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ANESTHESIA FOR COCHLEAR IMPLANT

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Abstract : Cochlear implant is now an acceptable alternative for patients with childhood sensory neural deafness. Role of anesthesiologist is crucial for the successful outcome of the surgery. Here, we present a 6 year old child posted for cochlear implant surgery and its anesthetic management.
Keyword : Anesthesia technique- Cochlear implant-Deaf-mutism

COCHLEAR IMPLANT
INTRODUCTION:
Cochlear implantation is effective in treating patients with irreversible hearing loss and deafmutism. It improves the quality of life and enables the child to acquire learning skills.
CASE REPORT:
A 6 year old male child admitted with complaints of inability to speak and respond to sound since childhood. Patient's peri-natal history was uneventful. Developmental milestones were normal except for inability to speak and respond to sound. There was no history of consanguinity and no history of similar illness in the family. No history of any congenital abnormality & birth defects. Preoperative assessment revealed no abnormalities. All investigations were within normal limits. Mallampati score was MMS I.
MONITORS - ECG, NIBP, SPO2, Temperature, Precordial Stethoscope. A vein in the dorsum of left hand cannulated with 22G IV cannula. Premedicated with Inj. atropine 0.2mg, Inj. Midazolam 0.5mg,Inj. Fentanyl 30mcg. Induced with Inj.Propofol 40mg,Inj. Atracurium 7.5mg , intubated with 5.5 size E.T tube & anesthesia maintained with O2:N2O(1: 2) with sevoflurane 1-2%. Patient's body was adequately covered with warm blankets to prevent hypothermia. Intraoperative vitals were stable Following post-auricular incision, sub-periosteal flaps elevated, mastoid bone drilled to gain access to the basal turn of the cochlea and cochlear implant was inserted via cochleostomy. Electro diathermy was switched off just before the placement of cochlear implant. Muscle relaxant was withheld, volatile discontinued and the patient was allowed to breathe spontaneously and nerve stimulator was used to stimulate facial nerve for stapedial reflex. Anesthetic plane was maintained with Inj.Propofol 10 mg i.v and Inj.Fentanyl 5 mcg i.v in order to ensure immobile patient while testing for stapedial reflex. Inj. Ondansetron 0.1mg/kg was given just before skin closure. Patient was extubated and postoperative analgesia provided with Inj. Fentanyl 1mcg/kg I.V.
DISCUSSION:
Cochlear implant is a computerised electronic prosthetic device that replaces the functions of the cochlea. Modern cochlear implant has two parts: an external non surgically implanted speech processor and an internal surgically implanted unit. The external speech processor worn behind the ear has a microphone to pick up sounds which in turn is converted into encoded signals that are transmitted by radio waves to the internal surgically implanted part. The internal receiver until then sends this coded information via an electrode array to stimulate the auditory nerve fibers in the inner ear. The activated auditory nerves transmit the sound signal to the brain for sound perception. Cochlear implants have 22 active electrodes with Electrode 22 inserted at the apical end of the cochlea and Electrode1 at the basal end.
Cochlear implant surgery is performed in children with impaired communicative skills. In preoperative assessment, anesthesiologist should build up good rapport with the patient and familiarize them and identify various associated syndromes, which have their own anesthetic concerns.
Associated Syndromes:
a. Usher Syndrome - Eye disorders(cataract)
b. Pendred Syndrome - Goiter & metabolic disorders
c. Klippel Fiel Syndrome - Fusion of cervical vertebra, difficult intubation
d. Treacher Collins Syndrome - facial abnormalities, difficult airway
e. Jervell and Lange Nielsen Syndrome- syncopal attacks, fits and prolonged QT interval syndrome with ventricular arrhythmias. Preoperative assessment also includes exclusion of organic brain dysfunction and mental retardation. Retro-cochlear hearing loss should be ruled out and ensured that the child has a communication handicap not amenable to hearing aids. If the

child has severe profound hearing loss and is likely to need the implant, further preparation requires objective assessment of hearing mainly HRCT scan of the temporal bone. HRCT scan of temporal bone is done to see the basal turn of cochlea, its patency and any abnormal ossification within the cochlea secondary to meningitis. It also gives an indication about degree of mastoid pneumatization, presence of fluid in middle ear and any congenital inner ear abnormality. Presence fluid in middle ear is a contraindication for cochlear implant surgery. All these factors have a bearing on insertion of electrode array. An objective assessment of hearing (BERA, ECoG) is needed when the child is less than five years of age. Parental presence is highly desirable during induction of anesthesia since lack of communication is a big hurdle in establishing rapport. These deaf-mute children, similar to a normal child, are able to recognize strange environment and have fear of separation, pain and physical harm. Parental presence reduces separation anxiety significantly in children. Gaseous or intravenous induction, both are equally suitable. Hypothermia is not a problem when the child is well covered with drapes. Active heating with forced warm air can be used if there is any concern of hypothermia. Blood loss is usually minimal but can be substantial if care is not aken in presence of a large mastoid emissary vein.

During the conduct of surgery it is essential to identify the facial nerve and it is often done with the help of a nerve stimulator. This precludes use of muscle relaxants, volatile agents and therefore necessitates use of an appropriate technique. It is noteworthy that since a cochlear implant is an electric device, a discharge of static electricity can damage the electrical component of the cochlear implant device and/or corrupt the programme in the speech processor. Hence, electro-surgical instruments should not be used at all, once the cochlear implant is in place. During insertion of electrode array complete haemostasis is to be ensured and mono-polar cautery is contraindicated, once the electrode has been inserted. At the conclusion of the operation, BERA testing of the electrode array is used or electrically evoked stapedial reflexes are evaluated to ensure proper function of the receiver stimulator, electrode array and to check the integrity of the implant. During these situations, the concentration of muscle relaxants must be kept at the minimal level. Electrically evoked stapedius reflex obtained intraoperatively, can be used to prove immediately the functioning of the device, integrity of the peripheral auditory pathways and to predict comfort levels. The intraoperative electrically evoked stapedius reflex threshold (ESRT) and evoked compound action potential (ECAP) are used to guide implant settings in many centers. The stapedius reflex, an autonomic reflex that protects the ear from the effects of loud noise, is evoked electrically during cochlear implantation to determine the loudest sound that can be tolerated without causing discomfort (the maximum comfort level, MCL).If MCL set too high causes discomfort that may adversely affect the child's ability to adapt to the cochlear implant. The ECAP is used to determine the hearing threshold, the minimum acoustic stimulus perceived as sound, if set too high, normal levels of speech may be inaudible thereby under-utilizing the ability of the implant to enable hearing. Adjusting implant stimulation limits to the patient's individual dynamic range (the range between the hearing threshold and the MCL) is essential for the successful use of a cochlear implant.

An ideal anesthetic technique for cochlear implant surgery is one that has no effect on the measured evoked auditory responses. It has been suggested that some general anesthetics, muscle relaxants can elevate the threshold of the electrically or acoustically elicited stapedial reflex. In the Neural Response Telemetry system, biphasic current pulses are delivered to intracochlear electrode in a monopolar stimulation mode, which activates auditory nerve to generate an ECAP. A second intracochlear electrode, typically located two electrodes away, is used to sample the voltage of the ECAP, which is transmitted to an external coil and captured by the Neural Response Telemetry software. Current pulses were biphasic, 25s in duration, and delivered at 80 Hz by Electrode 20 at the apical end, Electrode 9 at the middle and Electrode 3 at the basal end of the array. Facial nerve activity was monitored throughout the procedure, using an electrical probe positioned on the horizontal portion of the facial nerve in the middle ear to confirm its integrity. Stimuli were generated using an electrode positioned at the apical end of the cochlear implant array (Electrode 20), a midarray electrode (Electrode 9), and an electrode at the basal end of the array (Electrode 3).Current level was measured in current units (CUs) as defined by the cochlear implant programming software. Electrical pulse trains of 500 ms (number of pulses per burst, 450; stimulus pulse width, 25 s; interstimulus interval, 7 _s) were delivered in a stepwise manner, first in increments of 10 CU and subsequently in decrements of 5 CU to bracket the ESRT.Movement of the ipsilateral stapedius muscle were identified by the implant surgeon using direct microscopic observation. The ESRT was defined as the lowest level of stimulation at which a stapedius reflex was detected visually. The ECAP was measured at the electrode located two electrode positions apical to the stimulating electrode on the intracochlear array. The stimulating current, delivered at 80 Hz, was decreased in steps of 10CUs until the electrical response could no longer be visualized by the audiologist. The lowest level of stimulation at which a wave could be detected visually was defined as the threshold. Ultimately the Intraoperative Goals are,

- Maintain stable hemodynamics
- To provide bloodless field
- Avoidance of electro-cautery use during and after cochlear implant placement.
- Modulation of anesthetic technique to allow facial nerve monitoring and to reduce interference with stapedius reflex testing.
- Reversal and extubation should be smooth to prevent coughing and bucking on the tube to avoid dislodgement of implant.
- Prevention of Postoperative Nausea and vomiting
- To provide adequate analgesia.