Cochlear Implantation in a Residency Training Program: the Kaiser Oakland Experience

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ABSTRACT

Objectives: To assess the complications of cochlear implantation and determine whether resident physicians can perform this procedure safely.

Study Design: Retrospective chart review of consecutive cochlear implant recipients who underwent primary cochlear implantation performed with extensive resident surgeon involvement between January 1, 2005 and April 30, 2012.

Patients: One hundred and fifty-nine adults and children who collectively underwent a total of 194 primary cochlear implant operations (n=194).

Main Outcome Measures: Complications after cochlear implantation were classified into major and minor categories. Minor complications included those that either resolved spontaneously or with conservative management. Major complications were defined as those requiring further surgery or hospitalization. Spontaneous failures of internal devices were reported separately.

Results: The overall complication rate was 11.3% (22 of 194 cochlear implant cases). Minor complications occurred in 14 cases (7.2%). These included wound infection, dehiscence, hematoma formation, delayed facial paresis, and non-auditory stimulation. Major complications were present in 8 cases (4.1%). These involved implant malposition or migration, incorrect device implantation, flap-related problems, chronic infection with cholesteatoma, and severe vertigo requiring hospitalization. One of the 8 patients experienced a major complication requiring device explantation. There were no postoperative deaths, cases of meningitis, or persistent facial nerve palsies in this series. Device failures occurred in 4 cases (2.1%).

Conclusions: The rate of complications is comparable to those published by other institutions. Residents can safely and successfully perform cochlear implant surgery with close supervision.

INTRODUCTION

Cochlear implantation (CI) is a relative safe procedure. However, as with any surgical procedure, a subset of patients experience postoperative complications. These can be related to the operative approach, injury to surrounding structures, implantation of a foreign body, or functional problems with the implanted device. Given that CI is a technically challenging surgery, concerns exist regarding patient safety early in a surgeon’s career. This study was undertaken to examine the complication rates of CIs in our residency training program. At our institution, residents are integrally involved in these cases as early as their second year of training. Their level of participation is graduated. They receive more step-by-step instruction from the attending supervisor. As a resident becomes more experienced, the attending allows the resident more freedom and opportunity to perform the surgery until he or she asks for help or the attending deems the course of the operation needs to be redirected. At this level, residents can complete the operation from start to finish including the key aspects such as drilling the facial recess, creating a cochleostomy, and inserting the electrode array into the scala tympani.

METHODS AND MATERIALS

Patients

A retrospective analysis of medical records of all patients who had undergone CI between January 2005 and April 2012 was performed. Cases performed with resident surgeons and with full medical records were included. Altogether, 159 patients were included in the study. The patient demographics are summarized in Table 1. The average duration of follow-up was 3.09 years (median follow-up, 3.08 years; range, 0.08 to 7.25 years). See Figure 1 for duration of follow-up. Figure 2 shows the number of implants performed each year at our institution during the study period.

Implanted devices

Devices implanted at our institution were predominantly Advanced Bionics. The devices used are shown in Table 2.

Surgical technique

Cases were performed with the supervision of 5 different surgeons. Implantation was via a retro auricular incision. A bony well as drilled into the calvarium to place the device. Residents can safely and successfully perform this approach, and the key aspects such as drilling the facial recess, creating a cochleostomy, and inserting the electrode array into the scala tympani. Residents can safely and successfully perform this approach, and the key aspects such as drilling the facial recess, creating a cochleostomy, and inserting the electrode array into the scala tympani.

Outcome measurements

Complications were identified as major and minor. Major complications were defined as those requiring additional surgery and/or hospitalization for treatment. This included implant malposition or migration, delayed facial nerve injury, cholesteatoma, CSF leakage, meningitis, severe wound infection, and severe vertigo. Minor complications were those that could either be treated with conservative management or resolved spontaneously. This included transient facial palsy, non-auditory stimulation, scalp hematoma, and wound infection or dehiscence that resolved without surgery. Device failure was not considered as a complication, but detailed separately.

RESULTS

The incidence of complications was 11.3% of cases. Major complications occurred in 4.1%. See Table 3 for a full list of complications.

Major complications

Eight patients had major complications. There were no postoperative deaths, meningitis, or persistent facial palsies in this series. Three complications were recognized at the time of implant activation in which limited or no auditory stimulation was recognized. In each of these cases the electrodes were determined to be outside of the cochlea despite straightening insertions. There was one partial extrusion of the electrode array.

One major complication involved a boy who returned to the OR after 4 weeks of persistent scalp fluctuence. He underwent an exam under anesthesia and a seoma was not present.

One complication resulted in device explantation. The patient was a boy with CHARGE syndrome who had multiple congenital malformations of the ear. Post-operatively, he developed multiple ear infections, ultimately leading to device explantation.

One patient who had bilateral simultaneous implants was hospitalized for severe vertigo. She was diagnosed with labyrinthitis and resolved successfully with steroids and antibiotics.

One complication did not require re-hospitalization or re-operation, but was deemed major. The patient accidentally received an Advanced Bionics device in lieu of his expected Nucleus type.

Minor complications

The total number of minor medical and surgical complications was 14. Most were related to the scalp flap. There were 2 hematomas, 1 wound dehiscence, and 2 wound infections that all resolved with conservative measures. One patient got a forehead ulcer due to a dressing placed too tightly. Four patients developed delayed facial palsy that manifested 1 to 4 weeks after surgery. All had gradual improvement to near-complete or complete recovery. None of these facial nerve stimulations initially occurred in 3 patients. One had previously received a fenestration procedure for otosclerosis in one ear developed vestibular hypofunction after undergoing CI on the other side.

DISCUSSION

CI has been shown to be a safe and effective procedure for the profoundly deafened patient. As with other surgical interventions it is important to properly evaluate potential areas of difficulty in order to develop protocols to further diminish complications. To our knowledge, this study represents the largest single-center review of CI complications in a residency training program that reaffirms the notable safety profile of implant operations.

The rate of total complications in this series was 11.3%. This figure is in keeping with previous studies that have quoted complication rates ranging from 9.9 to 42%. Major complications occurred in 16% of cases in this study. This compares well with prior series with reported rates between 2.3 and 6.3%. See Table 4 for a comparison of complications among previously published literature.

Previous studies have shown the majority of surgical complications are flap-related. In this series, there were 6 patients who had flap-related problems.

Non-auditory stimulation occurs when electrical current from the implant electrode spreads from the cochlea and causes stimulation of surrounding structures. It usually manifests as facial nerve stimulation or pain in the throat or ear. Rogue electrodes in the apical segment are associated with facial nerve stimulation and rogue basal electrodes with pain. Three patients in the present series had non-auditory stimulation. Two cases resulted in facial stimulation that resolved after reducing current levels on rogue electrodes and altering the current strategy. Vestibular stimulation causing nystagmus occurred in 1 patient. He became a temporary non-user until device reprogramming minimized the problem enough that he was able to continue using the device.

CONCLUSIONS

As with all surgical procedures, complications are inevitable with CI. Complications rates with resident involvement do not appear to increase the rate of complications. The overall incidence of major and minor complications is low and most minor complications can be effectively managed with conservative measures.

Residents can safely and successfully perform cochlear implant surgery in carefully structured and supervised training programs. Gaining experience during residency training with the close supervision of more experienced surgeons enables residents to become proficient ear surgeons.

REFERENCES