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Comparison of Buprenorphine and Tramadol as an Adjuvant to Bupivacaine in Supraclavicular Brachial Plexus Block

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Abstract

Background: Supraclavicular brachial plexus block is a good alternative to general anaesthesia for upper limb surgery below shoulder as it avoids the untoward effects of general anaesthesia. Block when given only with local anaesthetic can't prolong postoperative analgesia. Presence of opioid receptors in the peripheral nervous system allows us to use various opioids as an adjuvant to achieve prolong postoperative analgesia. This study was done to compare tramadol and buprenorphine as an adjuvant to 0.35% bupivacaine in supraclavicular brachial plexus block in terms of efficacy and safety. *Methods*: A prospective, randomized study was done in 80 patients of American Society of Anaesthesiologist (ASA) class I and II undergoing elective upper limb orthopedic surgeries under supraclavicular block. Patients were randomized into two groups of 40 each. Group B- Patients received inj. bupivacine 0.35%, 2mg/kg + inj. buprenorphine 6μg/kg. while in group T- Patients received inj. bupivacine 0.35% 2mg/kg+ inj. tramadol 2 mg/kg. Onset and duration of sensory and motor block, duration of postoperative analgesia and adverse effects of study drugs were compared in both the groups. *Results*: Sensory and motor block onset times were shorter in group B than in group T ($p < 0.05$). Motor block duration was longer in group B than in group T ($p < 0.05$).Similarly, duration of analgesia was longer in group B compared to group T (942.83±124.51 min vs 478.31±52.60 min) ($p<0.001$). *Conclusion*: Buprenorphine when added to bupivacaine in supraclavicular block shortened the onset of sensory and motor block , enhances the duration of motor block and duration of analgesia compared to tramadol without significant side effects.

Keywords: Buprenorphine; Tramadol; Supraclavicular Block.

Introduction

Surgeries of the upper extremity are routinely done under brachial plexus anesthesia, as it is well known to provide surgical anesthesia and postoperative analgesia. Supraclavicular brachial plexus block is mainly used for any surgery in the upper extremity below shoulder, because it is a safe technique with rapid onset, reliable anesthesia and avoids the untoward effects of general anesthetic drugs and upper airway instrumentation [1].

Local anesthetic of a choice for brachial plexus anesthesia is inj.bupivacaine because it offers the advantage of providing a long duration of action with adequate sensory and motor neural block [2]. The problem solely with local anesthetics is that they cannot provide prolonged postoperative analgesia.

The aim of management of postoperative pain is minimizing the dose of medications in turn lessen side effect and still providing adequate analgesia. Management of postoperative pain relievers sufferings and leads to early mobilization, shortened hospital stay, reduce ospital coast and increase patient satisfaction [3].

Significant prolongation of brachial plexus analgesia can be achieved with placement of

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continuous catheters. For moderate prolongation of analgesia, various adjuvant drugs can be admixed with local anesthetic including opioids such as morphine, fentanyl, tramadol, buprenorphine, sufentanil and calcium channel blockers such as verapamil and α-agonists such as clonidine to prolong the duration of postoperative analgesia without prolonging motor blockade or causing systemic side effects [4].

The demonstration of presence of opioid receptors in the peripheral nervous system by Fields et al [5], prompted many investigations on the use of opioids either alone or combined with local anaesthetics for regional anaesthesia procedures. Important factors determining the duration of action include lipid solubility and the affinity of different opioids for their receptors [6].

Several studies have shown that the addition of buprenorphine, an agonist antagonist opioid to bupivacaine produces longer postoperative analgesia compared to other opioids [6,7].Tramadol, a μ receptors agonist has also been shown to improve postoperative analgesia when used as an adjuvant in brachial plexus block with less respiratory depressant effect due to weak μ receptor affinity [8].

The aim of this study was to evaluate and compare the efficacy of buprinorphine 6 μg/kg and tramadol 2mg/kg added to bupivacaine 0.35% regarding onset and duration of sensory motor block and total duration of post operative analgesia as a primary outcome , hemodynamic variables and side effects such as sedation, pruritus and nausea-vomitting associated with the study drugs were also evaluated.

Patients and Methods

This study was conducted in Department of Anaesthesiology, Acharya Vinobha Bhave Rural Hospital (AVBRH) affiliated to Jawaharlal Nehru Medical College, Sawangi (M), Wardha over the period of two years. After obtaining hospital ethics committee permission and written informed consent, 80 patients belonging to American Society of Anaesthesiologists (ASA) physical status class I and II and aged between 20 to 60 years, weighing between 40 to 70 kgs, scheduled for elective hand, forearm or arm orthopedic surgeries under supraclavicular block were included in this study. Exclusion criteria included history of allergic reaction to local anaesthetics and study drugs, coagulopathy, pregnant women, local sepsis or deformity, severe neurologic disorders.

Pre-anesthetic checkup of the patients were done a day prior to surgery. After taking detailed history, thorough general, physical and systemic examination was done. Weight & routine investigations of the patient were recorded. Informed consent was taken and patients were asked to have 8 hours of fasting. Patients did not receive any pre-medications.

On arrival in operation theater, 18G i.v. cannula was secured in opposite limb and infusion of Ringer's lactate was started at the rate of 80 ml/hr. Standard monitors including non-invasive blood pressure, pulse oxymetry and ECG were attached to the patient and baseline pulse rate, systolic & diastolic blood pressure and SpO_2 values were recorded. Emergency drugs and equipments including facilities for GA were kept ready. Study drug was prepared in a sterile bowl by taking 28 ml 0.5% inj. bupivacaine + 12 ml normal saline (40 ml 0.35% inj. bupivacaine) + inj. tramdol 100mg / inj. Buprinorphine 0.3 mg.

Patients were randomly allocated by computer generated random number table in one of the two groups of 40 patients each.

Group B (Buprenorphine): Patients received inj. bupivacine 0.35% 2mg/kg + inj. buprenorphine - 6 μg/kg.

Group T (Tramadol): Patients received inj. bupivacine 0.35% 2mg/kg + inj. tramadol-2mg/kg.

Block was given by subclavian perivascular technique using nerve locator. The nerve locator utilized was the Stimuplex DIG (B. Braun, Allentown, PA). A 22-gauge, 2-inch, short-bevel insulated needle (Stimuplex; B. Braun) was used for all blocks. Patients were made to lie down supine with head turned to opposite side. Under all aseptic precautions a skin wheal was raised 1 finger breadth over the lowermost palpable portion of the interscalene groove lateral to subclavian artery pulsations and the block needle was inserted through it. The intensity of stimulating current was initially set to deliver 0.9 mA with stimulation frequency was set at 1 Hz, the needle was advanced directly caudadly until a flexor or extensor response of all the fingers was obtained, at this point current was gradually decreased to 0.4 mA. If the response was still visible, the local anesthetic solution according to group was injected in 3-5 mL increments with repeated aspirations between each increment. If any arterial puncture was noted, the block needle was withdrawn slightly and its direction was changed. The time of administration of drug was noted. Visual and verbal contact with

the patient was maintained throughout the procedure.

Vital parameters such as pulse rate, respiratory rate, SpO_2 and blood pressure were monitored every 5 min for first 30 min and thereafter every 15 min till end of surgery.

Two minutes after performance of block, Sensory block was evaluated at 1 min interval by the response to pinprick testing over 4 major nerve distribution areas (radial, ulnar, median and musculocutaneous) on a three-point scale (0 - normal sensation; 1 - blunt sensation; 2 - no sensation) [9] and motor block was evaluated with Modified Bromage Scale (MBS; 0 - Normal muscle function, 1 - Elbow flexion, 2 - Wrist flexion, 3 - Full motor block) [7].

Onset of Sensory Block: Time from end of injection of study drug to pinprick test score of 1.

Onset of Motor Block: Time from end of injection of study drug to appearance of MBS grade 1.

Complete Sensory Block: Time from end of injection of study drug to pinprick test score of 2.

Complete Motor Block: Time from end of injection of study drug to appearance of MBS grade 3.

Duration of Surgery: The duration between first skin incision and complete closure was the duration of surgery.

Duration of Motor Block: Time between motor block onset and full arm mobility (MBS grade 0).

Total Duration of Analgesia (Duration of Sensory Block): The duration between sensory block onset and first injection of rescue analgesic.

The duration of analgesia was noted according to the 0-10 visual analogue scale (VAS) [10] where 0 represents no pain and 10 means worst possible pain. VAS assessment was done postoperatively half hourly for 12 h then every 1 hourly till patient complained of pain. Rescue analgesic Inj. diclofenac 75 mg IM was administered when VAS was 4 and above.

In case of pain sensation during the surgery, local anesthetic infiltration by inj.lignocaine 1.5%, 5–10 ml was done. If pain persisted, 50 μg fentanyl along with 1 mg midazolam was given IV. The doses was recorded if administered.

All patient complaints during and after block, all block-related complications and side effects of drugs were recorded.

Statistical Analysis

As a result of the power analysis we performed, it was decided that each group should have at least a minimum of 26 cases (80% power and 0.05% α error). Considering possible data loss due to technical reasons, both groups were admitted 40 patients.

Statistical analysis was done by using descriptive and inferential statistics using chisquare test and student's unpaired t test. Software used in the analysis was SPSS 17.0 version and $p<0.05$ is considered as level of significance.

Results

The mean onset of motor block was significantly faster in Group B (4.01±0.22 min) than Group T (6.14 ± 1.13 min).While, the mean onset of sensory block

Table 1: Demographic Data

Patients Characteristics	Group B	Group T	p- value
Age (years)	36.79 ± 10.23	33.62 ± 11.80	t= 1.28, p = 0.20,NS
Weight (kilograms)	55.42 ± 9.82	58. 69 ± 7.02	t= 1.71, p = 0.090,NS
Gender (male/ female)	29/11	27/13	χ^2=0.23, p = 0.62,NS
ASA (I/ II)	18/22	21/19	χ^2=0.44, p = 0.50,NS
Duration of surgery	79.57 ± 19.33	86.28 ± 15.28	t= 1.72, p = 0.089,NS

Table 2: Block Characteristics and Duration of Analgesia

Block Characteristics	Group B	Group T	t-value	p- value
Onset of Motor block(min)	4.01± 0.22	6.14 ± 1.13	11.70	0.0001,**S**
Onset of Sensory block(min)	7.10 ± 0.75	11.32 ± 1.41	19.55	0.0001,**S**
Complete Motor block(min)	9.74± 3.02	15.04 ± 3.17	7.65	0.0001,**S**
Complete sensory block(min)	12.41± 5.21	19.15± 4.87	5.97	0.0001,**S**
Duration of Motor block(min)	343.28 ± 47.82	305.49± 45.86	3.60	0.0006,**S**
Total Duration of Analgesia(min)	942.83±124.51	478.31 ± 52.60	50.62	0.0001,**S**
VAS at 12 hours	2.01± 0.63	4.00	19.97	0.0001,**S**

Table 3: Adverse Effects

Adverse Effects	Group B	Group T	p- value
Nausea & vomiting	2	2	
Pruritus	1	0	
Sedation	0	0	χ^2 value=0.21
Urinary retention	0	0	
Respiratory depression	0	0	p= 0.64, NS
Pnemothorax	0	0	
Phrenic nerve palsy	0	0	
Horner's syndrome.	0	0	

was significantly longer in Group T (11.32±1.41 min) than in Group B (7.10±0.75 min). Similarly, time required to achieve complete motor block was faster in Group B (9.74±3.02 min) than Group T (15.04±3.17min) and the time to achieve complete sensory block was significantly longer in Group T (19.15±4.87min) than in Group B (12.41±5.21 min).

The mean duration of motor block was more in Group B (343.28 ± 47.82 min) than Group T (305.49± 45.86 min) with $p<0.05$ which was statistically significant.

The duration of analgesia (i.e. onset of block to VAS>4) was much longer in Group B (942.83±124.51 min) than in Group T (478.31±52.60 min) with $p< 0.001$. In Group B 23 (57.5%) patients had duration of analgesia lasting for about 14-18 hrs, whereas in Group T only 18 (45%) patients had duration of analgesia lasting for about 6-8 hrs.VAS score was 4 at 12th postoperative hour in group T where as in group B it was only 2.01±0.63 (Table 2). No statistically significant changes were observed in hemodynamic and respiratory parameters in either group. No supplementation of block was required in any of the group.

Two patients each in group B and in group T out of 40 (5%) had nausea &/or vomiting. In group B, 1 patient had pruritus was mild, treated with cetirizine hydrochloride. No patient in either group was sedated or had any evidence of urinary retention postoperatively. No technique related adverse events like pneumothorax, phrenic nerve palsy or Horners syndrome was seen in either group (Table 3).

Discussion

There has always been a search for adjuvant in regional nerve block that prolong the duration of analgesia but associated with lesser side effects. The search for the ideal additive continues and leads us to try and compare commonly used opioids tramadol and buprenorphine.

All surgical procedures are associated with some degree of pain, it is a well-accepted fact that pain is maximum with orthopedic surgeries. Supraclavi-cular block is accepted as mode of regional analgesia for upper limb surgeries as it provides anesthesia for surgeries around elbow, forearm and hand. With this technique, landmarks are easy to locate and tourniquet pain is better tolerated [11]. With advent of opioid receptors, variety of opioid agents is used for postoperative analgesia via brachial plexus block [5].

In this study, 80 patients were enrolled, 40 in each group. Both the groups were comparable with respect to the demographic profile in terms of age, weight, gender ratio and ASA physical status. The duration of surgery was similar in both the groups. (Table 1).

We observed a 100% success rate in our study and none of our patients were supplemented with additional analgesics or local anaesthetics at surgical site or general anaesthesia. This is in accordance with the study by Jeon et al [12], wherein they concluded that the elicitation of a twitch on the fingers was more effective in increasing the success rate (93.7% versus 75.0%).

Onset time of the motor and the sensory blocks was delayed in the tramadol group compared to buprinoprphine group. Similarly, the time required to achieve complete motor and the sensory blocks were also longer in tramdol group compared to buprinorphine group (Table 2). These findings correlate with the study done by Yadav et al [8], they used tramadol and achieved the complete motor and the sensory blocks at 13.07± 1.36 min and 18.20±1.47 min, respectively. While , Mathew et al [6] used buprinorphine and achieved the onset of the motor and sensory blocks at 3.25±0.086 min and 6.17±0.081 min, respectively. Similar results cited by other researchers were also comparable with the results of our study [13,14]. Onset of motor block was earlier than the onset of sensory block, which can be explained by the "core and mantle" concept i.e. the outer motor fibers are blocked earlier than the sensory fibers which are situated deeper in the brachial plexus at the level of trunk and division [15].

Duration of analgesia was maximum in the buprenorphine group (942.83±124.51 min), as compared to that in tramadol group (478.31± 52.60 min).

Table 4: Duration of analgesia in other studies on Brachial Plexus Block by adding Buprenorphine or Tramadol with LA

Studies	Drug used	Approach	Duration of Analgesia
Bazin et al[16] 1997	0.5% Bupivacaine 1mg/kg + 1% Lignocaine. with Adr.1:200000 2mg/kg + buprenorphine 3µgm/kg	Supraclavicular	20 hours
Regmi et al[17] 2015	28 ml of 0.5% bupivacaine with 2 ml. (100 mg.) tramadol	Suraclavicular	456 ± 64.19 minutes
Mitra [18] 2007	38 ml of 0.25% bupivacaine + 2 ml tramadol (100 mg)	Supraclavicular	410 ± 95.1 minutes.
Thakur et al[19] 2015	15 ml 0.5% bupivacaine, 15 ml 2% lignocaine with adrenaline 1:200000, 9 ml normal saline (NS) plus 2 µg/kg buprenorphine	Axillary	20.61 ± 1.33 hours

Mean VAS score at 12 hr was 4 in tramadol group while it was only 2.01± 0.63 in buprenorphine group. This shows that quality of block was better in buprenorphine group.

Tramadol is centrally acting analgesic and has dual mechanism of action. It is µ receptors agonist, which are responsible for nociception. At the same time, in CNS it inhibits the reuptake of nor-epinephrine and serotonin which inhibits pain transmission in the spinal cord [8]. Buprenorphine, exhibits mixed agonist-antagonist activity at classical opioid receptors. Its analgesic effect is due to partial agonist activity at µ-receptors and antagonist activity at κ-receptor which results in hyper-polarization and reduced neuronal excitability. Importantly, buprenorphine slowly dissociates from its receptor which is responsible for the longer duration of action compared to other opioids [20].

It is unlikely to have systemic adverse effects with perineural administration of drugs, but the systemic absorption of the drug may have a central effect. Adverse effect profile of both groups did not exhibit any significant difference. (Table 3) The results were in accordance with studies done by Candido & Winnie [21] , Robaux et al [22] and Bono et al [23].

From the above findings, we can suggest that opioids can be safely and effectively used in the brachial plexus block for improving post operative analgesia. We compared buprenorphine and tramadol as an adjuvant to bupivacaine in supraclavicular brachial plexus block and found that buprenorphine group had earlier onset of sensory, motor blockade and longer duration of post operative analgesia than tramadol group.

A limitation of our study was the incorporation of an ultrasound guided localization of brachial plexus technique. It could have drastically decreased the total volume of the local anaesthetics.

Conclusion

We conclude that buprenorphine besides shortening the onset time of sensory and motor block, prolongs the duration of motor block, post-operative analgesia and enhances the quality of block compared to tramadol when used as an adjuvant to bupivacaine in supraclavicular brachial plexus block without any significant side effects.

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