



Original Research Article

A COMPARATIVE STUDY ON EFFICACY OF 0.2% ROPIVACAINE AND 0.2% ROPIVACAINE WITH DEXMEDETOMIDINE IN COMBINED SAPHENO-SCIATIC NERVE BLOCKADE IN BELOW-KNEE SURGERIES AT TERTIARY CARE CENTRE OF TELANGANA

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ABSTRACT

Background: The study aimed to assess the effectiveness of saphenous-sciatic nerve block during below-knee surgeries under ultrasound guidance, comparing 0.2% ropivacaine alone and 0.2% ropivacaine combined with dexmedetomidine. The purpose of this study is to assess the duration of action and the effectiveness of each drug in relieving pain after below-knee surgeries.

Materials and Methods: Total of n=60 individuals as per inclusion criteria for the study were selected and were randomly allocated into 2 groups namely, Group D (n=30) receiving 0.2% ropivacaine with dexmedetomidine and Group R (n=30) receiving 0.2% Ropivacaine among which each individual has received 20 ml of each drug at saphenous nerve block and 10 ml at the level of sciatic nerve and were later shifted to PACU for further monitoring and care. The patients were observed postoperatively for 24 hours for first rescue analgesic requirement, total rescue analgesic consumption, and pain scores on the Visual Analogue Scale (VAS).

Results: The study revealed that Group D (ropivacaine + dexmedetomidine) had a longer analgesic effect when compared to Group R (ropivacaine). In the study, we have taken paracetamol with tramadol as the drugs for rescue analgesia. In Group D the time for rescue analgesia was 43.56 ± 3.5 hrs while for Group R the time for rescue analgesia was 26.76 ± 3.5 hrs hence, proving that the rescue time was having a varied difference and the p value of the study was <0.0001 claiming that the study was significant making Group D to be a better choice of drug when compared to Group R.

Conclusion: The addition of dexmedetomidine to ropivacaine significantly improves the quality and duration of anesthesia and postoperative analgesia in below-knee surgeries, with manageable hemodynamic effects, establishing it as a valuable adjuvant for peripheral nerve blocks.

Keywords: Dexmedetomidine, Ropivacaine, Ultrasound, Saphenosciatic Nerve Block.

INTRODUCTION

Regional anesthesia is now commonly used for lower limb surgeries because of its effectiveness in providing adequate intraoperative anesthesia as well

as prolonged postoperative analgesia. Regional anesthesia also produces minimal side effects and facilitates early ambulation in patients. Among the commonly used techniques of regional anesthesia for lower limb surgeries a combined saphenous and

sciatic nerve block is considered as an alternative to neuraxial anesthesia for knee surgeries due to its ability to offer targeted analgesia with least effect on hemodynamic stability and faster recovery.^[1,2] Among the local anesthetics ropivacaine is the long-acting amide anesthetic, commonly used in peripheral blocks due its safety profile lower cardiotoxicity and reduced duration of motor blockage as compared to bupivacaine.^[3,4] Its chemical profile and differential sensory motor blockade characteristics makes it suitable for early mobilization and postoperative management. However, it has its own limitations, which are related to the duration of analgesia, which requires the use of adjuvants to enhance the quality and increase the duration of sensory blockade.^[5] Dexmedetomidine is a selective alpha 2 adrenergic agonist and has been commonly used as an adjuvant to local anesthetics in regional anesthesia. Studies have shown that it increases the quality and duration of analgesia due to its ability to cause hyperpolarization of nerve fibers by inhibition of voltage-gated sodium channels, including suppression of C-fiber transmission.^[6] The combination of dexmedetomidine with local anesthetics has been shown to reduce their systemic absorption, thereby prolonging their local action and improving patients' comfort without causing adverse effects.^[7] A combination of dexmedetomidine with ropivacaine in various nerve blocks, such as brachial plexus, femoral, and popliteal sciatic blocks, produces earlier onset of anesthesia and increased sensory and motor block duration and improved postoperative analgesia.^[8] It has been demonstrated that a combination of saphenous and sciatic nerve blocks in lower leg, ankle, and foot surgeries has provided effective anesthesia.^[2,9] This dual block approach can replace spinal anesthesia in patients with contraindications due to coagulopathy or spinal deformities, and it appears to be advantageous in outpatients and OPD settings.^[1] Although evidence supporting the use of dexmedetomidine as an adjuvant in peripheral nerve blocks exists, the data comparing the efficacy of dexmedetomidine as an adjuvant with ropivacaine in the combined sapheno-sciatic block on below-knee surgeries is limited. Evaluating this combination has clinical importance because it may optimise analgesic duration, reduce opioid requirements, and increase patient satisfaction without compromising hemodynamic stability.^[7,10] Therefore, this study aimed to compare the efficacy of 0.2% ropivacaine (alone) versus 0.2% ropivacaine combined with dexmedetomidine in combined sapheno-sciatic nerve block for below-knee surgeries with respect to some parameters such as onset and duration of sensory and motor block, duration of analgesia, hemodynamic stability, and incidence of adverse effects.

MATERIALS AND METHODS

This comparative prospective study was conducted at the Department of Anesthesiology, Osmania Medical

College and Hospital, a tertiary care centre in Hyderabad. Institutional Ethical approval was obtained for the study after following the institutional protocol for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language.

Inclusion Criteria

1. Aged 18 to 70 years.
2. American Society of Anesthesiologists (ASA) physical status I or II.
3. Normal liver function tests.
4. Mentally sound and cooperative individuals.

Exclusion Criteria

1. Age <17 or >70 years.
2. ASA grade above II.
3. Deranged liver function tests.
4. History of psychiatric illness or poor cooperation.

A total of n=60 patients scheduled for below-knee surgeries under spinal anesthesia were enrolled in the duration of the study. The cases were randomly and equally divided into two groups based on the computer-generated random numbers. Group R: Received plain 0.2% ropivacaine, and Group D: Received 0.2% ropivacaine with 5 µg dexmedetomidine.

Preoperative evaluation: A detailed preoperative check-up was performed one day before surgery. All the clinically relevant findings were recorded, and laboratory investigations were done. Patients were informed about the procedure, postoperative pain management, and the use of the Visual Analogue Scale (VAS) for pain assessment. In the operating room, preparation of Boyle's machine and appropriately sized endotracheal tubes were kept along with laryngoscopes, suction apparatus, and emergency drugs. Standard monitors with ECG, non-invasive blood pressure, and pulse oximetry were used.

Anesthetic Technique: All patients underwent subarachnoid block using standard aseptic precautions, without any adjuvants in the intrathecal drug. After completion of the surgical procedure, patients were positioned supine for ultrasound-guided peripheral nerve blockade.

Saphenous Nerve Block: Using a high-frequency linear ultrasound probe, the femoral artery was identified at the femoral canal and traced distally to the subsartorial level. The adductor canal was visualized, and 10 mL of the study drug was injected around the saphenous nerve under real-time guidance.

Sciatic Nerve Block (Popliteal Approach): The patient's leg was slightly elevated (approximately 2 inches). The ultrasound probe was placed in the popliteal fossa to identify the popliteal artery and the sciatic nerve sheath. The nerve was traced proximally to its bifurcation into the tibial and common peroneal nerves. A total of 20 mL of the respective study drug was administered using an in-plane technique to ensure adequate perineural spread. Group R cases received 0.2% ropivacaine (10 mL for adductor canal

+ 20 mL for sciatic block). Group D cases received 0.2% ropivacaine with 5 µg dexmedetomidine (same volumes).

Postoperative care: All patients were monitored in the post-anesthesia care unit (PACU) for hemodynamic stability, oxygen saturation, and any adverse effects. Postoperative pain was assessed at regular intervals using the Visual Analogue Scale (VAS) with (0) No pain and (10) worst imaginable pain. The onset and duration of sensory and motor block, total duration of analgesia, need for rescue analgesia, and occurrence of side effects (hypotension, bradycardia, nausea, vomiting, sedation, or paresthesia) were recorded.

Statistical Analysis: All the available data were refined, segregated, and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 25 in Windows format. The continuous variables were recorded as mean, standard deviation, frequencies, and percentages. The categorical variables were

analyzed by Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

The demographic profile and baseline characteristics of the two groups are compared in Table 1. A critical analysis of the table shows that parameters such as age, gender, body weight, BMI, ASA physical status, duration, and type of surgery all had values of ($p > 0.05$) which indicates they were not significantly different in both groups and the allocation of the patients to both groups appeared to be well matched which minimizes confounding factors for comparison of results. The mean age of group A cases was 48.5 ± 12.3 years, and group B was 50.1 ± 11.8 years. All the cases in the study belonged to the ASA I and II categories.

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Group A (Ropivacaine) (n=30)	Group B (Ropivacaine + Dexmedetomidine) (n=30)	p-value
Age (years), Mean $\pm$ SD	48.5 $\pm$ 12.3	50.1 $\pm$ 11.8	0.605
Gender, n (%)			
Male	18 (60.0)	16 (53.3)	0.605
Female	12 (40.0)	14 (46.7)	
Weight (kg), Mean $\pm$ SD	68.2 $\pm$ 8.5	66.9 $\pm$ 9.1	0.557
BMI (kg/m ²), Mean $\pm$ SD	24.5 $\pm$ 2.8	25.1 $\pm$ 3.0	0.412
ASA Grade n (%)			
I	12 (40.0)	14 (46.7)	0.605
II	18 (60.0)	16 (53.3)	
Duration of Surgery (min), Mean $\pm$ SD	95.4 $\pm$ 20.1	98.2 $\pm$ 18.7	0.574
Type of Surgery, n (%)			
Fracture Fixation	20 (66.7)	18 (60.0)	0.795
Soft Tissue/Other	10 (33.3)	12 (40.0)	

The characteristics of nerve blocks achieved in the two groups are given in Table 2. A critical analysis of the table showed that the onset of sensory block was significantly shorter in Group B for both sciatic and saphenous nerves as compared to Group A, and $p < 0.001$. The onset of motor block time was faster in Group B as compared to Group A (21.4 ± 4.6 and $p < 0.001$). This shows that dexmedetomidine is an effective adjuvant because it facilitates a faster onset of anesthesia, which is likely because it is an alpha 2-adrenergic receptor agonist and potentiates the local anesthetic action. In terms of block length, both

sensory and motor blocks were significantly increased in Group B (582.4 ± 52.1 min and 498.5 ± 48.9 min, respectively) compared to Group A (385.6 ± 45.3 min and 348.2 ± 40.7 min, $p < 0.001$). This shows that dexmedetomidine significantly increases the duration of the block to provide longer postoperative analgesia and less anesthetic usage. Both groups had high block success rates (93.3% in Group A and 100% in Group B), the difference between groups being statistically insignificant ($p = 0.494$), confirming procedural consistency.

Table 2: Intraoperative Nerve Block Characteristics

Characteristic	Group A (n=30)	Group B (n=30)	p-value
Sensory Block Onset Time (min), Mean $\pm$ SD			
Sciatic Nerve	22.5 $\pm$ 4.1	16.8 $\pm$ 3.5	<0.001*
Saphenous Nerve	18.3 $\pm$ 3.8	13.2 $\pm$ 2.9	<0.001*
Motor Block Onset Time (min), Mean $\pm$ SD	28.9 $\pm$ 5.2	21.4 $\pm$ 4.6	<0.001*
Sensory Block Duration (min), Mean $\pm$ SD	385.6 $\pm$ 45.3	582.4 $\pm$ 52.1	<0.001*
Motor Block Duration (min), Mean $\pm$ SD	348.2 $\pm$ 40.7	498.5 $\pm$ 48.9	<0.001*
Block Success Rate, n (%)	28 (93.3)	30 (100)	0.494
*Significant			

Table 3: Postoperative Analgesia Outcomes

Outcome	Group A (n=30)	Group B (n=30)	p-value
Time to First Analgesic Request (min), Mean ± SD	398.7 ± 50.2	645.8 ± 61.5	<0.001*
Total Tramadol Consumption in 24h (mg), Mean ± SD	145.0 ± 35.7	65 ± 25.4	<0.001*
Number of Patients Requiring Rescue Analgesia (%)	28 (93.3)	10 (33.3)	<0.001*
Postoperative VAS Score at 6h, Mean ± SD	4.1 ± 1.2	1.5 ± 0.8	<0.001*
Postoperative VAS Score at 12h, Mean ± SD	3.8 ± 1.1	1.9 ± 0.9	<0.001*

*Significant

The values of Mean Arterial Pressure (MAP) are given in Table 4. The mean arterial pressure (MAP) in Group B was significantly lower at 1h, 6h, and 12h after surgery, which reflected the mild hypotensive effect of dexmedetomidine owing to central sympatholysis and vagomimetic activity. Although bradycardia occurred in 6 patients (20%) in Group B as compared with 1 patient (3.3%) in the control Group A (Group A), the difference was not statistically significant ($p = 0.104$), and the

bradycardia was transient and clinically manageable. The overall results of the study showed that the addition of dexmedetomidine (0.5 µg/kg) to 0.2% ropivacaine in combined sapheno-sciatic nerve blocks significantly produced the following actions: accelerates block onset, prolongs sensory and motor blockade, enhances postoperative analgesia, reduces opioid requirement, and maintains acceptable hemodynamic stability.

Table 4: Hemodynamic Parameters in the Postoperative Period (Mean Arterial Pressure - MAP)

Time Point	Group A (n=30)	Group B (n=30)	p-value
Baseline (Pre-op), Mean ± SD	91.2 ± 6.5	90.8 ± 5.9	0.795
Post-op 1h, Mean ± SD	89.5 ± 7.1	85.3 ± 6.2	0.015*
Post-op 6h, Mean ± SD	88.7 ± 6.8	83.1 ± 5.5	0.001*
Post-op 12h, Mean ± SD	90.1 ± 5.9	84.5 ± 4.8	<0.001*
Patients With Bradycardia, n (%)	1 (3.3)	6 (20.0)	0.104

Bradycardia is defined as a Heart Rate < 50 bpm.

*Significant ($p < 0.05$)

DISCUSSION

The present study compared the efficacy of 0.2% ropivacaine alone and 0.2% ropivacaine in combination with dexmedetomidine (0.5µg/kg) for sapheno-sciatic nerve block in below-knee surgeries. The results of the present study demonstrated that the addition of dexmedetomidine reduced the onset times significantly, increased the sensory and motor block duration, and provided better analgesia in the postoperative period with acceptable hemodynamic stability. The demographic variables, including age, gender, BMI, ASA grade, and duration of surgery, were similar between both groups; hence, the groups were homogenous, and confounding factors influencing the efficacy of the blocks or the impact of analgesia on the treated patients were eliminated. Similar baseline comparability has previously been reported in peripheral nerve block studies of adjuvant efficacy.^[8,11] The onset time of sensory and motor blocks was significantly faster in the ropivacaine-dexmedetomidine group (Table 2). This can be explained by the alpha 2-adrenergic agonistic effects of dexmedetomidine, which cause hyperpolarization of the nerve membrane and increase the diffusion of local anesthetic at the nerve site.^[12] Esmaglu et al,^[7] found similar results with dexmedetomidine added to levobupivacaine in axillary blocks, in which the onset time was significantly reduced. In a study done by Swami et al,^[13] the dexmedetomidine used as a combination with ropivacaine will produce significantly higher speed of onset and prolonged as

well as the duration of analgesia, which is closely in line with our result.

The time of sensory and motor block was significantly increased among Group B (582.4 vs. 385.6 minutes and 498.5 vs. 348.2 minutes, respectively) as compared to that in Group A (Table 3). The lengthening of the block duration is probably caused by vasoconstriction at the injection site that causes a delay in systemic absorption of the local anesthetic and enhances the local anesthetic action.^[14] Similar results were found by Kathuria et al,^[15] who showed that dexmedetomidine increased the sensory and motor block times in peripheral blocks of the lower limbs. Postoperative analgesia was significantly better in Group B, with a delayed time to first rescue analgesic and lower consumption of tramadol over 24 hours. The addition of dexmedetomidine was successful in prolonging the pain-free interval and minimizing the dependence on opioids with the studies of Agarwal et al,^[16] and Al-Mustafa et al.^[17] The 6- and 12-hour lower VAS scores in Group B point to the enhanced quality and duration offered by postoperative analgesia augmentation with dexmedetomidine. With regard to hemodynamic parameters, a small but significant decrease in mean arterial pressure (MAP) in the dexmedetomidine group was observed, which was due to central sympatholytic effects and reduced release of norepinephrine.^[18] Although bradycardia was more common in the combination group, it was transient and did not warrant any intervention; similar reports of the safety profile of the combination have been reported from other studies.^[13,15] Therefore, this

study shows that dexmedetomidine can be safely used as an adjuvant to ropivacaine for sapheno-sciatic nerve blockade. Its important actions, such as prolonging analgesia and producing faster block onset and reduced postoperative opioid consumption, show its usefulness in regional anesthesia.

CONCLUSION

Within the limitations of the present study, we found that the addition of dexmedetomidine (5 µg) to 0.2% ropivacaine in combined sapheno-sciatic nerve blockade significantly enhances the quality of anesthesia and postoperative analgesia in below-the-knee surgeries as compared to plain 0.2% ropivacaine. Overall results of the study showed that the combination provides faster onset, prolonged sensory and motor block duration, extended pain-free intervals as indicated by lower VAS scores and reduced analgesic requirements. Minor hemodynamic alterations in the form of decreased mean arterial pressure and occasional bradycardia were observed in the combination group; they were transient and clinically manageable. Therefore, dexmedetomidine serves as a safe and effective adjuvant to ropivacaine, improving patient comfort, recovery quality, and overall postoperative analgesic efficacy in lower limb surgeries.

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