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Anesthesia management of awake craniotomy performed under asleep-awake-asleep technique using laryngeal mask airway: Report of two cases

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Asleep-awake-asleep technique of anesthesia is used during awake craniotomy with or without securing airway. We assessed this technique using laryngeal mask airway (LMA) in two patients. Patients underwent awake craniotomy for epilepsy surgery and the removal of a frontotemporal glioma. After anesthesia induction, airway was secured using LMA. Anesthesia was maintained using oxygen, nitrous oxide and sevoflurane, supplemented with an infusion of propofol and remifentanil. Twenty minutes before corticography, anesthesia was discontinued and LMA removed. Both patients were awake and cooperative during the neurological assessment and surgery on eloquent areas. The LMA was reinserted before the closure of the dura and remained in place until the end of surgery. Both patients had no recall of events under anesthesia, although experienced mild pain and discomfort during awake phase of surgery. Both expressed complete satisfaction over the anesthetic management. Asleep-awake-asleep technique using LMA offers airway protection. The painful aspect of surgery can be performed under anesthesia, hence minimizing the duration of stress and pain. Patients remained awake and cooperative throughout the time of neurological testing.

Key words: Awake, cortical mapping, craniotomy, propofol

Awake craniotomy is accomplished for the removal of epileptic foci and tumors involving eloquent areas of the brain. The anesthetic drugs administered during the procedure should provide analgesia, anxiolysis and comfort to the patient, but must not interfere with functional testing and electrocorticography. We are describing two cases of awake craniotomy performed under asleep-awake-asleep technique using laryngeal mask airway (LMA), where patients were anesthetized during opening and closure of the cranial vault and awakened during the neurological assessment.

Case Reports

Case 1

A 10-year-old male, weighing 45 kg, was scheduled to undergo awake craniotomy and surgery for the treatment of intractable seizures. Preoperatively he received daily doses of phenobarbitone 120 mg and carbamazepine 600 mg. He was premedicated with clonidine 3 mcg/kg on the day of surgery. Upon arrival in the operating theater, a venous cannula was secured on the dorsum of the left hand. Anesthesia was induced with propofol 100 mg and fentanyl 100 μg and the airway was secured using a size three PVC LMA (Portex, UK). Oxygen, nitrous oxide and sevoflurane were administered for maintenance of anesthesia, in the spontaneously breathing patient. An infusion of propofol at the rate of 1-2 mg kg^{-1} h^{-1} and of fentanyl at the rate of 25 μg h^{-1} was added to the anesthetic regimen. The end-tidal concentration of sevoflurane was adjusted to maintain a Bispectral (BIS) value between 50 and 60 (range of sevoflurane: 0.5-1.0%). Another peripheral venous cannula, an arterial cannula and urinary catheter were then introduced. Scalp nerve blockade and local anesthetic infiltration during surgery were done injecting 35 ml bupivacaine 0.25% and 35 ml lidocaine 0.5% mixed with epinephrine 1:200000 parts. No rise in heart rate or in blood pressure occurred at the time of the application of the pin head holder and during craniotomy. The antiemetic regimen consisted of dexamethasone 12 mg and ondansetron 8 mg. Pantoprazole 20 mg intravenously and Diclofenac sodium 75 mg intramuscularly was also injected. Thereafter, the patient was positioned supine, with a wedge under his right shoulder and his head turned to the left. An episode of high end-tidal partial pressure of CO_2 ($ETCO_2$) (48 mm Hg) was observed during craniotomy. The $ETCO_2$ was lowered using gentle assisted ventilation. Brain relaxation was acceptable throughout the procedure.

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Twenty minutes before the estimated time of electrocorticography, sevoflurane was discontinued. The interval between anesthetic induction and discontinuation of sevoflurane was almost 3 h. Fentanyl infusion 25 mcg/h and propofol 1 mg/kg/h were continued to maintain sedation. The LMA was removed 15 min after the discontinuation of sevoflurane, at the BIS value of 81. The patient woke up restless and continued to be in that state after the removal of the LMA, probably due to mild pain. It was treated with bolus fentanyl 25 mcg and injection haloperidol 1.25 mg. Oxygen was administered via nasal prongs. Within the next 20 min the BIS value rose to 90, when he became cooperative for neurological assessment. The neurological testing included speech testing, motor testing, corticography and cortical stimulation. While attempting cortical stimulation, he threw generalized seizures that abated on the irrigation of the surgical field with cold saline and the slow intravenous injection of phenytoin sodium 500 mg. After resecting the epileptic foci, propofol 100 mg was given and reintroduction of PVC LMA was attempted. Finding it difficult in the flexed position of the neck, we introduced size four intubating LMA (LMA, UK) and allowed the patient to breathe spontaneously through the anesthetic circuit. We did not introduce endotracheal tube via intubating LMA. At the end of surgery, anesthesia was discontinued. The LMA was removed after the patient regained consciousness within 15 min. Adequate patient cooperation during the awake stage was acknowledged by the neurosurgeon and the neurophysician. Patients were asked 24 h after surgery regarding their intraoperative experience, which included recall of events during anesthesia; pain and discomfort during surgery; and about overall satisfaction with anesthetic management. Recall was evaluated by questions related to the surgical procedures like scalp pin fixation and bone drilling. The satisfaction was assessed with respect to the general comfort and willingness to repeat the procedure using same anesthetic technique. Recalls were categorized as none, partial (two events) and complete (more than four events). Pain and discomfort were categorized as none, mild, moderate to severe; while intraoperative satisfaction as none, partial or complete. Patient had no recall of events; mild pain and discomfort during awake phase of surgery and he expressed complete satisfaction over the anesthetic management.

Case 2

A 33-year-old male patient, weighing 56 kg, underwent awake craniotomy for the removal of a left semiovale glioma extending posteriorly up to the motor cortex. Premedication, anesthesia induction and maintenance were similar as in the previous patient. Intubating LMA size four was sited to maintain airway patency. Patient was allowed to breathe spontaneously through the anesthetic circuit. After skull block, patient was positioned supine with head slightly extended. Hypercarbia ($PaCO_2$ 45 mm Hg) and mild bulging of the brain were observed during surgery. He regained consciousness within 15 min after discontinuation of anesthetic gases at the BIS value of 84 and cooperated during the clinical motor evaluation. The BIS value was maintained around 87 to 90 during the motor evaluation. The intubating LMA was repositioned before dural closure and retained *in situ* until the end of surgery. Patient had no recall of events during anesthesia. The pain and discomfort were mild, while satisfaction was complete.

Discussion

The optimal anesthetic management during an awake craniotomy should provide favorable working conditions for the surgeon and the neurologist involved in the patient care, without compromising the safety and comfort of the patient. The asleep-awake-asleep technique with airway protection using LMA is a common practice for the anesthetic management of awake craniotomies.[1,2]

Manninen *et al.*,[3] have reported 18% incidence of respiratory complications in patients undergoing awake craniotomy with unsecured airway. Airway obstruction may be observed as frequently as in 7% of cases during conscious sedation,[4] requiring emergency airway intervention using LMA or endotracheal tube.[5] Noninvasive ventilation with face mask may help in overcoming hypoventilation, though its safety would be questionable in the presence of obstructed airway in a deeply sedated patient. Respiratory problems can be minimized by electively inserting the LMA, which would be important while dealing with unanticipated medical emergencies as well. The LMA may not be the safest airway protection device. However, it is better tolerated than the endotracheal tube in a patient breathing spontaneously. Reinsertion of a PVC LMA in odd neck position may be difficult at times, but the thinner, siliconized intubating LMA is the alternative to it. Presence of LMA enables the anesthetist to administer general anesthesia and adjust its depth; thus comforting the patient by curtailing the duration of pain, anxiety and stress, nonetheless decreasing intraoperative recalls. Painful procedures like invasive cannulation, scalp blockade, craniotomy and skull closure can be performed under anesthesia. The LMA offers enough airway safety for the administration of inhalational agents. The endtidal concentration of sevoflurane was not very high and depth of anesthesia monitored by BIS value was not very low in our patients to make the airway unsafe. Deepening the anesthesia is a simple way to control the untoward tachycardia and hypertension

ascribed to the surgical stimulation. Mild hypercarbia with the rise in $PaCO_2$ to 50 mm Hg may be observed during asleep phase. Gentle assisted ventilation may be instituted and depth of anesthesia may be reduced to overcome this problem. Our patients expressed satisfaction over the anesthetic management, which we think is a fair outcome of our technique.

Preanesthetic oral clonidine 150 μg reduces the total requirement of propofol.[6] It also reduces the escalation in the arterial blood pressure resulting from pin head-holder application.[7] The awake patient should be able to perform multiple tasks including counting, naming objects and moving limbs on command. Patient may perform these tasks without pain in the presence of skull block. In addition, it effectively blunts the hemodynamic response to head pinning and removes the requirement for additional anesthesia or vasoactive drugs during the period of head pinning.[8]

Emergence from anesthesia before electrocorticography may be associated with problems like restlessness, delayed awakening and vomiting. A restless patient can move his head and disturb the surgical field. Prophylactic administration of diclofenac sodium and haloperidol may help in preventing restlessness. As pain causes restlessness, opiate infusion should be continued during the awake period; however, the dose should be titrated to avoid delay in the awakening. Delayed recovery from anesthesia before cortical stimulation may affect the neurological evaluation. Our patients were awake within 15-20 min, which is fairly acceptable considering the patient comfort under anesthesia. It suggests that endtidal gas monitoring and BIS are suitable for adjusting the depth of anesthesia.

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