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Comparative Study of Dexamethasone and Buprenorphine as Adjuvant to Ropivacaine for Supraclavicular Block.

Vijeta Kumari[1]

[1]Assistant Professor, Department of Anaesthesiology, Heritage institute of medical Science, Varanasi.

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ABSTRACT

Background: Ropivacaine is an amino-amide, local anaesthetic with higher toxic threshold, having less cardiac and central nervous system effects, less motor block and a similar duration of action of sensory analgesia compared to Bupivacaine. The addition of dexamethaxone or buprenorphine to the local anaesthetic improves the quality of block. This study was conducted to evaluate the effect of dexamethaxone and buprenorphine on characteristics of ropivacine induced supraclavicular block. **Methods:** A total of 120 patients, 40 patients in each of the three groups were randomly selected for study. Patients were randomly allocated to each of the three groups. Group R: Ropivacaine (0.5%) (36ml) + Normal saline (2ml). Group RD: Ropivacaine (0.5%) (36ml) + 8mg (2ml) Dexamethasone. Group RB: Ropivacaine (0.5%) (36ml) + 0.3mg (1ml) Buprenorphine +(1ml) Normal saline. **Results:** The duration of analgesia lasted significantly longer in patients of group RD and group RB as compared to group R. The Mean ± SD time for the group R, RB, RD were 479.27 ± 140.51 mins, 718.12 ± 217.74 mins, 983.30 ± 330.21 mins respectively. The p value between group R vs RB (0.001), R vs RD (0.001), RB vs RD (0.001) i.e. statistically significant. In group R the mean time of first rescue analgesic was 9.17 ± 1.98 hrs, group RB was 15.82 ± 4.54 hrs, group RD was 19.22 ± 5.60 hrs. The p value between the group R vs RB, R vs RD, RB vs RD was < 0.001 i.e. highly significant. The number of doses of rescue analgesic in R group has a mean value of 2.4 ± 0.74, in RB group is 1.41 ± 0.59, in RD group 1.3 ± 0.46. The overall p value is 0.001, the p value between R vs RB and R vs RD is statistically significant, p value between RB vs RD > 0.05 i.e. insignificant. Statistical significant difference in sedation score was noted between group RB and RD, RB and R group. The changes in VAS score was low in the first 5hrs, pain increased in group R in 6 - 10 hrs, while in group RB the pain started increasing in 12 -16 hrs, while in group RD the pain started increasing in 16 - 20 hrs. **Conclusion:** Both dexamethasone and buprinorphine have been found to have favourable effect on brachial plexus block characteristics with side effects slighty higher in buprenorphine group. Though a significant prolongation of duration of post operative analgesia is noted in dexamethasone group.

Keywords: Dexamethasone, Ropivaxcaine.

INTRODUCTION

"Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage".[1] Brachial plexus block is often used either as an adjuvant to general anesthesia (GA) or as a sole anesthetic modality for intraoperative and postoperative analgesia. Brachial plexus blockade for ambulatory upper limb surgery can significantly reduce pain as compared to GA.[2] It provides a superior quality of analgesia and avoids the common side effects associated with GA and preferably useful in patients with significant comorbidities who cannot tolerate GA.[3]

Ropivacaine, is a S(−) enantiomer, unlike bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity and improving relative sensory and motor block profiles.[4] This favourable clinical profile has prompted many clinicians to switch from Bupivacaine to Ropivacaine for all types of neural blockade.

For moderate prolongation of analgesia (<24 h), various adjuvant drugs can be admixed with local anesthetic. So various adjuvants like opioids,[5-7] Clonidine,[8] ketamine,[9] midazolam etc.[10] were added to local anesthetics in brachial plexus block to achieve a quick, dense and prolonged block, but the results are either inconclusive or associated with side effects eg: nausea, vomiting, pruritus etc.[11] Addition of adjuvants to the local anaesthetic drug increases the potency, duration and quality of anaesthesia and postoperative analgesia in supraclavicular block. Furthur these adjuvants may also reduce the side effects associated with local anaesthetics alone. The prolonged analgesic benefit of buprenorphine has been reported with brachial plexus block.[12,13] Some of these also report side effects in form of increased pruritis and nausea.[14,15]

Name & Address of Corresponding Author
Dr. Vijeta Kumari,
Assistant Professor,
Department of Anaesthesiology,
Heritage Institute of Medical Science,
Varanasi.

Steroids have powerful anti-inflammatory as well as analgesic property. Dexamethasone is a potent and highly selective glucocorticoid. Various studies have been done using dexamethasone 8 mg as an adjuvant to local anaesthetics mixture in brachial plexus block resulting in variable effects on onset but prolonged duration of analgesia and motor block.[15-19]

MATERIALS AND METHODS

After obtaining clearance from institutional ethical committee, a double blind, prospective, randomized study was carried out on 120 patients between age group 18 to 60 years and ASA grade I and II, undergoing elective upperlimb orthopedic surgeries.
GROUP R: Ropivacaine (0.5%) (36ml) + Normal saline (2ml).GROUP RD: Ropivacaine (0.5%) (36ml) + 8mg (2ml) Dexamethasone . GROUP RB: Ropivacaine (0.5%) (36ml) + 0.3mg(1ml) Buprenorphine +(1ml) Normal saline.
Patients of ASA grade III,IV,V, hypersensitivity to local anaesthetics, opioid addicts, systemic disease, local site infection, pregnant, neurodeficite, block failure, uncooperative one were excluded from the study.
Proper preoperative assessment was done on previous day of surgery. The nature, risk and safety of the procedure was explained and a written, informed consent obtained.
Patients were premedicated with tablet alprazolam (0.5mg) and tablet ranitidine (150 mg) per oral, night before surgery. On arrival in operation theatre, intravenous (IV) cannulation was done and normal saline infusion was started. Multiparameter monitor was connected and Oxygen saturation (SpO2), heart rate (HR), noninvasive blood pressure (NIBP), and continuous electrocardiograph were monitored. Patients were sedated with IV midazolam (0.05 mg/kg) before block was administered. No analgesic drugs were given during pre medication. The brachial plexus block was carried out after thorough explanation of the procedure and emphasizing the need for patient cooperation. All supraclavicular blocks were performed by using 22 G, 50mm insulated blunt needle, Stimuplex (B Braun) or Locoplex (Vygon) needles with extension tubing, and an Inmed nerve stimulator.The patients were administered Superaclavicular block under strict aseptic precautions , after infilterating the injection site with 1ml of 2% lidocaine subcutaneously. The location end point being a distal motor response with an output lower than 0.6 mA. During injection, negative aspiration was performed every 5-6 ml to avoid intravascular injection.
Sensory block was assessed by loss of sensation to Pinprick at the dermatomal areas corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve. At the onset of sensory block there is reduction in sensibility by 30%. Complete block was considered when there is complete loss of sensation to pin prick. Motor block was assessed by the time of injection of the drug to development of motor weakness. Motor score of 2 will be taken as onset time of complete motor block and duration of motor block will be taken as time interval between local anaesthetic administration and complete recovery of the motor block.
The duration of sensory block is defined as the time interval between the onset of sensory block and the first postoperative pain. The duration of motor block is defined as the time interval between the onset of motor block and complete recovery of motor functions.
Duration of analgesia is the interval between onset of analgesia to the time patient first complains of pain. VAS score (0-10scale), was assessed every hour after the surgery.
All the patients were observed for any side-effects like nausea,vomiting, urinary retention, horseness of voice, ipsilateral diaphragmatic paralysis etc or any complications like local anaesthetic toxicity, pneumothorax, hematoma, neuropathy or haemodynamic changes. Pulse rate, Blood pressure, visual analogue score, visual analogue rating score were observed every hourly for 24 hours post-operatively.
The statistical analysis was performed with "Graph Pad Prism version 5.03". Arithemic mean, median (range), standard deviation, Standard error of mean, Analysis of variance (ANOVA), Chi square test were performed, wherever applicable, on the data. Post ANOVA multiple comparison test was also performed to compare the groups.
All the three groups were compared with respect to: onset of sensory block, onset of motor block, duration of sensory block, duration of motor block, duration of analgesia, occurrence of adverse effects.

RESULTS

Analysis of the patient's characteristics (age, sex ratio, weight and ASA grad) demonstrated no significant difference between the three groups and the p value was > 0.05 i.e. statistically insignificant. Also all the three groups were similar with regard to the duration and type of surgery (p value > 0.05).
Time of onset of sensory block: the study reveals that the Mean ± SD time required for the onset of sensory block in group R was 8.85 ± 2.41 mins, in group RB was 8.87 ± 2.27 mins, group RD 9.22 ± 2.62 mins. So it was observed that duration of onset of sensory block among all the three groups had a p value > 0.05 i.e statistically insignificant.

Table 1: Distribution of patients according to onset of sensory block.

Time (min)	Group R (No. of patients)	Group RB (No. of patients)	Group RD (No. of patients)
≤ 5	5	4	2
6-10	26	25	26
11-15	9	11	12

16-20	0	0	0
> 20	0	0	0
Total	40	40	40
Range	5 -15	5 – 14	5 – 15
Mean ± SD	8.85 ± 2.41	8.87 ± 2.27	9.22 ± 2.62
SEM	0.349	0.38	0.41
P value	R vs RB - P value > 0.05 (ns) R vs RD - P value > 0.05 (ns) RB vs RD - P value > 0.05 (ns)		

Time of onset of motor block : The mean duration of onset of motor block in group R was 13.32±3.5mins, in group RB was 12.75 ± 3.29mins, in group RD was 12.42 ± 2.845 mins. So it was observed that duration of onset of motor block among all the three groups had a p value > 0.05 i.e statistically insignificant.

Table 2: Distribution of patients according to onset of motor block

Time (mins)	Group R (No. of patients)	Group RB (No. of patients)	Group RD (No. of patients)
≤10	10	12	13
11-15	20	22	24
16-20	8	4	2
>21	2	2	1
Total	40	40	40
Range	8 – 24	7 - 22	7 – 22
Mean ± SD	13.32 ± 3.5	12.75 ± 3.29	12.42 ± 2.845
SEM	0.56	0.52	0.44
P value	P value >0.05 (ns)		
	R vs RB > 0.05 (ns) R vs RD > 0.05 (ns) RB vs RD > 0.05 (ns)		

Total duration of analgesia : The Mean ± SD time for the group R, RB, RD were 479.27 ± 140.51 mins, 718.12 ± 217.74 mins, 983.30 ± 330.21 mins respectively. Analgesia lasted significantly longer in group RD and group RB as compared to R group. The p value between group R vs RB (0.001), R vs RD (0.001), RB vs RD (0.001) i.e. statistically significant.

Table 3: Distribution of patients according to duration of analgesia

Time (mins)	Group R (No. of patients)	Group RB (No. of patients)	Group RD (No. of patients)
≤180	2	0	0
181-300	4	0	0
301-420	8	2	0
421-540	9	8	5
541-660	17	7	2
661-780	0	10	6
781-900	0	8	2
901-1020	0	3	5
1021-1140	0	0	0
1141-1260	0	0	11
1261-1380	0	2	7
> 1381	0	0	2
Total	40	40	40
Range	175 – 660	390 - 1300	450 – 1822
Mean ± SD	479.27 ± 140.51	718.12 ± 217.74	983.30 ± 330.21
SEM	22.21	34.42	52.21
P value	P value < 0.001 (s) R vs RB < 0.001 (s) R vs RD < 0.001 (s) RB vs RD < 0.001 (s)		

Haemodynamics (HR, NIBP) and respiratory parameters (SpO2 and RR) observation showed that neither hypotension nor bradycardia or respiratory depression was noted in any group.

The side effects (intra operative and postoperative) observed is shown in the tables. The incidence of sedation was more with buprenorphine (RB) group than with dexamethasone (RD) group and R group.

Statistical significant difference in sedation score was noted between group RB and RD, RB and R group. Maximum sedation score of 2 was noted 2 patients of RB group and a sedation score of 1 was noted in 8 patients of RB group. The rest 30 patients of RB group has a sedation score of 0. While in group R and RD all the 40 patients had a sedation score of 0.

The changes in VAS score as shown in the table was low in the first 5hrs. The pain increased in group R in 6 - 10 hrs, while in group RB the pain started increasing in 12 -16 hrs, while in group RD the pain started increasing in 16 - 20 hrs.

In group R the mean time of first rescue analgesic was 9.17 ± 1.98 hrs, group RB was 15.82 ± 4.54 hrs, group RD was 19.22 ± 5.60 hrs. The p value between the group R vs RB, R vs RD, RB vs RD was < 0.001 i.e. highly significant. The number of doses of rescue analgesic in R group has a mean value of 2.4 ± 0.74, in RB group is 1.41 ± 0.59, in RD group 1.3 ± 0.46. The overall p value is 0.001, the p value between R vs RB and R vs RD is statistically significant, p value between RB vs RD > 0.05 i.e. insignificant.

DISCUSSION

Supraclavicular block provides a rapid, dense, and predictable anaesthesia of the entire upper extremity in the most consistent manner of any brachial plexus technique.[20] Although this is an excellent technique in experienced hands, the use of peripheral nerve stimulator has shown the considerable increase in the success rate of block and despite the advent of ultrasound-guided peripheral nerve blockade, nerve stimulation remains a popular technique used alone. Yasuda et al,[21] used a technique employing a nerve stimulator and an insulated needle for supraclavicular brachial plexus block that was successful in 98% of patients. That is why we had selected supraclavicular approach with peripheral

nerve stimulator to supraclavicular brachial plexus block in our study. Long acting local anaesthetic agent, Bupivacaine, is frequently used for brachial plexus anaesthesia. Its cardiac and central nervous system toxic effects in some patients prompted the researchers to develop new local anaesthetic agent with a profile similar to Bupivacaine without considerable toxic effects. One such possible replacement for Bupivacaine was Ropivacaine.[22] It also seems to be a less hazardous drug if overdose or accidental intravenous injection occur.It is a S(−) enantiomer, unlike bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity and improving relative sensory and motor block profiles.[4] This favourable clinical profile has prompted many clinicians to switch from Bupivacaine to Ropivacaine for all types of neural blockade.

For moderate prolongation of analgesia (<24 h), various adjuvant drugs can be admixed with local anesthetic. In the present study we studied the effect of adding inj. dexamethasone and inj. buprenorphine as an adjuvant to inj. Ropivacaine. According to the traditional theory of steroid action, steroids bind to intracellular receptors and modulate nuclear transcription. Honorio et al,[23] found that steroids produce analgesia by blocking transmission in nociceptive c-fibers and suppressing ectopic neuronal discharge. According to Attardi et al.,[24] steroids might bring about this effect by altering the function of potassium channels in the excitable cells and this might be the probable mechanism of action by dexamethasone for the prolongation of blockade in our study. The dose of dexamethasone as an adjuvant to local anesthetics for peripheral nerve block has not been described. We selected a dose of 8 mg because administration of this dose seems to be safe in adults. Adverse effects with a single dose of dexamethasone are probably extremely rare and minor in nature, and the previous studies have demonstrated that short-term (<24 h) use of dexamethasone was safe.[25,26] Several studies have shown that addition of 4-8 mg of dexamethasone to local anaesthetics effectively and significantly prolongs the duration of analgesia.[20]

Various studies have also assessed the effect of buprenorphine on post operative analgesia after brachial block and found that duration of post operative analgesia is increased significantly as compared to local anesthetic agent alone. An array of opioid are studied including fentanyl,[27] alfentanyl,[28] pethidine,[29] and morphine,[30] but the reason for the contrasting result are not clear. For example in a study by J.E.Bazin et al,[31] it has been shown that addition of sufentanil 0.2mcg/kg, buprenorphine (3mcg/kg) and morphine (75mcg/kg) to bupivacaine + lidocaine solution resulted in 24, 20 and 21 hrs of analgesia. The mean duration of analgesia in our study, using buprenorphine as an adjuvant with ropivacaine was 718.12±217.1 mins as compared to the ropivacaine group which was 479.27±140.51 mins. In a similar study conducted by Veil Ej.et al,[32] with 36 ml of 0.5% ropivacaine using supraclavicular technique and 0.3 mg buprenorphine, the authors observed the duration of analgesia to be 35 hrs (35.05 ±1.95). Boogerts J et al,[29] reported duration of analgesia to be 24 hrs with buprenorphine 0.15 mg.

CONCLUSION

Thus to conclude both dexamethasone and buprinorphine have been found to have favourable effect on brachial block characteristics with side effects slightly higher in buprenorphine group. Though a significant prolongation of duration of post operative analgesia was noted in dexamethasone group.

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