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An unusual occurrence in cochlear implantation surgery: misplaced electrode

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Abstract

Objective: To highlight the possibility of misplacement of electrodes during cochlear implantation surgery, to stress the importance of routine neural response telemetry, and also to emphasise the value of conventional radiography in confirming electrode positioning in the immediate post-operative period.

Case report: A two-year-old boy presented with bilateral, profound, sensorineural hearing loss and underwent conventional cochlear implantation surgery. During insertion of the implant, there was doubt regarding the direction of passage of the electrode array. Instead of the usual smooth passage of the electrode, some resistance was felt. Neural response telemetry, performed at the end of the procedure, showed absent responses. A confirmatory X-ray in Stenver's view confirmed the extra-cochlear positioning of the electrodes in the superior semicircular canal. The wound was reopened, the electrode array removed and the cochleostomy was positioned a little more antero-inferiorly on the promontory with respect to the round window. Correct insertion of the electrode was then performed without difficulty.

Conclusion: The misplacement of electrodes during cochlear implantation surgery is rare but can occur. Neural response telemetry and conventional radiography are invaluable in assessing the placement of the electrode intra-operatively. Conventional radiographs are very cost-effective and aid in confirming the position of the electrode array.

Key words: Cochlear Implants; Complications; Radiology; Telemetry

Introduction

Cochlear implantation is indicated for profound sensorineural hearing loss.[1] Pre-operative high resolution computed tomography (CT) of the temporal bones can demonstrate cochlear patency and detail middle- and inner-ear anatomy.[2] In the standard implantation technique, the electrode array is introduced through the transmastoid facial recess, inserted through a cochleostomy antero-inferior to the round window and advanced within the scala tympani of the basal turn from its inferior segment to its ascending, superior and descending segment.[3] Our case demonstrates accidental, improper positioning of a cochlear implant electrode array.

Case report

A two-year-old boy presented to the out-patient department of the Kombupalayam Kumarappagounder Ramalingam ENT Hospital and Research Institute with deafness and delayed speech and language development. Clinical examination and audiological evaluation confirmed bilateral, profound, sensorineural hearing loss. The child was hence referred for cochlear implantation surgery in the right ear.

A medical, psychological, social and educational evaluation was performed before implantation. Pre-operative high resolution CT of the temporal bones was performed in order to demonstrate cochlear patency and to rule out congenital anomalies of the inner ear. Magnetic resonance imaging (MRI) of the brain was performed to assess the integrity of the VIIth and VIIIth cranial nerve complex at the cerebellopontine angle. Both the high resolution CT and the MRI were normal.

Surgery was performed via a retroauricular approach, cortical mastoidectomy and posterior tympanotomy. Through the posterior tympanotomy, the round window niche was identified and the cochleostomy was made. The bed for the receiver package was drilled over the squamous part of the temporal bone and the implant was secured. The electrodes were introduced into the cochleostomy, using the introducer. Minimal resistance was encountered while introducing the electrodes, with a doubtful angle of insertion. However, complete electrode insertion was achieved. Soft tissue was used to seal the cochleostomy and the wound was closed.

Intra-operative neural response telemetry before extubation revealed absent responses. A conventional radiograph in Stenver's view confirmed abnormal

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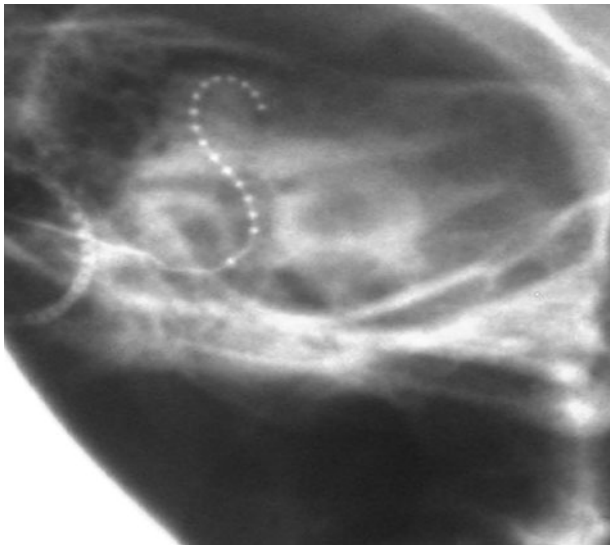

FIG. 1
Conventional X-ray in Stenver's view, showing the misplaced electrode entering the vestibule and probably the superior semicircular canal.

placement of the cochlear implant electrode array. The electrode array could be seen entering the vestibule and then taking an upward course into the superior semicircular canal (Figure 1). The cochlea was seen with no electrodes in place.

The electrode array was removed and the cochleostomy widened antero-inferiorly. The electrodes were then reintroduced. Repeat neural response telemetry elicited positive responses from the auditory nerve. A repeat X-ray in Stenver's view confirmed correct placement of the electrode array in the cochlea (Figure 2).

Discussion

Cochlear implants are routinely used to restore the sense of hearing in profoundly deaf patients.[4] The spiral ganglion cells are the targets of stimulation by the cochlear implant electrodes, and it is postulated that electrodes close to the modiolus may allow more focused and discrete electrical stimulation, reducing the stimulation threshold and channel interaction.[5,6]

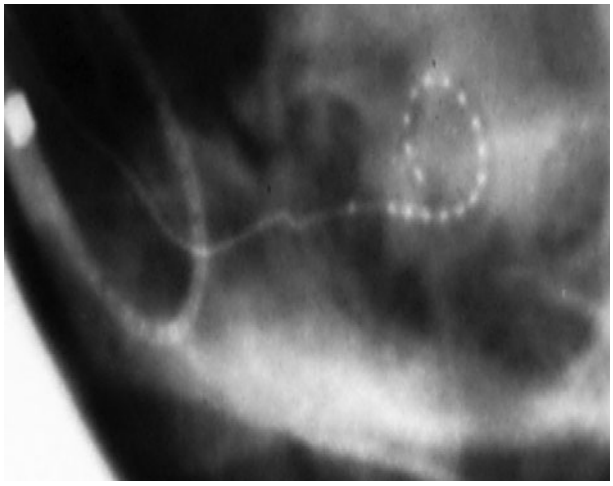

FIG. 2
Repeat X-ray in Stenver's view, showing the properly inserted electrode array following a gentle curve within the basal turn of the cochlea.

Imaging of the middle and inner ear is indispensable to the pre- and post-operative evaluation of patients.[7] Information provided by CT scanning is used (1) to exclude patients in whom multichannel cochlear implantation would probably be unsuccessful (owing to obliterative labyrinthine ossification, congenital cochlear malformation, or severe cochlear or fenestral otosclerosis); (2) to help select the best ear for cochlear implantation; and (3) to provide a pre-operative picture of normal variants and thus avoid surgical pitfalls. Magnetic resonance imaging helps in assessing the integrity of the cochlear nerve and the size of the membranous labyrinth.[8] Intra- and post-operative radiographic techniques assist the assessment of the electrode array position, the management of unexpected complications and the evaluation of infections.[1]

In this case, the operation was a conventional cochlear implantation with cortical mastoidectomy, posterior tympanotomy and cochleostomy. During insertion of the cochlear implant, there was doubt regarding the direction of passage of the electrode array. Neural response telemetry was performed as a routine intra-operative procedure to measure responses from the auditory nerve. An intra-operative confirmatory X-ray was performed in this case, as there were absent responses from neural response telemetry combined with doubt about the direction of electrode array insertion. This X-ray showed the extra-cochlear positioning of the electrode array in the superior semicircular canal. The wound was reopened, the electrode array removed and the cochleostomy widened slightly antero-inferiorly; correct insertion of the electrode array was then achieved without difficulty. Repeat neural response telemetry measurements showed positive responses, and the position of the electrodes was confirmed in the repeat X-ray.

The standard technique of cochlear implantation has been described, wherein the electrode array is introduced through the transmastoid facial recess and cochleostomy antero-inferior to the round window. It is then advanced within the scala tympani of the basal turn of the cochlea from its inferior segment to its ascending, superior and descending segments.[3]

Routine intra-operative imaging is performed in some units to confirm radiographically the integrity and positioning of the implant.[9,10] For such purposes, a plain radiograph in a posterior-anterior, Stenver's or modified Stenver's projection suffices. The properly inserted electrode array follows a gentle curve within the basal turn of the cochlea, with regular spacing between the electrodes.[7]

Mecca described a similar case of misplacement of the cochlear implant electrode. This patient presented post-operatively with vestibular symptoms and no improvement in hearing. High resolution CT demonstrated extra-cochlear positioning of the

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electrode in the superior semicircular canal.[1] In contrast, our patient did not have any post-operative vestibular symptoms and made a routine recovery.

In another study of 141 patients receiving cochlear implants, intra- or post-operative radiographic techniques were adequate to establish electrode position in 135 patients.[10]

In the case presented, intra-operative X-ray combined with neural response telemetry sufficed to demonstrate the misplaced electrode array.

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Professor K K Ramalingam takes responsibility for the integrity of the content of the paper.
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