Scalp block with bupivacaine and ropivacaine for attenuation of haemodynamic response to head pinning in neurosurgical patients: An observational study

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Abstract

Objective: Present study was performed to compare the effectiveness of bupivacaine and ropivacaine for scalp block on the haemodynamic response during skull-pin insertion.

Materials and Methods: Ninety patients who underwent elective craniotomy were divided into two equal groups (n=45). After routine induction, patients were intubated. All the patients received scalp blocks with 20 ml of either 0.5% bupivacaine (group B) or 0.5% ropivacaine (group R) approximately 5 minutes before skull-pins insertion. Heart rate (HR) and mean arterial pressure (MAP) were recorded at 60sec, 120 sec and 300 sec following head pin insertion.

Results: MAP and HR were stable during and after head pinning in both the groups at all time points.

Conclusion: Both bupivacaine and ropivacaine for scalp block are equally effective for blunting hemodynamic responses during head pinning. Ropivacaine being less toxic can be a safe alternative for scalp block.

Keywords: Anaesthesia, Local anaesthesia, Scalp block, Bupivacaine, Ropivacaine, Hemodynamic.

Introduction

Anesthesia for craniotomy requires special considerations. The brain is enclosed by the non-expandable skull with a limited reserve to compensate for increase in cerebral blood volume, cerebrospinal fluid, and brain tissue. Increase in any one of these can cause increase in intracranial pressure (ICP).[1,2] During craniotomy, noxious stimulus such as laryngoscopy, intubation, application of skull pin head holder, skin incision and extubation induce intense sympathetic stimulation which causes sudden increase in HR, blood pressure (BP), and ICP. It can be detrimental for patients with space-occupying lesions (tomours, intracranial haematoma, abscesses) in which intracranial compliance and auto-regulation are compromised.[1,3,4]

In cranial and cervical spine surgery, the head is fixed by means of head frames for adequate surgical exposure and immobilization. These head frames hold head by the application of bone-anchors as metallic pins or screws into the pericranium. Even though these head frames are applied under general anesthesia; they produce intense sympathetic as well as neuroendocrine response.[5] To blunt these responses various technique have been used such as different local anesthetic infiltrations, skull blocks, opioids, α2-adrenergic receptor agonist and increasing depth of anesthesia with inhalation and intravenous (IV) anesthetics.[6-11] Out of these, few methods can cause fall in BP and can compromise cerebral perfusion.

Nerves that supply the relevant region of the scalp if blocked blunts these noxious stimuli and can attenuate sympathetic response.[12] Furthermore; scalp blocks have been demonstrated to reduce the severity of postoperative pain due to craniotomy.[13] Apart from the onset and duration of action, degree of sensory and motor block, and neurotoxicity/cardio toxicity should be cosidered while selecting the local anaesthetic agent. For scalp blocks high volumes of local anaesthetic are injected at multiple injection sites, which may result in increased systemic absorption and/or unintentional intravascular administration as scalp tissues are highly vascular. Bupivacaine and ropivacaine both have been widely used to provide scalp blocks. Ropivacaine, a levorotatory isomer (S-), has better systemic toxicity profile such as; fewer cardiovascular side effects, less central nervous system toxicity and provides motor block of shorter duration than racemic bupivacaine.[14,15]

Aim

This study was performed to determine and compare the effectiveness of scalp blocks with bupivacaine and ropivacaine on the haemodynamic response to head pinning for neurosurgery.

Objectives

To determine and compare the effectiveness of scalp block with bupivacaine and ropivacaine in terms of

1. Change in heart rate
2. Change in mean blood pressure

Materials and Methods

This study had been carried out in the Department of Anesthesiology and Critical care, Pt. J.N.M. Medical College & Dr. B.R.A.M. Hospital, Raipur (C.G.) during period of September 2017 to June 2018 after approval from the institutional scientific and ethics committee. It was a prospective, observational study conducted in the young

adult patients between 18-60 years, ASA grade I and II, who underwent elective craniotomy under general anesthesia and required head fixation by application of head frames. After a detailed preanesthetic assessment and required investigations, all patients with history of hypertension, cardiac and pulmonary disease, pregnancy, morbid obesity, allergic to the study drug, and impaired kidney or liver function were excluded from study. Ninety patients who were meeting into inclusion and exclusion criteria were selected & divided into 2 groups (n=45).

Group B: scalp block administered with 20 ml of injection Bupivacaine 0.5%.

Group R: scalp block administered with 20 ml of injection ropivacaine 0.5%.

After obtaining written & informed consent from the patients, they were shifted to operation theatre and multipara monitor was attached to record automated noninvasive blood pressure, electrocardiograph, and oxygen saturation. Baseline HR and MAP were noted.

All the patients were induced with intravenous (IV) 2 μg/kg fentanyl, 2–3 mg/kg propofol and 0.1 mg/kg vecuronium was used for muscle relaxation. For anesthesia maintenance, mixture of nitrous oxide in oxygen (60:40) and 1–1.5 minimum alveolar concentration of isoflurane were administered. The patients were given additional doses of vecuronium bromide and fentanyl when necessary. All the patients were ventilated with tidal volume of 8–10 ml/kg and respiratory frequency of 12–15/min to achieve an end-tidal carbon dioxide level of 30–35 mmHg.

Monitoring

The following parameters were monitored perioperatively:

Heart rate and rhythm by five lead electrocardiography (ECG)

Automated noninvasive blood pressure (NIBP)

Pulse oxymeter (oxygen saturation)

End-tidal carbon dioxide ($EtCO_2$)

Scalp blocks

After normalization of the hemodynamic effects of tracheal intubation (approximately 5 min after intubation), the scalp blocks were performed bilaterally 5 min prior to head pinning by the surgeon. The site and amount of local anaesthetic injected for the nerve blocks were as follows:[12]

1. Supraorbital and supratrochlear nerves- 2 ml of solution above the eyebrow.
2. Auriculotemporal nerves- 2 ml of solution at the level of the tragus approximately 1.5 cm anterior to the ear.
3. Post-auricular nerves-3 ml of solution at the level of the tragus approximately 1.5 cm posterior to the ear.
4. Greater, lesser, and third occipital nerve-3 ml of solution approximately halfway between the occipital protuberance and the mastoid process, along the superior nuchal line.

Thirty seconds prior to pin insertion time was taken as the zero (T0) hours, 60 seconds following pin insertion (T60), 120 seconds following pin insertion (T120), and 300 seconds following pin insertion (T300). HR and MAP were recorded at all time points in both the groups. Any increase in HR and MAP > 20% of baseline was treated by increasing isoflurane concentration and IV fentanyl (1 mcg/kg). Decrease in the MAP >20% from baseline was defined as hypotension and treated with intravenous bolus of 6 mg mephentermine. Decrease in the HR >20% from baseline was defined as bradycardia and treated with intravenous 0.6 mg atropine sulfate. Any possible adverse effects of the study drugs were also noted.

Statistical Analysis

The data were calculated with the help of graph-pad in stat software for statistical analysis. The Categorical variables like gender were presented as numbers and were compared between both groups using chi square test. The quantitative data are being represented as Mean and standard deviation and were compared between groups using Student *t*-test. *P* value less than 0.05 was considered as significant and *P* value less than 0.001 was taken as statistically highly significant.

Result

Demographically (age, gender, weight) both the groups were comparable [Table 1]. The mean MAP and mean HR at 60seconds (T60), 120 seconds (T120), 300 seconds (T300) after pin insertion were noted and compared between both the groups. The differences between the values of MAP at 60sec and 0sec (ie.T60-T0) were calculated for each patient and the mean of these differences were then compared between both the groups. Similarly differences between the values (i.e.T60-T0) of HR at 60sec and 0sec was also calculated and compared.

The mean of the MAP measured at 60 seconds after skull pin insertion (T60) was 83.14 ±7.45 mmHg and 84.01 ±10.99 mmHg in group B and group R respectively, which was statistically insignificant (*P* =0.6838) [Table 2]. T60-T0 for MAP was 3.78 ±8.11 mmHg and 3.67 ±7.66 mmHg in group B and group R respectively (*P* =0.9474) [Table 2]. The mean HR measured at 60 seconds after skull pin insertion (T60) was 77.18±7.23 min and 79.89±7.11 min in group B and group R respectively, which was statistically insignificant (*P* =0.0764) [Table 3]. T60-T0 for HR was 1.24±0.81 min and 1.37 ±0.89 min in group B and group R respectively (*P* =0.4706) [Table 3]. Similarly in both the groups HR and MAP at T120 and T300 were statistically insignificant. No adverse effects related to both the study drugs were found in any group.

Table 1: Demographic characteristic between both the groups

Demographic	Group B (n=45)	Group A (n=45)	p Value
Age (years) mean±SD	48.3 ± 9.81	47.60 ± 7.89	0.7100
Male/Female (ratio)	21:24	19:25	
Weight (kg) mean±SD	66.33 ± 13.53	64.53 ± 12.00	0.5061

SD-Standard deviation

Table 2: Changes in MAP in the two groups

Time (sec)	Group B MAP (mmHg) Mean±SD	Group A MAP (mmHg) Mean±SD	p Value
Baseline	79.55±7.04	80.15±7.16	0.6895
T0s	80.28±7.45	81.32 ±6.85	0.4924
T60s	83.14±9.12	84.01±10.99	0.6838
Rise in 60s (T60-T0)	3.78±8.11	3.67±7.66	0.9474
T120s	82.54 ±6.22	83.75 ±7.22	0.3967
T300s	79.11±7.18	80.43±7.56	0.3980

Table 3: Changes in HR in the two groups

Time (sec)	Group B MAP (mmHg) Mean±SD	Group R MAP (mmHg) Mean±SD	p Value
Baseline	73.53±7.01	73.60 ±7.27	0.9644
T0s	76.13±6.85	78.01±7.81	0.2280
T60s	77.18±7.23	79.89±7.11	0.0764
Rise in 60s (T60-T0)	1.24±0.81	1.37 ±0.89	0.4706
T120s	77.08±6.69	77.21±6.81	0.9274
T300s	76.59±6.45	76.87±6.09	0.8328

Discussion

One of the great concerns of the neuroanesthesiologist is to maintain hemodynamic stability during neurosurgical procedures and ensuring optimal cerebral perfusion pressure to minimize nervous tissue trauma. The use of skull clamps has become common practice in neurosurgical procedure (brain tumours and vascular lesion) for better surgical field access and stabilization of head. External skull fixations devices such as Mayfield and Sugita are used to immobilize the head and neck during cranial procedure where three or four metallic pins are inserted through the scalp and the periosteum into the external lamina of the skull and are tightened with sixty to eighty pounds of pressure.[16] Even though these pins are applied under general anaesthesia, there always occurs a hemodynamic response to this noxious stimulus such as tachycardia and hypertension.[16] This 'uniform' stimulus should be blunted to avoid unwanted increase in BP, HR, and ICP which can be deleterious in the neurosurgical patients with compromised intracranial compliance.[17,18] Different methods have been proven to be effective for attenuation of these hemodynamic response with variable success.[3,19-23] The scalp block is safe, easy and effective technique for blunting these pressure responses and decreasing morbidity after craniotomy.[12]

In present study, 90 ASA classes I and II, adult patients who underwent elective craniotomy under general anesthesia and required skull fixation were divided into two groups (n=45). Both the groups were comparable in term of age, sex, and weight. The study groups received scalp blocks with either 20 ml of 0.5% bupivacaine or 0.5% ropivacaine, 5 min prior to application of the skull clamps (Mayfield). Hemodynamic parameter (MAP and HR) were recorded at different time points. We found that scalp nerve blocks with bupivacaine and ropivacaine attenuated the hypertension and tachycardia seen during skull-pin insertion and eliminated the need for additional anaesthetic drugs with no significant differences between bupivacaine and ropivacaine group.

Till date several studies have tested the efficacy of various local anaesthetic agents for scalp block, including bupivacaine and ropivacaine, for postoperative pain control and blunting the haemodynamic response.[12,13,16] One of the studies demonstrated that bupivacaine with or without epinephrine is associated with an increased risk of depressed cardiac contractility and conductivity.[14] Ropivacaine, a levorotatory isomer (S-) has gained popularity because it is less toxic to the central nervous system and has fewer cardiovascular side effects.[15]

In the study of Geze et al,[9] the effects of scalp-nerve block, local infiltration anaesthesia and routine anaesthesia were compared during skull-pin insertion and they also found that the scalp block reduced the stress response during and following skull pin placement with stable

haemodynamics. Pinosky et al[12] observed that hemodynamic parameters (SAP, DAP, HR) did not increase in patients who received scalp block with 0.5% bupivacaine. However, significant increase in SAP (40 ± 6 mm Hg), DAP (30 ± 5 mm Hg), MAP (32 ± 6 mm Hg), and HR (22 ± 5 bpm) were found in control group. In addition, 9 out of 10 patients in the control group while none of the patients in the scalp block group required rescue drugs. Lee et al[24] also showed that 0.25% bupivacaine for scalp block effectively blunted the haemodynamic response during pin insertion and during dural opening and reduced the need for rescue drugs. Similarly, Bala I et al[25] also noted decrease in incidence and severity of postoperative pain in patients undergoing supratentorial neurosurgical procedure when scalp block was performed using 0.5% bupivacaine with 1:4,00,000 adrenaline. Nguyen A et al[26] compared scalp block with ropivacaine (0.75%) and saline (0.9%) and demonstrated that ropivacaine decreases the severity of postoperative pain after supratentorial craniotomy.

Only few studies have tested the effects of ropivacaine scalp blocks on intraoperative haemodynamics during craniotomy. Gazoni FM et al[27] noted that no significant increase in hemodynamic parameter with application of head pins occurred in patients who received scalp block with 0.5% ropivacaine as compared to control group. In line with these previous findings, the present study revealed stable haemodynamics with bupivacaine and ropivacaine scalp blocks during placement of head pins.

Although the sample size was adequate but there are certain limitations to our study. We did an observational study where scalp blocks were performed by the surgeons who used drugs according to their preferences. A clinical trial or a case control study with randomization of population would have been better. Also, anesthesiologists were not blinded to the scalp block, so observer bias is possible. Further monitoring of neuroendocrine response by measuring changes in serum level (cortisol, prolactin, glucose, insulin) and intracranial pressure could also have been employed. Despite above mentioned limitations, our results showed that both, bupivacaine and ropivacaine for scalp block effectively blunts the hemodynamic response during head pinning in patients undergoing elective craniotomy.

Conclusion

Scalp blocks preserve the haemodynamic profile by blunting the sympathetic response to placement of head pins. The clinical effects of bupivacaine and ropivacaine are similar. Therefore, ropivacaine being less toxic than bupivacaine could be safely and effectively used for scalp blocks.

Conflict of Interest: None.

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