Effect of Scalp Blocks with Levobupivacaine on Recovery Profiles After Craniotomy for Aneurysm Clipping: A Randomized, Double-Blind, and Controlled Study

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Key words
- Analgesia
- Aneurysm
- Levobupivacaine
- Local anesthetics
- Postoperative
- Regional blockade
- Surgery

Abbreviations and Acronyms
CNS: Central nervous system
IV: Intravenous
MAP: Mean arterial blood pressure
NRS: Numerical rating scale
PCA: Patient-controlled analgesia
PONV: Postoperative nausea and vomiting
VAS: Visual analogue scale

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OBJECTIVE: **This study was conducted to evaluate the effect of scalp blocks using levobupivacaine on recovery profiles including postoperative pain, patient-controlled analgesia (PCA) consumption, postoperative nausea and vomiting (PONV), and other adverse events in patients undergoing frontoparietal craniotomy for aneurysm clipping.**

METHODS: **Fifty-two patients scheduled for elective frontoparietal craniotomy for unruptured aneurysm clipping were enrolled. After surgery, scalp blocks were performed using normal saline (group C, n = 26) or 0.75% levobupivacaine (group L, n = 26). Postoperative pain scores and PCA consumption were recorded for 72 hours after recovery of consciousness. The time from patient recovery to the first use of PCA drug and rescue analgesics, the requirement for vasoactive agents, and adverse effects related to PCA and local anesthetics also were recorded.**

RESULTS: **Postoperative pain scores and PCA consumption in group L were lower than in group C ($P < .05$). The time intervals from patient recovery to the first use of PCA drug ($P < .001$) and rescue analgesics ($P = .038$) was longer in group L than in group C. Additionally, less antihypertensive agent was required ($P = .017$), and PONV occurred less frequently ($P = .039$) in group L than in group C.**

CONCLUSIONS: **Scalp blocks with 0.75% levobupivacaine improved recovery profiles in that it effectively lowered postoperative pain and PCA consumption without severe adverse events and also reduced the requirement for a postoperative antihypertensive agent and the incidence of PONV in patients who underwent frontoparietal craniotomy for aneurysm clipping.**

INTRODUCTION

Up to 80% of patients undergoing craniotomy experience moderate to severe incisional pain postoperatively (13). However, postoperative pain after craniotomy is frequently undertreated because of a concern that opioid analgesia may produce sedation and interfere with the neurologic examination (18). Uncontrolled postoperative pain may contribute to a hypertensive response, which may be detrimental, particularly for patients with cerebral aneurysm (29). Furthermore, patients who undergo remifentanil anesthesia often experience significant postoperative pain and hypertension due to its short duration of action (16, 19). Therefore, early and proper transition analgesia is required after remifentanil-based neuroanesthesia for smooth emergence with haemodynamic stability (15).

The skin incision and reflection of muscles during craniotomy are considered the main causes of postoperative pain (32). Intravenous (IV) patient-controlled analgesia (PCA) with opioids can be used for postoperative analgesia after craniotomy. However, opioid-based PCA has adverse effects, such as postoperative nausea and vomiting (PONV) (27), which could be confused with a sign of increased intracranial pressure or result in increased intracranial pressure. Therefore, a scalp block with various local anesthetics has been used to provide effective analgesia for incisional pain after craniotomy without the adverse effects of opioid-based PCA (1, 2, 14, 24, 28).

Levobupivacaine, a levoisomer of racemic bupivacaine, is an effective local anesthetic for nerve block and has clinical advantages over the racemic bupivacaine because it has less systemic and central nervous system (CNS) toxicity (8). Costello et al. described the use of levobupivacaine for scalp block during awake craniotomy (10). A PubMed literature search was performed for the period between December 1987 to March 2011 using the terms "scalp block," "levobupivacaine," "craniotomy," and "pain," and we found no study that has evaluated the effect of scalp block with levobupivacaine on recovery profiles such as postoperative

pain and haemodynamics in patients undergoing craniotomy. We hypothesized that a levobupivacaine scalp block will not only provide effective pain control but also improve the recovery profiles after remifentanil-based neuroanesthesia. This prospective, randomized, and controlled study was designed to assess the effect of postoperative scalp block with 0.75% levobupivacaine on pain scores, PCA consumption, the use of vasoactive agents, and other adverse events in patients undergoing craniotomy for unruptured aneurysm clipping using remifentanil-based neuroanesthesia.

METHODS

Patients

The protocol for this prospective, randomized, double-blind study was approved by the Ethics Committee of Seoul National University Bundang Hospital (no. B-1105/128-004) and was registered at the Clinical Research Information Service (KCT0000274). After written informed consent was obtained, 52 adult patients (American Society of Anesthesiologists physical status I or II, ages 19 to 75 years) who were undergoing elective frontoparietal craniotomy for clipping of an unruptured cerebral aneurysm were included.

Patients with a ruptured cerebral aneurysm and subarachnoid haemorrhage, allergic reaction to local anesthetics, previous craniotomy incision, chronic use of opioids for >2 weeks, active psychiatric disorders, those undergoing an emergency operation, and those who were not able to understand a numerical rating scale (NRS) or communicate (scheduled to be sedated postoperatively or a Glasgow Coma Scale score < 14) were excluded.

Anesthesia

Anesthesia and monitoring were standardised for all patients. Patients received 0.03 mg kg^{-1} IV midazolam as a preanesthetic medication. Standard monitoring included electrocardiography, pulse oximetry, and noninvasive blood pressure. Induction of anesthesia was performed with propofol (4 mg mL^{-1}) and remifentanil (3–4 ng mL^{-1}) using target-controlled infusion. Neuromuscular blockade was provided with 0.6 mg kg^{-1} IV rocuronium to facilitate tracheal intubation. During induction, a 20-gauge arterial catheter was inserted for continuous mean arterial blood pressure (MAP) monitoring and blood sampling. Propofol (3 to 5 mg mL^{-1}) and remifentanil (3 to 5 ng mL^{-1}) were used during maintenance of anesthesia and adjusted to maintain a MAP of 60 to 80 mm Hg. Ventilation was mechanically controlled to achieve an end-tidal CO_2 of 4.4 to 5.1 kPa. During surgery, additional neuromuscular blocker was not administered due to the need for intraoperative neurophysiologic monitoring. After surgery, patients were transferred to the surgical intensive care unit without recovery. Scalp blocks were performed after surgery but before extubation. After the scalp block, the PCA device (15 μg mL^{-1} fentanyl, total 100 mL) programmed to run with a 1-mL bolus dose and a 10-minute lockout time was connected to the patient.

Randomization

Patients were randomized before induction of anesthesia by an independent anesthesiologist who was responsible for patient allocation using a computer-generated random-number chart (Random Allocation Software version 1.0) with a block size of 4. Patients were randomly assigned to the control (group C) or levobupivacaine group (group L). Syringes containing the same volume (7 mL) of normal saline (group C) or 0.75% levobupivacaine with epinephrine (group L) were prepared by an anesthetic nurse not involved in the study. The anesthesiologist performing the scalp block, patients, and investigators were blinded to group assignments.

Scalp Block

After surgery, the scalp block was performed by an anesthesiologist using aseptic technique while the patient was still under general anesthesia and before extubation. The scalp block was performed unilaterally by a blinded investigator using a technique described previously by Pinosky et al. (31). Group C received the scalp block with normal saline (7 mL), whereas group L received the scalp block with 7 mL of 0.75% levobupivacaine and 1:200,000 epinephrine. The supraorbital and supratrochlear nerves emerge from the orbit, and a 25-gauge needle was introduced above the eyebrow perpendicular to the skin. These nerves were blocked with 2 mL of solution; 3 mL of solution was injected 1.5 cm anterior to the ear at the level of the tragus to block the auriculotemporal nerves. After the scalp block, patients were awakened and extubated.

Outcomes

The primary end points were postoperative pain and PCA consumption. Patients were observed at 1, 2, 4, 8, 12, 16, 24, 48, and 72 hours after they were awake and fully oriented (Glasgow Coma Scale score ≥ 14). Pain scores using a 100-point NRS (0 = no pain, 100 = the worst imaginable pain) and PCA consumption (in mL) were recorded. Patients with a NRS ≥ 30 despite the use of PCA were administered 30 mg IV ketorolac as an analgesic rescue. Additionally, the time intervals from patient recovery to the first use of PCA and of analgesic rescue also were recorded.

An increase or decrease in MAP > 20% from baseline values (before anesthesia induction) was regarded as clinically significant and treated with nicardipine or dopamine. Nicardipine or dopamine was administered with continuous infusion or intermittent boluses. The number of patients with the use of nicardipine or dopamine was recorded.

Adverse events, including alterations in heart rate, MAP, ventricular arrhythmia, and seizure during the scalp block, were observed. Additionally, the occurrence of PONV, fever (axillary temperature >37.8°C), dizziness, sleeping tendency, respiratory depression (respiratory rate <8 or desaturation <90%), and delirium were recorded. PONV was graded using a 100 visual analogue scale (VAS); mild <30, moderate 30 to 70, severe >70. If a patient experienced more than 1 episode of PONV, the grade of the severest event was recorded. Delirium was assessed using the Intensive Care Delirium Screening Checklist (5).

Statistics

A power analysis was performed based on the results of a preliminary study. In the preliminary study with 10 patients (the same inclusion and exclusion criteria) without scalp block, pain scores at 2 hours postoperatively averaged 55 (24). A clinically significant difference was considered as a decrease in mean pain score from 55 to 35 by scalp block. The analysis showed that 24 patients per group were required to detect the analgesic effect of a scalp block with levobupivacaine with α error of 0.05 and power of 80%. Assuming a 10%