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Uneventful Cochlear Implantation through Round Window Approach in a Child with Persistent Stapedial Artery: A Case Report

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Abstract **Case Report**

Persistent stapedial artery (PSA) is a rare congenital vascular anomaly, with both clinical and surgical implications. When encountered during middle ear surgery, it represents a challenge to the otologic surgeon, since damage to this artery could lead to massive intraoperative bleeding and poor surgical exposure. Here we report the case of a 3-year-old boy with prelingual and profound bilateral sensorineural hearing loss who was referred to our Otolaryngology-Head and Neck Surgery Department for cochlear implant evaluation. Pre-operative computed tomography (CT) examination of the temporal bone confirmed the diagnosis of PSA. Further evaluation showed no contraindication for surgery and the patient underwent cochlear implantation using the classic transmastoid, facial recess approach. During surgery the vessel was coursing far enough from the round window niche, making it possible to achieve safe and complete electrode insertion into the scala tympani of the cochlear basal turn. This case demonstrates that cochlear implantation is safe and feasible in patients with PSA. Thorough analysis of the preoperative temporal bone CT scan might help with surgical planning by identifying thisanomaly prior to surgery.

Keywords: Persistent stapedial artery (PSA), ear surgery, Otolaryngology, computed tomography (CT).

INTRODUCTION

Persistent stapedial artery (PSA) is a rare congenital vascular anomaly, with an estimated prevalence ranging from 0.02% to 0.48% [1]. It is most often a benign anomaly, usually asymptomatic and encountered incidentally during middle ear surgery [2]. However, in some cases it may cause conductive hearing loss and pulsatile tinnitus [3].

The stapedial artery is a temporary embryonic structure that gives rise to several branches supplying the orbit, the meninges and the face [4]. Thereafter, it undergoes normal involution, leaving only the obturator foramen of the stapes as the evidence of its existence, and the vessels previously supplied by the stapedial artery eventually become part of the external carotid system [2, 4]. Failed regression of this fleeting embryonic vessel results in PSA.

When encountered during middle ear surgery, PSA represents a challenge to the otologic surgeon since damage to this artery could lead to serious intraoperative bleeding and poor visualization of the surgical field.

Here, we report the case of a successful cochlear implantation through round window approach in a child with PSA.

To our knowledge, this is the 3rd report published of a successful cochlear implant in a patient with PSA [2, 5], 2nd case of electrode insertion through round window approach [5] and 1st case of a child with PSA undergoing cochlear implant surgery.

CASE PRESENTATION

A 3-year-old boy with prelingual and profound bilateral sensorineural hearing loss was referred to our Otolaryngology-Head and Neck Surgery Department for cochlear implant evaluation.

Pre-operative computed tomography (CT) examination of the temporal bone showed a small vessel arising from the vertical portion of the left petrous carotid canal, ascending within the tympanic cavity over the cochlear promontory, through the

obturator foramen of the stapes (Figures 1 and 2), and an absent foramen spinosum on the ipsilateral side, confirming the diagnosis of PSA (Figure 3).

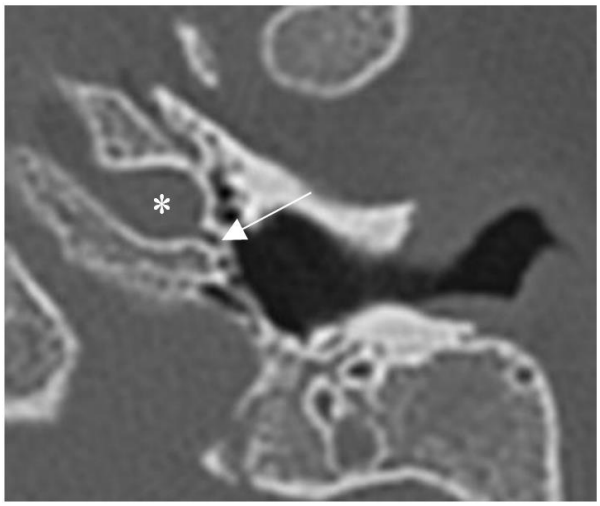

Figure 1: Axial HRCT image of the left temporal bone showing a small canaliculus (white arrow) arising from the vertical portion of the petrous carotid canal (*)

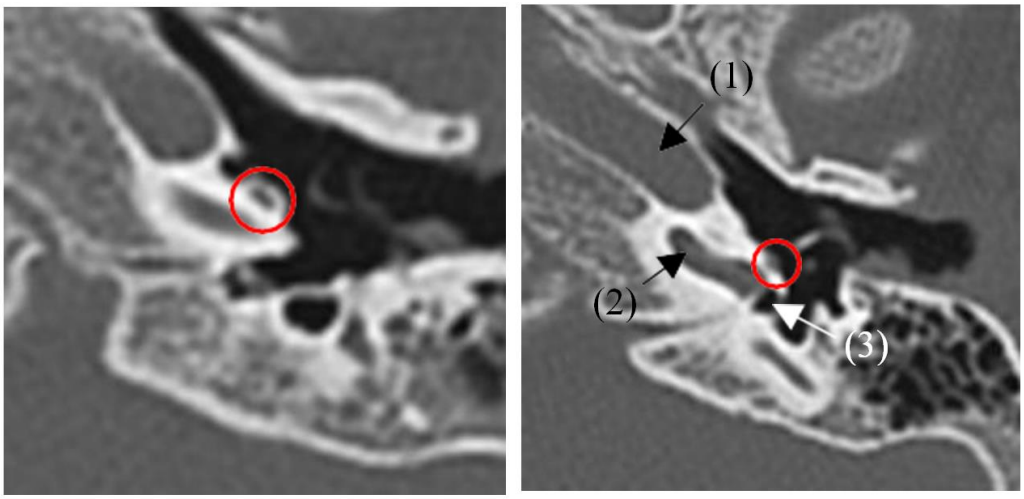

Figure 2: Axial HRCT cuts of the left temporal bone showing a vessel running along the cochlear promontory. Note that the round window niche appears patent and accessible for cochlear implant electrode insertion. (1): petrous carotid canal, (2): basal turn of the cochlea, (3) round window niche

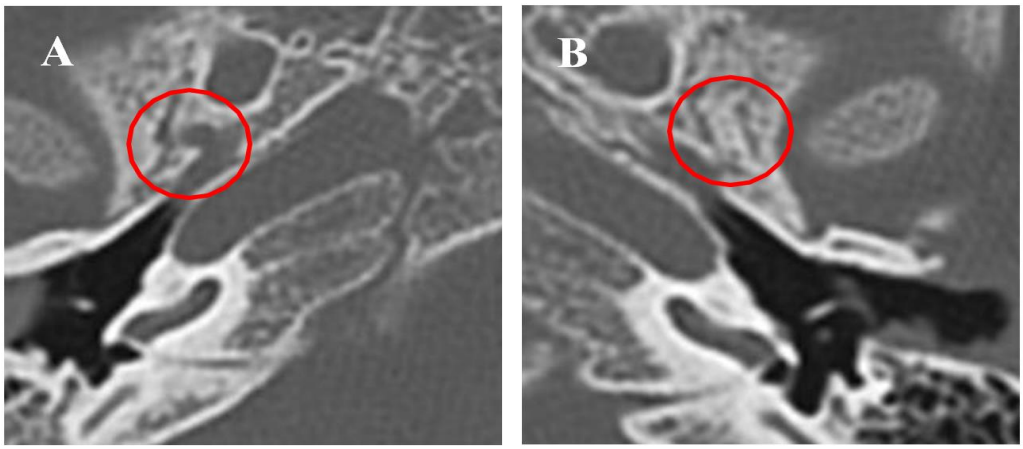

Figure 3: Axial HRCT images of the temporal bone revealing absence of foramen spinosum on the left side (B), compared to the normal right side (A)

Further evaluation showed no contraindication for surgery and the patient underwent cochlear implantation using the classic transmastoid, facial recess approach.

After gaining access to the middle ear via posterior tympanotomy, a pulsatile mucosa-covered structure could be seen coursing over the cochlear promontory without obscuring the round window niche, allowing complete electrode insertion through the round window membrane.

The procedure was uneventful with no intraoperative complications nor surgical difficulties regarding round window membrane identification and electrode insertion.

Intraoperative neural response telemetry elicited good responses and postoperative x-ray with a Stenvers view showed proper electrode placement.

DISCUSSION

Persistent stapedial artery (PSA) is a rare and most often benign congenital vascular anomaly, with an estimated prevalence ranging from 0.02% to 0.48%[1]. It is usually asymptomatic and discovered incidentally during middle ear surgery [2]. However, in some cases it may cause conductive hearing loss and pulsatile tinnitus [3].

PSA commonly originates from the internal carotid artery, and runs along the cochlear promontory, through the obturator foramen of the stapes, then enters the tympanic segment of the facial canal.

Thereafter, the PSA exist's the facial canal just posterior to the geniculate ganglion to supply the middle cranial fossa as the middle meningeal artery. As a result, the foramen spinosum that usually contains the middle meningeal artery does not develop and is consequently absent [2]

When encountered during middle ear surgery, PSA represents a surgical hazard since damage to this artery could lead to serious intraoperative bleeding and poor visualization of the surgical field.

Moreover, transection or ligature of this artery carries a theoretical risk for distal ischemia resulting in postoperative neurological complications (facial palsy, hearing loss, vestibular impairment, or hemiplegia) [2, 5]. A previous report of PSA encountered during cochlear implantation was abandoned for this reason [6]. However, more recent reports suggest that middle ear surgery is safe and should not be precluded in the presence of a PSA [7, 8].

Detection of this anomalous embryonic vessel prior to surgery is possible, using High Resolution Computed Tomography (HRCT) or Magnetic resonance angiography [9], and could therefore help with preoperative surgical planning.

Looking for a PSA is now part of our checklist when evaluating cochlear implant candidates.

Classic imaging features of the persistent stapedial artery on HRCT include [9]:

- Small canaliculus arising from the petrous carotid canal, coursing over the cochlear promontory and through the obturator foramen of the stapes.
- Enlargement of the anterior portion of the tympanic segment of the facial nerve canal.
- Absent foramen spinosum.

During cochlear implant surgery, the presence of PSA might block the round window niche entrance, making it impossible to achieve safe electrode insertion via the round window membrane.

Incautious manipulation of the vessel could lead to troublesome bleeding and poor surgical exposure. Lindemann *et al.,* [2], in their previous report of successful cochlear implantation in a patient with PSA, proceeded by performing a standard promontory cochleostomy, to avoid the vessel, minimize the risk of intraoperative bleeding and preserve blood flow to the middle cranial fossa.

Lindemann *et al.*, [2] suggested that ablation of the PSA to allow round window electrode insertion is also possible, but could result in serious, and difficult to manage, hemorrhage. Therefore, they recommended that this technique should be avoided as much as possible.

Jones *et al.*, [5] on the other hand, managed this surgical encounter, by carefully lifting the artery off the promontory to allow round window electrode insertion. This technique, although conservative, carries a potential risk for the electrode eroding the artery. For this matter, a tragal cartilage graft with perichondrium on both surfaces was placed between the electrode and the PSA, to ensure that these two don't come into direct contact with each other.

In our case, the vessel was coursing far enough from the round window niche, and its presence had no impact on the normal course of the surgical procedure. The round window membrane was completely visible, allowing safe and complete electrode insertion into the scala tympani of the cochlear basal turn.

CONCLUSION

This case demonstrates that safe and successful cochlear implant surgery is feasible in the presence of PSA.

Thorough analysis of the preoperative temporal bone CT scan might help with surgical planning by identifying this anomaly prior to surgery.

Adequate surgical approach should be determined intraoperatively and depends mainly on the extent of round window exposure.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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