

Original Research Article


# Anesthetic management of Pediatric cochlear implantation in a tertiary care centre

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## Abstract

**Background:** Cochlear implantation has been evolved as the management of choice in patients with bilateral severe to profound sensorineural hearing loss in both children and the elderly population. Children who undergo cochlear implantation early in life, followed by appropriate rehabilitation have improved communication and learning skills.

**Aim of the study:** In this study, we review the anesthetic management of seven cases of pediatric cochlear implantation done in our institution in the last one year.

**Materials and methods:** Randomized control study was done at Government Stanley Medical College Hospital, Chennai, Tamil Nadu (January 2018). Intraoperative facial nerve integrity testing was not done for any of our cases. The nasopharyngeal temperature was monitored. To prevent hypothermia, forced air warmer was used. In our institution, stimulation techniques to identify facial nerve were not used for any of the cases. The intraoperative period was uneventful in all cases. Hemodynamics was maintained in all the cases in order to provide a bloodless surgical field.

**Results:** No patients had emergence agitation. Post-operative analgesia was achieved with paracetamol rectal suppositories. No children had postoperative shivering. All children were followed up after discharge for stimulation of electrodes and speech therapy. Presence of mental retardation should be assessed as it may be associated with a retrocochlear hearing loss. Counseling was an important part of the pre-operative period to improve the outcome.

**Conclusion:** Cochlear implantation is a specialized surgery and anesthesiologist's awareness of the pitfalls and resourcefulness in dealing with communication impaired, pediatric age group makes the task challenging. The procedure itself has no significant anesthetic complications provided a thorough preoperative evaluation and good conduct of anesthesia is done.

## Key words

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Cochlear implantation, Pediatric, Anesthesia, Sensorineural hearing loss.

## Introduction

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A cochlear implantation is an expensive computerized electronic device that transforms various forms of sound energy into electrical signals which are used to stimulate the intact auditory nerve of the inner ear [1]. Cochlear implants are used to restore hearing in patients with bilateral severe sensorineural hearing loss and deaf-mutism in order to improve communication abilities [2]. The operative technique is complex, time-consuming and involves placement of the internal compressor assembly within the mastoid antrum and connecting the electrodes to the cochlear neurons [3]. The functional integrity of the facial nerve and the cochlear nerve is to be preserved during the procedure [4]. This surgery requires a team approach, with the crucial role of anesthesiologists in providing a bloodless surgical field use of nerve stimulators to assess facial nerve integrity and to treat postoperative complications. Co-existing conditions like congenital anomalies, genetic syndromes, airway abnormalities, and respiratory tract infections have a significant impact on anesthetic management [5]. With the pediatric age group being the most common candidates for cochlear implantation, difficulty in obtaining intravenous access, differences in airway anatomy, congenital anomalies, postoperative nausea and vomiting and high incidence of respiratory complications make the pediatric cochlear implantation more challenging [6].

## Materials and methods

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Randomized control study was done at Government Stanley Medical College Hospital, Chennai, Tamil Nadu (January 2018). Intraoperative facial nerve integrity testing was not done for any of our cases. The nasopharyngeal temperature was monitored. To prevent hypothermia, forced air warmer was used. In our institution, stimulation techniques to identify facial nerve were not used for any of the

cases. The intraoperative period was uneventful in all cases. Hemodynamics was maintained in all the cases in order to provide a bloodless surgical field. Seven children with severe to profound sensorineural hearing loss and deaf-mutism were evaluated with auditory evoked responses, electrocochleography, and radiographic imaging and selected for cochlear implantation. Preoperatively the patients were screened for the presence of genetic syndromes, congenital anomalies including cardiac defects and airway abnormalities, QT prolongation, anemia. A good rapport was established with the children preoperatively to allay anxiety and all the parents were counseled about the anesthetic procedure. Patient demographics were listed in **Table - 1**. General anesthesia with endotracheal intubation and controlled ventilation with Jackson Rees circuit was the anesthetic plan in all the cases. An intravenous induction technique and maintenance with volatile anesthetic agents was done for all the cases. The anesthetic procedure done was as follows. After obtaining informed written consent from the parents, the child was shifted to OT and intravenous access was done with a 22 gauge intravenous cannula. 1% dextrose in Ringer lactate infusion was started. NIBP, ECG, pulse oximeter was connected. Premedication was done with Inj. Glycopyrrolate 4 mcg/kg IV, Inj. Midazolam 0.05 mg/kg IV and Inj. Fentanyl 2 mcg/kg IV. Preoxygenation was done with 8 liters of 100 % oxygen for 3 minutes. Anesthesia was induced with Inj. Thiopentone 5 mg/kg IV and intubation were facilitated with the bolus dose of Inj. Atracurium at 0.5 mg/kg IV. Endotracheal intubation was done with Macintosh Laryngoscope and placement was confirmed with capnography. Anesthesia was maintained with Oxygen, Nitrous oxide, Sevoflurane and intermittent maintenance doses of atracurium at 0.01 mg/kg. Inj. Dexamethasone was given in the dose of 0.15 mg/kg. Intra-operative facial nerve integrity testing was not done for any of our

cases. The nasopharyngeal temperature was monitored. To prevent hypothermia, forced air warmer was used. In our institution, stimulation techniques to identify facial nerve were not used for any of the cases. The intraoperative period was uneventful in all cases. Hemodynamics was maintained in all the cases in order to provide a bloodless surgical field. At the end of the procedure, reversal was done with Inj. Neostigmine 0.05 mg/kg IV and Inj. Glycopyrrolate 10 mcg/kg. Inj. Ondansetron 0.1 mg/kg was given at the end of the procedure to prevent postoperative nausea and vomiting. No patients had emergence agitation. Postoperative analgesia was achieved with paracetamol rectal suppositories. No children had postoperative shivering. All children were followed up after discharge for stimulation of electrodes and speech therapy [8, 9].

## Results

**Table - 1** shows that there was no significant blood loss from the procedure itself but sometimes bleeding can occur from large non-collapsible mastoid emissary veins [12]. It is essential to provide a bloodless surgical field, especially during implantations by providing a good plane of anesthesia and adequate analgesia. Fluid management was usually done with crystalloid infusions. Extubation should be done in the lateral position and smooth recovery is ensured in order to prevent agitation. The incidence of PONV was as high as 40 – 50 % in middle ear surgeries. Inj. Ondansetron at a dose of 0.1 mg/kg was used for prevention and treatment of PONV. Other measures to prevent PONV include adequate anxiolysis preoperatively, avoidance of nitrous oxide and a total intravenous anesthesia technique with propofol infusion [13]. Use of dexamethasone 0.15 mg/kg at the beginning of surgery also prevents PONV [14].

**Table - 2** shows that these children should also be evaluated for the presence of congenital cataract which should be corrected before surgery to facilitate rehabilitation. Presence of

mental retardation should be assessed as it may be associated with a retrocochlear hearing loss. Counselling was an important part of the pre-operative period to improve outcome. It was essential to establish a good rapport with the children and the parents in the postoperative visit to allay anxiety. Objective assessment of hearing should be done with evoked potentials and electrocochleography, radiological assessment to evaluate the integrity of temporal bone and to rule out infections should be done preoperatively.

## Discussion

Cochlear implantation for both children and adults has become established as a means of auditory rehabilitation. The cochlear implant (CI) is a surgically implanted neurostimulator which is suitable for patients who have a bilateral severe/profound sensorineural hearing loss who gain limited benefit from optimal acoustic hearing aids [10]. In most cases, this deafness is a result of damage to the sensory structures within the cochlea. A cochlear implant will bypass these damaged structures and electrically stimulate the auditory nerve directly, thereby restoring a perception of sound to the patient [11]. Due to advancement in screening and diagnosing hearing problems, more number of young children often comes for early surgery for cochlear implantation. There is evidence suggesting that early bilateral cochlear implant surgery in children less than 12 months of age results in better auditory rehabilitation. A multidisciplinary approach involving pediatric anesthesiologist is essential for a positive outcome as studies in cochlear implant surgeries in infants have shown the age of the patient and experience and the skills of the anesthesiologist to be important risk factors [12]. Due to deterioration in the quality of life brought about by hearing impairment, many of the older population is now resorting towards more sophisticated cochlear implant devices. This is also due to noncompliance with the various hearing aids available [13]. But the cochlear implant surgery is less commonly performed in elderly patients due to the presence of coexisting

systemic diseases which increase the anesthetic complications postoperatively [14]. Recent evidence, however, suggests that the incidence of such complications in elderly patients is minimal and can easily be managed. Cochlear implantation with perianal electrode technique and transcanal cochlear implantation can be performed under local anesthesia with monitored anesthesia care in high-risk elderly patients [15]. However, special precautions have to be exercised in a few selected patients who may either be taking alternative medicines or may have potential contagious diseases like hepatitis or acquired immunodeficiency syndrome (AIDS). Although children implanted in the younger group (<12 months) and the older group (12–36 months) had similar preoperative hearing thresholds, the cause of hearing loss was variable and often unknown. It is likely that some children had hearing at birth and, therefore, more access to sound before CI. An earlier residual hearing would more likely advantage those in the

older group [16]. However, the children implanted below 12 months developed auditory skills more rapidly and were more likely to develop oral-only communication. Comparisons using the level of speech perception ability were not possible in this study due to the young ages and range of developmental status which required clinical use of different test measures and procedures [17]. This is a significant limitation of the study as achieving a low but greater than zero level on a test can represent a considerable difference in ability from achieving a score near the high end of a test. In addition, only information regarding communication mode(s) rather than comprehensive information about receptive and expressive language, at last, follow up was available [18]. We also note that there may be unknown differences such as parenting and socioeconomic status between children who receive an implant under age 12 months and those who do not, that might influence performance outcome [19, 20].

**Table – 1:** Patient demographics details with hemodynamic changes and postoperative complications.

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Age(years)	3	3	3	3	3	3	3
Sex	Male	Male	Male	Male	Female	Female	Male
Weight (Kg)	12	14	13	12	14	11	12
R/L							
Duration of the procedure (hours)	2 hrs 30 min	2 hrs 15 min	2 hrs 30 min	2 hrs	2 hr 30 min	2 hr 20 min	2 hrs 15 min
Cardiac anomalies/QT prolongation	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Intraoperative hemodynamics (Mean Arterial Pressure / Heart Rate)	79-95 mmHg & 94-128 /min	83-101 mmHg & 100-123 /min	81-112 mmHg & 103-133 /min	85-97 mmHg & 95-120 /min	83-117 mmHg & 105-135 /min	74-93 mmHg & 96-128 /min	80-107 mmHg & 102-125 /min
Emergence Delirium	Nil	Nil	Nil	Nil	Nil	Nil	Nil
PONV	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Postoperative Shivering	Nil	Nil	Nil	Nil	Nil	Nil	Nil

**Table - 2:** Congenital syndromes associated with deaf-mutism and its anaesthetic implications.

Syndromes	Anesthetic implications
Treacher Collins syndrome	Facial dysplasia can lead to difficulty in airway management
Klippel Fiel anomaly	The fusion of cervical vertebrae leads to restricted neck movements and difficult intubation
Pendred syndrome	Metabolic derangements involving goiter and hypothyroidism
Alport syndrome	Renal and endocrine abnormalities
Jervell and Lange Neilsen syndrome	Prolonged QT interval, risk of ventricular arrhythmia, and history of syncopal attacks, hypoglycemic episodes

### Conclusion

Cochlear implantation is a specialized surgery and anaesthesiologist's awareness of the pitfalls and resourcefulness in dealing with communication impaired, pediatric age group makes the task challenging. The procedure itself has no significant anesthetic complications provided a thorough preoperative evaluation and good conduct of anesthesia is done. Close communication between the surgeon and the anaesthesiologists throughout the perioperative period is essential for a positive outcome in these children.

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