

## A COMPARISON BETWEEN INTRATHECAL NALBUPHINE AND DEXMEDETOMIDINE AS ADJUVANTS TO HYPERBARIC BUPIVACAINE FOR LOWER LIMB ORTHOPEDIC SURGERIES

GEETANJALI SINGHAL\*, ARUN KUMAR SAXENA, GAGAN BHARADWAJ

Department of Anaesthesiology, Jaipur National University Institute for Medical Science and Research Centre, Jaipur, Rajasthan, India.

\*Corresponding author: Geetanjali Singhal; Email: singhalgeetanjali@yahoo.com

Received: 22 April 2023, Revised and Accepted: 12 July 2023

### ABSTRACT

**Objective:** Sub arachnoid block is a reasonably safe and simple technique of regional anesthesia. This randomized double-blind study was conducted to compare the efficacy of intrathecal nalbuphine and Dexmedetomidine as adjuvant with hyperbaric bupivacaine for lower limb orthopedic surgeries.

**Methods:** Sixty adult patients of American Society of Anaesthesiologists physical status 1 and 2 who were scheduled for elective lower limb orthopedic surgeries were divided into two groups, D and N, of 30 each. Group D patients received dexmedetomidine 4 mcg and Group N received nalbuphine 2 mg as adjuvant along with bupivacaine heavy 0.5% (3 mL) intrathecally. Sensory and motor block characteristics and time to first rescue analgesic (intravenous tramadol 100 mg) were the primary end points and drug-related side effects such as pruritis, nausea, vomiting, and respiratory depression were taken as secondary end points. Subsequently, data were entered into Microsoft Excel spreadsheet and Statistical Package for the Social Science software version 22 was used for statistical analysis.

**Results:** All 60 patients showed adequate block. The onset of sensory and motor block was statistically comparable in both groups. The duration of sensory and motor block and duration of analgesia were markedly extended in dexmedetomidine group patients. There were no significant intraoperative or post-operative side-effects in both group of patients.

**Conclusion:** Dexmedetomidine (4 mcg) increases the sensory and motor block duration and duration of post-operative analgesia significantly more than nalbuphine (2 mg), when administered intrathecally as an adjuvant to bupivacaine (15 mg).

**Keywords:** Spinal anesthesia, Sub arachnoid block, Dexmedetomidine, Nalbuphine.

© 2023 The Authors. Published by Innovare Academic Sciences Pvt Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>) DOI: <http://dx.doi.org/10.22159/ajpcr.2023v16i9.48157>. Journal homepage: <https://innovareacademics.in/journals/index.php/ajpcr>

### INTRODUCTION

Spinal anesthesia is a well established technique as it safe and simple. However, it has the limitation of providing analgesia for a brief duration. Therefore, many adjuvants have been used along with local anesthetics to enhance the duration of analgesia. This also allows the dose of local anesthetic to be reduced thereby minimizing the incidence of side effects. Some of these drugs are clonidine, opioids, ketamine, alpha2 agonists, etc.

The discovery of opioid receptors and endorphins in spinal and supra spinal regions popularized the use of spinal opioids [1]. Nalbuphine, a synthetic opioid analgesic with agonist-antagonist activity, acts as antagonist to mu receptors and agonist at kappa receptors and has been used to provide effective analgesia with very few side effects [2-4].

Dexmedetomidine is an alpha 2 agonist which acts by binding with pre-synaptic C-fibers and post-synaptic dorsal horn neurons. It depresses release of C fiber transmitters and causes hyperpolarization of postsynaptic dorsal horn neurons [5].

Bupivacaine is a well established, long acting local anesthetic commonly used as a spinal anesthetic. However, it has a limited duration of analgesia when used alone [6].

This study was aimed at comparing nalbuphine and dexmedetomidine as adjuvants to intrathecal bupivacaine heavy for lower limb orthopedic surgeries. Primary objectives were sensory and motor block characteristics and time to rescue analgesic while secondary objectives were to study the incidence of drug related side effects such as pruritis, nausea/vomiting, and respiratory depression.

### METHODS

After getting approval from JNUIMSRC ethical Committee, the trial was prospectively registered with Clinical Trial Registry of India with registration no. CTRI/2022/09/045923 and was conducted in accordance with principles of the Declaration of Helsinki.

After obtaining written informed consent from the patients, this prospective, randomized, and double blind study was conducted on 60 patients of ASA Grade 1 and 2. These patients were of both genders, aged 25-65 years, weighing 50-90 kg and height  $\geq 150$  cm scheduled for elective lower limb orthopedic surgery under subarachnoid block.

#### Exclusion criteria

Patients with history of cardiovascular, respiratory, hepatic, renal, neurologic, psychiatric, and metabolic diseases, those with coagulation or bleeding abnormalities, severe spinal deformity, and allergy to local anesthetics were excluded from the study.

Randomization of patients was done into two groups of 30 each by computer generated randomization table. Double blindedness of the study was ensured by the drug being prepared by one anesthesiologist while sub arachnoid block (SAB) was given by another anesthesiologist. Post-operative data were recorded by another resident who was unaware of the group allocation.

- Group D – patients received hyperbaric bupivacaine 15 mg (0.5%) with dexmedetomidine 4  $\mu$ g
- Group N – patients received hyperbaric bupivacaine 15 mg (0.5%) with nalbuphine 2 mg.

Pre-anesthetic checkup was done a day before and written informed consent was obtained from patients. Patients were given tab alprazolam on the night before surgery and were kept fasting overnight.

On arrival in the operation theater, an intravenous line with 20 G cannula was obtained. Intraoperative monitoring was carried out in the form of electrocardiograph, non-invasive blood pressure, heart rate (HR), and pulse oximetry.

Baseline vital parameters were noted and further monitoring was done at 5 min interval until 30 min and 15 min interval thereafter till end of surgery. Preloading with Ringer Lactate was started at 10 mL/kg and completed before giving anesthesia.

Spinal anesthesia was performed under all aseptic precautions with 25G Quincke needle in sitting position by midline approach through L3-L4 intervertebral space. All patients were laid supine immediately. Oxygen was given by nasal cannula at 3 L/min. Time of anesthesia was noted.

The parameters noted were onset time of sensory blockade up to T10, onset of motor blockade, regression time up to L1, duration of motor blockade, time of rescue analgesics, duration of surgery, assessment of visual analog scale (VAS) score and bromage score, and adverse effects.

Sensory blockade was tested using pin prick method with a bunt tipped needle at every 2 min for first 10 min and every 15 min till end of surgery. Onset of sensory block was defined as time to reach T8 (xiphoid process).

Regression until level L1 was checked every 15 min in the post-operative period. This was taken as the duration of sensory block.

Motor blockage was assessed by bromage scale [7].

1. Free movement of leg and feet
2. Able to move knee with free movement of feet
3. Unable to flex knee with free movement of feet
4. Unable to move any part of lower limb.

Onset of motor blockade was defined as time of spinal injection to time taken to achieve bromage scale 4. Duration of motor blockade was noted till complete motor recovery (Bromage1). Pain was assessed using VAS score [8], where 0=no pain to 10=worst possible pain. Duration of effective analgesia was taken as time from spinal injection to time of administration of rescue analgesic (at VAS score  $\geq 3$ ). Post-operative patients were observed for further monitoring. VAS score was assessed every 30-min postoperatively till patients complained of pain (VAS  $>3$ ).

For the study, hypotension was defined as fall in systolic blood pressure (SBP) of more than 20% of baseline or  $<100$  mmHg and was treated with increasing the infusion rate of crystalloid solution and if required, by incremental doses of mephentermine 6 mg iv. Bradycardia was defined as HR  $<50$ /min and was treated with atropine 0.6 mg iv. Intraoperative nausea was treated with intravenous ondansetron 4 mg. Pruritis was treated with inj pheneramine maleate 45 mg iv. Respiratory depression was defined as RR  $<8$  breaths/min or  $spO_2 <94\%$  on room air and treated with oxygen supplementation.

## RESULTS

The present study was done in 60 adult consenting patients undergoing elective lower limb orthopedic surgery under SAB. We compared the clinical efficacy of intrathecal nalbuphine and dexmedetomidine as adjuvant to 0.5% of hyperbaric bupivacaine. The study culminated successfully without any protocol deviation. Adequate block was achieved in all patients, surgical procedures were uneventful and no surgical and anesthetic complications were noted. Therefore, all patients were included for data analysis.

The patients of both groups were statistically comparable regarding mean age, weight, sex, ASA grading, surgical characteristics, and duration of surgery (Table 1).

The onset time of sensory block at T8 was  $6.23 \pm 3.13$  min in patients of Group D and  $5.57 \pm 1.52$  min in patients of Group N with no statistical significance ( $p=0.299$ ). Onset time of complete motor block was also statistically comparable in both group patients. Duration of sensory and motor block was significantly extended in Group D patients with significant statistical difference. The total duration of analgesia was markedly extended in Group D patients with statistically highly significant difference (Table 2).

The intraoperative and post-operative hemodynamic changes in mean HR and mean SBP were comparable in both groups and were

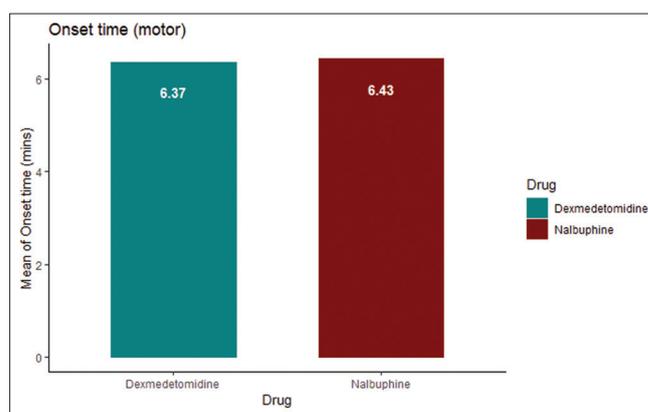


Fig. 1: Onset time motor

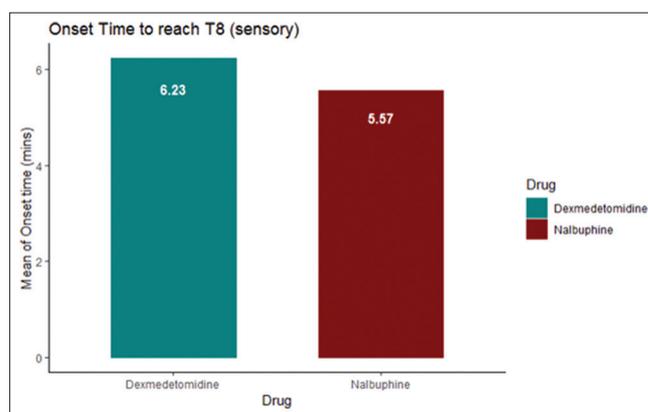


Fig. 2: Onset time to reach T8

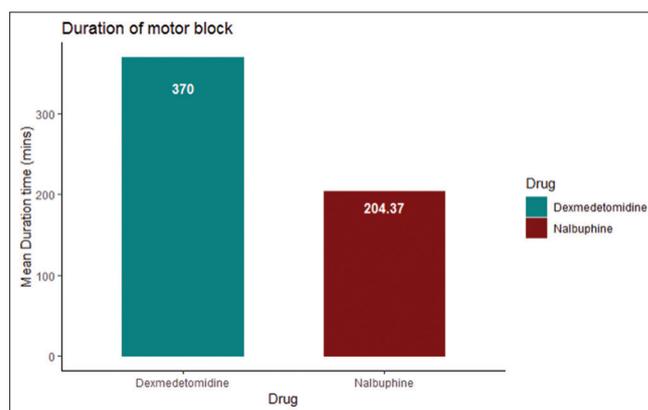


Fig. 3: Duration of motor block

Table 1: Demographic profile

Attribute	Dexmedetomidine	Nalbuphine	p-value
Age (years)	39±13.31	37.9±13.16	0.7487
Weight (kg)	64.03±9.3	57.67±11.24	0.02025
Sex (M/F)	23 (M)/7 (F)	21 (M)/9 (F)	0.7703
ASA grade (1/2)	18 (1)/12 (2)	18 (1)/12 (2)	1
Pre-operative heart rate	83.43±12.51	90.4±22.05	0.1391
Pre-operative blood pressure (systolic)	137.57±12.52	134.3±14.19	0.3483
Pre-operative blood pressure (diastolic)	79.47±8.25	81.87±8.23	0.2639
Duration of surgery	107.87±44.98	100.93±45.15	0.5536

Table 2: Sensory and motor blockade profile

Parameter	Dexmedetomidine	Nalbuphine	p-value
Onset time of sensory block till T8 level (min)	6.23±3.13	5.57±1.52	0.2997
Onset time of complete motor block (min)	6.37±2.74	6.43±1.65	0.9095
Duration of sensory block (min)	261.4±54.63	173.87±36.89	0.000000002
Duration of motor block (min)	370±60.36	204.37±31.13	0
Duration of analgesia (min)	439.4±44.98	296.87±20.6	1.504E-12

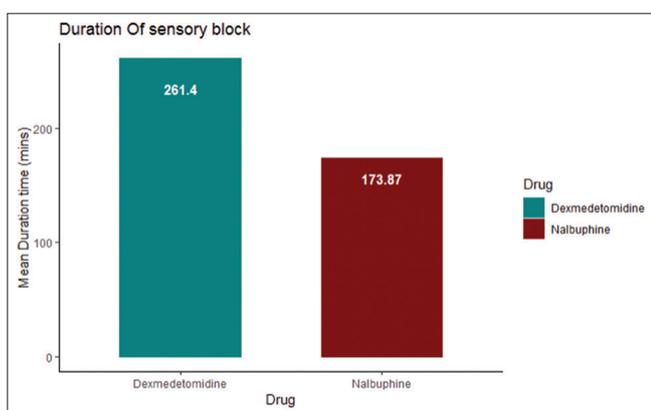


Fig. 4: Duration of sensory block

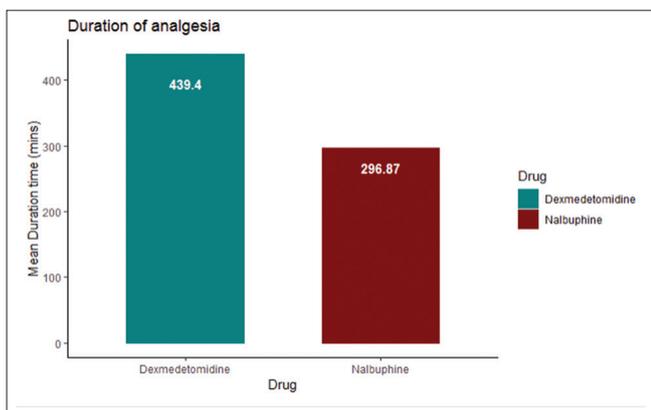


Fig. 5: Duration of analgesia

not statistically significant. Incidence of hypotension and bradycardia during intraoperative period was minimal and did not require any medical intervention. There was no incidence of any adverse effects in the form of pruritis, shivering, nausea, vomiting, or respiratory depression in both group patients. None of the patients required any supplemental analgesics in the intraoperative period.

## DISCUSSION

Intrathecal opioids have been used as adjuncts to local anesthetics to prolong the duration of surgical as well as postop analgesia and to allow early ambulation of patients because of their motor sparing action.

We compared the clinical efficacy of dexmedetomidine and nalbuphine when used as adjuvants to 0.5% of bupivacaine in SAB in lower limb orthopedic surgeries. Our primary end points were motor and sensory block characteristics and duration of post-op analgesia and secondary end points were intraoperative and post-operative adverse effects such as sedation, pruritis, nausea, vomiting, and respiratory depression.

The present study revealed no statistically significant difference in the onset of sensory blockade or motor blockade of hyperbaric bupivacaine when either dexmedetomidine or nalbuphine was used as an adjuvant. However, the duration of sensory block and motor block was significantly prolonged by the addition of dexmedetomidine as compared to nalbuphine. The duration of postop analgesia was also significantly enhanced in dexmedetomidine group as compared to nalbuphine group.

The results of the present study correlate with the previous studies where it was observed that the addition of dexmedetomidine and nalbuphine significantly prolonged the duration of sensory and motor block as well as post-operative analgesia without increasing the incidence of adverse effects [9-11]. A randomized and controlled study conducted by HalaEid *et al.* revealed that intrathecal dexmedetomidine in doses of 10 and 15 mcg significantly prolonged the effects of hyperbaric spinal bupivacaine in a dose dependent manner [12]. In another study, Mukherjee *et al.* studied the two-segment regression time and duration of effective analgesia with different intrathecal doses of nalbuphine (0.2, 0.4, 0.8 mg). They found that duration of analgesia was prolonged in groups with 0.4 mg nalbuphine and 0.8 mg nalbuphine while the incidence of side-effects was significantly higher in 0.8 mg nalbuphine group [4].

It was observed by Basunia *et al.* that 1.2 mg is the optimum intrathecal dose of nalbuphine when added as an adjuvant to 15 mg of 0.5% hyperbaric bupivacaine to prolong post-operative analgesia in the lower abdominal and lower limb surgeries. It was also found that nalbuphine exhibits an analgesic ceiling effect at a 1.2 mg dosage, above which it will not increase analgesia efficacy [13].

Halder *et al.* concluded that the addition of 10 µg of dexmedetomidine to 0.5% hyperbaric bupivacaine is more efficient in reducing the onset and prolonging the duration of sensory and motor blockade as compared to 5 mcg of dexmedetomidine [14].

Dubey and Bisht [16] conducted a randomized study and concluded that nalbuphine provides better quality of block as compared to Bupivacaine alone. It also prolongs post-operative analgesia when used as adjuvant to spinal bupivacaine in elderly patients [15].

The results of our study were similar to the previous studies stating that dexmedetomidine is a better adjuvant to bupivacaine than nalbuphine as it was more efficient in prolonging the duration of sensory and motor block. Dexmedetomidine was also found to provide longer duration of post-operative analgesia. However, our study had certain limitations. A small sample size was our main limitation. More randomized and controlled trials in larger sample size of population will further validate our results.

#### CONCLUSION

Dexmedetomidine (4 mcg) increases the sensory and motor block duration and duration of post-operative analgesia significantly more than nalbuphine (2 mg), when administered intrathecally as an adjuvant to bupivacaine (15 mg).

#### ACKNOWLEDGMENT

My acknowledgements go to Ms. Kaveri Singhal, for her invaluable support in managing the data and giving meaning to it.

#### CONFLICTS OF INTEREST

Nil.

#### FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

#### REFERENCES

- Hindle A. Intrathecal opioids in the management of acute postoperative pain. *Contin Educ Anaesth Crit Care Pain* 2008;8:81-5.
- Gunion MW, Marchionne AM, Anderson CT. Use of mixed agonist-antagonist nalbuphine in opioid based analgesia. *Acute Pain* 2004;6:29-39. doi: 10.1016/j.acpain.2004.02.002
- Culebras X, Gaggero G, Zatloukal J, Kern C, Marti RA. Advantages of intrathecal nalbuphine, compared with intrathecal morphine, after caesarean delivery: An evaluation of postoperative analgesia and adverse effects. *Anesth Analg* 2000;91:601-5. doi: 10.1097/00000539-200009000-00019, PMID 10960384
- Mukherjee A, Pal A, Agrawal J, Mehrotra A, Dawar N. Intrathecal nalbuphine as an adjuvant to sub arachnoid block: What is the most effective dose? *Anesth Essays Res* 2011;5:171-5. doi: 10.4103/0259-1162.94759
- Maze M, Tranquilli W. Alpha-2 adrenoreceptor agonists: Defining the role in clinical anesthesia. *Anesthesiology* 1991;74:581-605. doi: 10.1097/00000542-199103000-00029
- Cousins MJ, Bridenbaugh PO. Spinal neural blockade in neural blockade. In: *Clinical Anesthesia and Management of Pain*. 3<sup>rd</sup> ed. Philadelphia, PA: Lippincott-Raven; 1998. p. 675.
- Bromage PR, Philip R. *Epidural Analgesia*. 1<sup>st</sup> ed. Philadelphia, PA: Saunders; 1978. p. 258, 264.
- McCormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: A critical review. *Psychol Med* 1988;18:1007-19. doi: 10.1017/s0033291700009934, PMID 3078045
- Sharma A, Chaudhary S, Kumar M, Kapoor R. Comparison of nalbuphine versus fentanyl as intrathecal adjuvant to bupivacaine for orthopedic surgeries: A randomized controlled double-blind trial. *J Anaesthesiol Clin Pharmacol* 2021;37:529-36. doi: 10.4103/joacp.JOACP\_270\_18, PMID 35340949
- Nagaraj B, Vinay BR, Vani NV, Dayananda VP. Intrathecal nalbuphine and dexmedetomidine as adjuvants to bupivacaine versus Plain bupivacaine for Orthopedic Surgeries under subarachnoid Block: A Comparative Study. *Anesth Essays Res* 2022;16:381-5. doi: 10.4103/aer.aer\_127\_22, PMID 36620114
- Michael RM, Mehta M. Comparison between dexmedetomidine and nalbuphine as an adjuvant to bupivacaine in spinal anesthesia. *Int J Adv Res* 2016;3:1024-45.
- HalaEid EA, Shafie MA, Youssef H. Dose-related prolongation of hyperbaric bupivacaine spinal anesthesia by dexmedetomidine. *Ain Shams J Anesthesiol* 2011;4:83-95.
- Basunia SR, Chattopadhyay S, Das A, Laha B, Bhar D, Pal R. A prospective, double-blind dose ranging study of intrathecal nalbuphine in the lower abdominal and lower limb surgeries. *Indian J Pain* 2016;30:198-203. doi: 10.4103/0970-5333.198060
- Halder S, Das A, Mandal D, Chandra M, Ray S, Biswas MR, et al. Effect of different doses of dexmedetomidine as adjuvant in bupivacaine-induced subarachnoid block for traumatized lower limb orthopaedic surgery: A prospective, double-blinded and randomized controlled study. *J Clin Diagn Res* 2014;8:GC01-6. doi: 10.7860/JCDR/2014/9670.5118, PMID 25584237
- Dubey R, Bisht S. To study the effect of addition of nalbuphine to intrathecal bupivacaine used for elderly patient in lower abdominal surgeries under spinal anesthesia: A Randomized double blinded control study. *J Evol Med Dent Sci* 2014;3:14364-71.