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EFFECTS OF 0.5% ROPIVACAINE SCALP PIN AND PREINCISIONAL INFILTRATION WITH GENERAL ANESTHESIA ON HEMODYNAMIC RESPONSE IN CRANIOTOMY

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ABSTRACT

Aim: To compare the efficacy of 0.5% ropivacaine local infiltration in attenuating the hemodynamic response to the scalp pin and incision application in neurosurgical patients. **Method:** One hundred patients posted for elective craniotomy were randomly allocated into 2 groups of 50 patients each. Group R received 0.5% Ropivacaine (20 cc of 5 mg/ml) and Group L infiltrated with 1% Lignocaine with adrenaline (20 cc). Recording of the haemodynamic data was done at following times: pre operative, intubation, pre infiltration, post pinning, and pre incision, post incision, 5 min post incision and 10 min post incision. **Results:** No significant rise in pulse rate responses occurred during any event in patients receiving ropivacaine scalp pin and preincisional infiltration ($P < 0.05$). There was rise of systolic and diastolic blood pressure at post incision but it was not significant level It should be deleted in group R. Supplemental propofol required to control the hemodynamic variation at post incision was 48% patients in Group L and 12% of group R. Brain relaxation was very good in 92% of group R, 60% in group L. **Conclusion:** Infiltration at Scalp pin and pre-incisional with 0.5% ropivacaine is very effective, safe and superior to lignocaine hydrochloride 1 % with adrenaline in attenuating the hemodynamic response in craniotomy. As there was no difference in blood loss in both groups, supports the local vasoconstriction effect of 0.5% ropivacaine.

KEYWORDS: Scalp, infiltration, stress response, ropivacaine.

INTRODUCTION

Rigid head fixation is essential to maintain the desired head position and provide stability during the long neurosurgical procedures. The fact that placement of the clamp is always done under general anaesthesia, patients show a significant hypertensive response to this stimulus and this noxious stimulus that can be detrimental to patients clinically. When scalp and periosteal nerve endings are stimulated, blood pressure (BP) and heart rate (HR) increases.[1] It has been documented that, general anesthesia and systemic opioids not completely blocks the whole cascade of pain, but blockade of scalp innervations, by local anesthetics blocks both the superficial and deep layers of the scalp, was examined.[2] Thiopentone causes cardiovascular depression and does not really have any analgesic effects. Volatile anesthetic causes cerebral vasodilatation and increase in cerebral blood flow and cerebral blood volume with a resultant increase in intracranial pressure (ICP). For prevention or to reduce the intensity of this hemodynamic response, infiltration with a local anesthetic drug at site of incision to block nerve endings is the one of the ideal choice. Preemptive analgesia [3] has been defined as treatment that: (1) starts before surgery; (2) prevents the establishment of central sensitization caused by incisional injury (covers only the period of surgery); and (3) prevents the establishment of central sensitization caused by incisional and inflammatory injuries (covers the period of surgery and the initial postoperative period). Although the rapid onset of analgesia, stability of hemodynamic perturbations and small volume of the drug required are the advantages for the infiltration technique. Ropivacaine is a long acting amide local anesthetic agent, structurally related to bupivacaine. Ropivacaine when compared with bupivacaine exhibits differential blockade predominantly on sensory nerve fibers. Ropivacaine was chosen for this study because of

its theoretical improved efficacy, safety index and its duration of action of at least three to four hours.

AIMS AND OBJECTIVES

1) To compare the efficacy of 0.5% ropivacaine infiltration in attenuating the hemodynamic response to the scalp pin and incision application in neurosurgical patients.
2) To assess the effectiveness of ropivacaine and lignocaine in obtunding the hemodynamic response to the pin and incision application.

METHOD

Sample size was calculated using the software Rao software a sample size calculator for two sample means. The power of study was taken as 90% and significance as 5%. The sample size thus calculated was 43. To increase the strength of the study, the number in each group was increased to 50. Patients categorized as ASA class 1 and 2, Aged 20-70 years undergoing elective craniotomy surgery having preoperative Glasgow coma scale (GCS) -15. We had excluded those patients of known allergy to local anesthetics, pregnant, patients with intracranial aneurysms or previous scalp incision and refusal of participation. Informed consent was obtained from all patients before surgery by the anesthesiologist. All patients fasted for at least 10 h before surgery none had received premedication except corticosteroid and anticonvulsant s prescribed by neurosurgeon. Similar anesthetic and operative techniques were applied in all patients. Before induction of general anaesthesia, standard monitors such NIBP, ECG, SPO2, and end-tidal PCO2.Pre oxygenation was done for 5 minutes. General anesthesia with an endotracheal tube was performed with Inj Glycopyrolate 0.2 mg IV, Inj Propofol 2mg/kg IV, Inj Fentanyl citrate 2 mcg /kg IV, Inj. Vecuronium Bromide 0.1 mg/ kg IV. Inj. Ondansetron 8 mg, Inj.Phenytoin sodium 100mg IV slowly and Inj.

Dexamethasone 8 mg IV was given. Inj. Manitol 0.5 mg/kg IV was completed before the scalp incision. Maintenance was done with O_2 50%, Nitrous oxide 50%, sevoflurane, Inj Vecuronium Bromide 0.2 mg / kg/hr as an infusion. Ventilation was controlled to maintain end-tidal PCo_2 between 30 -35 mm of Hg. Inj. Diclofenac sodium 75 mg/kg IM was given just after induction. Muscle relaxant reversal was done with Inj. Neostigmine and Inj. Glycopyrolate at the end of surgery. 100 patients posted for elective craniotomy were randomly allocated into 2 groups of 50 patients each. Group R received 0.5% Ropivacaine (20 cc of 5 mg/ml) and Group L infiltrated with 1% Lignocaine with adrenaline (20 cc). In neurosurgery, the addition of adrenaline also reduces blood loss from the otherwise vascular scalp. Time interval from pre op oxygenation to intubation, intubation to infiltration and infiltration to incision was kept constant as 10 minutes. Patients were monitored for hemodynamic changes and adverse events. Recording of the pulse rate, systolic blood pressure (BP) and diastolic BP was done at following times: pre operative, intubation, pre infiltration, post pinning, and pre incision, post incision, 5 min post incision and 10 min post incision. A pair of 10 ml syringe was supplied in OT containing study solutions prepared by anesthesia resident who is not involved in this study. All syringes were identical in gross appearance. The one code number was given to those two syringes .All data were submitted and decoding was done after the surgery is over. Frame was hold/adjusted just beside to skull for pin insertion. The proposed points were marked with marker pen. Than this points were infiltrated with respected assign group drugs. The May field pin holder is the commonly used three pin head fixation device in our hospital. 1 ml of study drug was infiltrated at proposed site of each pin insertion under aseptic precaution. 23 gauge needle was inserted at 90 degree to skull skin than gradually withdrawn, with simultaneous injecting the solution in line of incision in all patients. Pin was pushed in skin 2 minutes after the solution injected. Scalp incision was similarly infiltrated by surgeon.

The surgeon performed local infiltration of the scalp incision after proper positioning and skin preparation with antiseptic solution before draping as per routine protocol. The injection volume was determined solely by the magnitude of incision length. Sustained severe hypertension (>30% rise in the SAP above pre induction level) was treated with additional propofol 2 mg/kg. If hemodynamic parameters were remained higher, than dial concentration of sevoflurane was gradually increased. Bolus Inj. Esmolol 0.5 mg/kg was given if previous drug regime was not effective; such treatment was noted in the recordings. Subjective counting of blood loss and feeling for brain relaxation by surgeon was recorded. All data are presented as mean ± SD. Student t-test was applied for comparison for continuous variables' mean rise in the heart rate, systolic and diastolic blood pressure. P value < 0.05 was considered statistically significant. Data were analyzed using the t-test online www.graphpad.com.

RESULTS

Twenty-four patients were female and 26 were male in group A, while in group B, 27 were male and 23 were female. The two groups were well matched for age, sex, weight and volume of infiltration drug. There were no differences in the type of craniotomy performed or time interval between induction and incision. Hemodynamic changes in response to each event were compared between two groups. Neither BP nor HR was affected significantly up to the process of infiltration in any of the two groups. In the lignocaine group- scalp incision, scalp reflection and craniotomy incision all resulted in increases in systolic, diastolic and heart rate significantly above baseline levels ($P < 0.05$).

None of the patient required propofol after post pinning in both groups. No statically significant hemodynamic

responses occurred during any event in the group receiving Ropivacaine pretreatment (P < 0.05). (Table I, II, III) No adverse reactions to infiltration were noted. There was significant rise in post pinning pulse rate in Group L (p =0.042). However the heart rate at post incision in the group L was significantly higher as compared to the group R (p =0.0001) (Table I), suggesting that scalp block with ropivacaine seems to have completely attenuated the heart rate response to incision. Increased levels of pulse was persists for 10 minutes of post incision even with IV propofol in group L. Post pinning systolic blood pressure (SBP) in the group L was significantly higher as compared to the group R at 5th minute. Although the SBP in the group R also recorded a mild increase in the systolic and diastolic blood pressure but it was well within 5% of the pre-pinning values and promptly returned to the pre-pinning value in 5 minutes and not needed any additional drug supplement, (Table II) reflecting a complete obtundation of sympathetic.

Table1: Pulse.

Time	Group R	Group L	P value
Pre op	87.5±5.78	88±4.98	0.64
Intubation	89.32±12.33	90±4.67	0.7
Pre infill.	88.42±10.65	89.56±5.65	0.48
Post pinning	89.28±2.79	90.47±3	0.042*
Pre incision	90.18±1.99	88.56±5.8	0.06*
Post incision	110.32±7.82	120.59±14.22	0.0001**
5 min post incision	110.7±8.28	120.3±12.57	0.0001**
10 min post incision	92.4±5.66	105.45±10.62	0.0001**

Table 2: Systolic pressure.

Time	Group R	Group L	P value
Pre op	125.44±15.43	130.45±14.65	0.09
Intubation	130.22±10.32	127.56±12.72	0.25
Pre infiltration.	120.22±12.34	124.27±11.11	0.08
Post pinning	129.34±12.54	124.66±15.78	0.35*
Pre incision	118.68±10.44	120.22±12.23	0.49
Post incision	120.31±4.52	135.47±13.24	0.0001**
5 min post infiltration.	115.7±3.21	120.0±11.67	0.01*
10 min post infiltration.	109.44±3.56	112.4±7.98	0.018*

Table 3: Diastolic BP.

Time	R group	L group	P value
Pre op	74.31±10.02	75.11±12.44	0.72
Intubation	80.33±3.56	80.56±4.61	0.78
Pre infil.	81.82±9.30	82.02±10.72	0.92
Post pinning	84.49±8.92	86.47±10.37	0.30
Pre incision	82.48±9.37	86.44±8.82	0.03*
Post incision	82.57±6.43	86.81±12.64	0.03*
5 min post incision	78.31±3.30	79.51±3.24	0.05*
10 min post incision	78.29±2.10	78.3±3.10	0.9

DISCUSSION

In the present study, we have shown that 0.5% ropivacaine infiltration to skull pin site and preincisional significantly blunts the rise in HR and BP ($P \leq 0.05$), reduced the rate for adjuvant systemic treatment and without causing any wound related or systemic side effects. The application of Mayfield pins into the skull is obviously a painful procedure and can potentially lead to a sympathetic response including rise in HR and BP even under general anesthesia. Administration of drugs to attenuate this response may cause hypotension. A sudden drop in BP below the lower auto-regulatory margin will result in a lower cerebral perfusion pressure (CPP), especially patients with space occupying lesion. The response to insertion of the pin and incision should therefore be accompanied by minimal haemodynamic changes. The use of local anesthetics as an adjunct in the anesthetic management of the patient presenting for craniotomy has been known for long. [1] 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. In a recent review article,[4] it was affirmed that regarding pre- or postoperative wound injection, pre is more effective than the other. However, Sara et al[5] suggested that preemptive injection is not as effective as postoperative injection. Therefore, it seems that this is a debatable issue.

Skull block with local anesthetics have been found to be quite effective in attenuating the hemodynamic response to pinning with bupivacaine 0.5% as shown by FJ Smith et al[6] and Pinosky et al.[7] Moreover, Gaze et al[8] in their study of comparison of scalp block with 0.5% bupivacaine with Alfentanyl and 0.5% bupivacaine infiltration have demonstrated that scalp block not only blunt the hemodynamic response but also reduce the sympathetic adrenal response as reflected by the reduced plasma cortical and ACTH levels measured at the fifth and sixtieth minute after pinning .Although the techniques – scalp block prove themselves superior to other treatment modalities / placebo. Although up to our best knowledge, there are no studies available for looking into pressure attenuating effect at time of incision in craniotomy using ropivacaine 5%. The main aim of this study was to assess the preincisional or pre stimulus use of ropivacaine to block sensory inflow from the periphery, preventing the pain stimuli. It seems that recent reports.[9, 10, 11] support this preemptive local infiltration. The scalp infiltration was found to be easily done and to effective in attenuate the haemodynamic stress response at time of incision. Ropivacaine acts at Na+ channels & additionally binds to the internal entrance of the K+ pore and blocks the channel in an open position. The mean half-life of the initial phase is approximately 14 minutes,[12] followed by a slower phase with a mean absorption t1/2 of approximately 4.2 hours, low plasma concentrations, fewer side effects, and is long lasting analgesia duration than bupivacaine. The duration of its action is 8 to 10 hours. Other studies used Ropivacaine infiltration at post procedure[13, 14] for post operative analgesia duration observation and had analgesic effects. Ropivacaine was used in neurological studies like Nguyen et al., [15] used ropivacaine (20 ml of ropivacaine 0.75%) scalp nerve block and stated that it is efficient in decreasing postoperative pain after craniotomy. Reduced nalbuphine consumption was noticed during the first postoperative day, after wound infiltration of 20 ml of ropivacaine 0.75% at the end of the craniotomy.[16] So ropivacaine has analgesic property when used as local infiltration in scalp. But none had examined its preincisional effects in craniotomy. In our study, SBP at post pinning and post incision in group R was markedly remained stable compared to control group. Marguerite Beacon observed that analgesic effect by wound infiltration and perfusion with ropivacaine was more effective than systemic analgesia especially during the early 48–72 hours after surgery. This supports our finding of analgesic property during incision. Preemptive analgesia is an antinociceptive treatment that prevents establishment of altered processing of afferent input, which amplifies postoperative pain. Pre incision per portal infiltration by ropivacaine is a safe, effective, and affordable method for pain relief after laparoscopic cholecystectomy. Its efficacy reduces the quantity of opioids required even in post operative period.[17]

Crile [18] advocated the use of regional blocks in addition to general anesthesia to prevent intraoperative nociception. There was haemodynamic stability during scalp incision under general anesthesia in our study with 0.5% ropivacaine. The ability of ropivacaine to produce cutaneous vasoconstriction offers advantages over other local anesthetic agents for infiltration use when use of epinephrine is undesirable [19]. As there was no difference in blood loss or oozing seen in both groups during incision in our study, demonstrating the vasoconstriction effect of 0.5% ropivacaine.

Ropivacaine decreased tissue oxygen saturation in vivo in children and young adults beginning 20 minutes following injection in the ipsilateral limb in peripheral nerve block. Change in saturation suggests 0.5% ropivacaine-induced local vasoconstriction.[20, 21]

Many other studies have failed to observe the occurrence of adverse events even at larger ropivacaine plasma concentrations when using it as local infiltration. For instance, Horn p et al[22] observed no toxic effects at plasma concentrations of 225 mg ropivacaine used as wound infiltration. Also exceeding doses of ropivacaine up to 300mg may not clinically yield a difference in terms of cost per active pain.[23] In our study no adverse effects observed with total of 100mg ropivacaine in scalp pin and incision infiltration. Lignocaine with adrenaline 1% 20 cc was infiltrated prior to skull pin application significantly blunts the rise in HR and MAP ($P \leq 0.001$) without complimenting with any systemic methods and without causing any wound related or systemic side effects. The effects were not noticeable 30 minutes after the infiltration, and at that point the hemodynamic

response had normalized. They had kept second group as no infiltration one, so they get significant data compared to us [24]. In our study, we had not kept saline or no infiltration group, we don't want to harm the patients 'outcome. Local infiltration of 0.5% ropivacaine at scalp pin site and preincisional in the craniotomy demonstrates the best adapted to our practice, because of its indisputable efficacy, simplicity and without toxicity.

CONCLUSION

We can state that scalp pin site and pre-incisional infiltration with 0.5% Ropivacaine is very effective, safe and superior to Lignocaine hydrochloride 1 % with adrenaline in attenuating the hemodynamic response in craniotomy.

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