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Ropivacaine vs Levobupivacaine Scalp Block-Intraoperative Hemodynamic Stability and Requirement of Additional Analgesia in Supratentorial Craniotomy, a Comparative Study

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ABSTRACT

Background: Neuroanaesthesia is very challenging as maintaining good haemodynamic stability intraoperatively is important. Scalp block can be an effective measure in providing good peri-operative haemodynamic stability and favourable postoperative neurological profile for assessment.

Aim: To compare the efficacy of isobaric 0.5% Ropivacaine with isobaric 0.5% Levobupivacaine when used for scalp block in terms of intraoperative haemodynamic stability and requirement of additional analgesia and anaesthetics intraoperatively.

Methods: 60 patients of either sex, aged between 18 to 60 years, ASA grade I and II undergoing elective supratentorial craniotomy under General Anaesthesia (GA) were randomly divided into 2 groups. Group B was given scalp block with isobaric 0.5% Levobupivacaine whereas Group R with isobaric 0.5% Ropivacaine. Scalp block was performed after standard GA induction using Modified Pinosky technique. Intraoperative surges in heart rate (HR) or systolic blood pressure (SBP) were noted in response to skull pin insertion and scalp incision. Overall haemodynamic stability and total requirement of additional analgesia and anaesthetics intraoperatively were noted.

Results: The response to pin insertion was obtunded by both Ropivacaine and Levobupivacaine but overall, the response to pin insertion concerning mean HR was better in Group B than Group R. The response to incision was blunted in both the groups but was better in Group R. The requirement of additional analgesia and anaesthetic was higher in Group R than Group B and therefore, hemodynamic stability also appears to be better in Group R.

Conclusion: Ropivacaine and Levobupivacaine (20 ml of isobaric 0.5% conc.) when used for scalp block, were both effective in preventing sympathetic response to skull pin insertion and incision. However, overall Levobupivacaine has better efficacy.

Key Words: Craniotomy, Scalp block, Ropivacaine, Levobupivacaine.

INTRODUCTION

The goals of neuro-anaesthesia are to ensure stable perioperative cerebral haemodynamics and avoid a sudden rise in intracranial pressure (ICP). The intense surgical stimuli associated with pin insertion, scalp incision and craniotomy frequently cause sympathetic activation which results in marked changes in systemic arterial pressure and cerebral blood flow[1]. These cerebrovascular responses if not adequately obtunded may result in elevated ICP and reduction in cerebral perfusion pressure leading to cerebral ischemia, especially in patients with the intracranial space-occupying lesion (SOL) with impaired autoregulation and compromised cerebral compliance[1,2].

Many interventions like pharmacological and regional techniques have been used to combat these hyperdynamic responses to noxious stimuli[3]. Pharmacological interventions like use of various IV drugs have a disadvantage in terms of exaggerated hypotension and delayed awakening[2,4--7]. Various regional techniques include local infiltration at the site of pin insertion, infiltration along with the site of incision and scalp block[8]. "Scalp block" involves regional anaesthesia to the nerves that innervate the scalp[9].

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Regional techniques provide intraoperative analgesia and reduce the requirement of IV analgesia and other anaesthetics which prevents delayed emergence. This facilitates immediate postoperative neurological examination which is a potential advantage of combining regional techniques with GA for craniotomy.

Consistent with the vascularity of the scalp the rate of rising of serum local anaesthetic concentration is faster and although rare, may result in seizure and cardiac arrest. The newer molecule Levobupivacaine, which is a Levo-isomer of Bupivacaine; and Ropivacaine which is a long-acting amide local anaesthetic has an advantage of reduced cardiac and neurotoxicity compared to Bupivacaine[10,11,12] and thus offers a considerable clinical advantage in providing analgesia with lesser adverse effects than Bupivacaine[13].

The present study compares the efficacy of Ropivacaine and Levobupivacaine when used for scalp block in terms of intraoperative hemodynamic stability and requirement of additional intraoperative analgesia and anaesthetic usage.

MATERIALS AND METHODS

This prospective randomized study was done in 60 patients of either sex, aged between 18 to 60 years, American Society of Anaesthesiologists (ASA) grade I and II undergoing elective craniotomy under general anaesthesia (GA) for the intracranial space-occupying lesion.

Exclusion Criteria - Incision extending beyond the field of the block, history of drug allergy**,** patients chronically treated (more than 2 weeks) with narcotic medications**,** pregnant or lactating mothers and presence of pre-existing intracranial defects (previous history of craniotomy)

After institutional ethical committee approval and written informed consent, the patients were randomly divided into 2 groups, Group B and Group R using the computerised program. On arrival in the operation theatre baseline preoperative values of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO_2) were recorded. Patients were premedicated with Inj. Glycopyrrolate 0.004mg/kg IV, Inj. Ondansetron 0.08mg/kg & Inj. Fentanyl 2mcg/kg IV followed by preoxygenation for 3 min. after which Inj. Propofol based induction was done. Intubation was done after administering Inj. Rocuronium 1mg/kg using an adequate sized armoured tube. A left radial artery was cannulated for invasive BP monitoring and a central venous line was inserted via antecubital route using appropriate size CVP catheter. Anaesthesia was maintained with N_2O, O_2 and Isoflurane. Inj.Rocuronium infusion was started at the rate of 0.5mg/kg/hr. Scalp block was performed after the induction with Levobupivacaine in Group B and Ropivacaine in Group R using Modified Pinosky technique[14]. The scalp nerve block was performed as follows:

The Supratrochlear and Supraorbital nerves were blocked as they emerge from orbit with 22g needle, introduced above eyebrow perpendicular to the skin. The Zygomaticotemporal nerve was blocked at the posterior part of the zygomatic arch lateral to the orbit. The Auriculotemporal nerves were blocked 1.5cm anterior to ear at the level of the tragus. With needle perpendicular to the skin, the prick was made deep to the fascia and drug injected as the needle was withdrawn. Posterior Auricular branch of Greater Auricular nerve was blocked between the skin and bone 1.5cm posterior to ear at the level of the tragus. Greater, Lesser and Third Occipital nerves were blocked by infiltrating only superior nuchal line approximately halfway between occipital protuberance and mastoid process.

The skull pin insertion was done 15 min after scalp block. If HR or SBP increased by more than 20% above baseline value at pin insertion or incision then 1mcg/kg of Inj. Fentanyl bolus was administered. Intraoperatively if the SBP increased above 100 mmHg, 1mcg/kg Inj. Fentanyl bolus was administered if the increase persisted Inj. Propofol infusion was started at the rate of 100mcg/kg/min and titrated to get the desired SBP between 90 – 100mmHg. HR, SBP, DBP, MAP, and SpO_2 were recorded at following intervals for analysis of the study-Pre-operative, Before scalp nerve block performance, 1, 2 and 5 min after scalp nerve block performance, Before pin insertion,1, 2 and 5 min after pin insertion, Before skin incision,1, 2 and 5min after skin incision, 30 min. interval intraoperatively, and at extubation. At the end of the procedure, neuromuscular block was antagonized and extubation was done when the TOF ratio was > 0.9. The total requirement of Inj. Fentanyl and Inj. Propofol intraoperatively was noted.

Statistical analysis

A power analysis was performed before the study. According to the power analysis, a total of 25 patients per group should be enrolled to detect at least 20% difference in MAP measurements among the groups, with an alpha error of 0.05 and a beta error of 0.2, based on a previous study[15]. The results were tabulated and statistical analysis was done using Graphpad Instat version 3.0. For categorical variables, the chi-square test and Fisher's exact test were applied. Continuous data were analysed using an independent sample t-test. Comparisons of hemodynamic data within groups were analysed using the paired sample t-test and ANOVA. A p-value of < 0.05 was considered to be statistically significant.

RESULTS

The patients in Group R and Group B were comparable in terms of the demographic data viz. gender, age, weight, and duration of surgery (Table 1).

Haemodynamic parameters

There was a significant fall in arterial pressure values (Mean systolic, diastolic and mean arterial pressure) after induction due to the effect of induction agents. There was no rise in Mean HR, Mean SBP, Mean DBP and Mean MAP following pin insertion and scalp incision in both the groups (Figure 4). Intraoperatively at all time intervals (30-360 min), all the parameters were significantly less than post scalp block value meaning better haemodynamic stability. There was a rise in all the arterial pressure values (Mean SBP, Mean DBP, Mean MAP) at extubation. Intraoperatively the Mean HR was more in Group B than Group R at 330 min and extubation. Similarly, the Mean SBP at 120, 300 and 330 min was also higher in Group B. (Figure 1,2,3)

The average requirement of Inj. Fentanyl in Group B was 5% lesser than in Group R. The requirement of Inj. Propofol was 20% lesser in Group B compared to Group R. The combined requirement of both Inj. Fentanyl and Inj. Propofol was analysed and it was observed that the requirement in Group R was significantly higher than Group B.(Table 2, Figure 4,5)

Table 1: Demographic characteristics of patients in Group R and Group B

Parameter	Group R	Group B	P-value
Age (yrs)	36+11.7	41.2+12.1	0.09
Gender (male:female)(%)	16:14; 53:47	18:12; 60:40	0.79
Weight (kg)	55.5 + 6.19	54.3 +5.53	0.72
Duration of surgery	4.5+0.89	4.06+0.81	0.06

Values are expressed as Mean+ SD or number (%) SD= standard deviation,

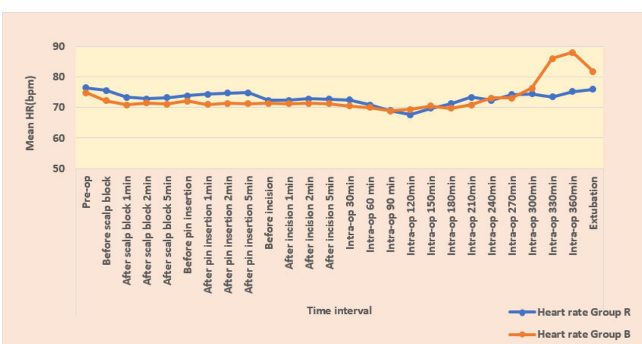

Figure 1: Trend of Mean HR in Group R and Group B.

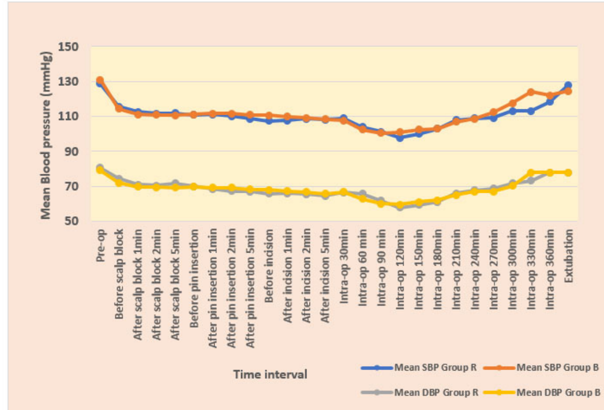

Figure 2: Trend of Mean SBP and Mean DBP in Group R and Group B.

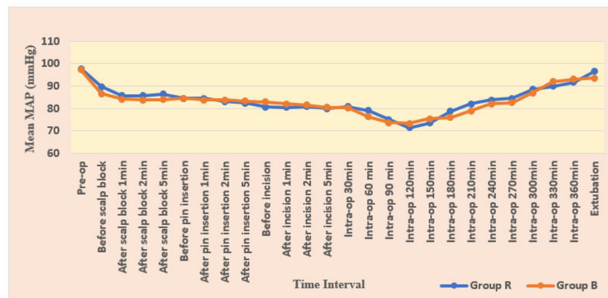

Figure 3: Trend of Mean MAP in Group R and Group B.

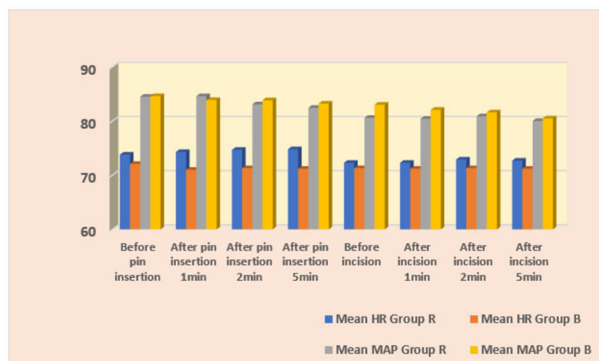

Figure 4: Mean HR and Mean MAP at various noxious stimuli in Group R and Group B.

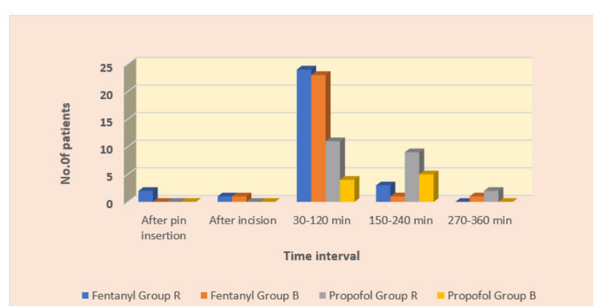

Figure 5: Requirement of additional analgesia and anaesthesia in Group R and Group B.

Table 2: Intraoperative requirement of additional analgesia and anaesthetics in Group R and Group B

Group	Group R (No. of patients)			Group B (No. of patients)		
Drug	Propofol is given	Propofol not given	Total	Propofol is given	Propofol not given	Total
Fentanyl given	14	11	25	5	20	25
Fentanyl not given	0	5	5	0	5	5
Total	14	16	30	5	25	30
P-value	0.04			0.55		

DISCUSSION

Noxious stimuli during craniotomy are detrimental to patients with intracranial SOL with impaired cerebral autoregulation, in whom a small increase in blood pressure and cerebral blood volume can further precipitate intracranial hypertension[16]. Thus, hemodynamic response to skull pin response needs to be attenuated.

Improved anatomic knowledge has refined the technique of scalp blockade and enabled the performance of nerve block with better precision. Pinosky et al. first described scalp blockade as a means to improve hemodynamic control during cranial fixation[9]. In the present study the scalp block was performed by the same technique as described by Pinosky et al. but with the use of 0.5% Ropivacaine and Levobupivacaine and results were obtained are concurrent with the findings in that study. Recent studies have shown clear efficacy when scalp block is used as an adjunct to general anaesthesia when good hemodynamic control is the desired outcome. Geze et al. in their study have demonstrated that scalp block with 0.5% Bupivacaine not only blunted the hemodynamic response but also the sympathoadrenal response as reflected by the reduced plasma cortisol and ACTH levels measured at the fifth and sixtieth minute after pinning[15].

In the present study, following induction, there was a significant drop in mean SBP, DBP and MAP which could be due to the effect of induction agent Inj. Propofol and Inj. Fentanyl used as premedication. However, the mean values of all the parameters were comparable between the two groups (Figure 1,2,3). The mean haemodynamic parameters were stable at the time of pin insertion and scalp incision as intended, suggesting the success of scalp block (Figure 4). The overall response to pin insertion concerning mean HR was better in Group B and that concerning incision was better in Group R. Gazoni et al.[17] studied the effect of Ropivacaine skull block on perioperative outcomes in patients with supratentorial brain tumours, Patients in the skull block group did not have a significant increase in blood pressure or heart rate with the placement of headpins, as compared to patients in the control group. G.F. Pardey Bracho et al.[18] studied the effect of Levobupivacaine scalp nerve block on haemodynamics and anaesthesia requirements in supratentorial craniotomy and demonstrated that scalp block successfully prevented significant increases in MAP occurred during head pinning and skin incision.

Intraoperatively, there was decreasing trends in all the four parameters in both the groups. On comparing the time interval at which these changes occurred it was observed that the parameters showed rising trends 30 min earlier in Group B than in Group R (Figure 1,2,3). The haemodynamic stability appears to be better in Group R but this could be due to increased combined requirement of additional analgesia and anaesthesia in Group R which was found to be statistically significant (Table 2).

Intraop Requirement of Additional Analgesia and Anesthetic: Overall the total average requirement of Inj.Fentanyl in Group R was 47.33+25.1mcg and in Group B was 45.33+21.6 mcg. Thus, the average requirement of Inj. Fentanyl in Group B was 5% lesser than in Group R, and that of Inj. Propofol in Group R was 402+129 mg and in Group B was 320+157 mg. Thus, the requirement of Inj. Propofol was 20% lesser in Group B compared to Group R (Figure 5). Stewart et al.[10] studied the central nervous system and cardiovascular effects of Levobupivacaine and Ropivacaine in healthy volunteers and commented that Levobupivacaine and Bupivacaine have similar potencies while clinical trials have clearly shown that Levobupivacaine and Bupivacaine have equal clinical efficacy in various indications. In contrast, Ropivacaine has 60% of the potency of Bupivacaine, suggesting that larger concentrations of Ropivacaine (0.75% or 1.0%) are needed to provide the same sensory block as Bupivacaine (0.5% and 0.75%). Mark Sanford and Gillian M. Keating[19] comment that clinical studies in various patient populations suggest that Levobupivacaine is less potent than Bupivacaine and more potent than Ropivacaine. This explains the significant difference in mean HR after pin insertion between Group R and Group B and also the increased requirements of additional analgesia intraoperatively to maintain hemodynamic stability in Group R.

Limitations

Monitoring of neuroendocrine response and ICP could have been employed. The plasma concentration of local anaesthetic agents was not measured, however, no patient developed side effects related to local anaesthetic toxicity. Long-term further study is needed on the preventive effect of Levobupivacaine and Ropivacaine scalp block on chronic post craniotomy headache.

CONCLUSION

Ropivacaine and Levobupivacaine when used for scalp block, were both effective in preventing hemodynamic sympathetic response to skull pin insertion and incision. Levobupivacaine has better efficacy when used for scalp block. Scalp block using Levobupivacaine and Ropivacaine is an effective method for maintaining stable hemodynamics for patients undergoing craniotomy.

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