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Research Article

COMPARISON OF ANESTHETIC EFFECT OF PLAIN ROPIVACAINE VERSUS DEXMEDETOMIDINE AS AN ADJUVANT TO ROPIVACAINE IN USG-GUIDED SUPRACLAVICULAR BLOCK FOR UPPER LIMB SURGERIES

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ABSTRACT

Objectives: Perioperative pain management is very important to achieve patient satisfaction. The objectives of the current study were to compare the anesthetic effects of dexmedetomidine and plain ropivacaine as an adjuvant to ropivacaine for upper limb surgeries in the supraclavicular brachial plexus block in terms of hemodynamic responses, quality, onset, and duration of sensory and motor block, post-operative pain management and side effects/complications if any.

Methods: Sixty adult patients scheduled for upper limb surgeries were randomized into Group A and Group B of 30 patients each. Patients in Group A received 0.5% Ropivacaine 20 mL+5 mL normal saline and Group B received 0.5% ropivacaine 20 mL+0.5 mL (50 µg) dexmedetomidine+4.5 mL normal saline. The primary objective of our study was to compare the groups in terms of quality of block, onset, and duration of sensory and motor block and post-operative pain management. The secondary objective was to compare the intraoperative hemodynamic changes and post-operative adverse effects.

Results: Time taken in the onset of the sensory as well as motor block in both the groups was statistically significantly more in Group A compared to Group B. The duration of the sensory as well as the motor block was much higher in Group B compared to Group A with a statistically significant difference. The total duration of analgesia was slightly higher in Group A compared to Group B. The mean numerical rating scale was significantly lower in Group B compared to Group A at all-time intervals till 24 h. No major side effects were observed with study drugs.

Conclusion: The study confirmed that dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block hastens the onset of the sensory as well as motor block and prolongs the duration of the sensory as well as the motor block in the upper limb surgeries.

Keywords: Upper limb surgeries, USG-guided supra clavicular block, Brachial plexus block, Ropivacaine, Dexmedetomidine, etc.

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INTRODUCTION

Proper perioperative pain management relieves the patient's suffering and achieves early mobilization after surgery, thus reducing the duration of hospital stay [1]. The peripheral nerve blocks have several benefits, such as better pain control, lesser side effects, and reduced hospital stay over general anesthesia, thus providing a superior outcome. The ultrasound (USG)-guided supraclavicular brachial plexus block is given at the C5-T1 level of the trunks of the brachial plexus. The standard approaches used were blind techniques [2,3]. Which rely on surface landmarks before needle insertion and evoke paraesthesias but multiple trial and error needle pricking attempts are necessary resulting in pain and other complications [4]. USG can determine the depth and exact location of the brachial plexus along with its neighboring structures. Local anesthetic drugs, such as ropivacaine are frequently used because it produces quick, dense, and prolonged block and has lesser side effects [5]. Due to the possibility of the local anesthetic effect wearing out before the surgical period leading to severe pain, the volume of the local anesthetic drug can be increased but it leads to systemic side effects, particularly on the cardiovascular and nervous system [6]. Therefore, adjuvants increase the efficacy and duration of local anesthetics and decrease the systemic side effects of a higher dose of local anesthetic. Dexmedetomidine is a α2-adreno receptor agonist that has sedative, anxiolytic, and analgesic properties and provides a prolonged block with better pain management post-operatively as an adjuvant to local anesthetics, such as bupivacaine or levobupivacaine or ropivacaine [7-9].

The current study compared the anesthetic effects of dexmedetomidine and plain ropivacaine as an adjuvant to ropivacaine for upper limb surgeries in the supraclavicular brachial plexus block in terms of hemodynamic responses, quality onset, and duration of sensory and motor block, post-operative pain management and side effects/complications if any.

METHODS

After obtaining approval of the Institutional Ethics Committee, this randomized double-blind controlled interventional study was registered prospectively with the Clinical Trial Registry of India (www.ctri.nic.in) with registration number CTRI/2022/10/046660 and was conducted keeping in mind the principles of the Declaration of Helsinki. This study was undertaken on 60 patients undergoing upper limb surgeries from September 2022 to April 2024 (approx. 2 years) in the department of anesthesiology, JNUIMSRC, Jaipur. Patients of the American Society of Anesthesiologists (ASA) grade 1 and 2, aged 18–60 years, and those who gave written informed consent were included. Exclusion criteria were patients with previous or present neurological disease, having coagulopathy or infection at the site of injection, and the presence of any condition contra-indicating regional anesthesia or elective surgery. Two study groups were made each consisting of 30 patients. One group was given the name R, in which only ropivacaine was administered. Another group was named RD, where dexmedetomidine was given along with ropivacaine. Blinding was done using the technique of concealment of allocation in opaque sealed envelopes after shifting the patients to the

operating room (OT). Pre-anesthetic checkup was done a day before the surgery and investigations, such as routine complete blood count, prothrombin time and International Normalized Ratio, renal function tests, liver function tests, serum markers, electrocardiogram (ECG), and chest X-ray were obtained as per hospital protocols and patients were scheduled for surgery. Patients were kept fasting as per standard guidelines. After receiving the patient into the OT. Informed written consent was obtained from all the participants after the complete study protocol and procedure was explained to them. An 18G intravenous (IV) cannula was secured in the opposite hand, and monitors, such as pulse oximetry, non-invasive blood pressure (BP) monitor, and ECG machine were attached.

Baseline parameters were recorded. The medication under study was prepared in identical 30 ml syringes by an uninvolved person in the study. The patients were given the optimum positions for the procedure of USG-guided supraclavicular brachial plexus block. With all the aseptic precautions, the USG scanning of the brachial plexus along with its surrounding structures was done after securing the IV cannula and attachment of all the routine monitors. The patients were made to lie in a supine position with the head angled at 45° to the contralateral side.

The USG probe was then placed in the coronal oblique plane in the supraclavicular fossa to visualize the subclavian artery and brachial plexus in the transverse sectional view lying at approx 90°. The brachial plexus and a few hypoechoic nodules were seen lateral to the round pulsating subclavian artery which was also hypoechoic and lying on top of the first rib, which was hyperechoic. Next, after skin sterilization was done and anesthesia was given, an insulated block needle (22-gauge 50-mm) was placed on the lateral end of the probe and advanced along the longer axis of the probe and in the same plane as the USG. Real-time needle movement was observed. Thereafter, patients in Group A (n=30) received 0.5% Ropivacaine 20 mL + 5 mL normal saline and Group B (n=30) received 0.5% ropivacaine 20 mL + 0.5 mL (50 μg) dexmedetomidine+4.5 mL normal saline increasingly over 3–5 min.

On assessing within 45 min of LA injection, if a complete sensory and motor block in all regions was observed, it was termed as a successful block. The evaluation was done every 2 min till 45 min. If at the end of 45 min, complete sensory or motor blockade was not achieved, such patients were excluded from the analysis, and further anesthetic management was changed accordingly.

The test of sensory block was confirmed by the loss of cold sensation using alcohol-soaked cotton in all dermatomes supplied by the brachial plexus.

Sensory block assessment is by a 3-point qualitative scale:

- Scale 2-perception of touch and temperature using ether-soaked cotton,
- Scale 1-perception of only touch,
- Scale 0-no perception of touch or temperature in the territory of musculocutaneous nerve, median nerve, ulnar nerve, and radial nerve.
- Similarly, the motor blockade was assessed on a 3-point qualitative scale. (Modified Bromage Score)
- Scale 2-normal motor function with power 4/5, 5/5),
- Scale 1-weakness against resistance with power 3/5, 2/5),
- Scale 0-paresis/no motor power (power 0/5, 1/5) for the four terminal branches.

The onset of motor blockade was considered when the patients were not able to move or raise their hands actively. After the surgery was complete, the patient was then transferred to post-anesthesia care room where reversal of the block as well as post-operative pain were assessed. Verbal numerical rating scale (VNRS) was used to evaluate and record pain. At the same time, motor recovery was assessed by the patient's ability to squeeze the examiner's hand. The duration of the motor block was also noted. For the current study purpose, the total duration between the onset of sensory block and the patient's pain score (VNRS) >4 resulting in the administration of rescue analgesia was termed as the duration of analgesia. A 24-h monitoring of the patients was done for the development of any kind of complication or side effects such as pruritus, nausea, and vomiting. However, a sensory and motor assessment was again performed at 24 h to look for any residual block or neurological deficit.

Adverse events comprised of hypotension, bradycardia, hypoxemia (SpO_2<90%) or nausea, and vomiting. Hypotension, defined as a [3]20% decrease of mean arterial pressure (MAP) in relation to the baseline value, was managed with IV fluid bolus and blood products as indicated. A heart rate of <50 beats/min (bradycardia) was treated with IV atropine 0.6 mg. Nausea and vomiting were treated with IV ondansetron 4 mg.

Statistical data analysis

Microsoft Excel was used to enter the data, and JAMOVI 2.2.5 was used to analyze it. A free third-generation statistical program that is simple to use is called JAMOVI 2.2.5. The two groups' initial baseline characteristics were compared. The unpaired t-test was utilized to compare the continuous variables, whereas the X2 test was employed to compare the categorical variables. For all intents and purposes, a $p<0.05$ was deemed statistically significant in both circumstances.

RESULTS

The current study was done in 60 patients divided into two groups with strength of 30 each. Group A was the group that was administered Ropivacaine alone and Group B was the group that was administered dexmedetomidine along with ropivacaine. The baseline demographic parameters in both groups were comparable (Table 1). The data analysis indicated that there were no statistically significant differences observed between Group A and Group B in terms of age, gender, height, weight, body mass index, ASA class distribution, duration of surgery, and the distribution of comorbidities. The baseline pre-operative vitals viz., heart rate, systolic and diastolic BP, Spo2 as well as MAP in both the groups were comparable with a statistically non-significant difference ($p>0.05$).

Table 2 shows the comparison of the onset time of sensory and motor block in both groups. The time taken in the onset of the sensory as well as motor block in both the groups was significantly more in Group A compared to Group B ($p=0.00$). This implies that the administration of dexmedetomidine along with ropivacaine significantly reduced the onset time of sensory and motor block in the study participants.

Table 3 shows the grade-wise comparison of Group A and Group B considering the maximal motor block at the commencement of surgery. It was observed that the maximum number of study participants in both groups experienced grade II of the maximal motor block. However, their difference in the proportions of study participants in the three grades between the two groups was not statistically significant ($p>0.05$).

Table 4 compares the two groups on the basis of the sensory and motor block duration. It was observed that the duration of the sensory as well as the motor block was much higher in Group B compared to Group A with a statistically significant difference ($p=0.00$) Table 5 compares the two groups based on the total duration of analgesia. It was observed that the total duration of analgesia was slightly higher in Group A compared to Group B. However, the difference between the two groups was not statistically significant ($p>0.05$).

Table 6 compares the two groups in terms of numeric rating score which determines the level of pain post-anesthesia in terms of scores 0–10, where 0 means no pain and 10 means excruciating pain. It was observed that the mean NRS is highly statistically significantly lower in Group B compared to Group A at all the time intervals starting from 6 h to 24 h ($p=0.00$).

Table 1: Comparison of both the groups based on various baseline variables

Variables	Group A	Group B	p-value
Mean age±SD	39.1±10.65	31.53±11.67	0.011
Gender			
Male	17 (56.67)	25 (83.33)	0.024
Female	13 (43.33)	5 (16.67)	
Mean weight±SD	56.9±8.04	55.6±9.30	0.565
ASA status			
Grade I	24 (80)	23 (76.67)	
Grade II	6 (20)	7 (23.33)	0.754
Mean duration of surgery (min)±SD	73.57±28.32	75.2±38.93	0.853
Mean HR±SD	89.37±11.59	88.9±16.02	0.897
Mean SBP±SD	130.97±12.51	127.3±14.68	0.310
Mean DBP±SD	83.5±9.12	79.03±10.57	0.083
Mean SpO_2±SD	97.03±6.18	97.9±1.56	0.442
Mean MAP±SD	98.93±9.84	94.27±11.04	0.085

SD: Standard deviation, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, ASA: American Society of Anesthesiologists

Table 2: Comparison of both the groups based upon onset time of sensory and motor block

Variables	Group A (Mean±SD)	Group B (Mean±SD)	p-value
Sensory block (in Min)	15.83±3.75	10.63±4.19	0.000
Motor block (in Min)	23.23±4.17	14.57±2.91	0.000

Table 3: Grade of the maximal Motor block at the commencement of surgery

Grade of motor block	Group A (%)	Group B (%)	p-value
Grade 0	0 (0)	0 (0)	0.741
Grade I	5 (16.67)	3 (10)	
Grade II	25 (83.33)	27 (90)	

Table 4: Comparison of both the groups based upon duration of sensory and motor block

Variables	Group A (Mean±SD)	Group B (Mean±SD)	P-value
Sensory block (in Min)	494.57±94.31	775.2±180.68	0.000
Motor block (in Min)	435.1±105.41	732.47±159.96	0.000

Table 5: Comparison of both the groups based upon duration of analgesia

Variables	Group A (Mean±SD)	Group B (Mean±SD)	p-value
Duration of analgesia (in Min)	587.67±76.65	547.83±90.03	0.064

Table 6: Comparison of both the groups based on Numeric Rating Score (NRS) at various time intervals

Time	Group A (Mean NRS±SD)	Group B (Mean NRS±SD)	p-value
0 min	0	0	-
30 min	0	0	-
1 h	0	0	-
3 h	0	0	-
6 h	1.76±0.77	0.36±0.55	0.00
9 h	2.1±0.75	0.4±0.62	0.00
12 h	1.6±1.24	0.63±0.61	0.00
18 h	1.63±1.11	0.59±0.48	0.00
24 h	1.6±1.02	0.5±0.57	0.00

DISCUSSION

In our study, it was observed that the time taken in the onset of the sensory as well as motor block in both the groups was statistically significantly more in the Group A compared to the Group B (p=0.00). This implied that the administration of dexmedetomidine along with ropivacaine significantly reduced the onset time of sensory and motor block in the study participants. Zhao *et al.* [10] in their meta-analysis also found similar results, i.e., shorter time of onset of sensory and motor block. In this study, Grade 1 of sensory block in Group A patients were 16.67% and in Group B patients were 20%. Consequently, Grade 2 of sensory block in Group A patients were 83.33% and in Group B patients were 80%. The grade-wise comparison of Group A and Group B considering the maximal sensory block at the commencement of surgery. It was observed that the maximum number of study participants in both groups experienced grade II of the maximal sensory block. However, their difference of the proportions of study participants in the three grades between the two groups was not statistically significant. Again, in our study, similar to sensory block, it was observed that Grade 0 in the motor block in Group A patients was 0% and that in Group B patients was also 0%. Grade 1 of motor block in Group A patients was 16.67% and that in Group B patients was 10%. Furthermore, 83% of Group A and 90% of Group B patients had Grade 2 level of motor block. However, the difference in this distribution was significantly non-significant (p=0.741). Our study showed the grade-wise comparison of Group A and Group B considering the maximal motor block at the commencement of surgery and the maximum study participants in both groups experienced grade II of the maximal motor block with no statistically significant difference. The current study revealed that the duration of sensory block in Group A patients was 494.57±94.31 min, i.e., approximately 8.2 h and that in Group B, it was 775.2±180.68 min, approximately 12.9 h. Similarly, it was observed that the duration of motor block in Group A patients was 435.1±105.41 min, estimated to be 7.2 h and that in Group B, it was 732.47±159.96 min, roughly about 12.2 h. Thus, it was observed that the duration of the sensory, as well as the motor block, was much higher in Group B where dexmedetomidine was added to the ropivacaine compared to Group A where only ropivacaine was administered with a statistically significant difference (p=0.00). Our results were quite similar to that of Murthy *et al.* [1] where the duration of sensory block in Group A and Group B were around 10.7 h and 12.1 h with p=0.00354. Whereas the duration of the motor block was 11.0 h in Group A and it was 9.3 h in Group B with p=0.0001. Another similar study by Dharmarao and Holyachi [11], Akhondzadeh *et al.* [7], and [12] revealed that the dexmedetomidine in their study too prolonged the duration of sensory and motor block significantly. Bangera *et al.* [13] and Koraki *et al.* [14] conducted a similar study but in a different block too suggested that the duration of sensory and motor block was significantly longer in the combination group. Hussain *et al.* [15] and Vorobeichik *et al.* [16] in their meta-analysis affirmed our results by suggesting the ability of dexmedetomidine to prolong the duration of the motor and sensory blockade.

The results of the current study revealed that the total duration of analgesia was slightly higher in Group A (587 min) compared to Group B (547 min). However, the difference between the two groups was not statistically significant (p>0.05). Murthy *et al.* [17] supported our finding as the duration of analgesia in their too Group A was around 457 min and it was 345 min in Group B. Vorobeichik *et al.* [16] in their meta-analysis too affirmed our results.

Our study compared the two groups in terms of numeric rating score which is useful in determining the level of the pain post-anesthesia. The mean NRS was observed lower in Group B compared to Group A at all

the time intervals starting from 6 h to 24 h, the difference of which was statistically significant, which suggested that the pain felt in the patients who were given dexmedetomidine along with ropivacaine was much lower than the ropivacaine alone. This could also be interpreted that the duration of analgesia was longer with dexmedetomidine. Moreover, that is why the need of rescue analgesia was much lesser. Maximum studies were in support of our findings such as Balakrishnaiah *et al.* [18], Li *et al.* [19], Zhao *et al.* [10], and Liu *et al.* [20]. There were no major side effects or complications documented in the current study which makes the addition of dexmedetomidine to ropivacaine a safe choice over ropivacaine alone. Only minor side effects such as bradycardia and hypotension were observed in few patients, which were found to be statistically non-significant.

Limitations

This study included a small sample size. More randomized controlled trials with larger sample sizes are needed to substantiate our findings. The patients of the age group between 18 and 60 years were included irrespective of their body weights and were given a constant amount of drug, hence, by this study, we could not explain the effect of dexmedetomidine as an effective adjuvant to local anesthetic in supra clavicular block for all age groups and body weights.

CONCLUSION

This study confirmed that dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block hastens the onset of the sensory as well as motor block and prolongs the duration of the sensory as well as motor block thereby, significantly reduces the post-operative pain in the upper limb surgeries.

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CONFLICT OF INTEREST

Nil.

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Nil.

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