 laser, improvement in pure tone audiogram postoperatively, no injury to the facial nerve and no tumor recurrence with mean follow-up of 11 months (5).

The presented series compares favorably with these studies, with similar audiological outcomes, no chorda tympani, or facial nerve injury in up to class B1 tumors. Furthermore, there was no tumor recurrence with a mean follow-up of 10 months.

Middle Ear Disease and Disease Extension

In the current series, all 10 patients had complete paraganglioma tumor excision by a transcanal totally endoscopic approach (MEEI Class III). The average operating time of 98 minutes is comparable to Killeen et al.'s 108 minutes in a case series of 14 (5). However in

Killeen et al.'s (5) study, three patients had a combined endoscopic and microscopic approach, which would have increased the operating time.

Disease extension beyond the mesotympanum in 3 of the 10 cases in the presented series did account for longer operating times (Table 2). In these 3 cases, tumor extension into the retrotympanum, protympanum, and hypotympanum (class B1) could be managed by a totally endoscopic approach thus avoiding the need for a post auricular incision (Fig. 2A). The areas identified above with MEPT extending outside the mesotympanum are challenging and the use of TEES with superior visualization is supported (1,15). This benefit is also reflected in the case series by Killeen et al., with 7 of the 9 paragangliomas involving the hypotympanum being managed by an exclusively endoscopic approach (5).

Three cases in the presented series required a canalplasty to facilitate a transcanal approach, thus avoiding a post auricular incision. In two of the three canalplasty cases, improved saccess was required for bipolar forceps. In the third, the disease extended to the sinus tympani. The peizosurgery device was preferred in this case to allow direct underwater endoscopic visualization of bone removal and preservation of canal skin and tympanic membrane soft tissue. No other study has described a canalplasty in the surgical technique to facilitate TEES. The longest surgical time was recorded for these three cases and this is attributable to this additional surgical procedure.

Paraganglioma tumors are highly vascular and managing larger tumors with a two-handed technique afforded by a microscope may be necessary. This is independent of tumor location. Pre-operative CT and MRI scans help to plan the required approach. In all cases, the authors advise the surgeon to be equipped and prepared to switch to the microscope if required. Control of bleeding in any surgical procedure is critical and presents a challenge in TEES. A clean surgical field provides optimal endoscopic vision, allowing precise surgical progression within the middle ear. Developing strategies to reduce and manage bleeding, including ideal hypotensive total intravenous anaesthetic conditions, pre-operative vasoconstrictive injection and intra-operative use of adrenaline, tranexamic acid, warm irrigation, and time will optimize the operative conditions (19,20).

In this series tumor excision and bleeding were managed with either CO_2 laser or bipolar cautery, with one patient requiring both. No studies have directly compared these two techniques. There was no significant difference in operating time, and in all cases complete tumor excision was achieved with either technique, with no recurrent disease at a mean follow-up of 10 months. Two conceivable complications from laser-assisted dissection include facial nerve injury and pneumolabyrinth but this has not been reported in the literature for MEPT nor did it occur in the presented cohort.

Given the low prevalence of MEPT, it is difficult to compare CO_2 laser and bipolar dissection with any statistical significance. Blood loss was minimal for each technique and across all cases. In the case with the largest blood loss (50 ml), this can be attributed to changing of technique, from CO_2 laser to bipolar diathermy, to manage bleeding. However, both techniques have been shown to be effective in disease removal and decision on use is usually dependent on availability and surgeon preference. A common problem with bipolar forceps can be maintenance of separated tips when operating down a narrow ear canal. Laser fibres are single point and finer, therefore lending themselves well to the transcanal approach, where space is limited. This was reflected in a significantly lower proportion of CO_2 laser dissection cases requiring a canalplasty.

Audiological Outcomes

Two patients in current series suffered a mild postoperative hearing loss. In one, a mild conductive hearing loss was suspected to be secondary to a pinhole tympanic membrane perforation. The second patient developed a mixed hearing loss, including a mild high frequency sensorineural loss (25 dB at 2,000 Hz). This loss was not audiologically appreciable at the first postoperative visit and was identified 4 months postoperatively. In this patient the tumor was located entirely within the left mesotympanum (MFM class A1) but was abutting the anterior crus of the stapes, tensor tympani tendon, and extending anterior to the handle of the malleus. The incudostapedial joint was divided to protect the stapes from movement of the ossicular chain during CO_2 laser dissection of the tumor. Ossicular manipulation can be a contributing factor to sensorineural hearing loss during middle ear surgery (21) and this may account for the hearing loss in this patient. Of note is that this is the only patient who required incudostapedial joint disarticulation and longer follow-up is required to determine whether this hearing loss resolves.

Limitations

The study suffers from small sample size and the weakness of a retrospective series. Complete postoperative audiological data was not available for all patients, with one case therefore being excluded from audiological analysis. A second limitation is the relatively short duration of follow-up. Documented recurrence rate is low for MEPT. In a review of 115 cases over 4 decades by Killeen et al., there was no reported recurrence in cases where macroscopic surgical clearance was achieved at the time of surgery (5). However, in a series of 68 cases, Sanna et al. recorded 1 case of recurrence at 9 years (11). This highlights the requirement for longer follow-up. Extended follow-up would also enable the assessment of audiological stability in determining the safety of TEES in the management of MEPT.

CONCLUSION

This study suggests that transcanal endoscopic ear surgery is a safe and effective technique for the management of early stage middle ear paragangliomas. A

learning curve exists with endoscopic ear surgery and it is likely that totally endoscopic excision of MEPT is best performed after endoscopic ear skills are well developed. Although a one-handed technique, the series found no problems managing bleeding, despite the vascular nature of these tumors. Advantages to the patient include a shorter procedure, performed as day surgery with a rapid and relatively pain free recovery.

REFERENCES

1. Carlson ML, Sweeney AD, Pelosi S, Wanna GB, Glasscock ME, Haynes DS. Glomus tympanicum: a review of 115 cases over 4 decades. *Otolaryngol – Head Neck Surg (United States)* 2015;152:136–42.
2. Orhan K, Polat B, Celik M. Endoscopic-assisted cochlear implantation: a case series. *J Int Adv Otol* 2016;12:337–240.
3. Marchioni D, Soloperto D, Rubini A, et al. Endoscopic exclusive transcanal approach to the tympanic cavity cholesteatoma in pediatric patients:our experience. *Int J Pediatr Otorhinolaryngol* 2015;79:316–22.
4. Hunter JB, O'Connell BP, Rivas A. Endoscopic techniques in tympanoplasty and stapes surgery. *Curr Opin Otolaryngol Head Neck Surg* 2016;24:388–94.
5. Killeen DE, Wick CC, Hunter JB, et al. Endoscopic management of middle ear paragangliomas: a case series. *Otol Neurotol* 2017;38:408–15.
6. Isaacson B, Wick CC, Hunter JB. Endoscopic ossiculoplasty. *Oper Tech Otolaryngol – Head Neck Surg* 2017;28:39–43.
7. Kiringoda R, Kozin ED, Lee DJ. Outcomes in endoscopic ear surgery. *Otolaryngol Clin North Am* 2016;49:1271–90.
8. Marchioni D, Alicandri-Ciufelli M, Gioacchini FM, Bonali M, Presutti L. Transcanal endoscopic treatment of benign middle ear neoplasms. *Eur Arch Oto-Rhino-Laryngol* 2013;270:2997–3004.
9. Emre IE, Cingi C, Bayar Muluk N, Nogueira JF. Endoscopic ear surgery. *J Otol* 2020;15:27–32.
10. Kozin E, Lehmann A, Carter M. Thermal effects of endoscopy in a human temporal bone model: implications for endoscopic ear surgery. *Laryngoscope* 2014;124:E332–9.
11. Sanna M, Fois P, Pasanisi E, Russo A, Bacciu A. Middle ear and mastoid glomus tumours (glomus tympanicum): an algorithm for the surgical management. *Auris Nasus Larynx* 2010;37:661–8.
12. Gurgel RK, Jackler RK, Dobie RA, Popelka GR. A new standardized format for reporting hearing outcome in clinical trials. *Otolaryngol Neck Surg* 2012;147:803–7.
13. Cohen M, Landegger L, Kozin E, Lee D. Pediatric endoscopic ear surgery inclinical practice: lessons learned and early outcomes. *Laryngoscope* 2016;126:732–8.
14. Bennett ML, Zhang D, Labadie RF, Noble JH. Comparison of middle ear visualization with endoscopy and microscopy. *Otol Neurotol* 2016;37:362–6.
15. Isaacson B, Nogueira JF. Endoscopic management of middle ear and temporal bone lesions. *Otolaryngol Clin North Am* 2016;49:1205–14. DOI 10.1016/j.otc.2016.05.011.
16. Rohit JY, Caruso A, Russo A, Sanna M. Glomus tympanicum tumour: an alternative surgical technique. *J Laryngol Otol* 2003;117:462–6.
17. Medina M, Prasad SC, Patnaik U, et al. The effects of tympanomastoid paragangliomas on hearing and the audiological outcomes after surgery over a long-term follow-up. *Audiol Neurootol* 2014;19:342–50.
18. Noel JE, Sajjadi H. KTP-laser-assisted endoscopic management of glomus tympanicum tumors: a case series. *Ear Nose Throat J* 2018;97:399–402.
19. Anschuetz L, Bonali M, Guarino P, et al. Management of bleeding in exclusive endoscopic ear surgery: pilot clinical experience. *Otolaryngol Neck Surg* 2017;157:700–6.
20. Das A, Mitra S, Ghosh D, Kumar S, Sengupta A. Does tranexamic acid improve intra-operative visualisation in endoscopic ear surgery? A double-blind, randomised, controlled trial. *J Laryngol Otol* 2019;133:1033–7.
21. Kazikdas K, Onal K, Yildirim N. Sensorineural hearing loss after ossicular manipulation and drill-generated acoustic trauma in type I tympanoplasty with and without mastoidectomy: a series of 51 cases. *Ear Nose Throat J* 2015;94:378–98.

MAO

Manuscript No. ON-20-702

Otology & Neurotology

Dear Author,

During the preparation of your manuscript for typesetting, some queries have arisen. These are listed below. Please check your typeset proof carefully and mark any corrections in the margin as neatly as possible or compile them as a separate list. This form should then be returned with your marked proof/ list of corrections to the Production Editor.

QUERIES: to be answered by AUTHOR

QUERY NO.	QUERY DETAILS	RESPONSE
<AQ1>	Please check the suggested running title for correctness.	
<AQ2>	Please confirm whether surnames/family names (red) have been identified correctly in the author byline.	
<AQ3>	Affiliation has been set as per style. Please check for accuracy of information.	
<AQ4>	Please check the accuracy of corresponding author information.	
<AQ5>	Please check whether the meeting information is required.	