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Comparison of buprenorphine and tramadol as an adjuvant to ropivacaine 0.5% used in supraclavicular brachial plexus block for orthopaedic upper limb surgeries

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Abstract

Background: Brachial plexus block is safe and effective regional anaesthetic method for upper limb surgeries. To prolong brachial plexus blockage, several opioid additives have been considered. The pursuit of a better compound resulted in the identification of opioids such as tramadol and buprenorphine as adjuvants**. Objectives:** To compare the effect of tramadol and buprenorphine in Supra clavicular brachial plexus block achieved with Ropivacaine 0.5% in patients undergoing upper limb surgeries. **Methods:** A total 100 patients of either sex, ASA grade I & II, age between 20-60 years were enrolled and randomly divided into 2 groups of 50 patients each. Group A: received Inj. Ropivacaine 0.5%, 2mg/kg and Buprenorphine 6mcg/kg and Group B: received Inj. Ropivacaine 0.5%,2mg/kg and Tramadol 2mg/kg. Onset and duration of sensory and motor block, duration of analgesia was noted. **Results:** The mean onset of sensory and motor blockade was slightly early in group A compared to group B, which was statistically significant ($p<0.05$). The mean duration of sensory and motor blockade as well as duration of analgesia was prolonged in group A compared to group B, ($p<0.05$). The visual analogue scale (VAS) showed significant values at fourth [Group A] and sixth [Group B] hours of post-operative period, ($p=0.0005$). In the fourth and sixth hours after surgery, the mean VAS was 2.80 and 2.96 respectively. **Conclusion:** Buprenorphine when added to Ropivacaine in Supraclavicular block, shortens the onset of sensory and motor block, increases the duration of sensory and motor blockade, and increases the duration of analgesia compared to Tramadol with no noticeable adverse effects.

Keywords: Supraclavicular block, Ropivacaine, Buprenorphine, Tramadol; Sensory, Motor block; Analgesia

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Introduction

The most common method for upper extremity surgeries is a brachial plexus block. The brachial plexus block can be done in a variety of ways, Interscalene approach, Supraclavicular approach, Axillary approach, and Infraclavicular approach [1]. The preferred regional anaesthesia for upper limb surgeries is Supraclavicular brachial plexus block. The brachial plexus is anatomically most compact at the proximal division or trunk level, which provides the most reliable anaesthesia for upper limb surgeries by anaesthetising the middle and lower plexus over 80% of the time (median, radial and ulnar) [2].

However, brachial plexus blocks have been performed using a variety of local anaesthetics. Ropivacaine is a type of local anaesthetic that belongs to the amino amide family [3]. It is having similar pharmacology to bupivacaine; however, has a wider safety margin due to its reduced lipophilicity resulting in decreased potential for the central nervous system toxicity and cardiotoxicity [4, 5]. A variety of adjuvants have been added to improve the quality of block, reduce the total dose of local anesthetics used, and to reduce the need for supplementary postoperative analgesia. Several combinations of LAs and various adjuvants such as morphine, tramadol, buprenorphine, clonidine, dexamethasone, fentanyl, and butorphanol have been used in various studies, but there was a scarcity of literature comparing tramadol with buprenorphine as adjuvants to LAs [6].

Buprenorphine, a lipophilic opioid has high molecular weight, high affinity for μ receptor, longer duration of action, [7, 8] is easily available and is cost-effective, also possesses lesser degree of significant side effects such as respiratory depression and sedation when compared to other opioids [9, 10]. Tramadol is a synthetic 4-phenyl-piperidine analog of codeine with a dual mechanism of action. Firstly, it stimulates the μ receptor and to lesser extent delta and kappa opioid receptors. Secondly it activates spinal inhibition of pain by decreasing the reuptake of nor epinephrine and serotonin. It is one fifth to one tenth as potent as morphine [11]. After thorough research in literature, we found very few published data comparing the effect of buprenorphine and tramadol as an adjuvant to ropivacaine for orthopaedic upper limb surgeries. Hence the present study was undertaken to compare the effects of tramadol and buprenorphine in Supra clavicular brachial plexus block achieved with Ropivacaine 0.5% in patient undergoing upper limb Orthopaedic surgeries of forearm and hand.

Materials and Methods

It is a prospective, randomized, controlled study, conducted in the Department of Anaesthesiology, at Deccan College of Medical Sciences, Kanchanbagh, Hyderabad over

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period of 18 months from May 2020- Nov 2021. A total 100 patients of either sex, ASA grade 1 and 2, age between 20-60 years and who were scheduled for Orthopaedic upper limb surgeries of forearm and hand were enrolled and randomly divided into 2 groups of 50 patients each. Group A patients received Inj. Ropivacaine 0.5%, 2mg/kg and Buprenorphine 6mcg/kg and group B patients received inj. Ropivacaine 0.5%, 2mg/kg and Tramadol 2mg/kg with peripheral nerve stimulator technique. Patients' refusal, patients having neurological complications, respiratory conditions like ipsilateral pneumonia, pneumothorax, patients who were mentally deficit, patient with sepsis at the site of block, patients having allergy and hypersensitivity to local anesthetics, coagulation abnormality and bleeding disorders were excluded from the study.

All the patients selected were explained about the procedure and a thorough informed consent taken. Intra dermal test for drug sensitivity was done. All patients were monitored for BP, heart rate, mean arterial pressure, ECG, proper IV access 18g venflon. During the procedure patients were given premedication and aspiration prophylaxis. Injection midazolam 1mg was given for sedation. Following this, assessment of sensory blockade was done by Pin Prick Method (0=Sharp pain; 1=Touch; 2=No sensation) and assessment of motor blockade was done by Bromage 3 Point Score (0=normal motor function; 1=decreased motor strength, ability to move fingers; 2=complete motor block with inability to move fingers). Pain was assessed by visual analog scale. The parameters noted were onset and duration of sensory and motor block, duration of analgesia. Any side effects were also noted.

Statistical Analysis

Data was collected and pooled into MS Excel version 7 and descriptive statistics used to draw the tables, frequencies and percentages followed by graphical representation and inferential statistics was used to analyse the data appropriate statistical technique such as t-test, chi-square, ANOVA etc. The level of significance was 5%. The p-value <0.05 was considered as statistically significant.

Observations and Results

A total of 100 patients were enrolled and divided into 2 groups of 50 patients each. Both the groups were comparable and found no significant difference with respect to demographic data of patients and duration of surgery as shown in table 1.

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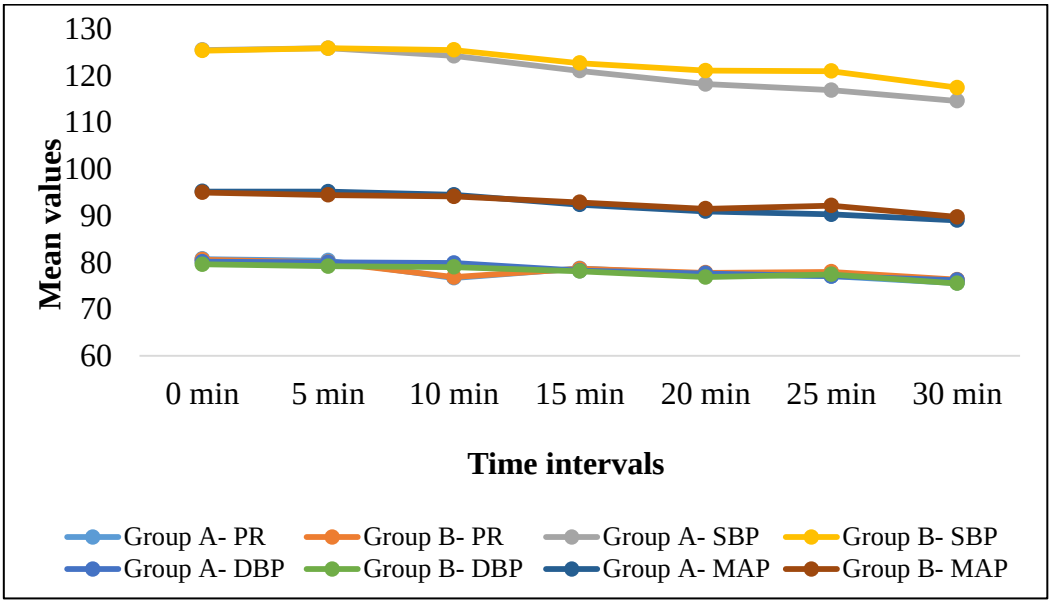
Table 1: Demographic profile of the patients and duration of surgery

Demographic data		Group A	Group B	P value
Age group (Years)	20-30	10 (20%)	20 (40%)	>0.05
	31-40	04 (8%)	06 (12%)	
	41-50	14 (28%)	10 (20%)	
	51-60	22 (44%)	14 (28%)	
	Mean ± SD	57.72±2.56	40.58±14.41	
Sex	Male	35 (70%)	38 (76%)	>0.05
	Female	15 (30%)	12 (24%)	
ASA	I	45 (90%)	43 (86%)	>0.05
	II	05 (10%)	07 (14%)	
Height(cm)		161.72±5.73	162.34±5.80	0.380
Weight(kg)		60.22±6.59	61.88±7.64	0.810
Duration of surgery (min)		98.4±22.80	98.2±38.77	0.976

Both groups were comparable with regard to pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP). There was no statistically significant difference (P >0.05) as depicted in figure 1.

Figure 1: Hemodynamic variables



The onset of sensory and motor blockade was slightly early in group A compared to group B. The mean duration of sensory and motor blockade as well as mean duration of analgesia was prolonged in group A compared to group B. There was statistically significant

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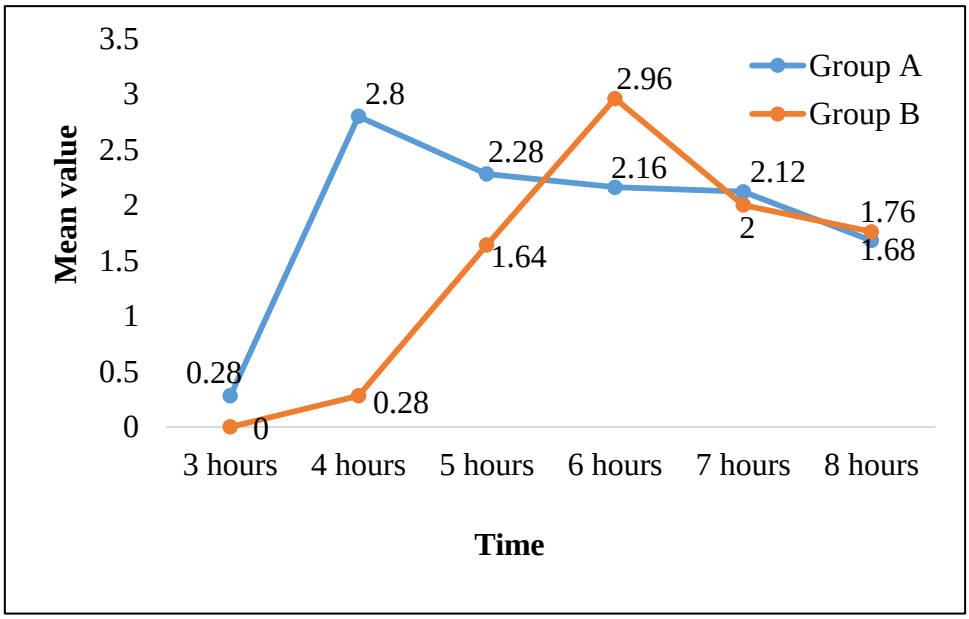
difference in block characteristics for both the groups with the p-value less than 0.05 as shown in table 2.

Table 2: Supraclavicular brachial plexus block characteristics

Block Characteristics	Group A	Group B	P value
Onset of Sensory blockade (min)	4.76±0.68	5.28±0.53	0.00569
Onset of motor blockade (min)	9.52±1.08	10.4±1.05	0.00949
Duration of Sensory blockade (hours)	12.04±0.79	10.96±0.89	0.0085
Duration of motor blockade (hours)	11.8±1.00	9.22±0.83	0.0002
Duration of analgesia (hours)	18.26±1.69	10.88±0.86	0.0002

The visual analogue scale shows significant values in the fourth [Group A] and sixth [Group B] hours of the post-operative period. 0.0005 was the p-value. In the fourth and sixth hours after surgery - post operative period, the mean VAS was 2.80 and 2.96 respectively, (Figure 2).

Figure 2: Distribution based on Visual Analog Scale



In group A, 6% of the cases reported only touch sensation while 94% reported pain sensation whereas in group B, only 4% of the cases reported only touch sensation while 96% reported pain sensation. In group A: The mean time to reach Bromage 3 was 7.48±1.2 minutes and in group B: The mean time to reach Bromage 3 was 7.52±1.2 minutes, (p=0.991). No adverse effects were noted in present study.

Discussion

Supraclavicular brachial plexus block is a commonly performed regional anesthetic technique for forearm and hand surgeries and provides good surgical anesthesia. It is easy to

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perform even if the arm is immobilized. In the present study, supraclavicular brachial plexus block characteristics were compared between buprenorphine (Group A) and tramadol (Group B) as an adjuvant to ropivacaine 0.5% used for orthopaedic upper limb surgeries. In group A, most of the patients were in the age group of 51 to 60 years (44%) whereas in group B the majority were in the age group of 20 to 30 years (40%). Male predominance was seen in both the groups which was comparable with the study conducted by Jain et al [12]. There was no statistically significant difference found in mean PR, SBP, DBP, MAP for both the groups. Similar findings are reported in Yadhuraj MK et al study [13].

Like other studies [12, 14], the present study demonstrated significantly faster onset of sensory and motor block in buprenorphine group. This can be attributed to high analgesic potency determined by its high lipid solubility which leads to faster penetration of lipid membranes, binding to receptors, and hastening of block. However, there was significantly longer durations of sensory and motor block in group receiving buprenorphine as an adjunct. These findings are consistent with those of Jain et al [12], Patil S et al [15] and Behr et al [16]. Orthopedic surgeries can be of prolonged duration. Thus, prolonged sensory and motor blockade along with prolonged analgesia are of utmost importance in these surgeries. Patients receiving buprenorphine also demonstrated significantly longer duration of analgesia than the tramadol group and the p-value was statistically significant which is correlated with the previous studies [12, 15, 17]. Prolonged duration of analgesia by buprenorphine can be explained by its high binding capacity and affinity for μ receptors. It dissociates slowly from its receptors which results in longer duration of action. Also, similar findings of prolongation of duration in sensory and motor block and duration of analgesia were observed by Sarkar et al [18] and Candido KD et al [19].

Hypotension, bradycardia, nausea, and vomiting were the most common side effects reported in previous studies. But during the course of current study, we did not observe any side effects in any of the patients in groups A or B due to the drugs at the doses used. Patil KN et al study on ropivacaine with adjuvants in supraclavicular peripheral blocks, found that the drug is well tolerated by patients and that there are no side effects [20]. Ropivacaine is a relatively new long-acting amide local anaesthetic that is structurally similar to bupivacaine but is less cardiotoxic. Buprenorphine is a semisynthetic thebaine congener that is 30-35 times stronger than morphine. Because of its strong affinity for Mu receptors, it is known to prolong the duration of local anaesthetic activity. When compared to patients with moderate levels of opioid dependence. However, buprenorphine is better for maintenance treatment and

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has higher clinical utility in severe levels of opioid dependence where maintenance therapy is required.

Limitations

The current study did not compare the effect of Ropivacaine treatment timing (preoperative vs. end of surgery) on post-operative pain alleviation. Also did not record the duration of hospital stay and did not compare it across groups, which is an important variable to examine in terms of health economics. Patients above ASA grade II and patients with significant co-morbidities were not included in the study.

Conclusion

Buprenorphine when added to ropivacaine in supraclavicular block, shortens the onset of sensory and motor block, increases the duration of sensory and motor blockade, as well as increases the duration of analgesia compared to tramadol with no noticeable adverse effects.

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