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A comparative study of analgesic efficacy of intravenous dexmedetomidine and perineural dexmedetomidine as an adjuvant to ropivacaine in supraclavicular block

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A B S T R A C T

Introduction: Dexmedetomidine is a frequently used adjunct to local anesthetics in various blocks because of its proven benefits. With this study we aim to compare the efficacy of dexmedetomidine via different routes (intravenous versus perineural) as an adjuvant to ropivacaine in supraclavicular brachial plexus block in patients undergoing upper limb surgery.

Material and method: The study was conducted on 70 adult patients undergoing upperlimb surgery, randomized into 2 groups. Group ID (n=35) received USG guided supraclavicular block with 30 ml volume (28 ml of 0.50% ropivacaine plus 2ml of normal saline) and 1 µg/kg of dexmedetomidine in 50 ml of normal saline infusion intravenously. Group PD (n=35) recieved USG guided supraclavicular block 30 ml volume (28 ml of 0.50% ropivacaine plus 1 µg/kg of dexmedetomidine in 2ml of normal saline) and 50 ml of normal saline infusion. The onset and duration of sensory and motor block, duration of analgesia, hemodynamic parameters and side effects were recorded.

Results: The demographic profile was comparable in both the groups. The group PD had faster onset of sensory (p=0.002) and motor blockade (p=0.001), longer duration of sensory (p=0.0009) and motor (p=0.005) blockade and longer duration of analgesia (p=0.010) as compared to group ID.

Conclusion Dexmedetomidine when used perineurally as an adjuvant in USG guided supraclavicular brachial plexus block shortens the onset of motor and sensory block, prolongs the duration of motor and sensory blocks and increases the duration of analgesia when compared with intravenous dexmedetomidine.

Key words- dexmedetomidine, perineurally ,intravenous, supraclavicular brachial plexus block, ropivaciane.

INTRODUCTION

In today's modern practice of anaesthesiology various methods and drugs have been researched and developed in order to give adequate anaesthesia and analgesia. For upper limb surgery, both general and regional anaesthesia can be used but at present there is adequate evidence to suggest that in most scenarios regional anaesthesia is cheaper, safer and has better outcomes than general anaesthesia (1).

Ultrasonography and peripheral nerve stimulators have greatly increased the accuracy and safety of brachial plexus blocks (2). With the development of safer long acting anaesthetics like ropivacaine with better cardiac safety and haemodynamic profile, it has become the preferred agent over old local anaesthetics (3).

Research to prolong the effect of blocks like the development of adjuvants and the use of continuous drug delivery catheters have also led to better motor and sensory blockade as well as longer postoperative analgesia. While both catheters and adjuvants have their own set of advantages, the use of adjuvants is generally cheaper, less complex and requires lesser postoperative monitoring. Insertion of peripheral nerve catheters is more time consuming, costly, may require more postoperative care and have higher complication rates like infection and catheter migration.

Many adjuvants belonging to different pharmacological classes have been extensively used as adjuvants to local anaesthetics in various regional blocks eg Opioids, vasoconstrictors like adrenaline, alpha2 adrenoceptor agonists like clonidine (4) and dexmedetomidine (5,6) and a whole host of other drugs including Ketotolac, Ketamine, Magnesium sulphate, Midazolam, Neostigmine etc(7). All these adjuvants have helped in different degrees to improve the efficacy, duration and safety of regional blocks (7).

Amongst these various agents available, dexmedetomidine has shown promise to provide better analgesia, reduce perioperative opioid consumption and provide stable hemodynamics (8). Dexmetomidine has been tried as adjuvant both via the perineural as well as the intravenous route but the ideal route and dosage is still a mystery. (5,6). So present study was planned to compare the onset and duration of sensory and motor blockade and postoperative analgesia comparing both intravenous and perineural dexmedetomidine in combination with ropivaciane in ultrasound guided supraclavicular block for upper limb surgeries.

Materials and methods

The study was conducted in a prospective randomized double blind manner in the Department of Anesthesiology in tertiary care rural hospital after approval by the Hospital Ethics Committee in patients undergoingupper limb surgeries under ultrasound guided supraclavicular brachial plexus block in age group between 18 to 65 years of age of either gender, giving valid informed and written consent belonging to American Society of Anaesthesiologists (ASA) Grade I and II.

Patients with any contraindication to regional anaesthesia, with body mass index (BMI) more than 30, with history of anaphylaxis to ropivacaine and dexmetomidine, with a history of intake of chronic opioids / analgesic drugs, pregnant or lactating patients were excluded from the study.

A thorough pre anaesthetic checkup of all participants was conducted preoperatively. During the anaesthesia interview, patients were instructed about verbal numerical rating scale (VNRS) preoperatively and about its use as a tool for measuring postoperative pain. All the patients were kept nil per orally for at least 6 hours prior to surgery. Tab. Alprazolam 0.25 mg was given as a premedication on the night prior to the surgery and again at 6 A.M. on the day of surgery with a sip of water.

All the patients were randomly allocated into either of 2 study groups of 35 patients each using computer generated randomization. **Group ID** received USG guided supraclavicular block with 30 ml volume (28 mL of 0.50% ropivacaine plus 2ml of normal saline) and 1 μg/kg of dexmedetomidine in 50 mL of normal saline administered intravenously as infusion over 10 min started 10 min before the supraclavicular block. **Group PD** was given a USG guided supraclavicular block with 30 ml volume (28 mL of 0.50% ropivacaine plus 1 μg/kg of dexmedetomidine in 2 ml of normal saline). 50 mL of normal saline administered intravenously as infusion over 10 min started 10 min before the supraclavicular block.

Peripheral I.V. line was secured. Pulse oximeter probe, ECG leads and blood pressure cuff attached for constant vitals monitoring. Baseline vitals of the patient ie. heart rate, respiratory rate, blood pressure, (systolic, diastolic, mean arterial) were recorded. Patients were positioned supine on the operation table with the operative arm placed by the side, the head of the patient was facing 45 degrees to the opposite side of the side to be blocked. Supraclavicular region was cleaned and block was performed using Ultrasound machine (Esaote Europe BV) with a linear transducer (8–14 MHz), Machine No.152000400 ,Probe No.122000200). Sterile 50 mm 22 gauge short bevel needle was advanced using an in the plane technique. Tip of the needle proceeded towards the nerve bundle, three or four separate injections of solutions were given. Patients were observed for adverse effects like bradycardia, hypotension, tachycardia, nausea and vomiting along with complications such as pneumothorax, hemothorax, systemic drug toxicity.



Image 1 - Technique for scanning the brachial plexus and inserting the needle.



Image 2 - Ultrasound guided visualisation of the brachial plexus.

Completion of injection was considered as time 0. Sensory and motor blockade evaluation was done every 1 minute, till the onset of the successful sensory and motor block. The sensory block was evaluated in the distribution of 4 nerves by pin prick and fine touch method (mucocutaneous, median, ulnar and radial). The response was graded using a 3 point scale (9).
0=normal sensation
1=loss of sensation of pinprick (analgesia)
2=loss of sensation of touch (anaesthesia)

The time interval between the end of local anaesthetic administration and establishment of score 2 on three point scale on all 4 nerve territories was noted as time of onset of complete sensory block. Motor blockade was graded on 3 point scale. 0-Total movement of fingers and wrist. 1-reduced movement of fingers and wrist. 2-inability to move fingers.

The block was judged to have failed, if anaesthesia is found inadequate in any of the major nerve distributions after 30 min of injecting of drug into the sheath and such patients were taken under general anaesthesia and these patients were excluded from the study.

Haemodynamic parameters were noted for every 5 minutes till 30 minutes and then every 10 min till 90 minutes and then every 30 mins till the end of the surgery. Hypotension was defined to be a fall in mean arterial pressure of > 20% of baseline values and treated with bolus of 100 ml fluid and if uncorrected, injection mephentermine 3 mg bolus, intravenously. Bradycardia was defined as pulse rate of < 50/ min and was treated with an intravenous bolus of injection Atropine 0.6 mg. If the SPO2 of the patients fell below 94% they were put on supplemental oxygen with a face mask @8 litres/min.

Duration of Block for sensory block was taken as time taken from regression of sensory block from grade 2 to grade 0. Duration of Block for motor block was taken as time taken from regression of motor block grade 2 to grade 0.

On arrival in the post-anaesthesia care unit, pain scoring was assessed using four-point VNRS on movement of operated arm,
0= no pain, 1-3=mild pain, 4-7=moderate pain and 7-10=severe pain

Duration of analgesia was taken as from the time of onset of sensory block to when the patient experiences considerable pain with VNRS >3. It was considered that analgesic action of the drug is terminated and rescue analgesic as injection paracetamol 1 gm (1000 mg) was given intravenously. Number of total rescue injections given during the first 24 hours of the postoperative period was noted. Second rescue drug was fentanyl 1 µg/kg. Postoperative follow-up was carried out in the recovery and postoperative ward hourly for the first 12 hours and then every 4 hours till 24 hours.

Sample size calculation was based on detecting a minimum 20% difference in duration of analgesia between the two groups, with 80% power and a 5% significance level. Data were analyzed using SPSS version 22.0. Quantitative variables were expressed as mean ± standard deviation and compared using the independent t-test. Categorical variables were analyzed using the chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

Results

The study was conducted in a prospective and randomised manner in the Department of Anaesthesiology, at tertiary care hospital on 70 adult patients including both males and females belonging to American Society of Anaesthesiologists (ASA) Grade I & II, aged 18-65 years, scheduled to undergo upper limb surgery under ultrasound guided supraclavicular brachial plexus block. Both the groups were comparable in terms of age, weight, height, BMI, gender, ASA status and duration of surgery.(Table 1)

TABLE 1. Comparison of the study groups according to demographic variables and duration of surgery. .

Variables	GROUP ID (n=35)	GROUP PD (n=35)	Unpaired T Test P value
AGE (years)	40.77 (±10.01)	37.46(±10.54)	0.1819
WEIGHT (kg)	65.6(±11.69)	68.2(±14.52)	0.4122
HEIGHT (cm)	166.89(±9.95)	164.57(±10.26)	0.3414
BMI(kg/m2)	23.43(±2.26)	24.5(±2.58)	0.07
Gender (male/female)	16/19	18/17	0.810
ASA status (ASA I/ASA II)	17/18	20/15	0.472
Duration of Surgery (in minutes)	109.97 ± 45.7	120.09 ± 47.35	0.3664

Onset and duration of sensory, motor blockade and duration of analgesia is shown in table 2

Table 2: comparison of the study groups according to sensory blockade and motor blockade and Duration of Analgesia p* value<0.05, Significant

	Group ID (n=35)	Group PD (n=35)	Unpaired T Test Value P Value
Onset of Sensory block (in minutes)	10.97 ± 1.93	9.57 ± 1.74	0.002*
Onset of Motor block (in minutes)	12.2 ± 1.78	10.57 ± 1.47	0.0001*
Duration of Sensory block (in minutes)	396.7 ± 70.3	450.9 ± 80.4	0.0009*
Duration of Motor block (in minutes)	357.3 ± 80.2	412.2 ± 81.7	0.005*
Duration of Analgesia(in minutes	665.8 ± 97.0	722.8 ± 81.4	0.010*

In haemodynamics the HR in group ID was lower at all the time intervals intraoperatively as shown in Figure 1.

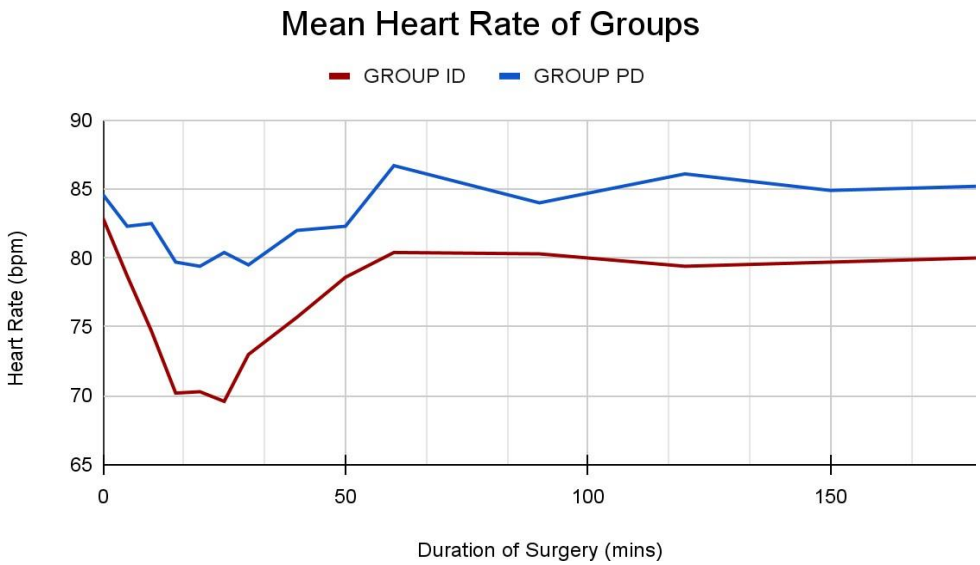


Figure 1: Comparison of intraoperative mean heart rate (bpm) in both the study groups at different time intervals

MAP was also lower in group ID at some of the time time intervals (figure 2)

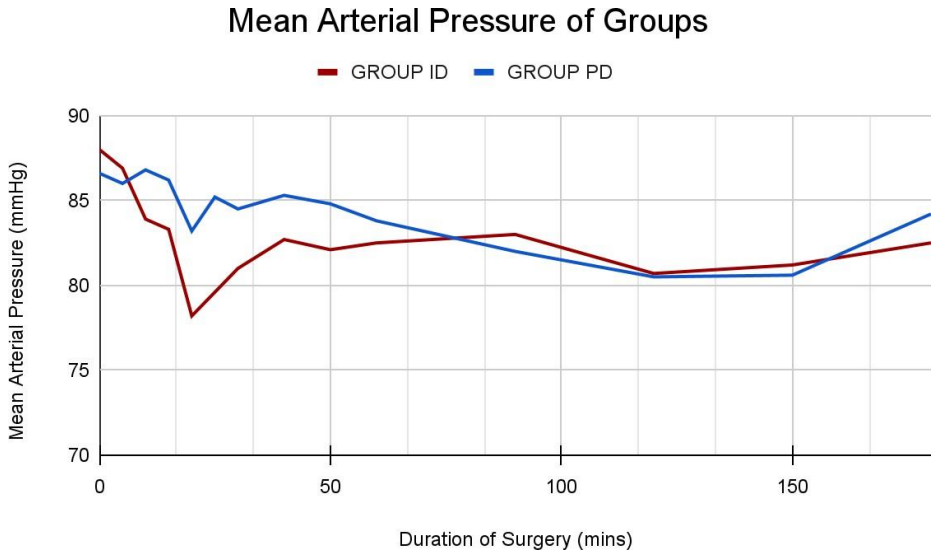


Figure 2. Comparison of intraoperative mean arterial pressure (MAP) at different time intervals in both groups.

The respiratory rate was comparable between 2 groups at all time intervals (Figure 3)

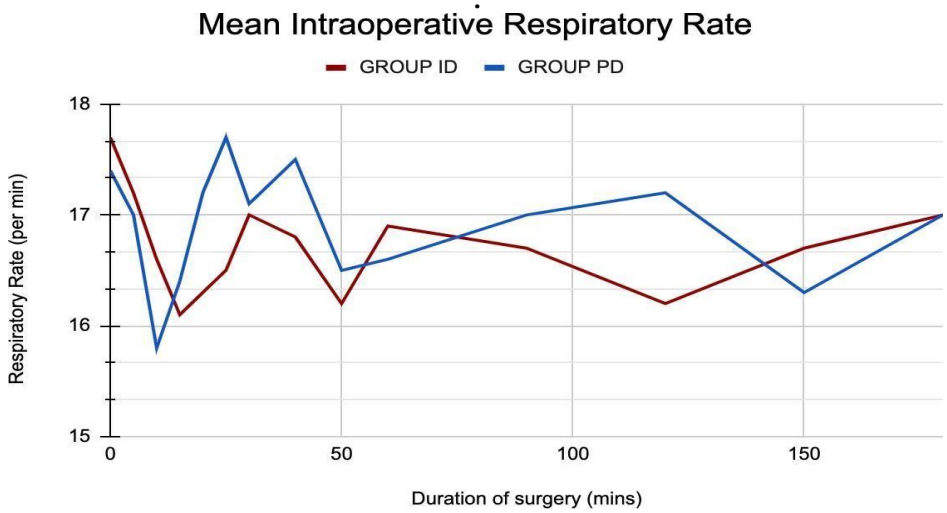


Figure 3: Comparison of mean intraoperative respiratory rate (RR) in both the study groups at different time intervals.

Table 3- Comparison of postoperative verbal numeric rating score (vnrs) in both the study groups at different time interval

Time (in Hrs)	VNRS		Unpaire d T Test P Value
	GROUP ID(n=35)	GROUP PD(n=35)	
Base Line	0	0	NA
1 hrs	0	0	NA
2 hrs	0	0	NA
3 hrs	0	0	NA
4 hrs	1.3 ± 1.1	0.8 ± 1.0	0.078
5 hrs	1.6 ± 1.4	1.1 ± 1.3	0.084
6 hrs	1.6 ± 1.3	1.2 ± 1.3	0.177
7 hrs	1.5 ± 1.2	1.6 ± 1.0	0.677
8 hrs	1.9 ± 1.7	1.0 ± 1.0	0.011*
9 hrs	3.0 ± 1.3	2.0 ± 1.7	0.008*
10 hrs	2.6 ± 1.4	1.9 ± 1.5	0.052*
11 hrs	1.4 ± 1.0	2.3 ± 1.4	0.001*
12 hrs	1.7 ± 1.1	2.6 ± 1.5	0.012*
16 hrs	1.9 ± 1.3	2.0 ± 1.2	0.699
20 hrs	2.3 ± 1.3	2.0 ± 1.3	0.264
24 hrs	2.5 ± 1.2	2.1 ± 1.1	0.289

Table 3 shows postoperative VNRS with standard deviation at various time points. Unpaired T-test applied between the groups. Statistically significant differences were observed between Group ID and Group PD between hour 8 and 12.

Table 4: COMPARISON OF REQUIREMENT OF POSTOPERATIVE

Group	Patients requiring ≤1 rescue analgesic doses	Patients requiring 2 or more rescue analgesic doses	P value of Chi-square test
Group ID	9	26	0.014*
Group PD	19	16	

Table 4 shows the requirement of postoperative rescue analgesics in the two groups. Chi-square T-test applied between the groups. And the total requirement of rescue analgesic was found to be significantly less in Group PD than Group ID (P-value >0.05).

Discussion

Regional anaesthesia exibit a number of advantages over general anaesthesia such hemodynamic instability, avoidance of airway instrumentation and polypharmacy, intra- and postoperative analgesia. It becomes more so important in trauma patients who generally experience severe pain preoperatively.

In present study we studied and compared Dexmedetomidine via different routes ie perineural and intravenous as an adjuvant to ropivacaine in ultrasound guided supraclavicular brachial plexus block and found that the mean onset of sensory and motor blockade was earlier in perineural Group as compared to intravenous group The duration of sensory,

motor blockade and duration of analgesia was also prolonged in perineural Group as compared to intravenous group. The requirement of rescue analgesics was also significantly less in **Group PD** as compared to **Group ID** P-value (0.014).

This shows that the peripheral action of dexmetomidine is the primary action by which it exibit its analgesic effects. This effects has been also supported by previous studies like Kathuria S et. al. who conducted a randomised, controlled, triple blind study of 60 patients posted for upper limb surgery under supraclavicular brachial plexus block and observed that onset was earlier when 50ug dexmetomidine was given perineurally (10)

Similarly Samar P et. Al studied intravenous and perineural dexmedetomidine as an adjuvant to 5mg/kg Lignocaine-Adr and 2mg/kg Bupivacaine and observed earlier onset in the perineural group. These observations correlate with the current study but the onset times in this study were significantly shorter than our study probably due to the use of a short acting anaesthetic agent, lignocaine in their study(11). Prolonged analgesia and sensory and motor block was also observed. This study correlates with the trend seen in the current study however as they had used VAS>4 as the endpoint of analgesia as compared to VAS>3 in the current study the duration of analgesia observed by them in both groups was understandably longer than the current study (11).

While comparing the haemogynamic profile, it was observed that intravenous group has lower MAP at certain points as compared to perineural group. Also HR was lower in intravenous group and there were incidence of bradycardia that required treatment. Simmilar observations has been observed by study done by Mahmoud A et. al. (12), Rayashettypura G et. al. (13)and Samar P et. al.(14)

This study was a small attempt to evaluate perineural and intravenous dexmedetomidine as an adjuvant to ropivacaine in USG guided supraclavicular brachial plexus block but the study had few limitations like study included a single dose of dexmedetomidine (1µg/kg) and that too used a bolus and did not compare it with a continuous infusion and its effects on block characteristics. We enumerated post operative pain using static VNRS scale and did not evaluate pain done by movement using a dynamic pain scale.

Conclusion

Dexmedetomidine when used in the dose of 1µg/kg perineurally as an adjuvant to ropivaciane in USG guided supraclavicular brachial plexus block shortens the onset of motor and sensory block, prolongs the duration of motor and sensory blocks and increases the duration of analgesia when compared with 1µg/kg intravenous dexmedetomidine.

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