BJHS
Birat Journal of Health Sciences

ISSN:

2542-2758 (Print) 2542-2804 (Online)

ARTICAE INFO:

Received Date: 7 August, 2024
Accepted Date: 15 April, 2025
Published Date: 30 April, 2025

KEYWORDS:

Analgesia, brachial plexus block, dexmedetomidine, ropivacaine.

CORRESPONDING AUTHOR:

Parasmani Shah
Lecturer, Department of Anaesthesiology, Critical Care and Pain Management
Nobel Medical College Teaching Hospital, Biratnagar, Nepal
Email: drparasmanishah@gmail.com
ORCID ID: 0009-0004-1969-090X

Access the article online

DOI: 10.62065/bjhs589

CITATION:

Shah P, Bhattarai R, Sarraf S. Efficacy of Dexmedetomidine as Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgery. 2025; 9 (2): 36-40.

Efficacy of Dexmedetomidine as Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgery.

Parasmani Shah[1*], Rupak Bhattarai, Supriya Sarraf

[1*]Department of Anaesthesilogy, Critical Care and Pain Management, Nobel Medical College Teaching Hospital, Biratnagar, Nepal

ABSTRACT

Introduction: Use of ropivacaine alone in brachial plexus block can provide dense anaesthesia of upper limb for shorter duration and have shorter period of postoperative analgesia. However, many drugs are being used as an adjuvant to local anaesthetic to enhance onset, efficacy and duration of anaesthesia and postoperative analgesia.

Objectives: The main objective of our study is to assess the efficacy of dexmedetomidine as an adjuvant to ropivacaine for supraclavicular brachial plexus block.

Methodology: This is a prospective comparative study conducted on 60 patients aged between 18 to 65 years undergoing below elbow upper limb surgery under brachial plexus block. Patients were equally divided into two groups. Group R patients received 25 ml of 0.5% ropivacaine with normal saline (2 ml) whereas Group D patients received 25 ml of 0.5% ropivacaine with 1mcg/kg dexmedetomidine (2 ml). The time of onset and duration of sensory and motor block and duration of analgesia were compared among groups.

Results: Demographic variables were comparable in both groups. There was faster onset and longer duration of sensory and motor block in group D than that in group R. Duration of analgesia was shorter in group R compared to group D.

Conclusion: Use of dexmedetomidine as adjuvant to ropivacaine in supraclavicular brachial plexus block hastens the time to onset and prolongs the duration of anaesthesia and postoperative analgesia.

INTRODUCTION

Brachial plexus block has been widely accepted as sole anaesthetic technique for upper limb surgery as an alternative to general anaesthesia. It can also be used as an adjuvant to general anaesthesia for intraoperative and postoperative analgesia for upper limb surgery. Various local anaesthetics with different half-lives and side effect profile are being used. Prolonged duration of anaesthesia and analgesia with minimal adverse effect is our priority. Significant improvement in efficacy and success rate of brachial plexus block has been seen after use of ultrasound.[1] To hasten the onset of block and to prolong the total duration of postoperative analgesia various adjuvants such as opioids, epinephrine, dexamethasone, dexmedetomidine, MgSO4, clonidine and midazolam to local anaesthetics can be used.[2,3] Many studies were conducted to compare the efficacy of adjuvants in prolongation of duration of anesthesia and analgesia. In humans, dexmedetomidine has shown to prolong the duration of block and postoperative analgesia when added to local anesthetic in various regional blocks.[4] The exact mechanism of action is poorly understood. The hypothesized mechanism of dexmedetomidine in prolonging duration of nerve block is the inhibition of neuronal sodium channel and rectified potassium current which reduces the neuronal activity.

Dexmedetomidine has been studied in brachial plexus block as a sole agent or in comparison with other adjuvants concomitantly with local anesthetic solution.[5] Due to unique pharmacologic properties (less lipophilic with decreased potential for systemic toxicity) and fewer side effects, ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve blocks.[6] However, there are very few published studies on dexmedetomidine in combination with ropivacaine. [7,8]

But there are variations in the result i.e. differences in duration of analgesia among studies. Therefore, our study is designed to assess the efficacy of dexmedetomidine on prolongation of total duration of perioperative analgesia in supraclavicular brachial plexus block in upper limb surgery in our setting.

METHODOLOGY

This prospective, randomized, comparative study was conducted at Nobel Medical College Teaching Hospital Biratnagar, Nepal from July 2023 to June 2024 after approval from the institutional review committee (ref: IRCNMCTH 821/2023). Total of 60 patients (30 in each group) of age between 18-65 years of either sex and American Society of Anaesthesiologist Physical Status I and II undergoing below elbow upper limb orthopedic surgery under supraclavicular brachial plexus block were enrolled in the study. Patients with any known allergy to study drugs, coagulopathy, preexisting neuropathy of surgical limb, pregnancy, diabetes, drug abuser and psychiatric disorder were excluded from the study. This is a prospective randomized comparative study. Purposive convenience sampling method was used. After enrollment, the study population was allocated to one of the two groups by using computer generated random number.

Group R: patients who received 25 ml of 0.5% ropivacaine and 2ml normal saline.

Group D: patients who received 25ml of 0.5% ropivacaine and 1mcg/kg body weight dose of dexmedetomidine making 2ml.

Using online calculator (openepi.com) with anticipated mean and standard deviation (SD) of duration of analgesia (min) in ropivacaine group of 593.19 and 114.44, respectively, and that in the dexmedetomidine group of 704.77 and 178.414, respectively, in the reference study, the calculated sample size per group was 29 patients with 80% power and 5% level of significance.[9] So, making round figure of 30 sample was taken in each group.

After enrollment in the study, on a day before surgery pre-anaesthetic check up with all routine laboratory investigations as per protocol of our hospital was done. Patients were explained about the procedure in detail and informed written consent was obtained. Patients were randomized to either of the group R or D on the day of surgery. Drug preparation was done by one anaesthesiologist and data collection by another anaesthesiologist who was blinded to the drug administered.

The patient was shifted to operating table and placed in supine position. Pre-procedure vitals were recorded by attaching standard ASA monitors. After obtaining good IV access, intravenous infusion of Ringer's lactate solution was started. Under all aseptic precaution, skin was prepped with 10% povidone iodine and draped. Head of patient was turned to opposite side and skin was infiltrated with 1% lignocaine with adrenaline. Supraclavicular brachial plexus was visualized in honeycomb appearance by linear probe. Under ultrasound guidance the block needle was inserted in plane to reach the plexus. Half volume of study drug was injected in corner pocket of brachial plexus and half in the central portion of plexus. After completing the administration of study drug, sensory block was assessed every 3 min for 30 minutes and then every 30 min for 12 hours, and thereafter, every 60 minutes till the presence of sensory and motor block. The sensory block was assessed by the pinprick sensation with a blunt 25 gauge hypodermic needle in all dermatomes innervated by the brachial plexus in the distribution of median (thenar eminence), radial (Dorsum of the hand over the second metacarpophalangeal joint), ulnar (hypothenar eminence), and musculocutaneous nerves (lateral side of forearm).

Sensory block was graded as: Grade 0 = Sharp pin sensation felt, Grade 1 = Analgesia, dull sensation felt, Grade 2 = Anesthesia, no sensation felt.[6] Onset time for sensory block was defined as time interval between end of study drug administration and complete sensory block (grade 2). Duration of sensory block was defined as time interval between complete sensory block and complete resolution of anesthesia (grade 0).

Motor block was measured at 0, 5, 10, 15, 20, 25, and 30 minutes till complete motor block by assessing modified Bromage scale (MBS) for upper limb; Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers, Grade 1: Decreased motor strength with ability to move the fingers only and Grade 2: Complete motor block with inability to move the fingers. Motor block onset was defined as time interval between end of the study drug administration to complete motor block (MBS score 3).[10] Duration of motor block was defined as time interval from complete motor block to recovery of complete motor function (MBS 0). The surgery was allowed to proceed when complete anesthesia is achieved. The time when patient started feeling incisional pain and the time when full power returned to the shoulder were recorded. After the end of surgery, patient was shifted to the PACU. In PACU patient was assessed hourly for pain, recovery of sensory and motor block till 24 hours. The data hence obtained was then recorded. The duration of analgesia was noted according to the visual analogue score (VAS) for pain for every hour for first 10 hours and then every second hourly till 24 hours. If VAS >4, inj Tramadol 50mg intravenously was given and time was noted. Patients were assessed hourly for recovery from sensory and motor block. Time between complete sensory block to first analgesic request was defined as duration of analgesia. Total amount of tramadol consumption in first 24 hours had also been recorded.

Data was collected in preformed sheet. Raw data was entered in SPSS version 19 and analysed. Categorical data is presented in number (percentage) and continuous data is presented as mean ± standard deviation. Unpaired t-test was used to compare mean

between two groups. Nominal categorical data was analysed using chi-square test. P-value < 0.05 was considered statistically significant.

General objective of our study was to assess the effect of dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Specific objectives were to assess the onset and duration of sensory and motor block and to assess the duration of analgesia after brachial plexus block in both groups.

RESULTS

A total of 60 patients were enrolled in our study after meeting inclusion and exclusion criteria. The demographic characteristics and duration of surgery were comparable in both study group (table 1)

Table 1: Demographic Profile of two study groups

Variables	Group R (n= 30)	Group D (n=30)	P –value
Age (Years)	31.26±9.06	28.72± 7.03	0.00
Sex (Male/Female)	23/7	25/5	0.49
Weight (Kg)	64.02±8.06	62.80±6.23	0.02
ASA (I/II)	26/4	24/6	0.38
Duration of Surgery (Min)	87.24±15.45	92.62±12.63	0.70

Table 2: Block Characteristics

Variables	Group R (n= 30)	Group D (n=30)	P –value
Onset of Sensory block(min)	7.84±0.23	6.03± 0.82	0.00
Onset of Motor block (min)	10.23±1.26	9.04±0.73	0.00
Duration of Sensory block (min)	624.32±96.23	702.24±125.26	0.02
Duration of Motor block (min)	690.62±102.63	760.26±128.02	0.00
Duration of Analgesia (min)	720.26±120.23	795.32±138.26	0.00
Total Analgesic Consumption (mg)	110.26±28.02	64.20±27.02	0,00

The mean duration of onset of sensory and motor block was lesser in group D as compared to group R (Table 2). The mean duration of sensory blockade was longer in Group D as compared to group R (702.24±125.26 min versus 624.32±96.23 min), which was highly statistically significant (P = 0.02) (Table 2).

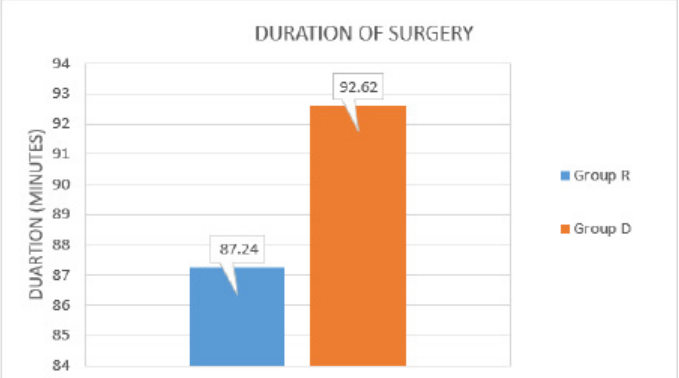

Figure 1: Duration of Surgery (Minutes)

DISCUSSION

A study conducted by Klein et al concluded that there was no clinically significant difference in times to onset and recovery of interscalene block for ropivacaine 0.5%, and ropivacaine 0.75% when injected in equal volumes.[11] Another study by Hickey and coworker resulted that when 0.5% of ropivacaine was used for subclavian perivascular brachial plexus block for upper limb surgery required frequent analgesic supplement due to lower concentration of local anaesthetic.[12] Hence to avoid the risk associated with higher total dose of ropivacaine and need for frequent supplementation we in our study used 0.5% ropivacaine. We used 1 µg/kg dexmedetomidine along with ropivacaine which is also supported by the study conducted by Bangera A et al.[13]

The result of our study demonstrated the faster onset and prolonged duration of sensory and motor blockade in dexmedetomidine group. These findings were consistent with the result of studies conducted by Ammar et al. and Kaygusuz et al.[14,15] They also found significantly faster onset of sensory block in the dexmedetomidine group than in the Ropivacaine alone group. A study conducted by Kathuria et al. also demonstrated quicker time to onset of sensory and motor blockade in the group receiving dexmedetomidine as compared ropivacaine.[16] They compared the effects of adding 50 mcg dexmedetomidine to 0.5% ropivacaine in supraclavicular brachial plexus block. The similar findings were demonstrated by study of Chinappa et al.[17] Sane et al. also found that the onset of sensory and motor block was faster by the use of dexmedetomidine as adjuvant in brachial plexus block with bupivacaine.[18]

Our study demonstrated significantly longer mean duration of sensory as well as motor block in dexmedetomidine group as compared to ropivacaine alone group. The similar result was found in studies conducted by Kathuria et al. and Chinappa et al. who assessed the effect of adding 1 mcg/kg and 50 mcg dexmedetomidine to 0.5% ropivacaine respectively.[16,17] The duration of sensory and motor block was significantly prolonged in the dexmedetomidine group. One study by Das et al. demonstrated prolongation of sensory and motor block in dexmedetomidine group compared to Ropivacaine only group.[19] Similar studies performed by Marhofer et al., Das et al., Ozaki et al., and Zhang et al. also demonstrated extended duration of

sensory and motor blockade in Dexmedetomidine group.[7,20-22]

In our study, the mean duration of analgesia was prolonged in dexmedetomidine group as compared to ropivacaine alone group which was statistically significant. The study done by Chinappa et al. and Bansal et al. also demonstrated a significantly prolonged duration of analgesia in the group receiving Dexmedetomidine.[17,23] The findings of our study was also supported by the observations of previous studies by Esmaoglu et al., Swamy et al., Ammar et al., Marhofer et al., Das et al. where the duration of analgesia was significantly prolonged in the group receiving Dexmedetomidine.[8,14,19,20,24]

CONCLUSION

From this study we can conclude that addition of dexmedetomidine (1 µg/kg) to 0.5% ropivacaine for ultrasound guided supraclavicular brachial plexus block is highly effective as it accelerates the time of onset of block and significantly prolongs the duration of sensory and motor block and postoperative analgesia without any potential sideeffects. The use of dexmedetomidine can delay the requirement of first rescue analgesia in post-operative period.

RECOMMENDATIONS

Further studies are needed with larger sample size to validate our results.

LIMITATIONS OF THE STUDY

This is single centre study and not a randomized control trail. The findings of our study cannot be generalized because of smaller sample size. There might be bias as the perception and tolerance to pain differs among individual.

ACKNOWLEDGEMENTS

We would like to acknowledge our department of Anaesthesiology, Critical Care and Pain Management, all the patients involved in the study, orthopedic surgeons, colleagues for their valuable support.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

REFERENCES:

1. Chan VWS, Perlas A, Rawson R, Odukoya O. Ultrasound-guided supraclavicular brachial plexus block. Anesth Analg. 2003 Nov;97(5):1514-7.
DOI: 10.1213/01.ANE.0000062519.61520.14
PMID: 14570677

2. Murphy DB, McCartney CJ, Chan VW. Novel analgesic adjuncts for brachial plexus block: a systematic review. Anesth Analg. 2000 May;90(5):1122-8.
DOI: 10.1097/00000539-200005000-00023
PMID: 10781465

3. Bailard NS, Ortiz J, Flores RA. Additives to local anesthetics for peripheral nerve blocks: evidence, limitations, and recommendations. Am J Health Syst Pharm 2014 Mar 1;71(5):373-85.
DOI: 10.2146/ajhp130336
PMID: 24534592

4. Hussain N, Grzywacz VP, Ferreri CA, Atrey A, Banfield L, Shaparin N, et al. Investigating the Efficacy of Dexmedetomidine as an Adjuvant to Local Anesthesia in Brachial Plexus Block: A Systematic Review and MetaAnalysis of 18 Randomized Controlled Trials. Reg Anesth Pain Med 2017 Mar/Apr;42(2):18496.
DOI: 10.1097/AAP.0000000000000564
PMID: 28178091

5. Agarwal S, Aggarwal R, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. J Anaesthesiol Clin Pharmacol 2014 Jan;30(1):3640
DOI: 10.4103/0970-9185.125701
PMID: 24574591 PMCID: PMC3927290

6. Kaur A, Singh RB, Tripathi RK, Choubey S. Comparison Between Bupivacaine and Ropivacaine in Patients Undergoing Forearm Surgeries Under Axillary Brachial Plexus Block: A Prospective Randomized Study. J Clin Diagn Res 2015 Jan;9(1):UC016.
DOI: 10.7860/JCDR/2015/10556.5446
PMID: 25738062 PMCID: PMC4347153

7. Zhang Y, Wang CS, Shi JH, Sun B, Liu SJ, Li P, et al. Perineural administration of dexmedetomidine in combination with ropivacaine prolongs axillary brachial plexus block. Int J Clin Exp Med 2014 Mar 15;7(3):680-5.
PMID: 24753763.

8. Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (a2 agonist drugs) as an adjuvant to local Anesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian J Anaesth 2012 May;56(3):243-9.
DOI: 10.4103/0019-5049.98767
PMID: 22923822 PMCID: PMC3425283

9. Mangal V, Mistry T, Sharma G, Kazim M, Ahuja N, Kulshrestha A. Effects of dexmedetomidine as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block: A prospective, randomized, double-blind study. J Anaesthesiol Clin Pharmacol. 2018 Jul-Sep;34(3):357-61.
DOI: 10.4103/joacp.JOACP_182_17
PMID: 30386020 PMCID: PMC6194815

10. Cline E, Franz D, Polley RD, Maye J, Burard J, Pellegrini J. Analgesia and effectiveness of Levobupivacaine compared with Ropivacaine in patients undergoing an axillary brachial plexus block. AANA J. 2004 Oct;72(5):339-45.
PMID: 15529729

11. Klein SM, Greengrass RA, Steele SM, D'Ercole FJ, Speer KP, Gleason DH, DeLong ER, Warner DS. A comparison of 0.5% bupivacaine, 0.5% ropivacaine, and 0.75% ropivacaine for interscalene brachial plexus block. Anesth Analg. 1998 Dec;87(6):1316-9.
DOI: 10.1097/00000539-199812000-00019
PMID: 9842819

12. Hickey R, Rowley CL, Candido KD, Hoffman J, Ramamurthy S, Winnie AP. A comparative study of 0.25% ropivacaine and 0.25% bupivacaine for brachial plexus block. Anesth Analg. 1992 Oct;75(4):602-6.
DOI: 10.1213/00000539-199210000-00024
PMID: 1530173

13. Bangera A, Manasa M, Krishna P. Comparison of effects of ropivacaine with and without dexmedetomidine in axillary brachial plexus block: A prospective randomized double-blinded clinical trial. Saudi J Anaesth. 2016 Jan-Mar;10(1):38-44.
DOI: 10.4103/1658-354X.169473
PMID: 26955309 PMCID: PMC4760039

14. Ammar AS, Mahmoud KM. Ultrasound-guided single injection infraclavicular brachial plexus block using bupivacaine alone or combined with dexmedetomidine for pain control in upper limb surgery: A prospective randomized controlled trial. Saudi J Anaesth. 2012 Apr;6(2):109-14.
DOI: 10.4103/1658-354X.97021
PMID: 22754434 PMCID: PMC3385250

15. Kaygusuz K, Kol IO, Duger C, Gursoy S, Ozturk H, Kayacan U, Aydin R, Mimaroglu C. Effects of adding dexmedetomidine to levobupivacaine in axillary brachial plexus block. Curr Ther Res Clin Exp. 2012 Jun;73(3):103-11.
DOI: 10.1016/j.curtheres.2012.03.001
PMID: 24648597 PMCID: PMC3954022

16. Kathuria S, Gupta S, Dhawan I. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Saudi J Anaesth. 2015 Apr-Jun;9(2):148-54.
DOI: 10.4103/1658-354X.152841
PMID: 25829902 PMCID: PMC4374219

17. Chinnappa J, Shivanna S, Pujari VS, Anandaswamy TC. Efficacy of dexmedetomidine with ropivacaine in supraclavicular brachial plexus block for upper limb surgeries. J Anaesthesiol Clin Pharmacol. 2017 Jan-Mar;33(1):81-5.
DOI: 10.4103/0970-9185.202196
PMID: 28413277 PMCID: PMC5374835

18. Sane S, Shokouhi S, Golabi P, Rezaeian M, Kazemi Haki B. The Effect of Dexmedetomidine in Combination with Bupivacaine on Sensory and Motor Block Time and Pain Score in Supraclavicular Block. Pain Res Manag. 2021 Apr 10;2021.
DOI: 10.1155/2021/8858312
PMID: 33927790 PMCID: PMC8053064

19. Das A, Majumdar S, Halder S, Chattopadhyay S, Pal S, Kundu R, et al. Effect of dexmedetomidine as adjuvant in ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded and randomized controlled study. Saudi J Anaesth. 2014 Nov; 8(suppl 1):S72-S77.
DOI: 10.4103/1658-354X.144082
PMID: 25538527 PMCID: PMC4268534

20. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: A volunteer study. Br J Anaesth. 2013 Mar;110(3):438-42.
DOI: 10.1093/bja/aes400
PMID: 23161360

21. Das B, Lakshmegowda M, Sharma M, Mitra S, Chauhan R. Supraclavicular brachial plexus block using ropivacaine alone or combined with dexmedetomidine for upper limb surgery: A prospective, randomized, double-blinded, comparative study. Rev Esp Anesthesiol Reanim. 2016 Mar;63(3):135-40.
DOI: 10.1016/j.redar.2015.04.012
PMID: 26091830

22. Ozaki M, Takeda J, Tanaka K, Shiokawa Y, Nishi S, Matsuda K, et al. Safety and efficacy of dexmedetomidine for long-term sedation in critically ill patients. J Anesth. 2014 Feb;28(1):38-50.
DOI: 10.1007/s00540-013-1678-5
PMID: 23912755 PMCID: PMC3921449

23. Bansal P, Khatri ML, Garg KL. Supraclavicular Brachial Plexus Block: Effect of Using Dexmedetomidine as Adjuvant to Ropivacaine. A Randomized Double Blind Study. J Dent Med Sci. 2016 Aug;15(8):124-33.
DOI: 10.9790/0853-150804124133

24. Esmaoglu A, Yegenoglu F, Akin A, TurkCY. Dexmedetomidine Added to Levobupivacaine Prolongs Axillary Brachial Plexus Block. Anesth Analg. 2010 Dec;111(6):1548-51.
DOI: 10.1213/ANE.0b013e3181fa3095
PMID: 20889939