The Journal of Laryngology & Otology, E12, 1 of 3.

doi:10.1017/S0022215108001989

Online Only Clinical Record

Another reason for intra-operative imaging during cochlear implantation

M Viccaro, E De Seta, E Covelli, V Marvaso, R Filipo

Abstract

Objective: We report a case of a rare cochlear implant complication: the introduction of the electrode array into the superior semicircular canal, with intra-operative measurements of neural response reactions suggesting reasonable functioning of the implant.

Case report: A two-year old patient affected by congenital, profound, sensorineural deafness underwent bilateral cochlear implantation at the ENT clinic of the 'La Sapienza' University of Rome. Two Clarion 90k devices were implanted, and electrophysiological and radiological checks were performed. After the introduction of the array in the right side, neural response imaging was performed, and a neural potential was found only on two apical electrodes, at a stimulation intensity of 431 clinical units. The situation differed on the left side, where neural response imaging was present at a stimulation intensity of 300 clinical units on the two electrodes tested (one apical electrode (number three), and one middle electrode (number nine)). Intra-operative radiological assessment with a transorbital plain films was performed as usual in order to assess the position of the electrodes inside the cochlea. This radiography showed the electrode array to be in the superior semicircular canal in the right ear.

Conclusion: Intra-operative monitoring tests during cochlear implant surgery play different roles; measurement of impedances and neural response imaging can evaluate the integrity of implant electrodes and the status of the electrode–cochlea interface, but it must not be the sole way in which correct positioning of the array is confirmed. In our opinion, intra-operative radiological assessment is mandatory during cochlear implant surgery.

Key words: Cochlear Implant; Superior Semicircular Canal; Radiography

Introduction

Cochlear implantation is a safe and reliable treatment procedure for patients with profound sensorineural hearing loss. The cochlear implant is inserted into the scala tympani of the cochlea in order to electrically stimulate residual spiral ganglion cells of the auditory nerve directly. Cochlear implants have shown good results in terms of overall hearing improvement. However, due to the very small distances between the cochlea and adjacent structures, incorrect positioning of the electrode may occur. Major and minor complications related to implantation surgery, and to the implant itself, have been reported in the literature. Misplacement of the device or electrode has been reported in 64 cases, according to the Cochlear Corporation complication data and the Advance Bionics complication database.[1]

We present a paediatric case of bilateral cochlear implantation in which intra-operative electrophysiological measurement of neural response imaging in the right ear showed a response in two channels; however, standard intra-operative radiography assessment showed the electrode array to be located within the right superior semicircular canal.

Case report

Due to an increased number of requests from parents for bilateral cochlear implantation for their children, at the time of writing our institution selected children for bilateral cochlear implantation on the basis of age, body weight and general condition.

A two-year-old child affected by congenital, profound, sensorineural deafness underwent bilateral cochlear implantation at the ENT clinic of the 'La Sapienza' University of Rome. Pre-operative radiological evaluation, including computed tomography (CT) and magnetic resonance imaging (MRI) of the brain and temporal bone, was performed to determine any contraindications for cochlear implantation.

Surgical access to the cochlea was achieved via mastoidectomy, which was kept as small as possible while still enabling a posterior tympanotomy adequate to visualise the anterior edge of the round window niche. Cochleostomy was performed using a Skeeter hand drill (Xomed Medtronic, Gladesville, Australia). Surgical evaluation of the temporal bone and cochlear anatomy correlated well with pre-operative imaging studies, and full electrode insertion was obtained in each side.

Two Clarion 90k devices (Clarion, Advanced Bionics, Sylmar, Ca, USA) were implanted, and electrophysiological and radiological assessments were performed. After the introduction of the array in the right side, neural response imaging was performed. A neural potential was found only on two apical electrodes (numbers three and five), using a stimulation intensity of 431 clinical units (Figure 1). The situation was very different on the left

From the ENT Department, University "La Sapienza" of Rome, Italy.
Accepted for publication: 19 December 2007.

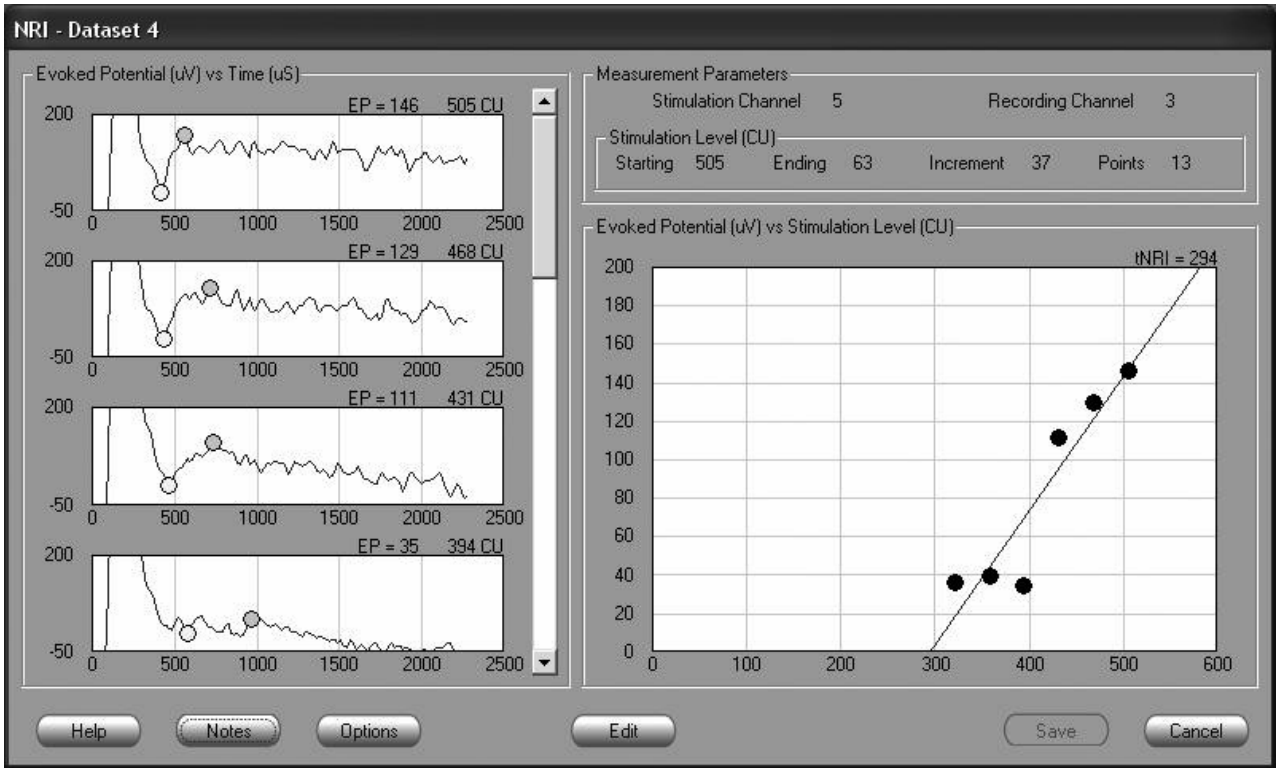

FIG. 1
Neural response imaging on the right side.

FIG. 2
Intra-operative, plain X-ray, showing the cochlear implant array in to the right superior semicircular canal.

side, where neural response imaging at a stimulation intensity of 300 clinical units revealed a neural potential on all two electrodes tested (i.e. one apical electrode (number three) and one middle electrode (number nine)). Intra-operative radiological assessment with a transorbital plain films was performed as usual in order to assess the position of the electrodes within the cochlea. This radiological imaging showed the electrode array in the right ear to be located within the superior semicircular canal (Figure 2).

https://doi.org/10.1017/S0022215108001989 Published online by Cambridge University Press

Discussion

In the literature, incorrect positioning of cochlear implant electrodes has been described recently in otosclerosis patients.[2] However, only one case report has described misdirected implantation of a Softip electrode in the horizontal semicircular canal, with impedances and neural response suggesting reasonable function of the implant.[3]

Intra-operative electrophysiological monitoring and radiological assessment during cochlear implantation surgery play different roles. Measurement of impedances and neural response imaging can evaluate the integrity of implant electrodes and the status of the electrode–cochlea interface. Radiological assessment is useful in order to evaluate the correct positioning of the array, depth of insertion and proximity to the modiolus, and the presence of bending or kinking of the array. While the electrical stimulation of implant channels, and assessment of their responses, can be useful to the surgeon as an indirect indication of electrode positioning, it must not be the sole method of confirming correct positioning of the array.

In our case, the two channels stimulated gave a response with normal morphology and a growing amplitude at high stimulation intensity. The neural response was probably due to a spread of current secondary to the high intensity of stimulation, and was similar to the response observed when the electrode array is correctly placed in the cochlea. Incorrect positioning of the electrode array in the superior semicircular canal was probably due to two, concomitant factors: (1) incorrect inclination of the patient's head on the operating table, and (2) the small dimensions of the cochleostomy, which may not have allowed adequate visualisation of the electrode array into the labyrinth. Intra-operative radiological monitoring revealed the incorrect position of the array. The array was subsequently correctly inserted in the scala tympani and further neural response imaging performed.

Six months after surgery, pure tone, free field audiometry showed an average threshold of 30 dB.

In our opinion, intra-operative radiological assessment is mandatory during cochlear implant surgery if there is any doubt concerning electrode placement,[4] and also to determine the actual location of the array within the cochlea.

References

1 Roland JT. Complication of cochlear implant surgery. In: Waltzman SB, Cohen N, eds. *Cochlear Implants*. New York: Thieme, 2000;170–7
2 Rotteveel LJ, Proops DW, Ramsden RT, Saeed SR, Van Olphen AF, Mylanus EA. Cochlear implantation in 53 patients with otosclerosis: demographics, computed tomographic scanning, surgery, and complications. *Otol Neurotol* 2004;**25**:943–52
3 Tange RA, Grolman W, Maat A. Intracochlear misdirected implantation of a cochlear implant. *Acta Otolaryngol* 2006; **126**:650–2
4 Rosenberg RA, Cohen NL, Reede DL. Radiographic imaging for the cochlear implant. *Ann Otol Rhinol Laryngol* 1987;**96**:300–4

Address for correspondence:
Dr M Viccaro,
University 'La Sapienza' Rome,
Viale dell Universita n 31,
00161 Rome, Italy.

Fax: 06 4454864
E-mail: marikaviccaro@tiscali.it

Dr M Viccaro takes responsibility for the integrity of the content of the paper.
Competing interests: None declared

https://doi.org/10.1017/S0022215108001989 Published online by Cambridge University Press