TABLE 9. DISTRIBUTION OF PATIENTS ACCORDING TO HANDEDNESS

<table>
<thead>
<tr>
<th>Patients</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipsilaterally implanted patients</td>
<td>41</td>
<td>54</td>
</tr>
<tr>
<td>Contralaterally implanted patients</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>Undifferentiated patients</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>76</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

larger response in cortical potential with monaural contralateral stimulation. However, the stimulus was not speech. Histologic studies show that contralateral auditory pathways are more important than ipsilateral pathways, although the distribution is bilateral. Dichotic tests suggest that there is a dominant ear, but there is a lack of data on monaural electrical stimulation.8-10

Our study failed to demonstrate any correlation of laterality with speech discrimination. Therefore, as long as we cannot prove influence of cortical dominance on speech discrimination with the cochlear implant, we cannot consider it as a parameter of choice for the side to be implanted. Nevertheless, daily use of the device will be easier if it is located on the same side as the dominant hand. Therefore, acknowledgment of handedness laterality may help the surgeon to choose the implantation side, more for a practical reason than for audiologic benefits.

CONCLUSION

Choice of the side to be implanted should take into account peripheral factors and central factors. Peripheral factors to consider are the anatomic situation of the cochlea (degree of cochlear ossification), the shorter duration of deafness, and the higher preoperative dynamic range on the promontory test (degree of response on the promontory test); according to these peripheral factors, the best ear should be chosen for implantation. When both ears are identical, handedness laterality of the patient was not a significantly correlated factor, but can guide the side of implantation at least for a practical reason. Further studies about cerebral dominance influence in speech discrimination with the cochlear implant should help in the choice of the side to be implanted.

CHRONIC MIDDLE EAR DISEASE AND COCHLEAR IMPLANTATION

M. J. DONNELLY, MB, FRCSI; B. C. PYMAN, DLO, FRACS; G. M. CLARK, PhD, FRACS

INTRODUCTION

Profound or total hearing loss can occur in the setting of chronic suppurative otitis media (CSOM), either coincidentally or secondarily to the disease process. Obviously, inserting a foreign body through a potentially infected field into a space that communicates intracranially presents a challenging management problem.

This paper presents the experience from the Melbourne Cochlear Implant Clinic (CIC) in implanting patients with bilateral CSOM. This is certainly not a common problem, as there have been only 3 cases from 121 implanted adults. However, we feel that it is an important issue with potentially devastating consequences. In addition, there are many countries in which bilateral CSOM is a more common problem and cause of profound or total hearing loss.

CASE REPORTS

Case 1. A 49-year-old woman presented to the CIC with a...
long history of bilateral CSOM and progressive sensorineural hearing loss that was profound on presentation. A number of previous operations had been carried out in an attempt to close perforations of her tympanic membranes, resulting in residual dry perforations and a left facial paralysis. After the standard selection procedure, the left ear was chosen for implantation. To prepare the ear for implantation, a cortical mastoidectomy was performed with an underlay temporalis fascia graft. During the procedure, brown fluid was noted in the attic region; otherwise, there was no significant mucosal disease. Cochlear implantation was carried out 6 months later with an intact tympanic membrane and healthy middle ear and mastoid system. The patient performed very well with the implant, having Central Institute for the Deaf (CID) open-set sentence scores of 90% to 100% for 2 years. Subsequently, she developed episodes of dizziness associated with distortion of sound. A computed tomography (CT) scan showed a soft tissue swelling in the mastoid system. Exploratory surgery was performed, during which granulation tissue was found in the mastoid cavity, and it was decided to convert the cavity to a modified radical mastoidectomy. The dizziness settled, hearing returned, and all remained well for a further 3 years, until a cystic swelling developed behind the ear, resulting in wound breakdown. At surgery, a mucosal cyst was found and removed, the implant re-sited, and the wound closed. There have been a number of episodes of discharge from the mastoid cavity associated with muffling of sounds heard. However, these settle with local toilet and topical and systemic antibiotics. Currently, the mastoid cavity is dry and the CID scores are over 90%.

**Case 2.** A 54-year-old man presented to the CIC with a history since childhood of bilateral CSOM (noncholesteatomatous). Previous surgery in the left ear failed to control the disease and may have contributed to the total hearing loss in that ear. There had been no previous surgery in the right ear, which had a profound hearing loss. On presentation he had a discharging central perforation of the right ear and a moist left mastoid cavity. After the usual selection procedure the right ear was chosen for implantation. A cortical mastoidectomy with an underlay temporalis fascia graft was performed to provide a sealed sterile middle ear for implantation. Implantation was carried out 6 months later, during which the mastoid and middle ear looked healthy. Performance scores on Bamford-Kowal-Bench (BKB) sentences were good, ranging from 55% to 68%. One year after implantation, the ear was discharging, and although a CT scan did not reveal evidence of middle ear disease, a perforation was subsequently found and successfully grafted. At present, 2 years postimplantation, the patient has been relatively trouble-free, with intermittent myringitis and BKB sentence scores in the mid-60% region.

**Case 3.** A 72-year-old woman presented to the CIC again with long-standing bilateral CSOM. Hearing loss had been progressive, with no measurable hearing for 10 years. No previous ear surgery had been performed, and when seen in the clinic, the patient had bilateral moist central perforations. This woman also had significant visual disability secondary to glaucoma and was unable to lip-read. After the standard workup, it was decided to offer a left implant. A cortical mastoidectomy with an underlay temporalis fascia graft was carried out, at which mild mucosal disease was found. Implantation was carried out after 6 months with an intact tympanic membrane and a healthy middle ear and mastoid system. She was delighted with the result, having CID sentence scores of 75%. Two years after implantation there was a discharge from the implanted ear and episodes of ataxia, and the implant was providing much less benefit. A CT scan showed soft tissue in the middle ear, and despite appropriate systemic antibiotics, there was no improvement. Exploration of the ear was carried out and granulation tissue was found in the middle ear, and it was decided to perform a modified radical mastoidectomy. There was some return of useful hearing and resolution of dizziness. However, 2 months later the ataxia returned with facial nerve stimulation, requiring switching off of channels 15 through 19. At this stage the patient was receiving no useful information from the implant. It was also noted that both threshold and comfort stimulus levels had been steadily rising, particularly for the apical electrodes. Computed tomography scans and three-dimensional reconstruction of these scans using an in-house program suggested that the otic capsule had broken down, with soft tissue continuity between the cochlea and middle ear. Further exploratory surgery was undertaken, and profuse granulation tissue was found in the middle ear with extension through the cochleostomy. The implant was removed (this had been discussed with the patient prior to surgery) and the promontory uncapped. A radical mastoidectomy was performed and a pedicled temporalis fascia flap was used to protect the otic capsule. At present the cavity is dry, the ataxia has settled completely, and the patient is anxious for another implant.

**DISCUSSION**

Contraindications to cochlear implantation have included chronic middle ear sepsis. Cholesteatoma-unsafe CSOM obviously requires surgical management to render a safe ear, which in the majority of cases required the creation of a modified radical mastoid cavity. Various surgical strategies for cochlear implantation in mastoid cavities have been described. With noncholesteatomatous CSOM, so-called safe disease, there is a temptation to be less aggressive in the preparation of the ear for implantation. However, it is essential to remove all risk of recurrence of middle ear sepsis before implantation. As our cases have demonstrated, the conventional approach to eradication of chronic middle ear disease, including tympanomastoidectomy, is not guaranteed to achieve this. Of particular note was the apparent absence of mastoid or middle ear disease at the time of implantation, which was 6 months after preparatory surgery. Chronic suppurative otitis media did not recur for at least 1 year postimplantation. This gave a false sense of security that the CSOM had been completely eradicated.

With a cochlear implant in situ there is a potential route for spread of middle ear sepsis intracranially. As can be seen from case 3, this is more than a theoretic risk. We would therefore recommend that "safe" CSOM should not be regarded as such, and that it should be managed aggressively before cochlear implantation. Irving and Gray described an obliteration technique for "safe" CSOM 3 to 6 months prior to cochlear implantation. This is an extensive procedure involv-
ing creating a radical mastoid cavity, obliteration of the eustachian tube, obliteration of the mastoid cavity with free abdominal fat, and permanent closure of the external ear canal. This technique has been evaluated for a period of less than 1 year, but seems to offer a real potential of disease eradication. In addition to this procedure, a device for sealing the cochlea at the point of entry of the electrode to prevent intracochlear spread of infection is another consideration. Such a sealing device has already been suggested for cochlear implantation in young children.3

SUMMARY

We have presented three patients with bilateral CSOM who were otherwise suitable for cochlear implantation. These patients had conventional surgical management of CSOM and were implanted after a period of 6 months through apparently healthy middle ears. However, all three had a recurrence of middle ear disease requiring further surgery, and one had a potentially life-threatening complication necessitating removal of the implant. Before considering cochlear implantation in patients with bilateral CSOM, it is essential to eradicate all disease, and radical mastoidectomy with obliteration may be necessary. The use of a cochlear sealing device may further ensure prevention of infection spreading into the cochlea.

REFERENCES


SURGICAL CONSIDERATIONS FOR THE PLACEMENT OF THE NEW COCHLEAR PTY LIMITED MICRO-MULTIPLE-CHANNEL COCHLEAR IMPLANT FOR RESEARCH STUDIES

G. M. CLARK, PhD, FRACS; B. C. PYMAN, DLO, FRACS; R. L. WEBB, DLO, FRACS

From the Human Communication Research Centre and the Department of Otolaryngology, University of Melbourne, The Bionic Ear Institute, and the Cooperative Research Centre for Cochlear Implant, Speech and Hearing Research, Melbourne, Australia.

A new micro-receiver-stimulator for research studies on very young children as well as adults has been developed by Cochlear Pty Limited (Figs 1 and 2). The dimensions of the device (Fig 2) are length 58 mm and width at front 18 mm. The width starts to increase 19 mm from the front, and the back section, which has the receiver coil and magnet, has a maximum diameter of 33 mm. The depth or thickness of the front portion of the electronic package is 5.7 mm, and the remainder of the package 4.0 mm. The antenna section is 3.5 mm thick. The other dimensions of the front section of the electronic package are length 9.5 mm and width 13.7 mm. There is an angle of 160° between the titanium electronic package and the receiver coil. The dimensions of the receiver-stimulator were arrived at after anatomic studies on the temporal bones of children ranging in age from 2 to 11 months (Pyman and Clark, this suppl, this section).

The prosthesis has been initially implanted in five adults for research studies (four at the Royal Victorian Eye and Ear Hospital, Melbourne, and one at the Royal Prince Alfred Hospital, Sydney).

As the new micro-implant has a longer and wider receiver
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Author/s:
Donnelly, M. J.; Pyman, B. C.; Clark, Graeme M.

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