

Nalbuphine as an Adjuvant to Bupivacaine for Supraclavicular Brachial Plexus Block under Ultrasonography Guidance

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ABSTRACT

BACKGROUND

Regional blocks remain as a widely-accepted essential component of comprehensive anaesthesia care. Peripheral nerve blocks with local anaesthetics provide good operating conditions. However, even with the longest acting local anaesthetics, the duration of analgesia may not be sufficient. So, various drugs are used as an adjuvant to local anaesthetic to enhance analgesic efficiency and the duration of the block. This study was done to determine the analgesic efficacy of nalbuphine with bupivacaine (0.5 %) compared to bupivacaine (0.5 %) alone in supraclavicular brachial plexus block under USG guidance for various elective upper limb surgeries.

METHODS

This study was carried out in 60 adult patients of ASA grade I/II of either sex, between 18-50 years of age posted for various elective upper limb surgeries. The patients were randomly allocated into two groups; each group containing 30 patients. Group B: received Inj. bupivacaine 0.5 % 20 ml and 1 ml normal saline, Group N: received Inj. bupivacaine 0.5 % 20 ml and Inj. nalbuphine 1 ml (10 mg). Onset and duration of motor and the sensory blocks were accessed. Intraoperative and postoperative hemodynamic monitoring was done. Intraoperative and postoperative complications were noted.

RESULTS

Nalbuphine added to bupivacaine for supraclavicular approach of brachial plexus block hastened the onset of sensory and motor block, but it was not statistically significant ($P > 0.05$). However, it prolonged the duration of sensory and motor blocks ($P < 0.0001$). The mean duration of analgesia was significantly longer in Group N (578.73 ± 23.77 min) than in Group B (470.83 ± 11.73 min) ($P < 0.0001$).

CONCLUSIONS

In conclusion, the addition of nalbuphine to bupivacaine in the ultrasound-guided supraclavicular approach of brachial plexus block produces adequate anaesthesia with prolonged duration of sensory and motor blockade and postoperative analgesia.

KEY WORDS

Bupivacaine, Nalbuphine, Supraclavicular Brachial Plexus Block.

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DOI: 10.14260/jemds/2022/14

How to Cite This Article:

Mehta SS, Patel NS, Patel KA, et al.
Nalbuphine as an adjuvant to bupivacaine
for supraclavicular brachial plexus block
under ultrasonography guidance. J
Evolution Med Dent Sci 2022;11(01):72-77,
DOI: 10.14260/jemds/2022/14

Submission 20-12-2021,

Peer Review 29-12-2021,

Acceptance 20-01-2022,

Published 25-01-2022.

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BACKGROUND

Regional blocks remain as widely-accepted essential components of comprehensive anaesthesia care. Peripheral nerve blocks with local anaesthetics provide good operating conditions. Their role has expanded from the operating room to the areas of postoperative & chronic pain management. With appropriate selection of technique and patients, they can be given in all age groups.

Peripheral nerve blocks are ideally suited for limb surgeries because of the peripheral location of the surgical site and the potential to block pain pathways at multiple levels. Brachial plexus block is a regional anaesthesia technique that is employed as an alternative or as an adjunct to general anaesthesia for surgery of the upper extremity. It is a block of roots, divisions and cords of the brachial plexus.¹ Effective postoperative pain management is an essential component of all surgical patients.

Due to current trends of rapid industrialization and mechanization, the number of accidental upper limb injuries is increased largely. To handle this workload, an appropriate technique of anaesthesia must be available which would be simple, safe, easy to administer, rapid and economical so that it can be applied and accepted on a wider scale of population.

Advantages of Peripheral Nerve Block over General Anaesthesia are,

- It avoids stress response to laryngoscopy and tracheal intubation.
- It prevents the risk of aspiration of gastric content.
- It decreases postoperative nausea and vomiting.
- It also facilitates early oral intake, returns to normal activity. Hence, reducing hospital stay and cost.
- It facilitates early ambulation. Hence, reduces the chances of thromboembolism.
- Advantages of supraclavicular technique over other brachial plexus blocks,
- It is performed at the level of the trunk where the plexus is presented most compactly,² hence providing isolated and dense motor and sensory anaesthesia.
- Once it was described as the "spinal of the arm" due to its relatively rapid onset and reliability.³

The conventional blind technique depends on surface landmarks before needle insertion and elicitation of paresthesia whereas ultrasound guidance detects the anatomical variants of brachial plexus, related anatomical structures, accurate needle placement and monitoring of drug spread in the appropriate tissue planes with painless performance. Ultrasound increases the success rate and reduces the injury to adjacent structures. It also minimizes the local anaesthetic volume, thereby reducing the incidence of systemic toxicity.^{4,5}

Peripheral nerve blocks with local anaesthetics provide good operating conditions. However, even with the longest acting local anaesthetics, the duration of analgesia may not be sufficient. So, various drugs like opioids, magnesium sulphate, alpha 2 adrenergic agonist, neostigmine, midazolam, dexamethasone etc. are used as an adjuvant to local anaesthetic to enhance analgesic efficiency and the duration of the block.

Bupivacaine is less neurotoxic and has a longer duration of action than other local anaesthetic agents. Hence, it is most commonly used for peripheral nerve blocks.

Nalbuphine is an opioid drug classified as agonist-antagonist, with mixed μ antagonist and κ agonist properties that provide good intraoperative analgesia and prolonged postoperative analgesia with reduced incidence and severity of μ agonist side effects such as pruritus, nausea, vomiting, urine retention and respiratory depression.^{6,7,8,9,10,11}

This clinical study was conducted to evaluate the efficacy of injection nalbuphine as an adjuvant to bupivacaine in supraclavicular brachial plexus block in 60 adults patients (ASA grade 1 & 2) posted for elective upper limb surgeries.

Objectives of the Study

- To study the onset and duration of sensory block.
- To study the onset and duration of motor block.
- To study perioperative hemodynamic stability, respiratory parameters, sedation score.
- To study the duration of postoperative analgesia.
- To study perioperative complications.

METHODS

It is a prospective randomized interventional study. It was carried out in SVPMSR Hospital, in 60 adult patients of ASA grade I/II of either sex, between 18-50 years of age posted for various elective upper limb surgeries between June 2021 and November 2021.

Inclusion Criteria

1. Patient undergoing upper limb surgeries.
2. All the patients belonged to the American Society of Anaesthesiologists (ASA) I or II.
3. Age groups of 18-50 years were included in the study.

Exclusion Criteria

1. Patient refusal.
2. Local infection, swelling, trauma, deformity.
3. H/O drug allergy.
4. Coagulation disorders.
5. Existing neurological disorder/ nerve palsy, psychiatric, neuromuscular disorder, major systemic diseases.
6. Pregnancy or lactating women.
7. Alcoholism or drug abuse.
8. Chronic analgesic therapy.
9. Nerve injury.
10. Inadequate effect of nerve blocks or supplemented with other types of anaesthesia.
11. Mentally retarded and uncooperative patients.

The Patients were Randomly Allocated into Two Groups; Each Group Containing 30 Patients

Group B: received inj. bupivacaine 0.5 % 20 ml and 1 ml normal saline.

Group N: received inj. bupivacaine 0.5 % 20 ml and inj. nalbuphine 1 ml (10 mg).

Study Protocol

Randomization was done by odd and even numbers in sealed opaque envelopes. Execution of randomization was done at the time of giving supraclavicular plexus block. The sample size was calculated as 30 subjects in each group with an alpha error of 0.05 and power of 80 %.

All the statistical analyses were performed using the SPSS software (version 20; SPSS Inc, Chicago, IL, USA). Data presented as mean and standard deviation or number and percentage. The student's t-test was used to examine the differences between means. Statistical significance was accepted for a P-value of < 0.05.

Preanesthetic Assessment

All the patients were examined to detailed pre-anaesthetic evaluation with clinical history, general & systemic examination. All routine investigations like hemogram, RBS-Random Blood Sugar, RFT-Renal Function Test, LFT- Liver Function Test, serum electrolytes, HIV, HBsAg, chest X-ray, ECG-Electrocardiogram and other specific investigations according to patient's clinical condition were carried out. Each patient was explained in detail regarding the procedure of anaesthesia, its advantages and risks. Patients were also explained about 0-10 point visual analogue scale (VAS) on a sheet of paper where a score of 0 was labelled as no pain and 10 as worst possible pain. An informed, written consent was taken. All the patients were kept nil by mouth for six hours before the surgery.

In the Operation Theatre,

After securing an intravenous cannula, Ringer's lactate solution was given. After establishing standard monitoring, baseline parameters such as pulse rate, blood pressure, electrocardiogram, respiratory rate and oxygen saturation were recorded. Premedication as inj. ondansetron 4 mg IV and inj. glycopyrrolate 0.2 mg IV was given. All the necessary equipment and drugs needed for the administration of general anaesthesia were kept ready. Emergency drug tray and equipment for emergency resuscitation were kept ready.

Equipments

1. Ultrasound machine with linear transducer (frequency: 5-10 MHz).
2. Sterile sleeve and gel.
3. 23G, 1.5 inches needle.
4. Standard nerve block tray containing sterile towels, gauge packs, gloves and 10 mL and 2 mL syringes.
5. Povidone Iodine.

Technique

Under all aseptic precautions, the block was performed with the patient in a supine position with his/her head turned to the contralateral side. The ultrasound probe (linear) was put

in the supraclavicular fossa, parallel to the middle third of the clavicle, in the sagittal plane, to visualise the brachial plexus as a cluster of 5-6 hypoechoic circles located superior and lateral to the subclavian artery between the anterior and middle scalene muscles at the lower cervical region. A 23 gauge, 1.5 inch long needle was inserted in the in-plane technique. Upon visualising its path to the desired location, the local anaesthetic mixture was injected according to the allocated group B or N. The predetermined volume of drug solution was administered after negative aspiration around the brachial plexus.

Proper dispersion of the local anaesthetic agents within the tissue sheath containing the brachial plexus through two different needle positions was done.

End of injection was considered as time 0 min.

Block Characteristics

Sensory Block

Sensory block was assessed using response to pinprick test at the palmar surface of the index finger, little finger and dorsum of thumb for median, ulnar and radial nerves respectively.

Assessment of Sensory Block by 3 Point Scale

3 Point Scale

0 Normal sensation

1 Loss of sensation of pinprick (analgesia)

2 Loss of sensation of touch (anaesthesia)

The onset of sensory block was taken as the time from the end of injection to complete loss of pin-prick sensation.

Motor Block: this was assessed by asking the patient to flex the forearm and hand against gravity and adduct the shoulder.

Motor block was assessed by Hollmen's scale.¹²

Hollmen's Scale

1 Normal muscle function.

2 Slight weakness in function.

3 Very weak muscular function.

4 Complete loss of muscle action.

The onset of motor blockade is considered as the time from the end of injection to the time of inability to do movements.

Patients with complete sensory block were included in the study.

After achieving complete sensory block (3 point scale: 2) and motor block (Hollmen's scale: 4) surgery was started. The time of starting of surgery was noted.

Intraoperative Hemodynamic Monitoring

The pulse rate, blood pressure (SBP, DBP), ECG, oxygen saturation (SpO₂) and respiratory rate (RR) were noted intraoperatively at 0 min, thereafter every 5 minutes for the initial 15 minutes, then at 30, 60, 90, 120, 150 mins till the end of surgery.

Intravenous fluids (Ringer's lactate) were continued in the intraoperative period at a rate of 2 ml/kg/hour. Oxygen was given at 4 litre/min through a venturi mask to each patient.

Intraoperative Complications

Patients were observed for complications like hypotension (fall in BP > 20 % from the baseline), bradycardia (pulse rate < 60/min), respiratory depression (RR < 10/min or SpO₂ < 95 %) and nausea and vomiting.

No patient in our study needed treatment for any complications.

The time of the end of surgery was noted and the total duration of each case was noted.

Duration of sensory block was taken as the time elapsed between injection of a drug to return of pinprick sensation.

Duration of motor block was taken as the time elapsed between injection of a drug to return of motor power evaluated by finger and shoulder movement.

Postoperative Hemodynamic Monitoring

Postoperatively, pulse rate, blood pressure (SBP, DBP), ECG, oxygen saturation (SpO₂), respiratory rate and VAS score were recorded at 0, 30 min then 1, 2, 4, 6, 8, 10 hrs.

Sedation Score

Sedation was assessed by Campbell Sedation score.¹³

1. Wide awake
2. Awake and comfortable
3. Drowsy and difficult to arouse
4. Not arousable

Duration of Postoperative Analgesia

Time interval from the end of local anaesthetic injection to the need for first rescue analgesia (VAS ≥ 4)

Post-operative pain was assessed using 10 point scale

Visual Analogue Scale (VAS)¹⁴

Patients were explained about this scoring system and asked to mark vertically on the following scale which reflected the intensity of pain, according to their experience at that time.

Whenever VAS ≥ 4 or the patient complained of pain, inj. diclofenac sodium (1.5 mg/kg) 75 mg IV was given as a rescue analgesic.

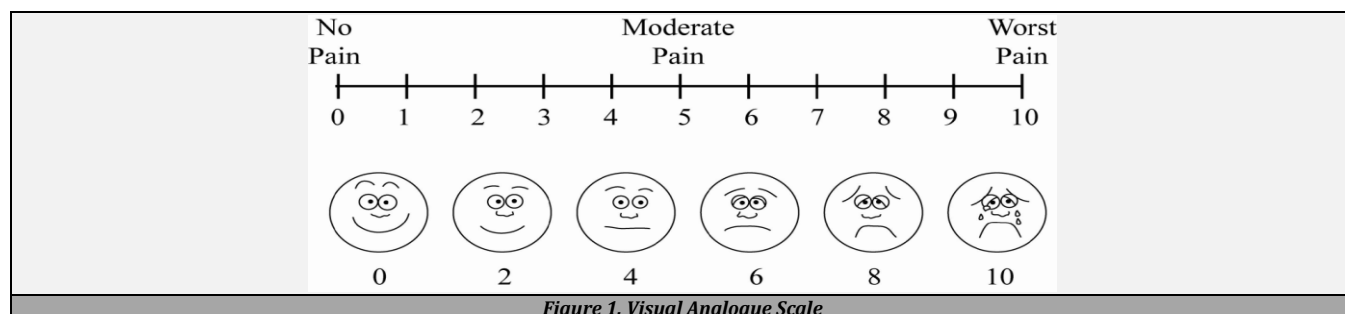


Figure 1. Visual Analogue Scale

Postoperative Complications

All patients were observed for postoperative complications like pneumothorax, pruritus, Horner's syndrome, nerve injury and local hematoma. In each patient, a chest x-ray was done 6 hours postoperatively to rule out pneumothorax.

RESULTS

In a study of 60 cases, comprising 30 patients in each group, observations and results are summarized in the tabulated form and described below.

	Group B	Group N	Inference
Sex (M/F)	17/13	16/14	NS
Age (years) (Mean±SD)	40.7±10.28	42.23±9.37	NS
Weight (kg) (Mean±SD)	64.23±7.64	64.73±8.73	NS
Height (cm) (Mean±SD)	161.13±4.95	159.76±6.80	NS

Table 1. Demographic Data

Table 1 shows no significant differences in male-female ratio, weight, height and age of patients between the two groups.

	Group B	Group N	P-Value	Inference
Duration of surgery (min) (Mean±SD)	103.33±20.14	110.83±16.19	0.12	NS

Table 2. Duration of Surgery

Table 2 shows no significant difference in duration of surgery between the two groups (P>0.05).

	Group B (Mean±SD)	Group N (Mean±SD)	P-Value	Inference
sensory block (min)	11.26±1.00	10.89±0.77	0.11	NS
motor block (min)	15.14±1.24	14.58±0.99	0.06	NS

Table 3. Onset of Anaesthesia

Table 3 shows the meantime of onset of sensory and motor blocks which was non-significant between the two groups (P>0.05).

	Group B (Mean±SD)	Group N (Mean±SD)	P-Value	Inference
sensory block (min)	449.17±8.99	555.07±20.06	<0.0001	S
motor block (min)	368.93±13.56	501.40±19.51	<0.0001	S

Table 4. Duration of Anaesthesia

Table 4 shows mean duration of sensory and motor block as significantly longer in Group N than in Group B (P<0.05).

	Group B (Mean±SD)	Group N (Mean±SD)	P-Value
Time (min)	471.93 ± 10.19	578.73 ± 23.77	<0.0001

Table 5. Duration of Analgesia

Table 5 shows that the mean duration for 1st analgesic requirement for Group N as (578.73±23.77 min) and it is significantly longer than that in Group B (471.93±10.19 min) (P<0.05).

There was no statistically significant difference in heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate and oxygen saturation found between the two groups perioperatively. During the intraoperative period, hemodynamics remained stable in a consistent manner.

Campbell Sedation Score	Group B (N=30) No. of Patients	% of Patients	Group N (N=30) No. of Patient	% of Patients
1	30	100	29	96.67
2	-	-	01	3.33
3	-	-	-	-
4	-	-	-	-

Table 6. Sedation Score

Table 6 shows that none of the patients developed significant sedation in both groups.

Complication	Group B	Group N
Bradycardia	0	0
Hypotension	0	0
Respiratory depression	0	0
Nausea/vomiting	0	0
Horner's syndrome	0	0
Pneumothorax	0	0
Local hematoma	0	0
Pruritus	0	0
Nerve injury	0	0

Table 7. Perioperative Complications

No complications and adverse events were observed in either group.

DISCUSSION

Brachial plexus block is a regional anaesthesia technique that is used as an alternative or as an adjunct to general anaesthesia for surgery of the upper extremity. The supraclavicular approach of brachial plexus block is an efficient regional anaesthesia technique for upper limb surgeries as it provides good surgical anaesthesia. It is performed at the level of the trunk where the plexus is presented most compactly. It's typical features include rapid onset, predictable and dense anaesthesia along its high success rate.

The present study was performed to evaluate the efficacy of nalbuphine when administered with 0.5 % bupivacaine in the supraclavicular approach of brachial plexus block under USG guidance in terms of onset and duration of sensory and motor block, postoperative analgesia, perioperative hemodynamic changes and side effects.

Nicolas Dio et al.¹⁵ (2013) concluded that upper limb regional anaesthesia has gained popularity because of its effectiveness and the safety profile associated with ultrasound-guided techniques.

In the present study, we have used only 20 ml of 0.5 % bupivacaine to establish the effective block.

In our study, demographic data and mean duration of surgery were comparable in both groups and no statistically significant difference was found between the two groups (Table 1 & 2).

Kumkum Gupta et al.⁹ (2016) studied normal saline 1 ml with 20 ml of 0.5 % bupivacaine in Group 1 and nalbuphine 1 ml (10 mg) with 20 ml of 0.5 % bupivacaine in Group 2 in supraclavicular block. They concluded that the differences were not statistically significant in both groups in the onset of sensory and motor blocks.

In our study as shown in Table 3, the onset of sensory and motor blocks was faster in Group N as compared to Group B, but without a statistically significant difference.

Kumkum Gupta et al.⁹ (2016) and Abdelhaq, M M et al.⁶ (2016) concluded that the duration of both sensory and motor block along with postoperative analgesia was longer in the nalbuphine group compared to the statistically significant control group.

In our study (table 4), duration of sensory and motor

block in Group N was longer than Group B, which was statistically significant.

Nazia Nazir et al.¹⁰ (2017) studied normal saline 1 ml with 30 ml of 0.375 % bupivacaine in Group C and nalbuphine 1 ml (10 mg) with 30 ml of 0.375 % bupivacaine in Group N in supraclavicular block. They concluded that the duration of postoperative analgesia was significantly longer in Group N as compared to Group C.

In our study (table 5), the duration of postoperative analgesia was significantly longer in Group N as compared to Group B ($P < 0.0001$).

Kumkum Gupta et al.⁹ (2018) concluded in their study that the use of nalbuphine was not associated with any hemodynamic variability or adverse event. As nalbuphine is an agonist to κ receptor and antagonist to μ receptors, it is devoid of pruritus, nausea, vomiting and respiratory depression.

In our study (Table 7), no major complications were noted in either group.

CONCLUSIONS

In conclusion, the addition of nalbuphine to bupivacaine in ultrasound-guided supraclavicular approach of brachial plexus block produces adequate anaesthesia with the following advantages:

- Nalbuphine prolongs the duration of sensory and motor blockade.
- It prolongs the duration of postoperative analgesia.
- It provides stable hemodynamics without any unwanted side effects in the perioperative period.
- It is cost-effective compared to other adjuvants.
- Ultrasound helps in better visualization of nerves, needle and spread of local anaesthetic at brachial plexus. So, a lesser amount of drug volume is needed for the rapid and complete block.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jemds.com.

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