The Journal of International Advanced Otology

J Int Adv Otol 2021; 17(3): 275–277 • DOI: 10.5152/iao.2021.8290

Case Report

Extracochlear Electrode Insertion in the Petrous Area in Cochlear Implantation

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Cite this article as: Lin C, Chiang T, Huang J, Lin H. Extracochlear electrode insertion in the Petrous area in cochlear implantation. *J Int Adv Otol*. 2021;17(3):275-277.

Cochlear implantation is a reliable and safe tool to rehabilitate patients with severe-to-profound sensorineural hearing loss, who get limited benefits from traditional hearing aids. Electrode misplacement is a rare but significant problem that fails to provide benefits and may cause injury to the nearby structures. We present a case that underwent mastoidectomy first to remove cholesteatoma, followed by cochlear implantation with electrode misplacement into the petrous area, with sustained hearing benefits and without any injury to the surrounding structures.

KEYWORDS: Extracochlear, petrous, cochlear implantation

INTRODUCTION

Electrode misdirection during cochlear implantation is a rare but important complication. The following case report focuses on the misdirection of the electrode into the petrous side during cochlear implantation (CI).

CASE PRESENTATION

A 57-year-old man underwent left mastoidectomy for cholesteatoma and right tympanoplasty for chronic otitis media (COM) several decades ago. Right COM with total deafness was noted for many decades, while on the left, profound hearing loss progressed in the last 2 years. Limited benefits were conferred by hearing aids. Pre-cochlear implantation assessment based on the cortical auditory evoked potential showed that the performance of the left ear was better than that of the right ear. Pre-CI temporal bone computed tomography (CT) scan showed markedly decreased right mastoid air cells. Moreover, a giant cholesterol cyst involving the left petrous tip, left clivus with erosion of the left internal carotid artery canal, left jugular foramen, and left internal auditory canal was suspected in the basal turn of the left cochlea (Figure 1A). A 2-stage surgery was performed on the left ear. Left mastoidectomy was performed first to remove the cholesterol cyst. CI was performed 1 year later. CI (Nucleus CI 24RE, Cochlear Corporation, Sydney, Australia) was performed smoothly with total insertion via cochleostomy. Intra-operative neural response telemetry (NRT) showed electrodes 12 through 22 were open circuits. Post-CI temporal bone CT demonstrated the distal electrodes extending into the extracochlear petrous area near the carotid artery, which contained a cholesterol cyst through the level of the basal turn (Figure 1B). Fortunately, the extracochlear misplacement of CI electrodes did not cause discomfort even 14 months after CI. Some speech perception benefits were noted 6 months after CI with a close set in vowel recognition of 50%, consonant recognition of 57%, open set in spondaic word recognition of 20%, and monosyllable word recognition of 0%. However, NRT was measured only in the basal electrodes and was absent in the apical electrodes 14 months after CI.

DISCUSSION

CI changes the fate of bilateral severe-to-profound sensorineural hearing loss in patients who experience limited benefits from hearing aids. It is safe and effective, and a low complication rate has been reported. The most common reasons for revision surgery are wound infection, device failure, and electrode array misplacement. A study revealed that 13.4% (35/262) of CIs resulted in at least 1 electrode outside of the cochlea, as observed on CT images.[1] These extracochlear electrodes extending outward from

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Received: June 1, 2020 • **Accepted:** July 10, 2020
Available online at www.advancedotology.org

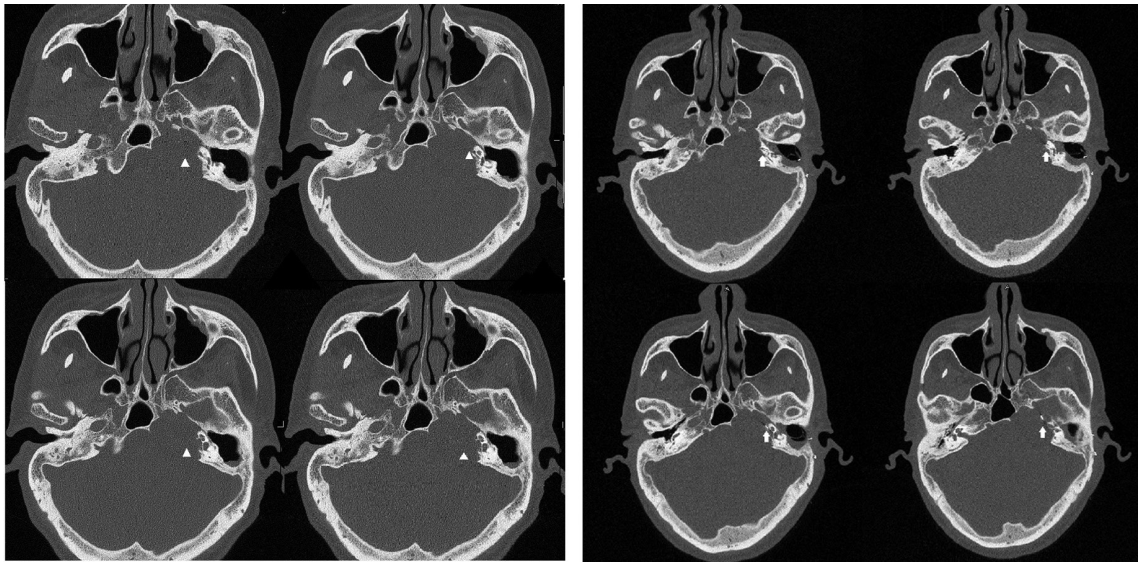

Figure 1. (1A) Pre-CI. A giant cholesterol cyst (arrowhead) involving the left petrous tip, left clivus with erosion of the left internal carotid artery canal, left jugular foramen, and left internal auditory canal was suspected in the basal turn of the left cochlea. (1B) Post-CI temporal bone CT scan demonstrated the electrode (arrow) extending into the extracochlear petrous area, which contained cholesteatoma through the level of the basal turn. CI, cochlear implantation; CT, computed tomography

the basal cochlea caused no serious CI malfunction. Electrode array displacement into the fallopian canal in revisions of long-standing cochlear implants has been reported to occur because of osteitis of the bony labyrinth capsule.[2] Cochlear implant electrode arrays have rarely been misplaced in Hyrtl's fissure, a rare malformation of the temporal bone that retains communication between the round window fossa and the posterior cranial fossa.[3] The purpose of our study was to report our encounter with a rare case of extracochlear electrode misplacement in the petrous area. CI was performed smoothly with total insertion via cochleostomy without unexpected resistance, and it was thought that the insertion of all 22 electrodes was performed well. However, intra-operative NRT showing an open circuit of electrodes 12-22 should have been a warning sign, but remained unnoticed. The audiologist brought up some concerns about electrodes being non-functional. Based upon the recommendations of the manufacturer's audiologist, we confirmed that the device was functioning as per specifications. No post-CI plain radiography was performed in our routine clinical practice. However, a study revealed that postoperative radiological plain imaging should be considered even when all intraoperative electrophysiological NRT measures and surgical reports are normal.[4] Meanwhile, another study suggested that intraoperative cone-beam CT using the O-arm is a safe, rapid, easy, and reliable procedure to immediately identify the misplacement or fold-over of an electrode array.[5] Post-CI temporal bone CT in our study showed distal electrodes extending into the extracochlear petrous area. Revised CI was not considered. Due to a cochlear split, the cholesterol granuloma had eroded into the otic capsule bone, weakening it. We also thought that the remaining 11 distal electrodes might still be clinically useful for speech perception. Our error arose from inappropriate pre-CI CT assessment, wherein we thought that the cochlear bony capsule was too hard to be perforated. These extracochlear misplaced electrodes 12-22 were near the carotid artery but fortunately caused no discomfort even 14 months after CI. This rare case of clinical CI electrode misplacement was worth sharing.

MAIN POINTS

- Extracochlear CI electrode insertion may still have substantial speech perception.
- A hard cochlear bony capsule may be penetrated by a cholesterol cyst.
- The extracochlear CI electrode near the carotid artery may be closely watched without immediate serious complications.

CONCLUSION

Adequate survey of the pre-cochlear implantation image is crucial in patients with COM or cholesteatoma history. In addition, in patients with x-linked deafness, extra cochlear insertion of electrodes into the internal acoustic canal is more common.[6] Intra-operation NRT and post-operation images may suggest electrode misdirection. If plain radiography is conducted after the insertion and before waking the patient up, the situation may be totally corrected. In addition, real-time intraoperative fluoroscopy is a useful tool in these difficult cases for the prevention of extracochlear array misplacement.[7]

Informed Consent: Written informed consent was obtained from the patient who participated in this study.

Peer Review: Externally peer-reviewed.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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