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Diode Laser-assisted Excision of Glomus Tympanicum Tumor: Do Diode Lasers Help in Hemostasis and Tumor Removal?

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This report focuses on the use of a diode laser on a 37-year-old woman with a glomus tympanicum tumor that completely filled her middle ear space. Through a postauricular approach, the exposed vascular tumor was gently coagulated to shrink it and sectioned to detach it from the middle ear using a diode laser, followed by the piecemeal removal of the tumor *in toto*. Ossicular reconstruction was performed in a single-stage tympano-ossiculoplasty. The patient had an uneventful postoperative course, and the audiometry revealed a complete closure of the air-bone gap one year after the operation. Due to its flexible delivery system that can sufficiently work in such restricted middle ear spaces, the application of the diode laser to treat the glomus tympanicum allowed adequate hemostasis to be achieved while avoiding subsequent sequelae. We demonstrate that the diode laser is a well applicable tool in treating highly vascular tumors of the middle ear like glomus tympanicum.

Key words: diode laser, glomus tympanicum, surgery, tinnitus, ossicular reconstruction, middle ear

INTRODUCTION

Glomus tumors, also known as paragangliomas, are rare vascular neoplasms that arise from the paraganglia. Paraganglia are normal structures that accompany cranial nerves. In the head and neck, paragangliomas can be present in the carotid body, the vagus nerve (glomus vagale), the middle ear (glomus tympanicum) (GT), the jugular bulb (glomus jugulare), or the larynx and pharynx.[1] Glomus tumors comprise 0.6% of all neoplasms in the head and neck and have become the most common primary neoplasm of the middle ear, arising anywhere along the course of Jacobson's nerve, typically on the cochlear promontory.

Both surgery and radiation have been recommended for the treatment of GT tumors, and surgery remains the most effective choice for operable lesions. However, conventional surgical methods often encounter great challenges with profuse hemorrhaging during excision of the GT because this tumor is composed of a rich vascular network within the fibrous septa.[2] The diode laser that emits laser light at a wavelength of 810 nm seems to fulfill the requirement for reducing bleeding and providing adequate coagulation during the operation. Although lasers have been used in otology since the 1970s, there have been only a limited number of reports on laser applications in GT tumor excision.[2-4] Herein, we report a case of a type II GT tumor in which the middle ear cavity is completely cleared of tumor judiciously using a diode laser.

CASE REPORT

A 37-year-old woman presented with a six-month history of pulsatile tinnitus and hearing impairment in her left ear. One month before her referral to our hospital, she went to a private practice clinic and received tympanocentesis under an impression of middle ear effusion. Unexpectedly, the aspirated fluid from the ear was found to be bloody. On her hospital admission, otoscopic examination showed a reddish lesion behind the eardrum that could be seen fully expanding and pulsating with her heartbeats (Fig. 1). A pure-tone audiogram confirmed a 32 dB conductive hearing loss without evidence of

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Fig. 1 An expanded and pulsatile eardrum suggests a possible glomus tympanicum tumor located behind the tympanic membrane.

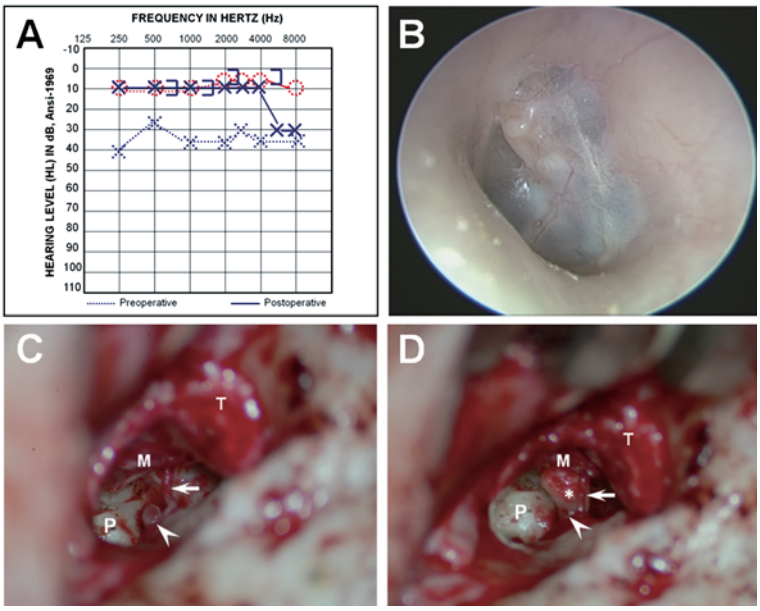

Fig. 2 (A) Pure-tone audiometry reveals a preoperative conductive hearing loss in the left ear and a complete closure of the air-bone gap twelve months after operation. (B) Otoscopic examination shows a properly healed eardrum. (C) Incus was removed to facilitate a good exposure and tumor removal in the attic region and ossicle chain. (D) Ossiculoplasty with autologous sculpted incus interposition was performed in a single stage. M = malleus; P = promontary; T = tympanomeatal flap; asterisk = incus interposition; arrow = chorda tympani nerve; arrowhead = stapes head.

sensorineural hearing loss (Fig. 2A). High-resolution computed tomography (CT) of the temporal bone showed a soft tissue mass overlying the promontory and totally filling the middle ear cleft, including the mesotympanium, epitympanium, hypotympanium, and Eustachian tube orifice, without bony destruction (Fig. 3A). Magnetic resonance imaging (MRI) revealed hypointense signals on T1-weighted images and lower signals on T2-weighted images, as compared to the obstructed fluids. Following the use of gadolinium- diethylenetriaminepentaacetic acid (Gd- DTPA), the mass was enhanced and delineated more clearly without intracranial or jugular bulb involvement (Fig. 3B). Those radiological characteristics were in keeping with a suspected GT diagnosis.

With the patient under general anesthesia, a postauricular approach for surgical exposure of the middle ear space was performed. After elevating the tympanomeatal flap, a diode laser (Diomed, Andover, MA) with a 0.4 mm fiber in a contact (focused) headpiece was introduced to shrink the tumor adjacent to the posterior wall of the external auditory canal (EAC). This was followed by a dissection of the tumor located in the hypotympanium and inferior margin of the EAC between the 4 and 6 o'clock positions. When the tumor margins were delineated and mobilized from the posterior aspect of the middle ear space, the tumor was excised piece by piece with concurrent diode laser coagulation and cutting in the 2-watt continuous mode. Surgicels® covered with small pieces of cotton ball were used to compress the tumor and isolate it from the middle ear cavity to reveal the optimal tumor margin for laser excision. Because this engorged GT tumor had surrounded the ossicle chain and extended superiorly to the epitympanium, the incus was temporarily disarticulated during the operation, and ossicular reconstruction was performed by incus interposition following tumor removal (Fig. 2C & D). Type III tympanoplasty was done to repair the operative perforation of the eardrum in one stage.

Histopathological examinations of the resected tumor revealed well-delineated cuboidal cell nests separated by richly vascularized sinusoidal fibrous septa (Fig. 3C), which was consistent with the diagnosis of GT. The patient experienced an uneventful recovery, and the preoperative complaint of pulsatile tinnitus completely disappeared. At a 12-month postoperative followup, no clinical evidence of tumor recurrence was detected by otoscopic examination (Fig. 2B) and the audiogram showed an almost normal hearing threshold with complete closure of the air-bone gap (Fig. 2A).

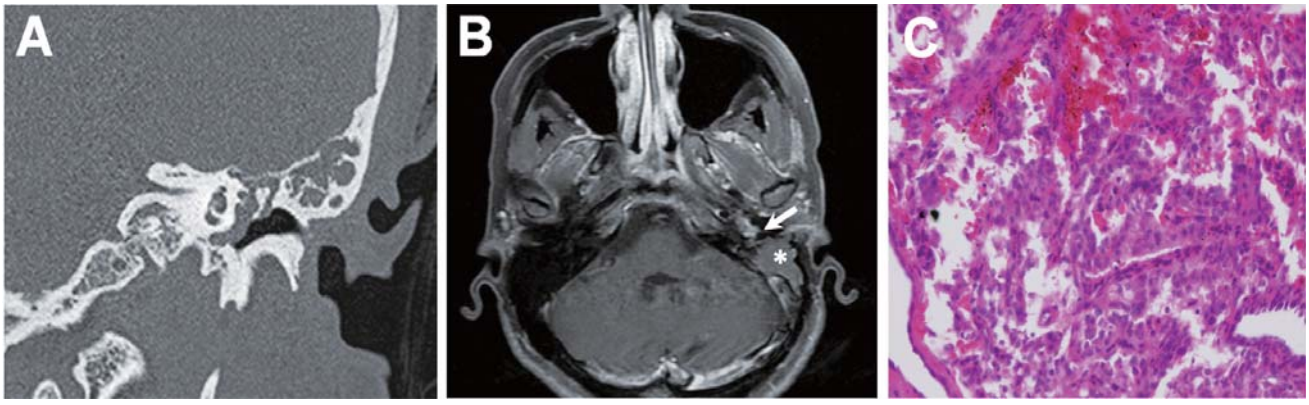

Fig. 3 (A) High-resolution coronal CT scan shows a mass lesion filling the mesotympanum, epitympanum, and hypotympanum with an intact jugular plate. (B) Contrast-enhanced T1-weighted MRI scans of the brain reveal a hyperintense mass (arrow) that could be distinguished from the fluid content accumulated in the mastoid region (asterisk). (C) Microscopically, this tumor is composed of well-delineated nests of cuboidal cells with abundant and eosinophilic cytoplasm and round to oval nuclei. The nests were separated by abundant capillaries and dilated sinusoidal fibrous septa-like "staghorn" appearance (H&E stain ×400).

DISCUSSION

The majority of previous reports, regardless of the type of surgical route or approach that was adopted, were performed with cold instruments combined with Bipolar electrocautery.[5-6] Although lasers have been used in otology since the 1970s, application of the neodymium-doped yttrium aluminum garnet (NdYAG) laser in treating type II (Glasscock and Jackson's classification)[7] GT tumors was first reported by Robinson *et al*.[4] in 1993, followed by Molony *et al*.[5], who used a potassium titanyl phosphate (KTiOPO4, KTP) laser in 1998. As of 2005, Durvasula *et al*.[3] had reported six cases of type A (Fisch and Oldring's classification)[8] GT tumors that were successfully treated with a diode laser and presented good long-term outcomes.

In comparison with the NdYAG and KTP lasers, the diode laser emits laser light at a wavelength of 810 nm, which possesses excellent penetration effects for vascularized tissue, as does the NdYAG laser (wavelength: 1064 nm), which provides deeper penetration than the KTP laser light at 532 nm.[3] Although there are advantages to using the diode laser, caution is required when manipulating it near the sensitive hearing organ, as in middle-ear surgery. A complication of transient postoperative sensorineural hearing loss has been reported following the excision of a GT tumor using the NdYAG laser.[4]

Regarding the coagulation effect, the diode laser offers efficient coagulation of blood vessels, like the KTP laser,[3] and both the diode and KTP lasers are superior to the NdYAG laser for absorption by hemoglobin.[2] Therefore, the diode laser offers benefits in both superficial and interstitial lesions. Moreover, it is not only broadly applied in various otorhinolaryngological procedures, but is also very suitable for providing a relatively bloodless field during GT tumor excision, as presented in our case. We would like to emphasize that the application of a diode laser does not guarantee an absolutely bloodless surgical process since any GT manipulation may tend to result in profuse bleeding, which is characteristic of GT. Nevertheless, to deal with a type II GT that has completely filled the middle ear cleft, the application of a diode laser should be superior to other instruments due to its flexible delivery system that can be easily manipulated in such restricted surgical spaces as the middle ear cleft. In addition, diode lasers also help in delineating a tumor's margin and freeing the tumor from the concave surface of the middle ear cleft where the tumor is attached.

The GT tumor in our case extended superiorly into the epitympanum, limited the movement of the ossicle chain, and resulted in subsequent conductive hearing loss. Separation of the incudostapedial joint to remove the incus was indicated in order to allow more adequate visualization of the tumor's invasion around the attic region and the ossicle chain. Because both the stapes and manubrium of the malleus were intact and mobile, ossiculoplasty with autologous sculpted incus interposition was preferred for reconstruction. An excellent postoperative hearing outcome with complete closure of the air-bone gap was demonstrated in our case, suggesting that a single-stage operation can be achieved even following

the operative injury of the eardrum and inevitable incudostapedial joint dislocation during operation.

An engorged eardrum resulting from a large GT tumor tends to be misdiagnosed as middle ear effusion, as compared with a small GT, which presents as a clear margin like a red ball behind the eardrum.[9] Therefore, large GTs may be more vulnerable to injury through an inappropriate aspiration procedure, as shown in our case. Pulsatile vibration of the eardrum, although not a definite sign, can indicate the presence of a vascular lesion, which the clinician should be aware of.

In summary, the diode laser appears to be an efficient and safe surgical instrument for treating glomus tympanicum tumors. It provides a relatively bloodless surgical field to accomplish the complete removal of a tumor without subsequent sequelae. Although procedures often involve transient separation of the incudostapedial joint and operative perforation of the eardrum, our results suggest that a good hearing outcome can be obtained following a single-stage type III tympanoplasty and ossiculoplasty. To prevent the risk of causing bleeding or other complications in tympanocentesis or myringotomy, the otolaryngologist should be aware of the specific symptoms of GTs such as a pulsatile reddish mass lesion behind the eardrum.

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CONFLICT OF INTEREST

No potential conflict of interests relevant to this article was reported.

DISCLOSURE

All authors declare no competing financial interests.

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