

Comparative Study of Nalbuphine and Buprenorphine as an Adjuvant to Local Anesthetics in Supraclavicular Brachial Plexus Block

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Abstract

Background and Aim: Regional anesthesia for upper extremity by brachial plexus block is simple, safe and reliable method. Among all brachial plexus blocks supraclavicular brachial plexus block is most commonly used technique. The present study was design to compare the efficacy of adding Nalbuphine and Buprenorphine to local anaesthetics for supraclavicular brachial plexus block.

Material and Methods: Sixty patients of ASA Grade I and II, age between 18 to 60 years of either sex were enrolled for the study. The patients scheduled for upper limb orthopedic surgery under supraclavicular brachial plexus block were randomly selected. Patients were randomly divided into following 2 Groups: Group N (n=30): Inj Bupivacaine (0.5%) 20 ml + Inj lignocaine hydrochloride 15 ml +Inj NS 5ml + Inj Nalbuphine 10 miligm (1 ml) Group B (n=30): Inj Bupivacaine (0.5%) 20 ml + Inj lignocaine hydrochloride 15 ml +Inj NS 5ml + Inj Buprenorphine 150 microgm(1 ml) The statistical analysis was done by chi-square test and independent t-test for intergroup comparison with usage of SPSS software.

Results: There was no significant difference in mean duration of surgery between two Groups. There was statistically significant difference present in duration of achieving complete block with least duration in Group N. Sedation score was higher in Group B compared to Group N. There were no statistically significant difference in requirements of supplementation in both the groups ($p>0.05$).

Conclusion: Buprenorphine provides prolong duration of analgesia with subsequently prolongs the need of rescue analgesia as compared to Nalbuphine(10 mg) when added to local anesthetics in supraclavicular block.

Keywords: Analgesia; Brachial plexus; Local anesthetics; Upper limb

Introduction

Regional anaesthesia, as the name suggest, implies that the anaesthetic is limited to the part of the body involved in the surgical procedure. Limiting the anaesthetic to the site of surgery also limits the physiological side effects and stress associated with surgery. A well conducted regional anesthetic technique has very much to offer to anesthesiologist, surgeon as well as patients owing to its advantages over general anesthesia. The reduction of blood loss of 20-50% in many procedure, less interference with immunocompetence, avoids polypharmacy, Provides better hemodynamic stability, Excellent post operative analgesia, Less

interference with normal metabolic process and vital functions of most patients and Reduction in hospital stay^[1,2].

Regional anesthesia for upper extremity by brachial plexus block is simple, safe and reliable method. Among all brachial plexus blocks supraclavicular brachial plexus block is most commonly used technique.

Various drugs such as opioids, alpha 2 agonists, midazolam, mgso4, dexamethazone have been tried as adjuvants to local anaesthetic drugs in supraclavicular block in upper limb surgeries for prolonging the duration of postoperative analgesia.

Nalbuphine is a derivative of 14-hydroxymorphine which is a strong analgesic with mixed kappa agonist and mu an-

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tagonist. Its affinity to kappa opioid receptors results in sedation, analgesia and cardiovascular stability with lower incidence of pruritus, nausea, vomiting and minimal respiratory depression. Prolongation of anesthetic effect and analgesia could be secondary to the stimulation of kappa receptors by Nalbuphine which inhibits release of neurotransmitters for pain such as substance p^[3,4].

Buprenorphine is a derivative of the opioid alkaloid thebaine which is potent and longer lasting analgesic with partial agonist at mu and kappa opioid receptors and an antagonist at delta receptors. The affinity of Buprenorphine for mu receptors is 50 times greater than that of morphine and subsequent slow dissociation from these receptors account for its prolong duration of action. It has advantage of cost effectiveness and lack of significant side effects like respiratory depression. It also provides sedation^[5].

This study was design to compare the efficacy of adding Nalbuphine and Buprenorphine to local anaesthetics in terms of duration of analgesia and secondary aim was to record onset and duration of sensory and motor block and any adverse events^[6]. The present study was design to compare the efficacy of adding Nalbuphine and Buprenorphine to local anaesthetics for supraclavicular brachial plexus block.

Materials and Methods

The present study was carried out after obtaining approval from the institutional ethical committee.

60 patients of ASA Grade I and II, age between 18 to 60 years of either sex were enrolled for the study. The patients scheduled for upper limb orthopedic surgery under supraclavicular brachial plexus block were randomly selected.

Written informed consent was obtained from all the patients enrolled.

Study type: Observational study

Duration of study: 15 months

Sample size: 60 according to open EPI SOFTWARE

Exclusion criteria:

- Patient's refusal
- Infection at the site of injection
- Clinically significant coagulopathy
- Severe pulmonary pathology
- Pre existing motor and sensory deficit

Methodology

Complete medical history and physical examination was done for all the patients. Basic hematological and laboratory investigations like complete haemogram, blood sugar, renal function test, etc. were reviewed. Where indicated ECG and Chest X-RAY were also reviewed. All the patients were kept nil by mouth for 6 hours prior to anaesthesia. On the day of surgery all the patients were premedicated with injection Glycopyrrolate 5-10 µg/kg intramuscularly and injection midazolam 2 mg i.v. 30 minutes prior to induction of anesthesia. Pre operative Heart rate and blood pressure were noted in operation room before giving study drug and was considered for baseline value. Patients were randomly divided into following 2 Groups:

Study Group:

- Group N (n=30): Inj Bupivacaine (0.5%) 20 ml + Inj lignocaine hydrochloride 15 ml +Inj NS 5ml + Inj Nalbuphine 10 miligm(1 ml)
- Group B (n=30): Inj Bupivacaine (0.5%) 20 ml + Inj lignocaine hydrochloride 15 ml +Inj NS 5ml + Inj Buprenorphine 150 microgm(1 ml)

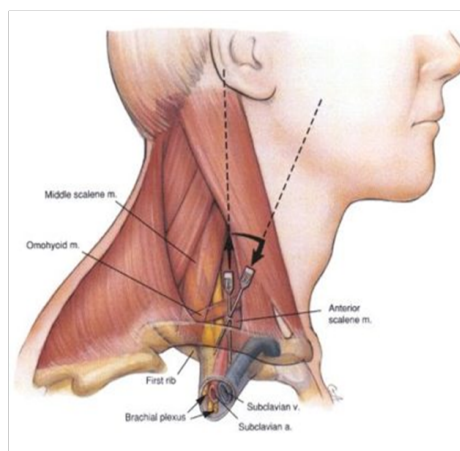
Table 1: Demographic Data

Parameter	Group N (MEAN±SD)	Group B (MEAN±SD)	P value
Age (years)	36.52 ± 16.07	33.76 ± 12.67	P >0.05
Weight (Kg)	56±5.5	57±4.1	P >0.05
No. of Male Patients	20(80%)	18(72%)	p>0.05
No. of Female Patients	05(20%)	07(28%)	

Technique: Supraclavicular block was given by conventional technique of classic approach"

Landmarks

- Clavicle
- Sternoclavicular joint
- Acromioclavicular joint
- Sternocleidomastoid muscle
- Scalenus anterior muscle
- Subclavian artery



Figure

Procedure

The block was performed with patient lying supine with his/her head turned in the direction opposite the limb to be anaesthetized. The arm to block lay in neutral position along the body. Feel the pulsation of subclavian artery which is often palpable and lateral to the outer border of sternocleidomastoid muscle.

A 23 G 4 cm short beveled needle was introduced about 1.5cm above the midclavicular point and directed caudal, backward and medially just lateral to the subclavian artery pulsation. After hitting first rib, parasthesia was elicited over hand. Keeping needle in same position solution was injected slowly. Accidental intravascular injection was checked by frequent aspiration through the syringe.

Precautions

- Landmarks should be clearly assessed
- Keep control over needle at all times. Do not go more medial to avoid pneumothorax
- Avoid multiple needle insertion to prevent vascular puncture, hematoma, pain
- Always negative aspiration should do before injecting the drug.
- If pain or abnormal pressure is felt at any point during injection, the needle should be withdrawn 1-2 mm after which a new assessment is made.

Assessment

1. Onset of sensory and motor block
2. Complete sensory and motor block
3. Quality of block:
 - Complete
 - Incomplete
 - Failed
4. Total duration of sensory and motor block
5. Complications

Sensory Block

- Onset time of sensory blockade was taken as the time between the injection and the ablation of Blunt sensation. (sensory score 1)
- Duration of complete sensory blockade was taken as the time between the injection and complete ablation of perception. (Sensory score 2)

Bromage 3 point scale for sensory block:

- Normal sensation=0
- Blunt sensation=1
- No perception=2

Sensory block was assessed by:

- Pin-prick with 23G Needle in an area innervated by
- Musculocutaneous nerve: Lateral side of forearm
 - Medial cutaneous nerve: Medial side of forearm
 - Median nerve: Thenar eminence
 - Radial nerve: Dorsum of hand over 2nd metacarpophalangeal joint
 - Ulnar nerve: Little finger

Motor Block:

- Onset time of motor blockade was taken as the time from the performance of block to the decrease motor strength compare to contralateral limb.
- Duration of complete motor blockade was taken as the time from the performance of the block to the complete motor block. (Motor score 2)

Bromage 3 point scale for motor block:

- Normal motor function(no effect) – 0
- Decrease motor strength compared to contralateral limb-1
- Complete motor block-2

Motor block was assessed by:

It is evaluated by examining the following response:

- Musculocutaneous nerve: Elbow flexion
- Median nerve: Third finger flexion
- Radial nerve: Thumb abduction
- Ulnar nerve: Little finger flexion

Quality of block:

Quality of block assessed as scale for sensory and motor block-age.

- Complete block- 2
- Incomplete - 1
- Failed- 0

Total duration of analgesia:

Time from complete block to the need of first rescue analgesia.

- Vital parameters like PR, BP, SpO2 were monitored intra-operatively every 15 minutes.
- Any complications like vascular puncture, hematoma, pneumothorax, drug toxicity were noted.
- Incomplete block were supplemented with propofol.
- Failed block were supplemented with full GA with intubation.

I.V fluids: were administered depending on weight of patient, type of surgery and hemodynamic status.

Post operative: All patients were followed up in ward for 24 hrs.

The statistical analysis was done by chi-square test and independent t-test for intergroup comparison with usage of SPSS software.

Formulation of Hypothesis:

Null Hypothesis: H0= There is no difference in the various parameters when both groups compared.

Alternate Hypothesis: Ha= There is difference in the various parameters when both groups compared. P value <0.05 is considered as statistically significant P value <0.05 we can reject the null hypothesis and consider the alternate hypothesis.

Results

In the present study 60 patients scheduled for upper limb surgery under brachial plexus block of ASA Grade I and II between age Group of 18-60 years belonging to either sex were included in the study.

Two Groups were comparable in terms of age, sex and weight distribution. (P>0.05)

Mean duration of surgery was 2.12 ± 1.04 hrs in Group N and 1.65 ± 0.65 hrs in Group B.

Table 2: Duration of Surgery

Duration of surgery (HR)	Group N	Group B	P Value
MEAN	2.12	1.65	1
SD	1.04	0.65	

There was no significant difference in mean duration of sur-

gery between two Groups. ($P>0.05$). Mean duration of onset of motor block in Group N was 5.06 ± 1.83 min and in Group B was 5.6 ± 1.22 min. ($P>0.05$). Mean duration of onset of sensory block was 3.9 ± 1.86 in Group N and Group B was 4.63 ± 1.61 min. ($P>0.05$).

Duration of onset of block

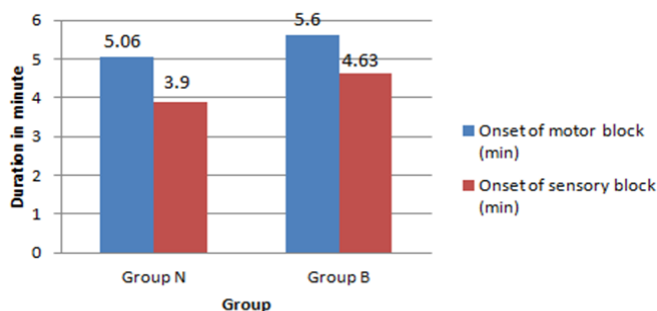


Chart 1: Duration of onset of block (Min)

Thus, no statistically significant difference present in duration of onset of anaesthesia in both groups. The mean duration of achieving complete block (Bromage scale 2 sensory and motor) was 12.32 ± 3.52 min Group N and 15.48 ± 2.66 min in Group B.

Complete Block (min)

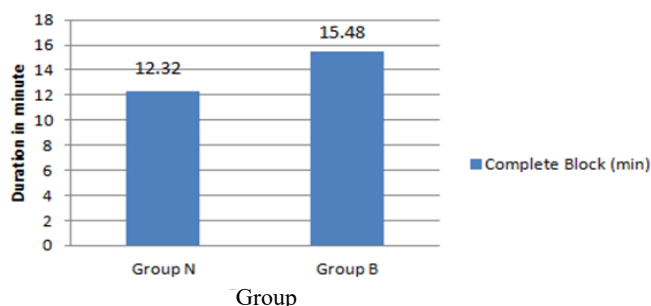


Chart 2: Duration of achieving complete block

There were statistically significant difference present in duration of achieving complete block with least duration in Group N ($P<0.05$).

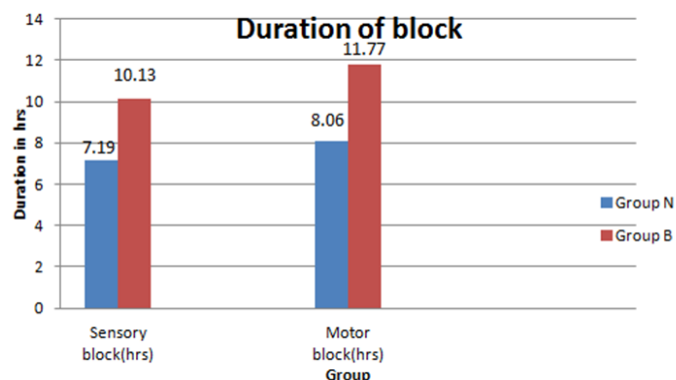


Chart 3: Total duration of block

Chart 3 shows that time of total duration of motor block was 7.19 ± 1.83 hrs in Group N and 10.13 ± 2.46 hrs in Group B. Time of total duration of sensory block was 8.06 ± 1.80 hrs in

Group N and 11.77 ± 2.98 hrs in Group B. There were statistical significant difference present in total duration of block (sensory and motor) in both groups with prolong duration in Group B ($P<0.05$).

Duration of rescue analgesia(hrs)

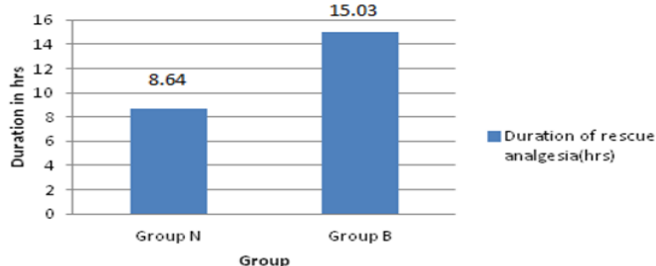


Chart 4: Total duration of rescue analgesia

Chart 4 shows that patients in Group B required rescue analgesia at 15.03 ± 3.29 hrs while in Group N, the patients demanded analgesic medication earlier at 8.64 ± 2.38 hrs which was statistically significant. ($P<0.05$)

Quality of block

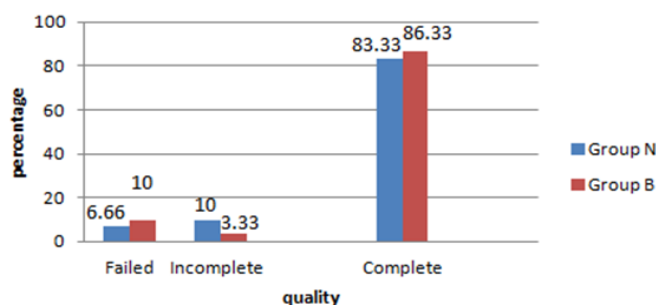


Chart 5: Quality of block

Chart 5 shows that there were no statistically significant difference in both groups regarding quality of block. ($P>0.05$)

Table 3: Intra-Operative vitals

Parameter	Group N		Group B	
	Preoperative	Intra operative	Preoperative	Intra operative
P u l s e rate	89.05 ± 4.82	88.69 ± 4.54	86.0 ± 7.05	86.97 ± 6.37
Respira-tory rate	15.41 ± 1.09	15.38 ± 1.07	14.49 ± 2.04	14.54 ± 1.86
Systolic BP	126.23 ± 8.15	124.22 ± 6.27	128.12 ± 6.09	122.34 ± 7.05
Diastol-ic BP	82.12 ± 4.22	79.28 ± 4.23	84.2 ± 6.28	81.21 ± 3.22

There were no significant difference in preoperative and intra operative PR, RR and BP in both the Group N and Group B.

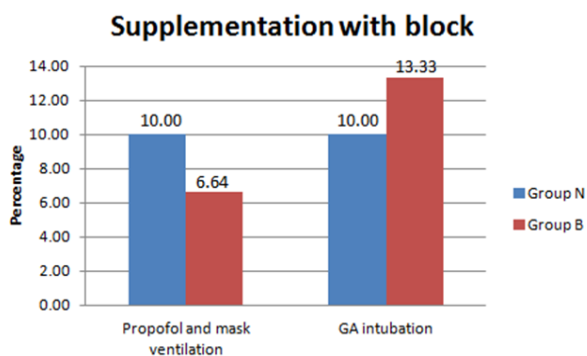


Chart 6: Supplementation

Chart 6 shows that 3(10%) patients in Group N and 2(6.64%) patients in group B required supplementation with Inj propofol and mask ventilation. 3(10%) patients in group N and 4(13.33%) patients in group B required GA with intubation. Total 6(20%) patients required supplementation in group N and 6(20%) patients required supplementation in group B. There were no statistically significant difference in requirements of supplementation in both the groups($p>0.05$).

During peri-operative period sedation was assessed by Ramsay Sedation Scale.

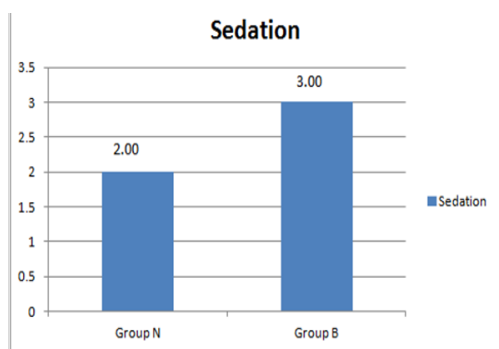


Chart 7: Comparison of Peri-operative sedation by Ramsay Sedation Scale

Sedation score was higher in Group B compared to Group N. Total number of complications were 2(6.6%) in Group N and 5(16.6%) in Group B. In group N 2(6.66%) patients had hematoma. In group B 1(3.33%) patient had aphonia, 1(3.33%) patient had hematoma and 3(10%) patients had irrelevant talking.

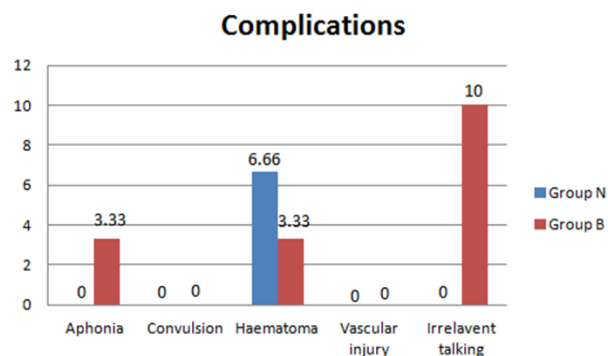


Chart 8: Perioperative complications

There was statistically significant difference in both the groups regarding complication rate. ($p<0.05$) Complications were higher in group B as compared to Group N.

Discussion

Regional anesthesia for upper extremity surgery is close to the ideal match for anesthetic and surgical procedure for patients, anesthesiologist and surgeons. Regional anesthesia provides a safe, low cost technique, with the advantage of prolonged post-operative pain relief.

Peripheral neural blockade remains a well accepted component of comprehensive anesthetic care. Brachial plexus block was first performed by William Stewart Halsted. A supraclavicular approach for brachial plexus was first described by Kulenkampff in 1911. It is most commonly used technique for providing surgical anesthesia for upper extremity surgery. In recent years, this technique has gained importance as regional anesthetic technique for surgical and diagnostic and therapeutic purposes in interventional pain management. It includes blocking of brachial plexus where it is most compactly arranged, with less requirement of anesthetic solution and rapid onset of action. It provides ideal condition for surgery, maintains stable hemodynamic intra-operatively, decrease vasospasm, edema and post-operative pain^[7,8].

Increasing the dose of local anesthesia may prolong the duration of anesthesia, but may also increase the risk of local anesthesia systemic toxicity. Use of catheter in nerve block can help but their placement requires additional time, cost and skill. So, adjuvants are best to prolong the block and thus, prolong duration of analgesia. Addition of adjuvants like opioids, clonidine, neostigmine, dexamethazone, hyaluronidase, bicarbonate and midazolam are supposed to prolong the duration of analgesia without producing any unwanted effects and reduces the dose requirements of local anesthetic used^[9].

Butorphanol can be used alone or in combination with a local anesthetic agent, for brachial plexus block. Butorphanol is a synthetically derived opioid agonist-antagonist analgesic of the phenanthrene series. It exhibits partial agonist and antagonist activity at the μ opioid receptor and agonist activity at the kappa receptor. Stimulation of these receptors on central nervous system neurons causes an intracellular inhibition of adenylyl cyclase, closing of influx membrane calcium channels, and opening of membrane potassium channels. This leads to hyperpolarization of the cell membrane potential and suppression of action potential transmission of ascending pain pathways^[10].

The present study was undertaken to evaluate and compare the effect of Nalbuphine and Buprenorphine as an adjuvant to local anesthetics in supraclavicular brachial plexus block. In our study supraclavicular brachial plexus block was performed by conventional technique which was common practice in our institute.

There are many studies, where they compared nalbuphine as an adjuvant to local anesthetics in supraclavicular block. E.g. Ambi et al^[11], Gupta et al^[12] used Nalbuphine in Supraclavicular Block.

Potency relates to the dose of a drug required to produce a given effect. Abdelhaq, M.M. et al^[13] attempted to compensate for any difference in potency between the Nalbuphine

and Buprenorphine by allowing patients the opportunity of reaching the same level of analgesia and found that the potency ratio of Nalbuphine to Buprenorphine is 75:1. So, according to potency we selected 10 mg dose of Nalbuphine in comparison with 150 µg dose of Buprenorphine.

The present study revealed that onset time of motor and sensory block was not statistically significant in both the Groups. Similar results were observed by Nishikawa, K et al^[14], Hamed, M.A et al^[15], they studied effect of buprenorphine as an adjunct with plain local anesthetic solution in supraclavicular brachial plexus block.

The duration of achieving complete block (assessed by Bromage scale in our study) was faster in Buprenorphine Group compared to Nalbuphine Group. The faster effect of Buprenorphine is due to high lipid solubility which leads to faster penetration of lipid membrane, binding to receptors and thus hastening the block. Marashi, SM^[16] found the similar result, as block achieved faster with Buprenorphine. ($P < 0.001$). Chiruvella, S et al^[17] also revealed that onset of motor block was faster with Buprenorphine, but P values were insignificant. ($P > 0.05$).

In our study Buprenorphine showed prolong duration of sensory and motor block compared to Nalbuphine. Thus, the duration of rescue analgesia was also prolonged in Buprenorphine Group (Group B) compared to Nalbuphine Group (Group N).

The prolongation of anesthetic effect and analgesia could be secondary to stimulation of kappa receptor by Nalbuphine, which inhibits the release of neurotransmitter for pain such as substance P. The prolonged duration of analgesia by Buprenorphine can be due to its high binding capacity and affinity for mu receptors. It dissociates slowly from its receptors. It is also highly lipophilic drug, results in low plasma concentration and prolongs duration.

The duration of analgesia was higher (481.53 ± 42.45 min) in patients who received Nalbuphine as compared to patients who received NS (341.31 ± 21.42 min) $P < 0.001$. Marashi, SM et al^[16] compared the effect of Nalbuphine with tramadol as adjuvant to lidocaine in IVRA and concluded that both were comparable, but Nalbuphine was more effective than tramadol for prolonging the duration of analgesia.

Quality of Block was similar in both the Groups in our study. Intraoperative changes in vital parameters showed insignificant difference between the Groups during present study. Above results supported by the studies done by Nishikawa, K^[14] and Hamed, MA^[15].

In our study sedation score (Assessed by Ramsay sedation scale) was higher in Buprenorphine Group as compared to Nalbuphine Group. Similar to our study, Wajima et al^[18] conducted comparative study of Buprenorphine and clonidine under supraclavicular block. They observed that sedation score was higher in patients who received Buprenorphine (40%) as compared to clonidine (5%).

Many studies have been conducted where Nalbuphine was used as an adjuvant to local anaesthesia in epidural, caudal and intrathecal anaesthesia, without any report of neurotoxicity. No hemodynamic instability or variabilities were noted with Nalbuphine. As Nalbuphine is k-agonist and mu antagonist is devoid of pruritus, nausea, vomiting and respiratory depression. Due to its high affinity for k-opioid receptors result in analgesia,

sedation, cardiovascular stability and minimal respiratory depression. Buprenorphine also used through different routes in various studies in different doses. It was noted that dose-ceiling effect of buprenorphine was on respiratory depression but not on analgesia.

In the present study, 3.33% patients were observed with aphonia and 10% patients were observed with irrelevant talking in Buprenorphine Group. Thus, neurological sequelae were observed higher in Buprenorphine Group as compared to Nalbuphine.

Conclusion

From above study we concluded that Buprenorphine(150 µg) provides prolong duration of analgesia with subsequently prolongs the need of rescue analgesia as compared to Nalbuphine(10 mg) when added to local anesthetics in supraclavicular block.

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