Section: Anaesthesiology and Critical Care

Original Research Article

COMPARATIVE STUDY OF TWO DIFFERENT DOSES OF DEXMEDETOMIDINE ADDED TO ROPIVACAINE IN ULTRASOUND GUIDED FEMORAL NERVE BLOCK FOR POSITIONING OF FEMUR FRACTURE PATIENTS FOR SUBARACHNOID BLOCK

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ABSTRACT

Background: Positioning a patient for spinal anesthesia in fracture femur surgery is difficult due to fracture site pain. Femoral nerve block effectively reduces the fracture site pain. This study compares two different doses of dexmedetomidine added to ropivacaine in ultrasound-guided FNB for positioning patients with femur fractures before subarachnoid block. **Materials and Methods**: Sixty-six patients aged 18–60 years, scheduled for elective femoral fracture surgery were randomly allocated to two groups (n=33 each). Group I received 15 ml of 0.5% ropivacaine + dexmedetomidine 1 µg/kg. Group II received 15 ml of 0.5% ropivacaine + dexmedetomidine 1.5 µg/kg. Vitals, onset and peak of sensory block, visual analogue scale (VAS) pain scores at regular intervals, and adverse effects were recorded and analyzed using statistical tests with a significance level of $p< 0.05$. **Result:** Both groups showed effective pain relief, facilitating optimal positioning for subarachnoid block. Group II demonstrated a significantly faster onset and peak sensory blockade ($p< 0.05$), and reduced VAS scores compared to Group I. Group II showed a relatively higher proportion of Grade 2 responses, but the difference is not statistically significant. Both groups demonstrated clinically insignificant reductions in heart rate and blood pressure. The adverse effects included bradycardia, hypotension, and nausea/vomiting, with no statistically significant differences between two groups. **Conclusion:** The addition of dexmedetomidine to ropivacaine in ultrasound-guided FNB enhances analgesia for femur fracture patients undergoing subarachnoid block. Dose 1.5 µg/kg dexmedetomidine provides superior pain relief and can be safely used without much adverse effects.

INTRODUCTION

Femoral bone fractures are the most frequently treated injuries in orthopedic surgery and are often linked to a higher rate of morbidity due to non-orthopedic complications. Surgical fixation of these fractures is most commonly performed under spinal anaesthesia. However, achieving the ideal position for effective spinal anesthesia can be greatly challenged due to severe pain, anxiety and muscle spasms associated with femur fractures.[1] Conventional pain management methods, such as intravenous opioids, nonsteroidal anti-inflammatory drugs (NSAIDs) and other systemic analgesics, often fail to provide adequate analgesia and may lead to undesirable systemic effects like respiratory depression, sedation, and gastrointestinal disturbances.[2]

Regional anaesthesia, particularly the femoral nerve block (FNB), has proven to be an effective method for relieving pain associated with femur fractures, thereby enabling easier patient positioning for spinal anaesthesia.[3] Ultrasound-guided femoral nerve blocks have improved both the effectiveness and

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safety of this technique, reducing the risk of complications such as vascular puncture, nerve injury, and local anaesthetic systemic toxicity.[4]

Among various local anesthetics, ropivacaine is frequently selected due to its safer cardiovascular and neurological profile compared to older agents like bupivacaine. Ropivacaine preferentially produces sensory blockade, reducing motor blockade intensity, thereby allowing better patient cooperation during positioning. Despite its advantages, ropivacaine alone has a relatively short duration of analgesia.[5]

To extend its effects and improve analgesic quality, adjunctive agents are commonly used. Dexmedetomidine, a selective alpha-2 adrenergic agonist, is increasingly employed as an adjuvant in peripheral nerve blocks due to its sedative, analgesic, and anxiolytic properties, while minimizing the risk of respiratory depression.[6]

Studies have consistently shown that dexmedetomidine enhances the onset, duration, and quality of analgesia when used in conjunction with local anesthetics.[7] However, there is limited clarity regarding the optimal dose of dexmedetomidine that maximizes analgesic benefits while minimizing adverse effects.

Recognizing this gap in existing knowledge, the current study is designed to compare two different doses of inj. Dexmedetomidine 1 mcg/kg vs inj. Dexmedetomidine 1.5 mcg/kg added to inj. Ropivacaine0.5% in ultrasound-guided femoral nerve block. The primary aim is to determine the optimal dose that effectively facilitates patient positioning for spinal anesthesia by providing rapid onset, enhanced patient comfort, and minimal hemodynamic disturbances.

MATERIALS AND METHODS

After obtaining institutional ethical committee clearance and written informed consent, 66patients of 18 to 60 yrs of age belonging to American society of anaesthesiologists (ASA) grade I and II undergoing fracture femur surgery were enrolled for the study. Sample size was calculated considering 60% prevalence of pain on sitting for spinal anaesthesia, allowing 5% error and to achieve 80% power study, 66 patients were selected. Based on computerized randomization, 33 patients were included in each of the two groups.

After preoperative evaluation, patients were shifted to preoperative holding area and baseline vital parameters and visual analogue scale (VAS) scores were recorded. Patients were positioned supine with the ipsilateral leg slightly abducted and externally rotated to allow optimal access to the inguinal region. Following aseptic skin preparation with chlorhexidine, a high-frequency linear ultrasound probe (6–13 MHz) was placed transversely at the inguinal crease to visualize the femoral nerve. The femoral artery, femoral vein, and iliopsoas muscle were identified, with the femoral nerve typically appearing as a hyperechoic, triangular structure located lateral to the femoral artery and beneath the fascia iliaca. The probe was adjusted to optimize nerve visualization, and color Doppler was used to confirm vascular structures. The skin was infiltrated with 2–3 ml of 1% lignocaine using a 26G hypodermic needle. A 21G, 50-mm short-beveled nerve block needle was inserted in-plane from lateral to medial 1cm away from the lateral edge of transducer probe which pierces sartorius muscle, fascia lata and fascia iliaca under continuous ultrasound guidance and the tip of the needle is visualized next to the femoral nerve. Local anaesthetic is administered after negative aspiration was confirmed and the spread of local anaesthetic agent was noted below the fascia iliaca and surrounding the femoral nerve. Group I patients received 15 ml of 0.5% ropivacaine + dexmedetomidine 1 µg/kg. Group II patients received 15 ml of 0.5% ropivacaine + dexmedetomidine 1.5 µg/kg. Sensory assessment was done by pin-prick method using 25-gauge hypodermic needle and the time of onset as well as peak effect of the drug injected was noted. The sensory onset time recorded as the time from end of injection to dull response to pin-prick and peak sensory effect was recorded as time from the end of injection to attainment of adequate pain attenuation. Pain assessment is done by using visual analogue scale (VAS) score at 0, 1, 3, 5, 7, 10, 15, 20, 25, 30 minutes interval. The patient's hemodynamic parameters like heart rate (HR) and blood pressure were recorded following femoral nerve block at 0, 1, 3, 5, 7, 10, 15, 20, 25, 30 minutes interval.

Following the femoral nerve block, once the VAS score reaches <4, the patients were made to sit for spinal anesthesia and assessed for the comfort of patients for positioning before the procedure of spinal anaesthesia. The comfort score was given as grade 0 (No comfort), grade 1 (moderately comfort), grade 2 (Comfortable). Patients were preloaded with appropriate IV fluid 10-15ml/kg. Under aseptic precaution spinal anaesthesia was performed at L3-L4 level using 3ml of 0.5% hyperbaric bupivacaine with 25G Quincke-Babcock needle. Patients were made to lie down and assessed for the level of blockade, and vitals were monitored at regular intervals. Once T10 level is achieved patients were positioned for the surgery. Appropriate intravenous fluid management and vasopressor support were kept ready in case of hypotension or bradycardia. Postoperatively patients were monitored for analgesia, vitals and adverse effects such as bradycardia, hypotension, nausea & vomiting.

The data was recorded using SPSS software version 26.0. Statistical analysis was done by independent t-test for comparing continuous variables (e.g., VAS scores, duration of analgesia), chi-square test for categorical data (e.g., incidence of adverse effects), repeated measures ANOVA for trends in VAS scores over time. A p-value of <0.05 will be considered significant.

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RESULTS

A prospective randomized comparative study was conducted to assess the effectiveness of two different doses of dexmedetomidine added to ropivacaine in femoral nerve block in reducing the pain before positioning the patients for spinal anesthesia. Demographic characteristics of the patients between two groups were comparable as shown in Table 1.

Comparison of sensory block characteristics are shown in Table 2. The mean onset time of the sensory block was 9.9 ± 2.9 minutes in Group I and 9.8 ± 2.6 minutes in Group II with the p-value of 0.03 indicates statistically significant difference. The mean peak sensory block time was 17.9 ± 3.5 minutes in Group II and 18.3 ± 3.3 minutes in Group I, with a p-value of 0.02 indicates statistically significant difference.

Pain on sitting was assessed with VAS scroe which is shown in figure 1. At baseline, the VAS scores were comparable between the groups (8.0 ± 1.1 in Group I vs. 7.9 ± 1.1 in Group II). The scores progressively decreased after the block. By 10 minutes, VAS scores had dropped to 4.3 ± 1.0 in Group I and 4.0 ± 1.1 in Group II, showing early signs of analgesic effectiveness. At the 20-minute mark, Group I reported a VAS score of 2.5 ± 0.9, while Group II reported 2.3 ± 1.0. At 30 minutes, Group I recorded a mean score of 1.5 ± 0.7 compared to 1.3 ± 0.6 in Group II. Although these differences were not statistically significant ($p > 0.05$), Group II consistently demonstrated slightly superior pain relief across all time points.

The effect of dexmedetomidine on heart rate and blood pressure were assessed at various time points, including baseline, intraoperative, and postoperative periods. Both the groups exhibited reductions in HR following drug administration but within normal physiological ranges and without any statistical difference (Figure 2). The mean arterial pressure (MAP) values showed a mild decline following drug administration, with no statistically significant differences between groups (Figure 3).

Patient comfort during positioning for spinal anesthesia was evaluated using a grading system. Although both groups had patients who attained a comfortable level of positioning, Group II showed a relatively higher proportion of Grade 2 responses, but the difference is not statistically significant (Table 3).

The incidence of adverse effects was analyzed between the two groups to assess the safety profile of dexmedetomidine at different doses. The most commonly observed side effects included bradycardia, hypotension, and nausea/vomiting, which were clinically managed, but with no statistically significant differences between Group I and Group II. (Table 4)

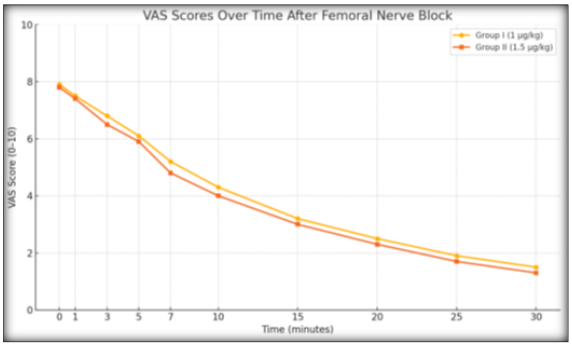

Figure 1: VAS Scores at Different Time Intervals

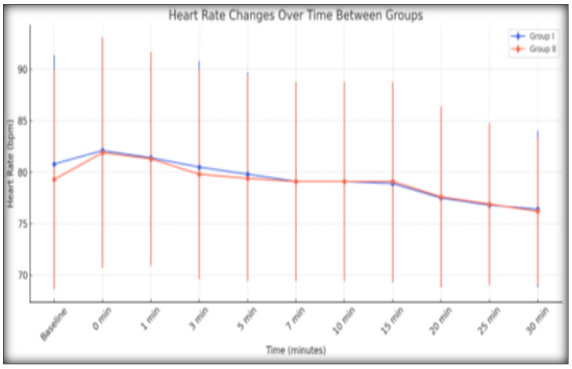

Figure 2: Heart Rate (HR) Changes Over Time

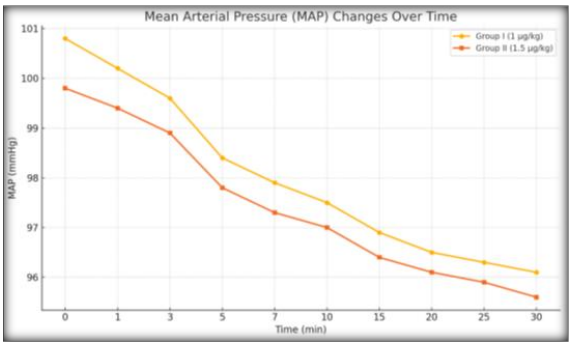

Figure 3: Mean Arterial Pressure (MAP) Changes Over Time

Table 1: Demographic characteristics

Demographic characteristic	Group I (n=33)	Group II (n=33)	p value
Age in years Mean ± SD	45.2 ± 10.5	46.1 ± 9.8	0.78
Sex (M/F)	18/15	19/14	0.67
BMI Mean ± SD	26.5 ± 3.1	27.0 ± 3.5	0.19
ASA grading (I/II)	15/21	18/12	0.25

Table 2: Comparison of Sensory Block Characteristics

Sensory Block Characteristics	Group I (n=33)	Group II (n=33)	p value
Onset of sensory blockade minutes Mean ± SD	9.9 ± 2.9	9.8 ± 2.6	0.03
Peak sensory blockade minutes Mean ± SD	18.3 ± 3.3	17.9 ± 3.5	0.02

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Table 3: Comfort positioning for spinal anaesthesia

Comfort Level	Group I (n=33)	Group II (n=33)	p value
Grade 0 (No comfort)	0	0	0.43
Grade 1 (Moderate comfort)	18	13	
Grade 0 (Comfort)	15	20	

Table 4: Adverse effects between two groups

Side effects	Group I (n=33)	Group II (n=33)	p value
Bradycardia	4	7	0.32
Hypotension	3	5	0.28
Nause & Vomiting	6	8	0.41

DISCUSSION

This study evaluated the effects of two different doses of dexmedetomidine (1 µg/kg vs. 1.5 µg/kg) added to ropivacaine in ultrasound-guided femoral nerve block (FNB) for positioning of femur fracture patients for subarachnoid block. The onset of sensory blockade was significantly faster in Group II (1.5 µg/kg dexmedetomidine) compared to Group I (1 µg/kg dexmedetomidine), with a statistically significant reduction in the time required to achieve peak sensory block. Similar results have been observed in studies by Yoshitomi et al., which demonstrated that dexmedetomidine as an adjuvant to local anesthetics accelerates the onset of nerve blockade due to its alpha-2 adrenergic agonist activity, enhancing hyperpolarization of C and A-delta fibers.[8]

Preoperative pain relief as assessed using the Visual Analog Scale (VAS), was significantly better in Group II at all time intervals. These findings align with those reported by Brummett et al., who found that dexmedetomidine enhances the duration of pre-operative analgesia when added to local anesthetics for peripheral nerve blocks.[9]

Comfort during positioning for the subarachnoid block was greater in Group II, with 66.7% of patients reporting Grade 2 (comfortable) positioning compared to 50% in Group I. Although the difference was not statistically significant (p = 0.432), Group II exhibited a clear trend toward improved comfort, suggesting a potential clinical benefit.

This observation may be attributed to the sedative and analgesic properties of dexmedetomidine, which contribute to anxiolysis and attenuation of pain during movement. Similar findings were reported by Kaur et al., who observed that the addition of dexmedetomidine to local anesthetics improved patient comfort and cooperation during spinal positioning due to its synergistic effects on pain modulation and sedation levels.[10]

Furthermore, better comfort during positioning may translate into smoother procedural performance and enhanced patient satisfaction. This aligns with the work of Bajwa et al., which highlighted that the use of dexmedetomidine as an adjuvant improves patient tolerance during neuraxial procedures by providing a calm and pain-relieved state without significant hemodynamic compromise.[11]

The mechanism underlying this improvement is likely multifactorial, including inhibition of nociceptive neurotransmitters, reduction of central sympathetic outflow, and mild sedation that reduces anxiety. Hence, while not statistically significant, the increased rate of Grade 2 comfort in Group II indicates a potentially important advantage of dexmedetomidine in facilitating subarachnoid block positioning.

The incidence of adverse effects, including bradycardia, hypotension, and nausea/vomiting, did not differ significantly between the two groups, confirming the safety of both dexmedetomidine doses. Similar results have been reported by Gandhi et al., suggesting that dexmedetomidine at doses up to 1.5 µg/kg maintains a favorable safety profile when used in peripheral nerve blocks. The absence of severe adverse effects further supports its clinical utility in enhancing nerve block efficacy while maintaining an acceptable risk-benefit profile.[12]

The hemodynamic effects, although dose-dependent, remained within a safe range. Both dosages demonstrated hemodynamic stability, with only mild, clinically insignificant reductions in heart rate and blood pressure. The safety profile remained consistent even at the higher dosage, indicating that dexmedetomidine up to 1.5 µg/kg can be safely used without substantial hemodynamic disturbances. Given its benefits, the higher dose of dexmedetomidine may be a preferable option for optimizing perioperative analgesia and facilitating improved patient outcomes in femur fracture surgeries. These findings reinforce the growing body of evidence supporting dexmedetomidine as a valuable adjunct in regional anesthesia, offering both anesthetic and analgesic benefits while maintaining a favorable safety profile.

CONCLUSION

Femoral nerve block (FNB) using ultrasound guidance significantly facilitates optimal patient positioning for spinal anesthesia in femur fracture surgeries. The outcomes clearly indicate the superior benefits of using a higher dexmedetomidine dose (1.5 µg/kg) compared to the lower dose.

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