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Early complications following cochlear implantation in children and their management

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ABSTRACT

Objectives: To report the early postoperative complications of cochlear implantation (CI) in the pediatric population and discuss the intervention measures.
Methods: We retrospectively analyzed 260 consecutive pediatric cochlear implantations performed at the First Affiliated Hospital of Zhengzhou University between March 2010 and July 2013. All patients were younger than 12 years old at the time of implantation, with a mean age of 4.3 years, and 47 cases had inner ear malformations. Complications correlated to age at CI and inner ear malformations were analyzed using the χ^2 test.
Results: Of the 260 patients, early postoperative complications were observed in 17 (6.54%) cases, of which 16 (6.15%) were minor and one (0.38%) was major, none required surgical device removal or reimplantation. Among the 16 minor complications, transient vertigo was the most common (nine cases, 3.46%), three (1.15%) of them with severe CSF gusher during the surgery; followed by transient facial nerve palsy (two cases, 0.77%, both were reversible); external auditory canal injury, subcutaneous hematoma each in two cases (0.77%), and minor dural injury in one case (0.38%). One major complication included an epidural hematoma in a 7-year-old boy who recovered completely without any neurologic deficits following immediate evacuation. Inner ear malformations were significantly associated with the surgical complications, especially vertigo and gusher ($P < 0.05$).
Conclusions: Cochlear implantation in children is fairly a safe procedure with a relatively low complication rate. The most common early postoperative complications are minor, but serious and life threatening complications rarely may occur. Awareness of complications helps clinicians to adopt the specific preventive measures and immediate interventions so that the outcome will be successful.

1. Introduction

Cochlear implantation (CI) is increasingly being performed in many hospitals in recent years. Various medical, surgical, or device related complications due to this surgical intervention have been reported [1–6] and classified further as early vs. late and major vs. minor [1,3–6]. Early complications refer to those occurring during the week after surgery [3]. The minor complications are those that can be resolved either spontaneously or with conservative treatment and the major complications are those that require hospital admission, surgery and later re-intervention [1–4].

The multicenter surveys indicate that the most prevalent complications are due to the device failure, including flap or magnet problems [2–6]. Cullen et al. [6] reviewed 107 cases of revision cochlear implant out of 952 pediatric CI operations and identified hard and soft device failure in 61% ($n = 65$) and medical/surgical causes responsible for failure only in 37% ($n = 40$). The early postoperative complications are generally associated with the surgery and could be avoided or minimized if surgeons had a higher level of awareness. As the symptoms develop soon after the operation, timely identification of the complication may avoid any subsequent problems. Cochlear implantation in children presents several additional challenges such as the high percentage of inner ear malformations and the thin nature of skull or scalp flap. Epidural hematoma (rarely) may complicate the surgery, but needs an immediate intervention. Therefore, specific preventive management strategies and good vigilance are required in the early postoperative period.

This study aims to share our cumulative experience on a series of early postoperative complications following CI in the pediatric population. All the early complications and treatments were systematically summarized. In addition, a first case of epidural hematoma following cochlear implantation in China is presented and discussed.

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2. Materials and methods

2.1. Patients

This retrospective study included 260 unilateral cochlear implants performed between March 2010 and July 2013 in children younger than 12 years old (mean age at CI, 4.3 years). Written informed consent was obtained from the family for publication of the case and any accompanying images.

2.2. Implanted devices (Fig. 1)

Implanted cochlear devices included Med-El Combi 40+ ($n = 16$), Med-El Sonata ($n = 22$), Med-El Pulsar ($n = 11$), Nucleus CI 24 M ($n = 13$), Nucleus CI24RE(CA) ($n = 167$), and Advanced Bionics HiRes 90K ($n = 31$). All Med-El devices were manufactured by Medel Corp., Innsbruck, Austria; Nucleus devices were manufactured by Cochlear Corp., Lane Cove, Australia; Clarion devices were manufactured by Advanced Bionics, Sylmar, CA, USA. Of the total implants, 154 Nucleus CI24RE(CA) and 31 Advanced Bionics HiRes 90K implants were funded by the National Cochlear Implant Program and the rest were chosen by parents of the children.

2.3. Surgical technique

All cochlear devices were implanted by the same group of surgeons (Zhaobing Qin. MD, PhD and her team). An updated surgical procedure with a small incision was performed. A bony seat was drilled into the skull bone to place the receiver/stimulator. The bone in the periphery of the seat was drilled to the level of dura, creating a central island of bone if necessary to facilitate proper inset of the receiver. Electrode insertion into the scala tympani was achieved either through the round window or through a cochleostomy created immediately anterior-inferior to the round window. Then small pieces of temporalis muscle fascia were placed to seal the cochleostomy. The intra-operative neural response threshold and stapedial reflex were tested depending on the device type. Following surgery, patients were transferred back to the unit for close monitoring of vital signs, level of consciousness, pupil size and light reflex, and wound dressings. An X-ray was performed to verify the position of electrode array prior to discharge. Intravenous antibiotic prophylaxis was started prior to skin incision and continued until three to seven days. Following discharge, children were seen at the outpatient department one week later for general examination and at one month for the first activation of the cochlear implant.

3. Results

Age and gender of the 260 children used this study are shown in Fig. 2. Congenital inner ear malformations were present in 47 cases: bilateral enlarged vestibular aqueduct (EVA) in 27 cases; bilateral incomplete partition type II (IP-II, Mondini deformity) accompanied by EVA in 16 cases, vestibule and lateral semicircular canal dysplasia in three cases and unilateral IP-II combined with contralateral incomplete partition type I (IP-I) deformity in one case. The cochlear implant surgery was successful in all 260 cases; normal electronic cochlear implant function was confirmed, the electrodes and implant devices were verified to be in proper position by skull radiography. Early complications were observed in 17 (6.54%) cases, minor complications occurred in 16 (6.15%) cases, and one case had a major complication. Among minor complications, transient vertigo was the most common, which was observed in nine cases (3.46%); three of them (1.15%) had severe cerebrospinal fluid (CSF) gusher during the surgery. Other minor complications included temporary facial nerve palsy in two cases (0.77%) that were reversible, external auditory canal injury in two cases (0.77%), and minor dural injury in one case (0.38%) case. Inner ear malformations, mainly IP-II and/or EVA were encountered in 47 cases during cochlear implantation, and Table 1 shows early complications of cochlear implants among different age group and those with or without inner ear anomaly. Inner ear malformations were significantly correlated with the surgical complications, especially vertigo and gusher ($P < 0.05$) (Table 1). Young age ($\leq$3 years) at CI was not correlated with the surgical complications ($P > 0.05$). None required re-implantation surgery.

3.1. Minor complications

The symptoms of all nine patients who had vertigo manifested within the first postoperative day were resolved using medical treatment (e.g., steroids and vasodilators). Severe CSF gusher during the surgery was observed in three patients with IP-II deformity. The cochleostomy was sealed by carefully placing small pieces of temporalis muscle fascia. Intravenous hyperosmolar solution (mannitol) was given for three to five days. Patients were discharged without any sign of CSF rhinorrhea.

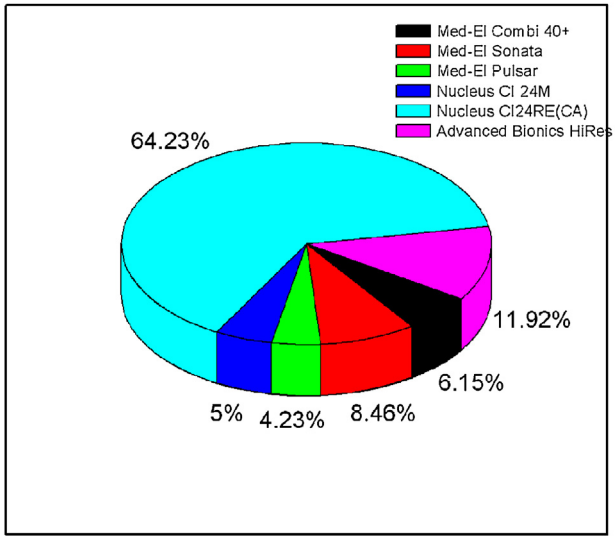

Fig. 1. Distribution of the types of implanted cochlear devices.

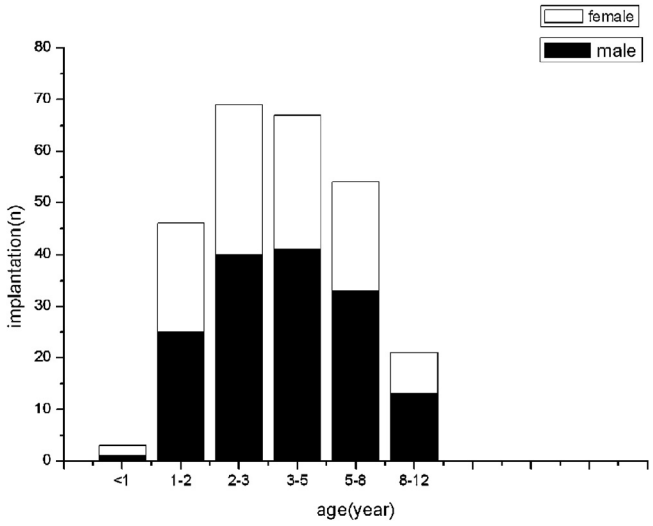

Fig. 2. Age and gender distribution of the study population.