ORIGINAL RESEARCH

Addition of buprenorphine to 0.5% ropivacaine in supraclavicular block, can prolong anaesthesia and post operative analgesia in patients posted for isolated forearm and hand embolectomy cases

[1]Dr. Arun Bhumarkar, [2]Dr. Ashwin Beohar, [3]Dr. Ritika Dhurwe, [4]Dr. Meena Singh, [5]Dr. Aparna Tamaskar

[1]P.G. Student, [2]Assistant Professor, Department of Anesthesia and Intensive Care, NSCB Medical College and Associated Hospitals, Jabalpur, MP, India
[3]Assistant Professor, [4]Associate Professor, [5]Professor, Department of Anesthesia and Intensive Care, Superspeciality Block, NSCB Medical College Jabalpur, MP, India

Corresponding author
Dr. Meena Singh
Associate Professor, Department of Anesthesia and Intensive Care, Superspeciality Block, NSCB Medical College Jabalpur, MP, India
Email: Dr.Meenasingh2010@Gmail.Com

Received: 03 May, 2023 Accepted: 06 June, 2023

ABSTRACT:
Background: Supraclavicular block has emerged as reliable alternative to general anaesthesia for upper limb surgery and for providing post operative analgesia. Availability and use of nerve stimulator and now ultrasound in anaesthesia, making regional anaesthesia techniques more safe and more successful than blind technique. Buprenorphine as an adjuvant to local anaesthetics in peripheral nerve blocks has been used in only a few studies. AIM: Weaimed to evaluate the quality and duration of postoperativeanalgesia by addition of buprenorphine to 0.5% ropivacaine. **Method:** This random, prospective, double-blind study was carriedout on 68 patients, divided into two groups of each group having 34 patients. Group B: 30 ml 0.5% Ropivacaine + 0.3 mg 1 ml Buprenorphine, and Group C:30 ml 0.5% Ropivacaine + 1 ml normal saline,PNS guided supraclavicular brachial plexus block. Parameters observed were, onset time of sensory and motor block, duration of sensory and motor block, duration of post operative analgesia and any untowards side effects. **Result:** All demographic parameters age, sex, weight and height were statistically nonsignificant. On statistical analysis, the difference in the time to onset of sensory block and motor block, between Group B and Group C was found to be highly significant p value = <0.0001.Mean duration of sensory blocked in Group B was (mean ± SD) 612 ± 85.219 and group C was (mean ± standard deviation) 451.18± 70.356 minutes respectively. mean duration of motor blocked in Group B was (Mean ± SD) 540 ± 83.5 and group C was 379.0± 42.3 minutes respectively. The Duration of analgesia was longer in Group B than in Group C. Time for Rescue Analgesia was longer in Group B than in Group C. **Conclusion:** Buprenorphine added to local anaesthetic solution in supraclavicular brachial plexus block in dose of 3 µg/kg provides excellent postoperative analgesia lasting almost 2.5 times longer than local anaesthetic solution alone.

Keywords: Buprenorphine, Ropivacaine, Supraclavicular block

INTRODUCTION

Among brachial plexus block, supraclavicular block is considered the primary anaesthetic modality for most upper extremity, because it is easiest and effective block to perform and also eliminates all side effects associated with general anaesthesia increasing patient's safety, painless hospital stay, early discharge and recovery[1]. The peripheral nerve stimulator (PNS) allows better localization of the brachial plexus by locating the nerves using a low-intensity electric current (up to 2.5 mA) for a short-duration (0.05–1ms) with an insulated needle to obtain a defined response of muscle twitch or sensation and to inject local anaesthetic solution in close proximity to the nerve.[2] previous studies have shown many adjuvants as epinephrine, a2 agonists (i.e. clonidine and dexmedetomidine), midazolam, or the corticosteroid dexamethasone.[3-5] used to prolong intraoperative

anaesthesia and postoperative analgesia.[6] without concomitantly increasing the risk of complications.[7] In our study we had used buprenorphine, a lipophilic opioid, in supraclavicular block to evaluate its effect on intraoperative anaesthesia and post operative analgesia. Ropivacaine has been shown to be less cardiotoxic even with accidental intravascular administration and has less motor block and similar duration of sensory analgesia when compared to bupivacaine[8].

METHOD AND MATERIALS

After taking approval from institutional ethics committee, this prospective double blind randomized study was conducted on 68 adult patients of ASA Grade I & II, in the age group 18 to 65 years, having body weight 50-90 kg, posted for forearm embolectomy under supraclavicular BPB. Patient refusal for regional anaesthesia, Patient with history of allergy to local anaesthetics, Infection at local site of injection, Patient with uncontrolled diabetes mellitus, seizures, peripheral neuropathy, liver and renal disease, and patient with coagulation disorders were excluded from our study. Detailed Preanaesthesiacheckup was done and patients were thoroughly explained about the procedure and use of VAS scoring system(0: no pain and 10: maximum/worst imaginable pain). Informed written consent was taken.Sensitivity testing was done for lignocaine in all patients, and the patients were kept fasting 8 hours prior to surgery. Patients were randomized according to the computer-generated random number table into two equal groups of 34 patients each. Group B(34): 30 ml 0.5% Ropivacaine +1ml of 0.3mg Buprenorphine. Group C(34): 30 ml 0.5% Ropivacaine + 1ml Normal saline.After shifting the patient to the OT, one large bore (18 G) IV line was obtained, and Ringer lactate was started at the rate of 10 ml/kg/hr. Pre-induction monitors like pulse oximeter, non-invasive blood pressure, 3-lead electrocardiogram were connected and Base-line Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Oxygen Saturation (SpO2) were recorded.For unanticipated complications, Emergency drugs(Lipid emulsion 20%), Intubation kit and Resuscitation equipment were kept checked and ready. The drug solutions were prepared by an anaesthesiologist not involved in the study and an experienced anaesthesiologist who was blinded, performed the block and data was collected. IV midazolam 0.03–0.04 mg/kg was given and oxygen was administered at 4 L/min through a Hudson face-mask. Patient was placed in supine position with arm adducted to 90 degree and forearm supinated and elbow was flexed to 90 degrees and head tilted 45 degrees to opposite side. The positive electrode of the Nerve stimulator is attached to an ECG lead and stuck on the ipsilateral arm.Under sterile precautions cleaning and draping of the block area was done.Supraclavicular brachial plexus block was performed by the "Classic Approach," which was first described by Kulenkampff[9] in 1911 by using PNS. The skin was anaesthetized with 2 ml of 2% lignocaine prior to introducing the Stimuplex needle. We used brand Vygon, Peripheral nerve stimulator in our study. Nerve stimulator was set to deliver a current of 1.5 mA in the internal mode. The needle was advanced until an evoked motor response of hands muscle or forearm was obtained at 0.2 -0.4 mA. Once the desirable motor response was obtained, the needle was stabilized, total volume of drug mixture as allocated to study groups was injected slowly after repeated aspiration in divided portions.Time of administration of drug was noted.Patients were evaluated every 5 minutes after the completion of local anaesthetic injection till complete sensory and motor blockade took place.

Assessment of **sensory block** was done at 5 mins interval till 30 mins after injection in the appropriate area by pinprick test with a blunt 23 G hypodermic needle by using a 3-point scale-

- normal sensation of pin prick
- loss of sensation of prick (analgesia)
- 2-loss of sensation of touch (anaesthesia) and compared to same stimulation on contralateral arm.

The **onset time of sensory block** was the time from injection till the sensory block score reached one. **Time for the complete sensory block (TCSB)** was the time from injection till the sensory block score reached two. The **total duration of the sensory block** was duration of the time between complete sensory block (TCSB) till the time when the score reached <2 in the postoperative period.

Assessment of **motor block** was done at 5 mins intervals till 30 mins after injection by **Modified Bromage Scale** (3-point score) for the upper extremity.

0- Normal motor function with full flexion and extension of elbow, wrist, and fingers.
1- Decreased motor strength with ability to move the fingers only.
2- Complete motor block with inability to move the finger.

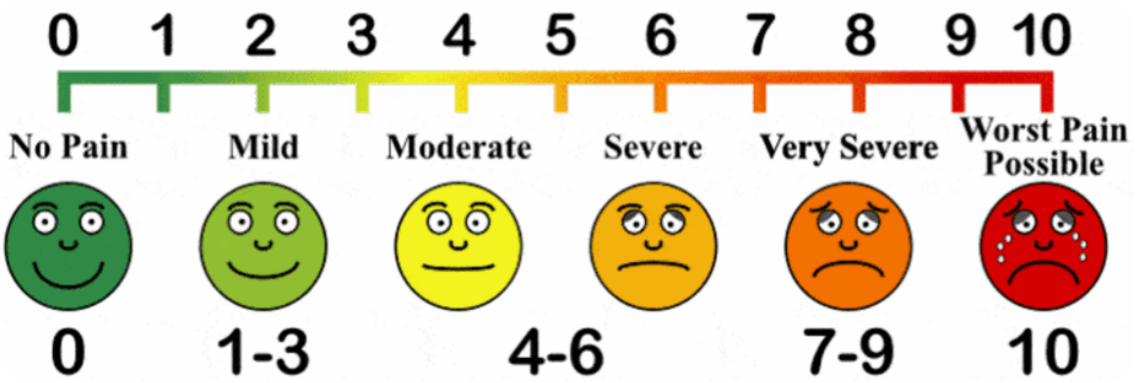
The **Onset time of motor block** was considered as the time interval in mins from injection of the local anaesthetic till motor block score reaches one. The **time for Complete motor block (TCMB)** was time from injection till the motor block score reached 2. The **total duration of the motor block** was taken as the duration of the time in mins between the time to complete motor block(TCMB) till the time when score reached < 2.

Motor block was evaluated by examining the following response:Musculocutaneous nerve: Elbow flexion, Median nerve: Third finger flexion, Radial nerve: Thumb abduction, Ulnar nerve: Little finger flexion

Duration of analgesia was measured as time interval between complete sensory block (TCSB) till post-operative VAS score ≥4 or patient demands for postoperative analgesic. The block was considered failed if complete sensory and/or motor block was not achieved after 30 min and GA was given.

HR, SBP, DBP, MAP, RR, and SpO_2 was recorded at the time of induction, 10 mins, 20 mins, 30 mins, 60 mins, 90 mins, 120 mins, 150mins intervals throughout the procedure during intraoperative period.

VISUAL ANALOGUES SCALE[10]



The VAS measurements was obtained every 30 minutes for first 2 hours postoperative then every 2 hours for 24 hours. Rescue analgesic in the form of slow IV bolus of 50 mg injection tramadol was administered at the VAS score ≥4.

During the procedure, complications if any, including Vessel injury and Hematoma, Nausea and Vomiting, Dyspnea and Phrenic Nerve Block, Fall in RR or SpO_2, Any symptom/sign of local anaesthetic toxicity, ECG changes, Pneumothorax, Horner's syndrome was planned to be noted.

STATISTICAL ANALYSIS

Age, height, body weight, onset and duration of sensory and motor block, were analyzed by using Student's *t*-test. VAS and sedation score were compared using Mann-Whitney U-test for pairwise comparison. $P < 0.05$ was considered as statistically significant.

RESULTS

Demographic profile and surgical characteristics were similar in both groups(TABLE 01).

Table 2, shows the time to onset of sensory block in Group B (mean ± standard deviation) was 6.09 ±1.026 minutes and in Group C was 9.85±0.892 minutes respectively. Time to onset of motor block in Group B was (mean ± SD) 10 ±1.255 minutes and in Group C was 14.5±1.08 minutes respectively (Table 2). On statistical analysis, the difference in the duration of sensory block between Group B and Group C was found to be highly significant p value = <0.0001. The mean duration of motor block in Group B was (Mean ± SD) 540 ± 83.5 and group C was 379.0± 42.3 minutes respectively. Duration of analgesia was much longer in Group B than in Group C (p value = <0.0001)(TABLE 2).

The VAS score of Group B was statistically lower than as compared with VAS score of Group C. VAS score ≥ 4 (the point at which first dose of analgesic was given inj. Tramadol 50 mg.) was achieved in 8-9 hours post operatively in Group C and VAS score ≥4 was achieved after 16 hours post operatively in Group B.On statistical analysis, the difference in the VAS score between Group B and Group C was found to be highly significant p value = <0.0001. Buprenorphine was effective in reducing VAS score during post-operative period(TABLE 3).

TABLE 4, shows the mean Time for Rescue Analgesia (Hrs) in Group B was (mean ± SD) 15.53 ± 1.56 and Group C was 9.15± 1.23 hours respectively. On statistical analysis, the difference in time for rescue analgesia between Group B and Group C was found to be highly significant p value = <0.0001.

In Group B,3 Patients were complained of nausea and vomiting as compared to one patients in Group C which were statistically insignificant (P = 0.303)(TABLE 5)

Table: 01(A): Demographic data & duration of surgery.
Source: original

	GROUP B		GROUP C		T-Test	P-Value
	Mean	SD	Mean	SD		
Mean age of patients (years)	35.9	12.9	40.74	11.4	1.69	0.095
Weight (KG)	64.74	11.183	63.44	8.425	0.539	0.592
Duration of surgery (MIN)	112.94	13.6	111.76	16.4	0.322	0.749

Table: 01(B): Distribution of patients (male /female) in groups:
Source: original

Sex	GROUP						Chi square	P value
	GROUP B		GROUP C		Total			
	N	%	N	%	N	%		
Female	15	44.12	14	41.18	29	42.65	0.06	0.806
Male	19	55.88	20	58.82	39	57.35		

Table no: 02, Time to onset and duration of sensory block& motor block.
Source: original

	GROUP B		GROUP C		t-test	p-value
	Mean	SD	Mean	SD		
Time To Onset Of Sensory Block (Mins)	6.09	1.026	9.85	0.892	16.1	<0.0001
Time To Onset Of Motor Block(Mins)	10	1.255	14.5	1.08	15.84	<0.0001
Duration Of Sensory Block (Mins)	612.94	85.219	451.18	70.356	8.535	<0.0001
Duration of Motor Block (Mins)	540	83.5	379	42.3	9.98	<0.0001
Duration of Analgesia (mins)	911	74.6	540.6	58.5	22.8	<0.0001

Table: 03, VAS Score
Source: original

VAS	Block Drug Given				t test	P value
	GROUP B		GROUP C			
	Mean	SD	Mean	SD		
Immediate post op	0	0	0	0	0	0
Post op 0.5 hr	0	0	0	0	0	0
Post op 1 hr	0	0	0	0	0	0
Post op 1.5 hr	0	0	0.32	0.47	3.97	<0.0001
Post op 2hr	0.15	0.459	0.65	0.597	4.183	<0.0001
Post op 4hr	0.32	0.475	1.79	0.41	13.66	<0.0001
Post op 6hr	0.71	0.579	2.24	0.554	11.13	<0.0001
Post op 8hr	1.24	0.654	3.59	0.557	15.97	<0.0001
Post op 10hr	2.09	0.514	4	0	13.19	<0.0001
Post op 12hr	2.74	0.567	-	-	-	-
Post op 14hr	3.34	0.545	-	-	-	-
Post op 16hr	3.82	0.395	-	-	-	-
Post op 18hr	4	0	-	-	-	-

Table: 04. Time for rescue analgesia.
Source: original

Duration	GROUP B		GROUP C		t-test	p-value
	Mean	SD	Mean	SD		
Time for Rescue Analgesia (hrs)	15.53	1.56	9.15	1.23	18.70	<0.0001

Table: 05, Adverse effects.
Source: original

Adverse Effects	GROUP						Chi square	P value
	GROUP B		GROUP C		Total			
	N	%	N	%	N	%		
Nil	31	91.18	33	97.06	64	94.12	1.06	0.303
Nausea/Vomiting	3	8.82	1	2.94	4	5.88		

Vitals parameters like mean respiratory rate and mean oxygensaturation value were similar in both groups and did not show any significant difference. The HR, Mean SBP, Mean DBP, MAP, SpO2 and RR, from the time of induction(0 mins), 10, 20, 30, 60, 90, and till 120 mins, was statistically not significant between both the groups.

DISCUSSION

The Supraclavicular brachial plexus block is a commonly performed regional anaesthetic technique for forearm and hand surgeries, and provides good surgical anaesthesia. The nerve trunks are most compactly arranged in supraclavicular region, and hence smaller volume of the local anaesthetic drug

produces rapid, reliable and intense block with high success rate[10] and also peripherally administered opioid, improves regional anesthesia without centrally mediated side effects.[11]In our study we preferred 0.5% Ropivacaine as local anaesthetic agent. Due to its low lipophilicity, it is less likely to penetrate large myelinated A-beta motor fibers, resulting in a relatively reduced motor blockade.[12] it is associated with less cardio and neuro toxicity[13]. There is no difference in action profile of 0.75% and 0.5% ropivacaine, already studied in previous studies thasy we preferred to study with low concentration of ropivacaine. Many opioids have already been tried with local anaesthetics in nerve blocks. In our study we have used buprenorphine which is partial agonist–antagonist opioid as adjuvant to ropivacaine for SBPB. Due to easy availability, cost effectiveness, lack of significant side-effects like respiratory depression and sedation, longer duration of action[14]lipophilic nature, high affinity for μ receptor, buprenorphine has been selected for study as an adjuvant for study in brachial plexus block. It has a dose- ceiling effect on respiratory depression, but not on analgesia.[15,16] Our study demonstrated a significantly faster onset of sensory and motor block in buprenorphine group which can be explained by its high analgesic potency determined by its high lipid solubility leading to faster penetration of lipid membranes, binding to receptors and hastening of block. Similar results in the onset of sensory block were observed by Behr et al.[17]who studied the effect of adding buprenorphine to levobupivacaine. Patil et al.[18]studied the effect of 3 μg/kg buprenorphine as an adjuvant to a mixture of bupivacaine and lignocaine in supraclavicular block and found significant prolongation of motor block, sensory block and analgesia. **Sonali et al**[19] was conducted the study of comparison of Nalbuphine and Buprenorphine as an Adjuvant to local anaesthetics in supraclavicular brachial plexus block. Time of total duration of sensory block was 8.06 ± 1.80 hrs in Group N and 11.77 ± 2.98 hrs in Buprenorphine Group. There are many supportive studies using Buprenorphine as adjuvant to local anaesthetic in brachial plexus which have demonstrated significant prolongation of analgesia, sensory and motor block[9,10,16,20].

Though most of the studies showed a prolongation in analgesia with use of adjuvant, the onset time of block varied in the studies. These conflicting results could be attributed to use of different local anesthetic in different concentrations, type of approach for the block and technique of block. Limitation of our study is, nonavailabilty of ultrasound machine in our institute so we had used, peripheral nerve stimulator.

The VAS score of Group B was statistically lower than as compared with VAS score of Group C. VAS score ≥4 (the point at which first dose of analgesic inj. Tramadol 50 mg. was given) was achieved in 8-9 hours post operatively in Group C and VAS score ≥4 was achieved after 16 hours post operatively in Group B. The mean duration of satisfactory analgesia and higher VAS score observed in our study are incordance with the results of Jadon *et al*[21]

We observed that three patients in Buprenorphine group (Group B) complained of nausea and vomiting as compared to one patients in plain ropivacaine group (Group C) for which injection ondansetron 4 mg intravenously was given. it was observed that side effects in both the groups were not statistically significant (P < 0.303). None of the patients in either group complained of pruritus, urinary retention, sedation, respiratory depression, pneumothorax, or any neurological sequelae.

CONCLUSION

Buprenorphine (0.3 mg) as an adjuvant to 0.5%Ropivacaine for supraclavicular brachial plexus blockcan lead to Earlier time to onset of sensory and motor block , Prolonged duration of block and analgesia with nonsignificant adverse effects.

REFERENCES

1. Fischer HB. Brachial plexus anesthesia. In: Wildsmith JA, Armitage EN, McClure JH, editors. principles and Practice of Regional Anesthesia. 3rded. London: Churchill Livingstone; 2003. p. 193-204.
2. Fanelli G, Casati A, Garancini P, Torri G. Nerve stimulator and multiple injection technique for upper and lower limb blockade: Failure rate, patient acceptance, and neurologic complications. Study Group on Regional Anesthesia. *AnesthAnalg.* 1999;88(44):847–52.
3. Cummings KC III, Napierkowski DE, Parra-Sanchez I, et al. Effect of dexamethasone on the duration of interscalene nerve blocks with ropivacaine or bupivacaine. Br J Anaesth 2011; 107(3): 446 – 53.
4. Ilfeld BM, Morey TE, Wright TW, Chidgey LK, Enneking FK. Continuous interscalene brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. AnesthAnalg 2003; 96(4): 1089 – 95.
5. Popping DM, Elia N, Marret E, Wenk M, Tramer MR. Clonidine as an adjuvant to local anesthetics for peripheral nerve and plexus blocks: a meta-analysis of randomized trials. Anesthesiology 2009; 111(2): 406–15.
6. Cahill J, Murphy D, O'Brien D, Mulhall J, Fitzpatrick G. Epidural buprenorphine for pain relief after major abdominal surgery. A controlled comparison with epidural morphine. Anaesthesia 1983;38:760-4.
7. Hussain N, McCartney CJL, Neal JM, Chippor J, Banfield L, Abdallah FW. Local anaesthetic-induced myotoxicity in regional anaesthesia: a systematic review and empirical analysis. *Br J of Anaesth*.2018 Oct;121(4):822-84.
8. McClellan KJ, Faulds D. Ropivacaine: an update of its use in regional anaesthesia. Drugs. 2000; 60:1065-93.
9. Cahill J, Murphy D, O'Brien D, Mulhall J, Fitzpatrick G. Epidural buprenorphine for pain relief after major abdominal surgery. A controlled comparison with epidural morphine. Anaesthesia 1983;38:760-4.
10. Mc Cormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. Psychol Med 1988; 18:1007– 19.

11. McClure JH, editors. Principles and Practice of Regional Anesthesia. 3rd ed. London: Churchill Livingstone; 2003. p. 193-204.
12. Akerman B, Hellberg IB, Trossvik C. Primary evaluation of the local anaesthetic properties of the amino amide agent ropivacaine (LEA 103). Acta Anaesthesiol Scand. 1988; 32:571-8.
13. Klein SM, Greengrass RA, Steele SM, D'Ercole FJ, Speer KP, Gleason DH et al. A comparison of 0.5% bupivacaine, 0.5% ropivacaine, and 0.75% ropivacaine for interscalene brachial plexus block. AnesthAnalg. 1998; 87:1316-9.
14. Downing JW, Leary WP, White ES. Buprenorphine: A new potent long-acting synthetic analgesic. Comparison with morphine. Br J Anaesth 1977;49:251-5.
15. Koppert W, Ihmsen H, Körber N, Wehrfritz A, Sittl R, Schmelz M et al. Different profiles of buprenorphine-induced analgesia and antihyperalgesia in a human pain model. Pain. 2005; 118:15-22.
16. Murphy DB, McCartney CJ, Chan VW. Novel analgesic adjuncts for brachial plexus block: A systematic review. AnesthAnalg. 2000; 90(5):1122-8.
17. Behr A, Freo U, Ori C, Westermann B, Alemanno F. Buprenorphine added to levobupivacaine enhances postoperative analgesia of middle interscalene brachial plexus block. J Anesth. 2012; 26:746-51.
18. Patil S, Debata D, Doshi C, Vyas V, Sinha S. Effect of buprenorphine as an adjunct with plain local anesthetic solution in supraclavicular brachial plexus block on quality and duration of postoperative analgesia. J Anaesthesiol Clin Pharmacol. 2015; 31:496-500.
19. Sheth A R , Sonali A Joshi A J, Pandya M. Comparative Study of Nalbuphine and Buprenorphine as an Adjuvant to Local Anesthetics in Supraclavicular Brachial Plexus Block. J Anesth Surg.2019;6(1): 31-37.
20. Casati A, Danelli G, Baciarello M, Corradi M, Leone S, Di Cianni Setal. A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. Anesthesiology. 2007; 106(5):992-6.
21. Jadon A, Panigrahi MR, Parida SS, Charaborty S, Agarwal S, Prashant S etal. Buprenorphine improves the efficacy of bupivacaine in nerve plexus block. A double blinded randomized evaluation subclavian perivascular brachial block. Journal of Anaesthesiology Clinical Pharmacology.2009;25(2):207-21.