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COCHLEAR IMPLANTATION AND ANESTHESIA

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In light of the strong trends toward performing cochlear implantation in infants, it is necessary to consider anesthetic issues. Just as anesthetic risk may play an important role in surgical candidacy in the elderly population, anesthesia is of special consideration in infants as well. Even healthy infants are known to be at increased risk for anesthetic complications. For this reason, the most elective surgical procedures are not routinely done within the first two years of life.

The advancement in the technology of cochlear implants has resulted in increasing trend of cochlear implantation in both the children and elderly population. The anesthesiologist is faced with the task of smoothly conducting the surgery without any interference in the stimulation techniques used (1).

The preoperative evaluation is mainly focused on the presence of any congenital anomalies in these patients which may affect anesthetic technique. The reduction of anxiety of the patient, as well as the parents of small children, are important aspects of the preoperative visit. The anesthetic technique chosen should not interfere with the stimulation of the cochlear implant electrode assembly. Postoperative management is mainly focused on prevention of agitation and good analgesia. A close cooperation between the surgeon and the anesthesiologist is essential for a positive outcome in this surgery.

Induction of anesthesia can occur in the standard manner in adults using propofol 2.5mg/kg intravenously with the analgesia given by fentanyl 0.5 - 2μg/kg intravenously for pediatric patients, and 2 - 20μg/kg intravenously for adult patients. Induction in children without intravenous access can be achieved by inhalational induction by oxygen and sevoflurane. Tracheal intubation is achieved after neuromuscular blockade with rocuronium 0.5mg/kg intravenously, with appropriately sized endotracheal tube. Attenuation of hemodynamic response with preoperative remifentanil in a dose of 1mg/kg not only provides stable hemodynamics during induction and intraoperative period enabling a smoother control to provide a bloodless field during surgery, but also decreases the requirement of anesthetic drugs during perioperative period (2).

Anesthesia is usually maintained with oxygen, air and sevoflurane, without intermittent doses of rocuronium. Alternatively, a total intravenous technique involving infusion of propofol can be used to maintain anesthesia. However, the choice of anesthetic technique and drugs is solely the priority of the attending anesthesiologist whether to use experience-based or evidence-based anesthesia based on scientific logical empiricism (3).

The standard monitoring should include heart rate, five lead electrocardiogram, noninvasive blood pressure, pulse oximetry, capnography and neuromuscular monitoring. Tissue oxygenation monitoring is an advance monitoring that give us valuable information about tissue oxygenation during hypotensive anesthesia technique that is the most desirable technique for cochlear implantation inpediatric patients, as well as inthe adult population.

The surgical duration is usually 3 hours with no significant blood loss with proper use of hypotensive technique. There is no requirement of blood transfusion, however sometimes significant blood loss may

occur from large non-collapsible mastoid emissary veins. Adequate blood volume is maintained by infusion of crystalloids compensating for fasting and blood losses.

An important step during the surgery is preservation of facial nerve which may be identified intraoperative by electrical stimulation, thus precluding the use of muscle relaxants. This should be used after the effect of the muscle relaxant used for intubation has weaned off, as evidenced by the response on the train of four stimulation, and during this process the anesthesia can be maintained by propofol infusion in combination with remifentanil, or a combination of remifentanil with sevoflurane.

The two main aspects of electrical stimulation are usually used, that is, the electrically elicited stapedius reflex threshold (ESRT) and electrically elicited compound action potential (ECAP) (4).

ESRT mainly determines the maximum comfort level which is defined as the loudest sound tolerated without pain, while ECAP mainly determines the noise threshold - lowest acoustic stimulus perceived as sound. Anesthesia can affect the ESRT leading to wrong estimationof the maximum comfort level which may produce pain during stimulation. In various studies it has been found that there is a strong correlation between the level of hypnosis and the mean stapedius reflex threshold value (5).

The use of electroencephalograph has been found to be useful in maintaining a sufficient level of hypnosis. In a prospective study including children, it was found that the ESRT increased with increasing concentration of inhalational agent with minimal effect of propofol and nitrous oxide. The ECAP was not found to be affected by either the inhalational agents or the propofol. Thus, it can be concluded that the use of total intravenous anesthesia using propofol and opioid is beneficial in pediatric cochlear implant surgery (6).

Sudden coughing and bucking should be avoided at the end of surgery to prevent dislodgment of the electrode array of the implant. Neuromuscular blockade should be reversed, and spontaneous respiratory efforts are allowed. The child can be extubated in deeper planes and kept in lateral recovery position to prevent sudden agitation. The child should be nursed in post-anesthesia care unit in presence of the parents with proper care of postoperative analgesia.

The major postoperative concern in cochlear implant surgery is the prevention of postoperative nausea and vomiting which is common in ear surgery. The various measures employed are adequate anxiolytics preoperatively, use of total intravenous anesthesia with propofol, avoidance of nitrous oxide, administration of antiemetics like ondansetron 0.1mg/kg intravenously at the end of surgery.Postoperative analgesia can be maintained with parent or nurse-controlled boluses of intravenous paracetamol. It is effective in reducing doses of opioids and thus helps in prevention of opioid-related side effects (7,8).

The incidence of postoperative shivering can also be reduced to a large extent by use of perioperative dexmedetomidine (9).

The patient should be monitored in the post-intensive care unittill the consciousness is regained fully with minimal postoperative nausea and vomiting.

The cochlear implant surgery is considered to be relatively safe and minimal, or no anesthesia-related complications are reported. The complications are mainly surgical including minor complications like mild flap infection, change in taste, minor balance problems and transient facial palsy. The major surgical complications include flap necrosis, device failure, device migration, cerebrospinal leak, meningitis and persistent facial palsy (10,11).

Late postoperative complications requiring reimplantation are less frequent, and thus these patients should be followed for long-term (12). Other less frequent complications include displaced magnet from the receiver pocket by magnetic toys and silicone allergy (13).

Conclusion

The anesthetic technique used may have implications on the method of stimulation of the electrodes of the cochlear implant intraoperative. Moreover, most of these patients are children and it is the responsibility of anesthesiologist to prevent any agitation and smooth induction and emergence from anesthesia. Close cooperation between the anesthesiologist and surgeon is essential for a positive outcome.

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