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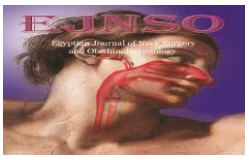

Transcanal Endoscopic excision of tympanic paraganglioma, a report of our surgical technique

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Abstract: Paraganglioma is the commonest middle ear tumor and the 2nd most common temporal bone tumor after vestibular schwannoma. Different classification systems have been proposed based on the extension of the tumor. Diagnosis is based on both clinical and radiological features. CT is valuable in defining the extension of the lesion and excluding erosion of the jugular bony plate. Endoscopic excision of these tumors has been described in the early 2010s. We report a case of female patient 40-years-old with right tympanic paraganglioma extending to the protympanum and hypotympanum. Exclusive transcanal endoscopic excision was performed.

Key words: Endoscopic ear, tympanic paraganglioma, glomus tympanicum.

Introduction

Tympanic paraganglioma represents the most frequent primary neoplasm of the middle ear.[1, 2] Paraganglioma is the second most common temporal bone neoplasm after acoustic neuroma. Pulsatile tinnitus is the most frequent symptom followed by hearing loss whereas bleeding is a late presentation.[3]

Diagnosis of paraganglioma depends on physical examination and radiological features. Reddish-blue pulsatile mass behind the tympanic membrane is the classic finding but pulsating aural polyp may be found.[2]

Classification of paraganglioma is based on the clinical and radiological extension of the tumor. Different classification systems had been proposed with Fisch and Mattox4 and Glasscock-Jackson classifications [5, 6] are most commonly used, however the modified Fisch classification of tympanomastoid paragangliomas provides detailed description of the tumor class based on different compartment involvement (Table 1).[7, 8]

Different treatment modalities have been proposed including surgical excision, radiotherapy and wait-and-see with the main modality being complete tumor removal.[2]

Table 1: **Modified Fisch classification of tympanic and tympanomastoid paragangliomas (TMPs)**

Class	***Description***
Class 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
Class 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 the hypotympanum and the mastoid • B3: Tumors confined to the tympanomastoid compartment with erosion of the carotid canal

Case report:

A 40-years-old female patient presented to the outpatient otorhinolaryngology clinics at Alexandria university hospital complaining from pulsatile tinnitus in her right ear of 9 months duration not associated with hearing loss, discharge, vertigo or facial nerve weakness.

Examination revealed a reddish pulsating mass behind an intact tympanic membrane on the right side involving the anterior half of the tympanic membrane the margin of which could not be seen neither anteriorly, nor inferiorly (Fig. 1). The left ear showed normal otoscopic picture with no abnormality detected .

Audiological evaluation revealed right pure tone average (PTA) of 27 dB, air-bone gap (ABG) of 12.5 dB, speech reception threshold (SRT) was 25 dB with excellent discrimination score. The left ear showed PTA of 24 dB, no ABG, SRT of 20 dB with excellent speech discrimination. Tympanogram was type B for the right side and type A for the left side. Clinical diagnosis was paraganglioma.

Computed tomography (CT) of the temporal bone was requested aiming at confirming the diagnosis and excluding other differential diagnoses. The CT revealed the presence of a soft tissue mass in the right middle ear centered on the promontory with extension to both protympanum anteriorly and hypotympanum inferiorly (Fig. 2). There was no bone erosion and the jugular bony plate, and the carotid canal were intact. Magnetic resonance imaging (MRI) was not requested.

Exclusive transcanal endoscopic excision of the tumor was planned as the tumor was localized with no extension outside the confines of the middle ear and the meatus was wide enough allowing manipulation of the instruments.

Surgical technique:

1. **Equipment composed of :**
   - The light source: xenon or LED light sources adjusted to no more than 50-60% strength proved to

provide sufficient illumination but avoid possible thermal damage to the delicate middle ear structures .

- Rigid endoscopes (0° and 45°rigid Karl Storz Hopkins rod telescopes, 3mm in diameter, 14 cm in length) and fiberoptic light cable .
- Endoscopic video camera: high resolution digital or three-CCD (Charged Couple Device) sensors .
- A high resolution medical monitor.
- The microscope with its camera and monitor connections was always prepared.
- Facial nerve neuromonitoring (for lesions with preoperative CT finding of dehiscent or eroded tympanic segment of the facial nerve).

Beside the basic standard ear instruments the following instruments and materials are used:

- 3mm 45° round knife for meatal incision.
- Round knife with suction shaft for elevation of the tympanomeatal flap.
- Dissectors with single and double curved ends.
- Micro cupped forceps with different directions of curvatures and different angles.
- Micro bipolar forceps for coagulation of the pedicle of the tumor after its identification.
- Curved suction tubes of different lengths and angulations.
- A high-speed drill, with an extra-long hand-piece with a protected rotating shaft to avoid damage to the flap and the endoscope.
- SURGICEL® (Ethicon SARL, Switzerland) and Gelfoam® (Pharmacia and Upjohn Co., Michigan, USA) for obtaining surgical hemostasis for either venous or arterial bleedings.

2.**Operative procedure**:

2.1. Anesthesia: The operation was performed under general endotracheal inhalation anesthesia with hypotensive technique .

2.2. Positioning of the patient and arrangement of surgical team :

Patient was placed supine on the operating table. The back of the patient was elevated by about 10°. The head of the patient was turned to the opposite side (left side) so that the operated ear was facing the ceiling. The nurse on the opposite side of the surgeon. The assistant was standing beside the main surgeon. The anesthesiologist stayed next to the patient's feet. The video endoscopic surgery equipments (monitor, camera, light source and documentation equipment) were placed in front of the surgeon and the assistant at the level of their eyes so both could comfortably watch the monitor. The monitor was adjusted at the eye level of the surgeon, neck and back strain as well as fatigue. The microscope was placed in the sterile field ready to be used alternately with the endoscope if required. We used a three- or four-handed technique, with the endoscope and suction held by the assistant and the operative instrument and bipolar diathermy held by the main surgeon allowing bimanual manipulation, however the instrument and endoscope holding arrangement could change during the procedure (Fig. 3).

2.3. Operative steps:

2.3.1. Preparation of the external auditory canal:

After patient positioning the operating field (auricle with pre- and postauricular area and the external auditory canal) was prepared with 5% povidone-iodine solution and the patient was draped as in usual transcanal middle ear surgery. The posterosuperior bony meatal wall was

infiltrated with 1:80000 epinephrine with 2% lidocaine local anesthetic in saline 5 minutes before the beginning of the procedure to minimize bleeding during dissection. The fine hair in the lateral third of the external canal was trimmed in order to avoid soiling of the endoscope lens. The external auditory canal was cleaned meticulously from any wax or debris.

2.3.2. Canal incision:

Performed 5-7 mm away from the annulus in the bony canal using a 3 mm diameter 45° angled round knife starting from 12 O'clock position and preceding counterclockwise till 3 O'clock leaving an anterosuperiorly based tympanomeatal flap. This can be modified as required by extension of the tumor. For left ear the incision would start at 3 O'clock and precede counterclockwise till 12 O'clock.

2.3.3 .Elevation of the tympanomeatal flap and tumor exposure:

Tympanomeatal flap was elevated from lateral to medial till the annulus with exposure of the middle ear tumor. Bleeding during elevation of the flap was controlled by a piece of cottonoid soaked with 1:1000 epinephrine. A round knife with a suction tube (KARL STORZ GmbH & Co. KG, Tuttlingen, Germany) was used to facilitate flap elevation. Separation of the stria mallearis and the umbo was performed by traction with a crocodile forceps .

2.3.4. Examination of the middle ear:

Tumor involvement of the different middle ear compartments was assessed revealing involvement of the mesotympanum with extension to both protympanum and hypotympanum. The area of the round window was clear from tumor and there was no extension medial to the ossicular chain.

2.3.5. Tumor removal:

Bipolar coagulation was used to fulgurate the tumor and then removal was performed in piece-meal manner. A piece of cottonoid soaked with saline/adrenaline was kept between the flap and the bipolar forceps and saline irrigation was used to dissipate the heat from the coagulation and avoid thermal damage to facial nerve, inner ear or the flap (Fig. 4A). Coagulation of tumor pedicle using microbipolar forceps after its identification provides vascular control and minimizes the bleeding (Fig. 4B). Tumor pedicle was sectioned using microscissor after bipolar coagulation (Fig. 4C). Tumor removed in one piece with cupped forceps. Bleeding from the site of tumor pedicle was stopped with adrenaline soaked cottonoid then microbipolar forceps was used to complete the hemostasis.

2.3.6. Examination of the middle ear cleft:

After complete tumor removal 30° endoscope was used to inspect middle ear cavity ensuring total tumor removal (fig. 5).

Figure 1: Endoscopic view of the right ear revealing reddish mass behind an intact TM the anterior and inferior borders of which are not seen.

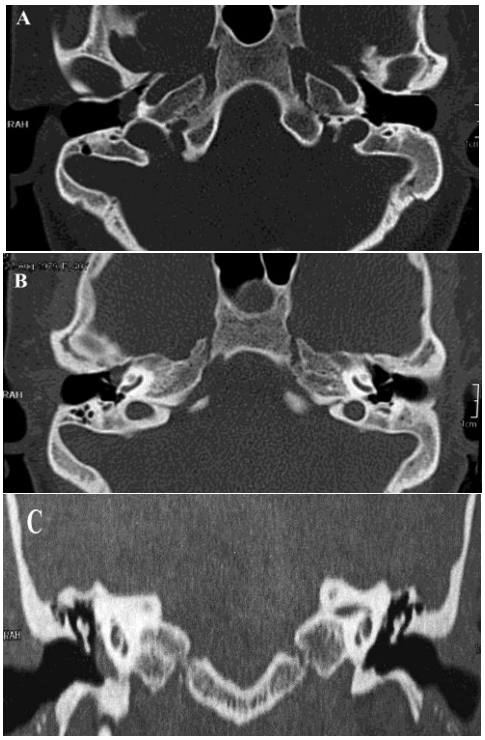

Figure 2: CT showing right middle ear mass centered on the promontory with no bony erosion and with intact jugular and carotid bony canals. **A** and **B** are axial views showing anterior extension to the protympanum while **C** is a coronal view showing inferior hypotympanic extension.

Figure 3: Arrangement of the surgical team with the main surgeon holding the endoscope and bipolar forceps while the assistant holds the suction and irrigation.

2.3.7 .**Post-excision management:**

2.3.7.1.Control of bleeding:

Residual localized bleeding was controlled with bipolar cauterization.

2.3.7.2. Packing of the middle ear:

Absorbable gelatin sponge (Gelfoam® (Pharmacia and Upjohn Co., Michigan, USA)) was used to pack the middle ear and give medial support to the graft.

2.3.7.3. Tympanic membrane grafting:

Repositioning of TM revealed a central tear at the site of attachment to the umbo. With the 0° 3mm endoscope reinforcement of tympanic membrane was performed with composite tragal cartilage/perichondral graft harvested through separate external incision. Grafting was performed by underlay technique.

2.3.7.4. Repositioning of the flap, packing of the EAC and dressing:

Tympanomeatal flap repositioned and absorbable gelatin sponge soaked with antibiotic solution was applied to fill external canal. A sterile dressing was applied over the ear.

2.3.7.5. Management of the specimen:

The resected lesion was preserved in formalin and send for histopathological examination using hematoxylin and eosin stain and immunohistochemical staining for synaptophysin, S-100 and Ki67.

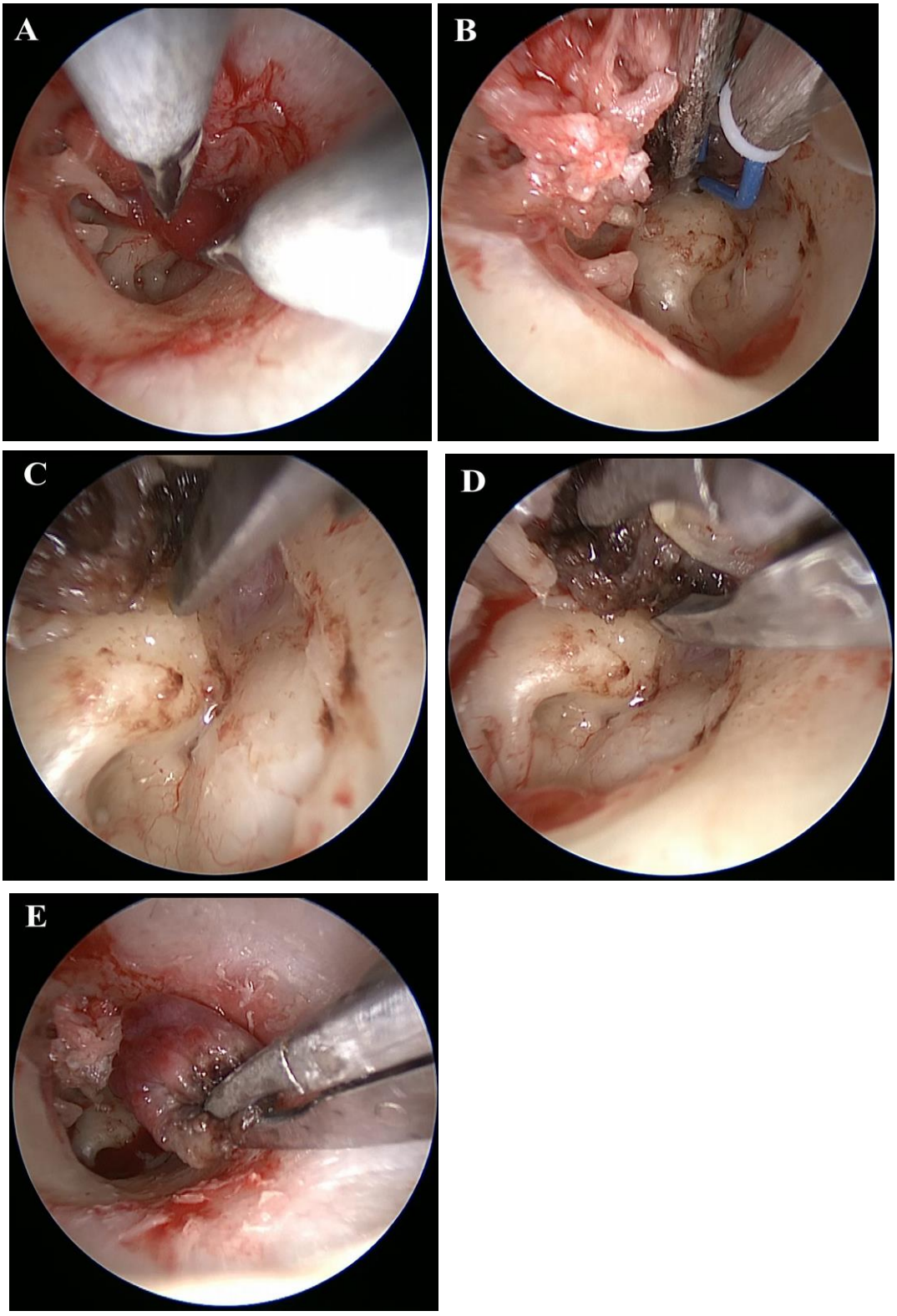

Figure 4: Tumor removal. **A-** Bipolar coagulation of the tumor. **B-** Microbipolar coagulation of tumor pedicle. **C-** Microscissor used to cut tumor pedicle after its coagulation. **D & E-** Tumor removed in one piece with cupped forceps.

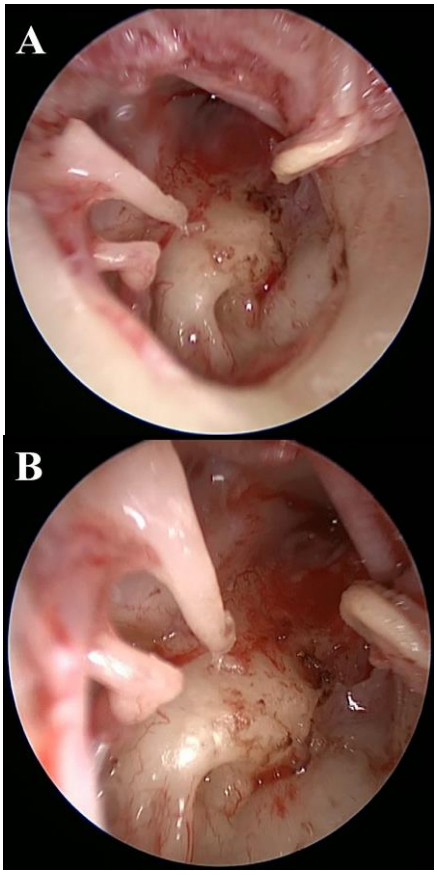

Figure 1: Middle ear cavity after complete tumor removal.

1.2.4. Postoperative management:

- Facial nerve function was grade I immediately postoperative.
- The patient was discharged on the second postoperative day.
- The stitches -when present- didn't need to be removed as they were done using absorbable material.
- Systemic antibiotic was administered as 2 gm ceftriaxone intraoperatively, then amoxicillin with clavulanic acid 1 gm twice daily for 2 weeks.
- Analgesic was given intraoperatively and then on demand only.
- Antibiotic ear drops with or without steroids were used after the 2nd week and continued for 2 weeks.
- Water precaution and avoidance of Valsalva maneuver were instructed after the operation and until the complete healing of the graft.
- Patient was instructed to return immediately if she develops bleeding, facial paresis or inner ear symptoms.

2.5. Follow up :

2.5.1.Clinico-endoscopic assessment:

Performed 3 weeks postoperatively and then at monthly intervals for the first 6 months and every 3 to 4 months for a year. Consultation then was performed as required by the appearance of new symptoms. Postoperative evaluation of the facial nerve grading was performed using the House-Brackmann grading.9 Postoperative follow up at 3 months revealed a taken graft.

2.5.2. Radiological follow up:

Computed tomography (CT) without contrast scanning of the temporal bone was performed 3 months postoperatively as a baseline then is planned at 1, 3, 6 and 10 years. Magnetic Resonance Imaging (MRI) with contrast of the temporal bone was done 1 year postoperatively as a baseline then only if any residual or recurrent pathology was detected on clinical or CT base.

2.5.3. Audiological assessment :

Audiogram was not performed postoperatively as the pulsating tinnitus improved with no development of new hearing loss.

2.5.4. Histopathology results:

Confirmed the diagnosis of paragangliomas.

Immunohistochemistry revealed diffuse staining of tumor cells with synaptophysin, staining of sustentacular cells by S-100 and a low proliferative activity Ki67 was 2%.

Discussion:

Sanna et al., in 2010 proposed an algorithm for treatment of tympanic paragangliomas in which class A1 tumors are removed by transcanal approach, class A2 with a postauricular transcanal approach using glove finger flap technique with wide canaloplasty.

For class B tumors, class B1 necessities a canal wall up mastoidectomy with posterior tympanotomy, class B2 were managed by canal wall up mastoidectomy with posterior tympanotomy and subfacial recess tympanotomy. Inner ear fistula, inadequate exposure or bleeding requires subtotal petrosectomy with middle ear obliteration which is also used for class B3. Large class B3 tumors need an infratemporal fossa approach type A.[1, 10]

Endoscopic excision of tympanic paraganglioma was first reported by **Marchioni et al., in 2013**. Endoscopic approach provides round-the-corner views of hidden recesses and avoiding unnecessary external incisions and soft tissue and bone dissection..[11, 12] In their approach they used either a stapedotomy type meatal incision or totally degloved the tympanic membrane using a 360° incision in the bony meatal skin. They recommended that canaloplasty should be performed circumferentially to provide wider exposure and space for four-handed technique. They also described the necessity to remove the ossicular chain for tumors extending medial to the chain.

We found it unnecessary to perform canaloplasty in each case and that tumor could be dissected from medial to the ossicular chain with preservation of the middle ear conductive mechanisms.[11, 12]

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