ORIGINAL RESEARCH PAPER

Anesthesiology

CLINICAL EFFICACY OF SCALP INFILTRATION WITH 0.25% LEVOBUPIVACAINE TO ATTENUATE HEMODYNAMIC RESPONSE TO SKULL PIN INSERTION IN SUPRATENTORIAL CRANIOTOMIES UNDER GENERAL ANESTHESIA

KEY WORDS:

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ABSTRACT

Sudden hemodynamic changes caused by skull pins in neurosurgery can be prevented by scalp block which blocks both the superficial and deep layers of the scalp.Levobupivacaine has been used in 0.75% and 0.5 % concentrations for this purpose. No previous study has determined the efficacy of 0.25% levobupivacaine for scalp block. This prospective observational study included 50 patients, after obtaining approval from ethics committee of Grant Govt Medical College & Sir J.J Hospital and written informed consent from patients who underwent supratentorial craniotomy at this institute. Scalp block with 20ml of 0.25% levobupivacaine was given bilaterally after induction of general anesthesia and prior to application of Mayfield skull pin head holder. The hemodynamic parameters were recorded at baseline, during scalp block and after head pin insertion, incision and craniotomy. Values of heart rate and blood pressure before and after anesthesia induction compared to values after painful stimuli were in the 10 to 15% range. Mean intraoperative Fentanyl requirement was 150 micrograms (2-3microgm/kg) Keywords: levobupivacaine; neuroanesthesia; scalp block.

INTRODUCTION:

Rigid head fixation is necessary to maintain the desired head position for providing stability during the long neurosurgical procedures. It is of utmost importance to maintain hemodynamic stability and optimal cerebral perfusion perioperatively. Skull pins may cause sudden hemodynamic changes despite an adequate depth of anaesthesia. A sudden increase in the systemic blood pressure can cause an abrupt increase in the intracranial pressure, in patients with impaired cerebral auto regulation, which precipitates intracranial hypertension.[1,2]

Combining scalp block just after induction of general anesthesia offers several advantages for most patients. As shown by FJ Smith et al[3] and Pinosky et al[4] scalp block with local anaesthetics have been found to be quite effective in attenuating the hemodynamic response to pinning with bupivacaine 0.5%. Blockade of scalp innervations blocks both the superficial and deep layers of the scalp. Scalp block is easily performed by direct local anesthetic infiltration at the typical anatomical places where nerves that provide sensory innervations to scalp and forehead (supraorbital nerve, the supratrochlear nerve, the zygomaticotemporal nerve, the auriculotemporal nerve, greater and lesser occipital nerves) emerges from the skull.

Bupivacaine 0.5% is widely used to provide scalp blocks.[4,5] Bupivacaine is available as a racemic mixture of its enantiomers, dextrobupivacaine,and levobupivacaine.

Levobupivacaine is a pure S-enantiomer of bupivacaine and is increasing in popularity because it has fewer cardiovascular side effects and is less toxic to the central nervous system. The decreased toxicity of levobupivacaine is due to its faster protein binding rate.

The high vascularity of the scalp tissue may result in high amounts of systemic absorption or unintentional intravascular administration as high volumes of local anaesthetic are administered at multiple injection sites in scalp blocks The safety profile of levobupivacaine is advantageous for this purpose.

The present study was performed to determine the effects of scalp block with 0.25% levobupivacaine on the haemodynamic response to head pinning and incision during craniotomy and to evaluate the efficacy and reduced opioid analgesic requirements intraoperatively.

AIMS AND OBJECTIVES:

To evaluate the efficacy of 0.25% levobupivacaine infiltration in attenuating the hemodynamic response to the scalp pin application and incision in neurosurgical patients undergoing supratentorial craniotomies

MATERIALS AND METHODS:

This prospective observational study included 50 patients (American Society of Anesthesiologists physical status, I or II; age, 18–60 years) who underwent elective scheduled operations including supratentorial craniotomy at the Grant Medical College and Sir Jamshedjee Jeejebhoy Group of Hospitals. Patients with co-existing severe cardiovascular, respiratory or neurological disorders, allergy to local anaesthetics, known history of coagulation disorders, inflammatory skin lesions at the site of giving block and pre-existing neuropathies and also pregnant and lactating mothers were excluded from the study.

Following detailed pre-anesthetic check up, informed written consent was obtained from patients fulfilling the required criteria. Patients were taken up for surgery after adequate starvation of 8hrs.

After taking the patient in the operation theatre, intravenous access was established. All non-invasive monitoring was attached including pulse oximeter, cardioscope; sphygmomanometer. The patient was premedicated with glycopyrrolate 4µg/kg and sedated with midazolam 0.03mg/kg iv and fentanyl 2µg/kg i.v.

After preoxygenation for 5mins general anesthesia was induced with propofol 2mg/kg and after ensuring adequate mask ventilation patient was paralysed with 0.9-1 mg/kg rocuronium and trachea intubated with flexometallic endotracheal tube of 7.5mm ID for females and 8.5mm ID for males. After ensuring correct placement with end tidal CO2 and proper positioning of the tube positive pressure ventilation was initiated. Anesthesia was maintained with a mixture of 50% O2 and nitrous oxide mixture and sevoflurane (MAC 1 to 1.2) with 0.3mg/kg/hr rocuronium infusion. An arterial line was then secured for invasive arterial blood pressure and heart rate monitoring.

The patient was in the supine position for the scalp block. We blocked six sensory nerves with direct infiltration of local anesthetic.[Figure1]

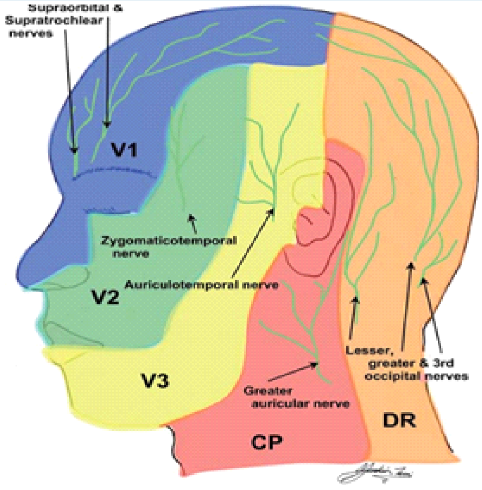


Figure 1: Nerve Distribution

A total volume of 20ml of 0.25% levobupivacaine (10ml of 0.5% levobupivacaine with 10ml of normal saline) was infiltrated, half the volume on either side. 1 to 2 ml of drug was infiltrated for each nerve.

Supraorbital nerve was blocked as it emerges from the orbit. After identification of supraorbital notch the needle was inserted along the upper orbital margin perpendicular to the skin 1 cm medial to the supraorbital foramen. Supratrochlear nerve was blocked as it emerges from the superomedial angle of the orbit finger's breadth medial to supraorbital nerve. Auriculotemporal nerve was blocked over zygomatic process 1 to1.5 cm anterior to the ear at the level of the tragus. The zygomaticotemporal nerve was blocked with infiltration from the supraorbital margin to the posterior part of the zygomatic arch with deep and superficial injection of local anesthetic. The greater occipital nerve was blocked by infiltration of local anesthetic 2.5 cm lateral to the nuchal median line, halfway between the occipital protuberance and the mastoid process. Lesser Occipital Nerve was blocked by infiltration along the superior nuchal line, 2.5 cm lateral to the greater occipital nerve block. The incision site was infiltrated with 1:2,00,000 adrenaline by the neurosurgeon after the scalp block Head pinning was performed by a neurosurgeon 5mins after the scalp block. Systolic arterial pressure, diastolic arterial pressure, mean arterial pressure (MAP), heart rate (HR), peripheral oxygen saturation, and end-tidal carbon dioxide was recorded at baseline (T1), after the induction of anaesthesia (T2) during (T3), 1min after (T4) and 5mins after (T5) the scalp block, during (T6) 1 min after (T7) and 5mins after (T8) the head pinning, during (T9) and 5min after (T10) the incision, and during (T11), 5min and 10min after (T12) craniotomy. When the systolic arterial pressure and HR values exceeded the baseline values by 15%, an additional dose of fentanyl (1 μg/kg intravenously) was administered. A >15% decrease in the MAP from baseline was defined as hypotension and treated with a phenylephrine bolus (25μg). Additionally, a >15% decrease in the HR from baseline was defined as bradycardia and treated with intravenous glycopyrrolate (0.2 mg). As per statistical software nMaster 1.0 results of the study were observed and analyzed statistically. Data were tested for normality and analyzed using Student's t-test for numerical data and chi-square test for categorical data. Statistical difference was considered significant if $p < 0.05$

RESULTS: The present study included 50 patients.All patients underwent craniotomy for treatment of a supratentorial intracranial mass, arteriovenous malformation, or cerebral aneurysm In all patients measured values of heart rate and blood pressure during scalp block compared to values after painful stimuli i.e pinning(Table1) ,incision(Table2) and craniotomy(Table3) were almost the same with minimal variation that not exceed 20% change.(Figure2) The mean intraoperative Fentanyl requirement was 150 micrograms. There were no complications associated with scalp block in any patients.

Table 1: Hemodynamics at Pin Insertion

	SCALP BLOCK	PINNING	P VALUE	SIGNIFICANCE
HEART RATE (bpm)	69.92±11.60	70.14±12.10	0.898	NOT SIGNIFICANT
SBP (mmHg)	106.84±14.92	108.18±15.79	0.551	NOT SIGNIFICANT
DBP (mmHg)	63.82±10.99	64.24±13.80	0.8305	NOT SIGNIFICANT
MAP (mmHg)	81.82±11.92	80.44±14.14	0.493	NOT SIGNIFICANT

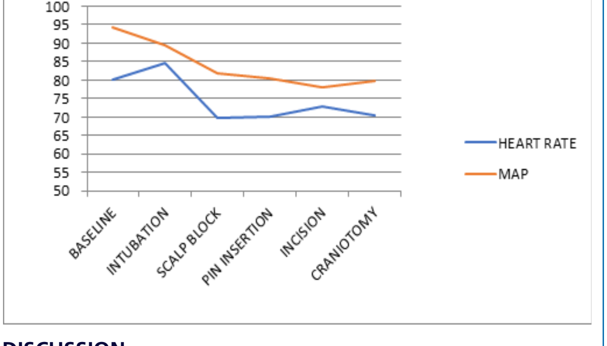
Table 2: Hemodynamics at Incision

	SCALP BLOCK	INCISION	P VALUE	SIGNIFICANCE
HEART RATE (bpm)	69.92±11.60	72.94±13.55	0.121	NOT SIGNIFICANT
SBP (mmHg)	106.84±14.92	105.92±9.979	0.517	NOT SIGNIFICANT
DBP (mmHg)	63.82±10.99	63.8±8.769	0.987	NOT SIGNIFICANT
MAP (mmHg)	81.82±11.92	77.9±7.5	0.005	SIGNIFICANT

Table 3: Hemodynamics at Craniotomy

	SCALP BLOCK	CRANIOTOMY	P VALUE	SIGNIFICANCE
HEART RATE (bpm)	69.92±11.60	70.54±14.58	0.764	NOT SIGNIFICANT
SBP (mmHg)	106.84±14.92	105.12±11.06	0.277	NOT SIGNIFICANT
DBP (mmHg)	63.82±10.99	64.1±10.05	0.844	NOT SIGNIFICANT
MAP (mmHg)	81.82±11.92	79.94±7.35	0.0769	NOT SIGNIFICANT

Figure2: Hemodynamic variation



DISCUSSION:
In the present study, we have shown that 0.25% levobupivacaine infiltration given as scalp block significantly blunts the rise in HR and BP, reduces the need for adjuvant analgesic or systemic treatment, without causing any side effects. The main cause of pain in neurosurgical procedures arises from pin insertion into the periosteum and craniotomy. Systemic administration of high dose opioids blunts the stress response however an adverse effect of hypotension and delayed emergence. Especially in patients with space occupying lesion, a sudden drop in BP below the lower auto-regulatory margin will result in a lower cerebral perfusion pressure (CPP). The use of antihypertensive agents, opioids, and intravenous anaesthetics that blunt the hemodynamic response to head pinning cause sudden or prolonged reductions in blood pressure which is undesirable.

Pain control and cardiovascular stability has shown positive findings in outcome of neurosurgical patients. General anesthesia and systemic opioids does not completely block the whole pain cascade which can be successfully achieved by blockade of scalp nerve endings by local anaesthetics.

Several studies have described the use of scalp block to limit the neuroendocrine and hemodynamic response. [6,7,8] Scalp block is easy to learn, simple to use ,effective, ,with known but rare side effects. Various local anaesthetics such as lidocaine, bupivacaine, ropivacaine, with or without adrenaline, could be used.

Although bupivacaine with or without epinephrine has been used and recommended for scalp blocks in previous studies [9,10], it is associated with an elevated risk of depressed cardiac contractility and conductivity. Geze et al. [9] evaluated the effects of scalp blocks using 20mL of 0.5%bupivacaine versus local infiltration on the hemodynamic and stress responses to skull pin insertion during craniotomy. They found that the scalp block provided better hemodynamics and reduced the stress response during and after skull pin placement.

Levobupivacaine, the S enantiomer of bupivacaine has now been used in a wide variety ofclinical areas for the provision of intra-operative anaesthesia and postoperative analgesia.(11) Few studies have demonstrated the intraoperative hemodynamic effects of levobupivacaine scalp blocks during craniotomy. [11,12,13]In a retrospective study by Pardey Bracho et al., 16 patients who received a scalp nerve block with levobupivacaine 0.5% prior to skull pin placement and incision were compared with controls in terms of hemodynamic stability and anaesthesia/analgesia requirements.[12]The scalp block resulted in good intraoperative hemodynamic stability and reductions in the dose requirement of anaesthetics and opioids.

Levobupivacaine scalp blocks in paediatric patients were evaluated in three patients who received the blocks before craniotomy. [14] The drug provided good hemodynamic stability and reduced the need for opioids duringthe first 24 hours.

In a recent study by Hwanget al.[16] the levobupivacaine block or saline injection was performed after surgery when thepatient was still under general anaesthesia,and patients were compared with controls in terms of postoperative pain control.The postoperative pain scores and patient controlled analgesia consumption were lower, and the time from recovery to the first use of patient-controlled analgesia and rescue analgesics were longer in the levobupivacaine group than control group. Also antihypertensive agent use was lower and postoperative nausea and vomiting was less frequent in the scalp block group.. The study conducted by Can and Bilgin [17] demonstrated that both 0.5% bupivacaine and levobupivacaine can be effectively and safely used for scalp blocks to control hemodynamic responses and postoperative pain.[15,17]

In a series of 120 patients, Yıldız et al[18] reported that local scalp infiltration with 0.25% bupivacaine had no advantage over a large intravenous bolus of fentanyl just before skull pin insertion, and they advocated the use of the latter because of its simplicity.In the present study we studied the efficacy of 0.25% levobupivacaine and found it to be satisfactory in abolishing the noxious response to head pinning, scalp incision and craniotomy.

In neurosurgery, the addition of adrenaline has added advantage as it reduces blood loss from the vascular scalp, which makes this infiltration a common practice; over scalp incisions[19]The decision to add epinephrine to the local anaesthetic agent was made as it was assumed that the absorptionof local anaesthetic would be rapid from this highlyvascular area. In the present study, no intraoperative or postoperative local anaesthetic-related toxicity was observed.

CONCLUSION

There have been several studies establishing the analgesic efficacy of levobupivacaine 0.75% and 0.5% in neurosurgical procedures. Our study shows that 0.25% levobupivacaine infiltration given as scalp block minimises hemodynamic fluctuation by 15%,reduces the requirement for adjuvant systemic treatment {Mean intraoperative Fentanyl requirement was 150 micrograms (2-3microgm/kg,)} without causing any wound related or systemic side effects.

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