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Case Report

Ultrasound-Guided Scalp Block as an Anesthetic Technique and Postoperative Analgesia for Awake Cranioplasty in High-Risk Patients

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Abstract

Cranioplasty is a surgical procedure that restores normal anatomy following craniectomy. Skull bone reconstruction ensures protection and normalizes physiology as well as cerebrospinal fluid dynamics. We present a case of a 37-year-old male following intracerebral hemorrhage (ICH) evacuation via craniotomy. The patient had uncontrolled hypertension and cardiomegaly on chest X-ray, with secondary hemiparesis. Scalp nerve block was employed as an anesthetic technique and for postoperative analgesia. Preoperatively, his heart rate was 70–80 beats/min, blood pressure 158/107 mmHg, and oxygen saturation 100% on room air. Intravenous dexmedetomidine infusion was started (loading dose 1 mcg/kg for 15 minutes, followed by 0.4–0.8 mcg/kg/h) along with 2% lidocaine infusion at 1 mg/kg/h titrated to the desired level of sedation and analgesia. A unilateral (landmark-guided) scalp block was performed using 22 mL of 0.5% levobupivacaine to block the supraorbital, supratrochlear, zygomaticotemporal, auriculotemporal, greater occipital, and lesser occipital nerves. The patient also received intravenous paracetamol 1 g three times daily. Hemodynamics remained stable throughout surgery. The Numeric Rating Scale (NRS) score was 0 at 30 minutes to 6 hours postoperatively, and 1–2 between 8 and 48 hours. Awake regional anesthesia allowed sympathetic tone to remain intact and enabled rapid postoperative neurological assessment. Ultrasound-guided scalp block is an effective alternative anesthetic technique for awake cranioplasty, providing hemodynamic stability, optimal pain control, and faster recovery in high-risk patients.

Keywords: Anaesthesia, cranioplasty, dexmedetomidine, scalp block

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Introduction

Decompressive craniotomy is performed to reduce intracranial pressure caused by brain swelling following traumatic brain injury, intracranial hemorrhage, or postoperative complications of tumors and aneurysms.[1] After decompression, the brain loses part of its protective bone. Replacing the bone flap has been shown to improve motor function and cerebral blood flow after cranioplasty. Cranioplasty aims to protect the brain, restore head contour, enhance brain glucose metabolism, improve cerebral hemodynamics, and reduce neurological deficits by lowering intracranial pressure and normalizing Cerebrospinal fluid low.[2] General anesthesia with intubation is commonly used for cranioplasty. However, anesthetic management in high-risk patients with comorbidities such as cardiomegaly and uncontrolled hypertension remains challenging. Goals include maintaining stable hemodynamics, optimizing pain control, reducing opioid requirements, and minimizing postoperative recovery time.[3]

Enhanced Recovery After Surgery (ERAS) and multimodal interventions have improved perioperative care in neurosurgery. Scalp

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nerve block is widely used to stabilize surgical procedures, reduce postoperative pain, and decrease opioid consumption.[4,5] Awake cranioplasty is gaining popularity because it allows intraoperative neurological testing, avoids general anesthesia and invasive monitoring, reduces morbidity, and shortens hospital stay.[6] We report a case of anesthetic management using scalp nerve block for cranioplasty in a patient with hypertension and cardiomegaly.

Case

History

A 37-year-old male, height 168 cm, weight 70 kg, with a body mass index (BMI) of 24.8 kg/m², presented with a sudden onset of severe headache, vomiting, and weakness of the left extremities while watching television. He was brought to the hospital three hours after the onset of symptoms. Based on the medical history, the patient had a history of uncontrolled hypertension. Based on physical examination and supporting investigations including chest X-ray, head CT scan, and laboratory tests, the patient was diagnosed with intracerebral hematoma.

A right-sided decompressive craniotomy was performed under general anesthesia. Postoperatively, the patient was admitted to the intensive care unit (ICU) for one day with ventilator support. Patient received analgesic

Figure 1. Chest X-ray

therapy with opioids and NSAIDs during the ICU stay. The postoperative course was stable with a Glasgow Coma Scale (GCS) score of E4V5M6. The patient was discharged after four days of hospitalization and planned for cranioplasty six months later. Currently, the patient is six months post–decompressive craniotomy and is scheduled for cranioplasty at Cilacap regional public hospital. He has a history of uncontrolled hypertension and cardiomegaly based on chest X-ray findings.

Physical Examination

Preoperatively, his blood pressure was 179/106

Figure 2. Scalp Block Procedure

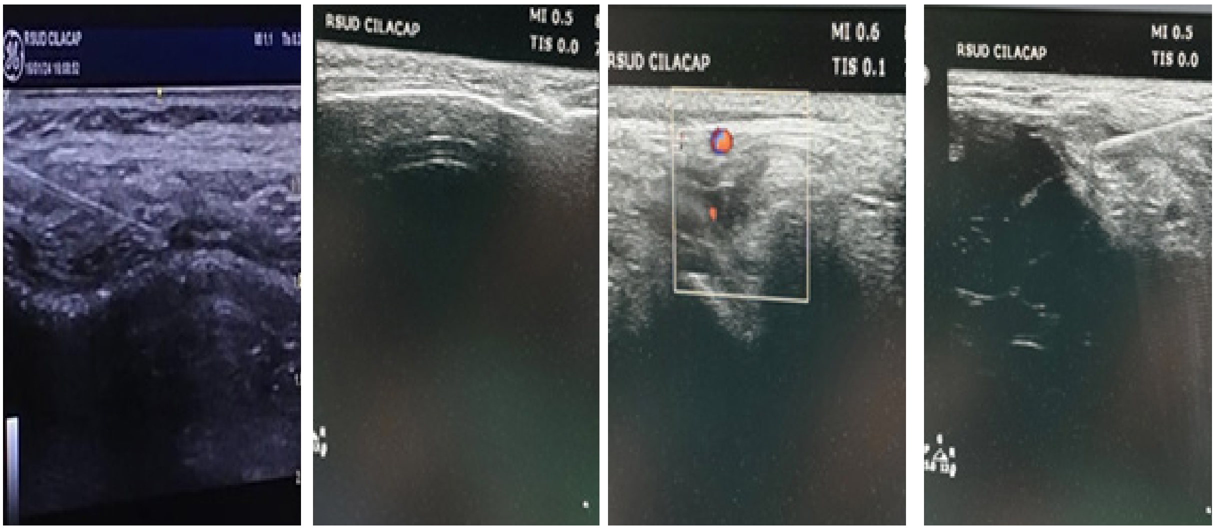

Figure 3. Sonoanatomy Scalp block

Table 1. Preoperative Laboratory Results

Laboratory	Result	Range
Hemoglobin	14.6 g/dL	10.9-14.9 g/dL
Hematocrit	41.8 %	34-45 %
White blood cell	8600/mm3	4790-11340/ mm3
Platelet	350000/µL	216000-451000/µL
Blood glucose	121 mg/dL	80-139 mg/dL
Ureum	28.4 mg/dL	15-40 mg/dL
Creatinin	0.8 mg/dL	0.0-0.9 mg/dL
Sodium	140 mmol/L	135-145 mmol/L
Potassium	4.4 mmol/L	3.5-5.1 mmol/L
Chloride	104 mmol/L	97-107 mmol/L
Bleeding Time	5 s	2-7 s
Clotting Time	8 s	8-15 s

mmHg, heart rate was 70–80 beats per minute, and the radial pulse was strong and regular. Oxygen saturation was 99% on room air. Breath sounds were vesicular in both lung fields with no additional rales or wheezes. The peripheral perfusion was warm, capillary refill time was less than two seconds, and the patient was fully conscious.

Laboratory Examination

Routine laboratory results were within normal limits. Chest X-ray showed cardiomegaly with normal pulmonary vascular markings and no evidence of infiltrates, consolidation, or pleural effusion. Non-contrast head CT scan revealed a cranial bone defect post–decompressive craniotomy on the right side, with central midline structures and a normal ventricular system. There was no evidence of cerebral edema or intracranial hemorrhage.

Intraoperative Management

Preparations included ultrasound, local anesthetics, emergency drugs, and resuscitation

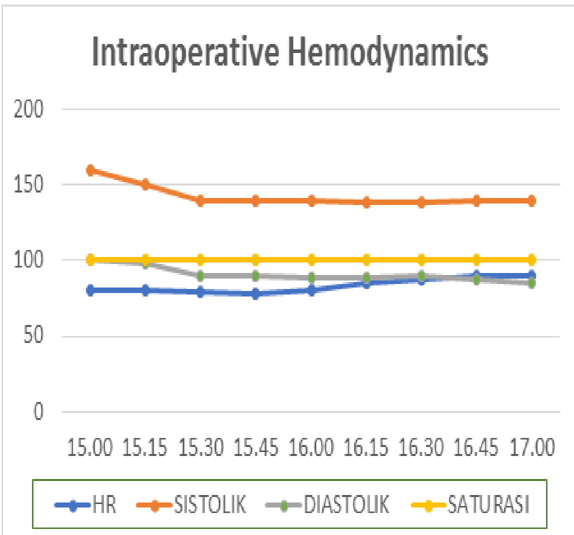

Figure 4. Intraoperative Hemodynamics

equipment. The patient was monitored for blood pressure with Non-invasive Blood Pressure (NIBP), heart rate, oxygen saturation, and ECG. The patient was not intubated prior to surgery. Sedation was initiated with intravenous dexmedetomidine (1 mcg/kg over 15 minutes, followed by 0.4–0.8 mcg/kg/h infusion) and 2% lidocaine infusion (1 mg/kg/h), titrated to the desired level of sedation and analgesia. Scalp block was performed using ultrasonography and a 25G needle at several points. A unilateral (landmark-guided) scalp block with 20 mL of 0.5% levobupivacaine was administered to the supraorbital, supratrochlear, zygomaticotemporal, auriculotemporal, greater occipital, and lesser occipital nerves using a 24G needle. During surgery, the patient received lactated ringer's fluid without colloid or blood. Bleeding during surgery was 200cc and the patient was haemodynamically stable. Injection was performed slowly until the nerves were adequately anesthetized. Hemodynamics were continuously monitored, and the patient remained stable throughout surgery.

Postoperative Management
The patient was transferred to the recovery room for half an hours of observation. He remained stable with good consciousness, hemodynamics, and low pain scores during half an hours of observation in the recovery room. Postoperative pain was assessed using the Visual Analog Scale (VAS), with scores ranging from 1–2. The patient was managed in the ward with paracetamol 1 g every 8 hours and ketorolac 30 mg every 8 hours. He was able to eat, drink, and mobilize independently during recovery. The patient was discharged three days after the surgery.

Discussion

General anesthesia is widely used in craniotomy, but anesthetic agents such as isoflurane, sevoflurane, and opioids may increase the risk of postoperative nausea and vomiting (PONV). Increased intracranial pressure and hematoma formation may result from elevated venous blood flow caused by PONV. Opioids, although frequently used for analgesia, carry risks of respiratory depression, gastrointestinal suppression, addiction, and increased PONV incidence, which may reach 22–70% without prophylaxis.[7] The goals of awake cranioplasty mirror those of awake craniotomy: to keep the patient comfortable, immobile during surgery, and awake at the conclusion.[8] Ventilation management must be adequate and the airway secure, with the patient immobile during the operation but still comfortable and cooperative. Proper patient preparation, a controlled surgical environment, appropriate sedation and analgesia, and continuous communication are essential.[9] Awake cranioplasty has indications and contraindications that must be met before the procedure is performed. Contraindications to awake cranioplasty include refusal, inability to cooperate, psychiatric disorders, and inability to remain still. Relative contraindications include OSA (Obstructive Sleep Apnea), obesity, reflux, cough, language impairment, and age below 14 years.[10]

Scalp block in awake cranioplasty is safe for patients with hypertension and cardiomegaly. Administering a scalp block during craniotomy procedures helps to minimize hemodynamic fluctuations, minimizes airway manipulation, and decreases opioid use.[11] Such fluctuations, often triggered by pain, may lead to elevated blood pressure and heart rate. Pain caused by cutting the skin or scalp can increase intracranial pressure, potentially resulting in brain injury and contributing to higher rates of morbidity and mortality. Hypertension and cardiomegaly are high-risk conditions in patients undergoing traumatic brain injury surgery under general anesthesia. Hypertension contributes to secondary brain injury by increasing cerebral blood flow, disrupting autoregulation, and elevating the risk of intracranial hemorrhage during perioperative stress. Cardiomegaly, reflecting impaired cardiac reserve, predisposes patients to hemodynamic instability, hypotension during anesthetic induction, and arrhythmias, which may compromise cerebral perfusion pressure.

The coexistence of these conditions substantially amplifies perioperative cardiovascular and neurological risks, necessitating meticulous anesthetic management to maintain hemodynamic stability and prevent secondary brain injury. A scalp block can reduce the stress response, provide longer postoperative analgesia, and maintain patient awareness during surgery. It also blunts the stress response, prolongs postoperative analgesia, preserves sympathetic tone, and allows early neurological evaluation. This technique can reduce opioid consumption during the first 48 hours after surgery.[12] A scalp block inhibits the sensory branches of the trigeminal nerve and the occipital nerve. Scalp block is performed on the supraorbital, supratrochlear, zygomaticotemporal, auriculotemporal, greater occipital, and lesser occipital nerves.

Performing a scalp block on patients with various comorbidities must be done carefully. Inherent scalp defects in postcraniotomy patients are associated with shifts in bone landmarks with dura mater attached to the scalp. Ultrasound guidance improves safety and precision by visualizing nerves and vessels, ensuring accurate anesthetic deposition.[13] Careful dosing of local anesthetics is crucial to avoid toxicity. Both bupivacaine and levobupivacaine (0.5%, 20 mL) are effective for hemodynamic stability and pain control.[14] Intraoperatively, patients undergoing scalp block are sedated using intravenous dexmedetomidine. Dexmedetomidine is advantageous due to its sedative and analgesic effects, preservation of respiration, reduction in cerebral oxygen consumption, and prevention of CO_2 retention. It decreases opioid needs and lowers the incidence of atrial fibrillation.[15] Patients undergoing scalp block and dexmedetomidine sedation can undergo a neurological examination while maintaining sedation and analgesia within the targeted therapeutic range.[16] Maintaining optimal sedation levels is critical: oversedation reduces cooperation, while undersedation increases discomfort and anxiety.[14] Initial bolus dosing of dexmedetomidine followed by maintenance infusion, with or without fentanyl supplementation, is effective before local anesthetic infiltration.[14]

The Punctures of Local Anesthetic in Scalp Block
Anesthesia induction begins when the patient is comfortable on the operating table. It is necessary to describe in this case report whether it is in accordance with this procedure or whether there are modifications. The injection of local anesthetic can cause pain and anxiety in the patient, so analgesia and sedatives must be given before injecting the local anesthetic agent. One technique is to first give the patient a bolus dose of dexmedetomidine 1 mcg/kg given over 10–15 minutes, after which the dose of dexmedetomidine is reduced to 0.4 mcg/kg/hour. If necessary, fentanyl 1 mcg/kg is given slowly. After that, the local anesthetic can be injected into the area where the graft will be installed.[14]

Conclusions

Awake cranioplasty with ultrasound-guided scalp block is an effective anesthetic alternative for high-risk patients. It provides hemodynamic stability, effective analgesia, reduced opioid use, and faster recovery. Careful planning, appropriate sedation with dexmedetomidine, and precise local anesthetic administration are key to successful outcomes.

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