International Journal of Research in Medical Sciences
Debnath M et al. Int J Res Med Sci. 2023 Jul;11(7):2483-2487
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20232086

Original Research Article

A comparative study of dexmedetomidine and fentanyl as adjuvants to ropivacaine on analgesic efficacy in supraclavicular brachial plexus block

Malin Debnath[1], Takhelmayum Hemjit Singh[2]*, Rupendra Singh Thokchom[2], Nongosal Kirha[3], Mahasweta Das[2], Pabin Pious[2]

[1]Department of Anaesthesiology, AGMC and GBPH, Agartala, Tripura, India
[2]Department of Anaesthesiology, Regional Institute of Medical Sciences, Imphal, Manipur, India
[3]Department of Health Services, Government of Nagaland, Nagaland, India

Received: 30 March 2023
Revised: 04 May 2023
Accepted: 31 May 2023

***Correspondence:**
Dr. Takhelmayum Hemjit Singh,
E-mail: takhelhcnlr@gmail.com

ABSTRACT

Background: Various adjuvants have been added to improve the quality of the supraclavicular brachail plexus block and prolong postoperative analgesia. The aim of the present study was to compare the onset and duration of sensory and motor blockade provided by dexmedetomidine and fentanyl as adjuvants to ropivacaine in such block.
Methods: In this study 60 patients with American Society of Anesthesiologists grade I/II scheduled for elective upper limb surgeries were randomly allocated into two groups. Group A received 30 mL of 0.5% ropivacaine with 1 µg kg-1 dexmedetomidine, and group B received 30 mL of 0.5% ropivacaine with 1 µg kg-1 fentanyl for supraclavicular brachial block. The onset and duration of sensory and motor block and adverse events during the perioperative period were noted.
Results: The onset of sensory and motor blockade was 13.47±1.73 min and 22.87±2.27 min respectively in the dexmedetomidine group and 14.80±2.20 min and 24.33±2.63 min respectively in the fentanyl group which was statistically significant (P<0.05). The duration of the sensory blockade was significantly higher in the dexmedetomidine group as compared with fentanyl (826±58.29 vs 592±51.62 minutes, p< 0.0001).
Conclusions: Dexmedetomidine provides faster onset of sensory and motor block with longer duration of block as compared with fentanyl when used as an adjuvant with ropivacaine in supraclavicular brachial plexus block without any significant side effects.

Keywords: Dexmedetomidine, Fentanyl, Ropivacaine, Supraclavicular brachial plexus block

INTRODUCTION

Operations on upper limb are generally performed under general anaesthesia but due to increasing cost of anaesthetic agents, associated sequelae (nausea, vomiting, dry mouth, sore throat, hoarseness, shivering, dizziness, post operative cognitive dysfunction, etc.) and the problems of operation theatre pollution, focus has been shifted towards regional anaesthesia.[1] Moreover, postoperative pain relief is an added advantage of regional anaesthesia. Regional technique is always superior whenever general condition of the patient is poor, or the patient is not adequately prepared or in the presence of associated conditions like uncontrolled diabetes, cardiovascular or respiratory diseases. It is also useful when the patient prefers to retain his consciousness

during surgery and when it is important for the patient to remain ambulatory.[2]

When local anaesthesia is used solely, they have a shorter duration of action. The duration of analgesia with local anaesthesia alone can be prolonged with the use of indwelling catheters, but misplacement, migration and infection are the inherent problems with catheter placement.[3,4] Adjuvants to local anaesthesia provide the benefits of prolonging the duration of action without the need of an additional procedure and risks of catheter insertion.[5] Adjuvants, such as opioid and non-opioids, have been used for supraclavicular block to enhance the duration of analgesia and minimise the use of systemic analgesics.[6-8]

Ropivacaine, an amide-linked local anaesthetic and an S (−) enantiomer, is less lipophilic than bupivacaine and hence a decreased potential for cardiotoxicity and central nervous system (CNS) toxicity.[9-13] It has less penetration of large myelinated nerve fibres due to less lipophilicity, resulting in greater degree of motor sensory differentiation.

In the present study, 30 mL of 0.5% ropivacaine was used. It was observed from previous studies that increasing the concentration of ropivacaine from 0.5% to 0.75% fails to improve the onset or duration of the block, and using 0.25% ropivacaine for subclavian perivascular brachial plexus block requires frequent analgesia and supplementation.[12.,13] The primary objective of the study was to compare the onset and duration of sensory and motor blockade provided by dexmedetomidine and fentanyl as adjuvants to ropivacaine in supraclavicular brachial plexus block.

METHODS

This was a prospective, randomised clinical trial study conducted in the Department of Anaesthesiology at Regional Institute of Medical Sciences, Imphal, Manipur from September 2019 to August 2021. The Institutional Ethics Committee approved the study. Written informed consent was obtained from all of the patients. The trial was registered with the CTRI (Clinical trial registry-India). The registration number of this trial being CTRI/2021/07/035010.

A total of 60 adult patients were randomly allocated into two groups (n=30) using a computerised random number table. Patients with American Society of Anesthesiologists (ASA) grades I and II, aged between 18 and 60 years, either gender and who underwent elective surgeries of the elbow, forearm and hand were included in the study.[3] Patients with coagulopathies or on anticoagulants; severe renal, hepatic, respiratory or cardiac diseases; infection at the site of the block; pregnancy and neuromuscular disorders were excluded from the study. Any contraindication to ropivacaine, dexmedetomidine or fentanyl and patient refusal were also excluded.

Patients in group A received 30 mL of 0.5% ropivacaine with 1 µg kg-1 of dexmedetomidine, and those in group B received 30 mL of 0.5% ropivacaine with 1 µg kg-1 of fentanyl under supraclavicular brachial plexus block.

Preoperative assessment included detailed history, general physical examination, systemic examination, airway assessment and necessary routine investigations. All patients received tab ranitidine 300 mg and tab alprazolam 0.5 mg orally the night before surgery, and a preoperative fasting status of 8 h was ensured. The block procedure was explained to the patient. Preoperative baseline vital parameters were recorded. Intravenous line was secured with an 18G cannula. Premedication was given with inj. ondansetron 4 mg IV and inj. ranitidine 50 mg IV.

After aseptic precautions, skin infiltration was given with 1 mL of 2% lignocaine. Supraclavicular brachial plexus block was performed with ultrasonographic guidance by in plane technique with the volume and adjuvant according to the study groups. The onset of sensory and motor blockade was assessed every 2 min until complete sensory or motor block (with Hollmen scale)[1,14]. The onset of sensory block was assessed by a pinprick method and defined as the time from the completion of local anaesthesia injection to the time when sensory block was detected i.e., Hollmen scale 3. The onset of motor block was measured as the time between the completion of local anaesthesia injection to the achievement of score 3 of Hollmen scale. If anaesthesia was found inadequate after 20 min of administration of the drug, such patients were excluded from the study.

The total duration of sensory block was measured as the duration between the onset of Hollmen scale 3 sensory block to the appearance of pain. The total duration of motor blockade was calculated as the time between the onset of Hollmen scale 3 motor block to the complete recovery of motor activity.

Bradycardia was defined as heart rate <60/min and hypotension <20% of baseline parameters. Complications, such as intravascular injection, arrhythmias, pneumothorax and paresis, were noted. Heart rate, respiratory rate, oxygen saturation and blood pressure were recorded every 5 min to 30 min and then every 15 min to the regression of the block.

Sample size was calculated based on the study of Farooq et al where we enrolled 30 patients for each group with α value of 0.05 and power of 90%.[11] The data collected were entered in SPSS 21.0 for Windows (Statistical Package for Social Sciences, Chicago, IL, USA). The continuous data such as the patient's age and weight were expressed as mean ± standard deviation, whereas the categorical data, such as sex, ASA physical status were

expressed in frequencies. Data analysis was carried out by another independent researcher who was not involved in any stages of the procedure. The data were analysed using one-way analysis of variance (ANOVA) and Pearson Chi-square test for continuous and categorical variables, respectively. P<0.05 was considered as statistically significant.

RESULTS

The study was completed in all the enrolled patients. The demographic parameters such as age, sex, weight and ASA were comparable in the two groups, as shown in Table 1, and statistically not significant.

Table 1: Comparison of demographic parameters of the study groups.

Parameter	Group A (dexmedetomidine)	Group B (fentanyl)	P value
Age (years)	36.23±13.833	41.7±11.481	0.101
Weight (kg)	65.23±8.787	64.73±8.642	0.825
Sex (Male:Female)	15:15	18:12	0.436
ASA(I:II)	13:17	18:12	0.196

P<0.05 was significant

Table 2: Comparison of onset time and duration (in minutes) of sensory and motor block between groups.

Parameters		Group A (Mean±SD)	Group B (Mean±SD)	P value
Onset (in min)	Sensory	13.47±1.737	14.80±2.203	0.012
	Motor	22.87±2.270	24.33±2.631	0.024
Duration (in min)	Sensory	826±58.29	592±51.62	<0.001
	Motor	682±62.001	462±57.14	<0.001

P<0.05 was significant

Table 3: Adverse effects of both the groups.

Adverse effects	Group A (no. of patients)	Group B (no. of patients)	P value
Nil	26	29	>0.05
Bradycardia	2	0	>0.05
Nausea	1	1	>0.05
Hypotension	1	0	>0.05

P<0.05 was significant

The onset time of sensory block was significantly higher in group B (14.8±2.203) as compared to group A (13.47±1.737) and onset time of motor block was also higher in group B (24.33±2.631) as compared to group A (22.87±2.270) significantly. The duration of sensory block was higher in group A (826±58.27) as compared to group B (592±51.62) and duration of motor block was also higher in group A (682±62.001) as compared to group B (462±57.14). These difference in the duration of sensory and motor block were found statistically highly significant (P value is <0.01). Dexmedetomidine (Group A) provided faster onset and longer duration of sensory and motor block when compared with Fentanyl (Group B), as shown in Table 2.

The adverse effects, as shown in Table 3, was almost comparable in both the groups and statistically not significant even though two patients in group A reported episodes of bradycardia.

DISCUSSION

Brachial plexus block provides adequate muscular relaxation and maintains stable perioperative hemodynamics for upper limb surgeries.[15] Ropivacaine, a long-acting amide local anaesthesia, has better safety profile than bupivacaine with reduced cardiotoxic effects.[14,16-18] Adjuvants have been administered to achieve prolonged block with improved quality of anaesthesia and local anaesthesia.[1,2] The aim of the present study was to compare the two adjuvants, dexmedetomidine and fentanyl, in terms of efficacy and any side effects.

Dexmedetomidine is a centrally acting α2 agonist mediating antinociception via peripheral α2 adrenoceptors. The effect of the addition of dexmedetomidine to ropivacaine has been studied and found to be effective with no postoperative neurological deficits.[2-4,8-11]

Fentanyl, a potent synthetic opioid analgesic with a strong agonistic action at the μ-opioid receptor with a rapid onset and short duration of action when added to local anaesthesia in peripheral nerve blocks, potentiates the local anaesthesia action via central opioid receptor-mediated analgesia by the peripheral uptake of fentanyl to the systemic circulation. The effect of fentanyl as

adjuvant with ropivacaine has been studied and found to be effective with no side effects.[6,8-13]

The present study recorded the onset of sensory blockade as 13.47±1.737 min in the dexmedetomidine group (Group A) and 14.80±2.203 min in the fentanyl group (Group B) with P value of 0.012. This result is consistent with the observation of Dharmarao PS et al who observed that the onset of sensory blockade was 13.95±1.34 min in group A and 14.18±1.41 min in group B.[19]

The onset of motor blockade was 22.87±2.270 min in the dexmedetomidine group (Group A) and 24.33±2.631 min in the fentanyl group (Group B) with P value of 0.024 in our study, and this result is inconsistent with the observation of Dharmarao PS et al who observed that the onset of motor blockade was 24.25±1.56 min in group A and 24.38±1.46 min in group B with P value of 0.776.[19] But our study findings are consistent with the observation of Kaur et al who observed that the onset of motor blockade is faster in dexmedetomidine group (8.075±0.27 min) when compared to fentanyl group (9.738±0.54 min) with P value of <0.001.[10]

The duration of sensory block in our study was significantly prolonged in dexmedetomidine group (826±58.29 min) as compared to fentanyl group (592±51.62 min) with P value of <0.0001. This result is consistent with the observation of Dhar et al who observed that the duration of sensory block was 801.75±46.07 min in dexmedetomidine group and 590.25±40.41 min in fentanyl group with P value of <0.0001.[19]

Similarly, the duration of motor block was significantly prolonged in dexmedetomidine group (682±62 min) as compared to fentanyl group (462±57.14 min) with P value of <0.0001 in the present study and the result is also consistent with the observation of Dharmarao et al who observed that the duration of motor block was 649.56±42.73 min in dexmedetomidine group and 456.75±32.93 min in fentanyl group with P value of <0.0001.[19]

Significant results of early onset and prolonged analgesia with dexmedetomidine as compared with fentanyl on ropivacaine nerve block studies have been also highlighted in the studies of Kathuria et al, Das et al and Marhofer et al which are corroborative with the present study.[9,20,21]

Limitations

The limitations of our study are that the actual duration of sensory and motor blocks was not evaluated by electromyography or nerve conduction velocity, studies with other ASA physical status needs to be evaluated. The plasma level of the study drugs was not measured and paediatric and geriatric age groups were not included.

CONCLUSION

It can be concluded from the present study that dexmedetomidine significantly provides a faster onset of sensory and motor block, a longer duration of sensory and motor block as compared with fentanyl when used as an adjuvant with ropivacaine in supraclavicular brachial plexus block without any significant side effects.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kothari D. Supraclavicular brachial plexus block: A new approach. Indian J Anaesth. 2003;47(4):287-8.
2. Sudani C, Rao SM, Munta K. A comparative study of ropivacaine alone versus ropivacaine with dexmedetomidine in supraclavicular brachial plexus block. Anesthesiol Open J. 2016;1:28-34.
3. Daabiss M. American Society of Anaesthesiologists physical status classification. Indian J Anaesth. 2011;55(2):111-5.
4. Nallam SR, Chiruvella S, Karanam S. Supraclavicular brachial plexus block: Comparison of varying doses of dexmedetomidine combined with levobupivacaine: A double-blind randomized trial. Indian J Anaesth. 2017;61(3):256-61.
5. Abdallah FW, Brull R. Facilitatory effects of perineuraldex-medetomidine on neuraxial and peripheral nerve block: A systemic review and meta-analysis. Br J Anaesth. 2013;110(6):915-25.
6. Sinha C, Kumar A, Kumari P, Singh AK, Sharma S, Kumar A, et al. Comparison of two doses of dexmedetomidine for supraclavicular brachial plexus block: A randomized controlled trial. Anesth Essays Res. 2018;12(2):470-4.
7. Simpson D, Curran MP, Oldfield V, Keating GM. Ropivacaine: a review of its use in regional anaesthesia and acute pain management. Drugs. 2005;65:2675-717.
8. Hamed MA, Ghaber S, Reda A. Dexmedetomidine and fentanyl as an adjunct to bupivacaine 0.5% in supraclavicular nerve block: A randomized controlled study. Anesth Essays Res. 2018;12(2):475-9.
9. Kathuria S, Gupta S, Dhawan I. Dexmedetomidine as an adjunct to ropivacaine in supraclavicular brachial plexus block. Saudi J Anaesth. 2015;9(2):148-54.
10. Kaur M, Kaur R, Kaur S, Baghla N, Bansal A, Kalia A, et al. A study to compare the analgesic efficacy of dexmedetomidine and fentanyl as adjuvants to levobupivacaine in ultrasound-guided supraclavicular brachial plexus block. Anesth Ess Res. 2018;12(3):669-73.
11. Farooq N, Singh RB, Sarkar A, Rasheed MA, Choubey S. To evaluate the efficacy of fentanyl and

dexmedetomidine as adjuvant to ropivacaine in brachial plexus block: A double-blind, prospective, randomized study. Anaesth Ess Res. 2017;11(3):730-9.
12. Bisui B, Samanta S, Ghoshmaulik S, Banerjee A, Ghosh TR, Sarkar S. Effect of locally administered dexmedetomidine as adjuvant to levobupivacaine in supraclavicular brachial plexus block: Double-blind controlled study. Anesth Essays Res. 2017;11(4):981-6.
13. Kaur H, Singh G, Rani S, Gupta KK, Kumar M, Rajpal AS, Aggarwal S. Effect of dexmedetomidine as an adjuvant to levobupivacaine in supraclavicular brachial plexus block: A randomized double-blind prospective study. J Anaesthesiol Clin Pharmacol. 2015;31(3):338-8.
14. Fanelli G, Casati A, Garancini P, Torri G. Nerve stimulator and multiple injection technique for upper and lower limb blockade: failure rate, patient acceptance, and neurologic complications. Anesth Analg. 1999;88(4):847-52.
15. Kulenkampff D and Persky MA. Brachial plexus anesthesia: its indications, techniques, and dangers. Anesth Analg. 1998;87(6):1316-9.
16. Lanz E, Theiss D, Jankovic D. The extent of blockade following various techniques of brachial plexus block. Anesth Analg. 1983;62:55-8.
17. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: Anatomic analysis of a method to prevent pneumothorax. Anesth Analg. 1993;76(3):530-4.
18. Carty S, Nicholls B. Ultrasound guided regional anaesthesia. Oxford Jo Med Br J Anaesth. 2007;7(1):20-4.
19. Dharmarao PS and Holyachi R. Comparative study of the efficacy of dexmedetomidine and fentanyl as adjuvants to ropivacaine in Ultrasound-guided supraclavicular brachial plexus block. Turk J Anaesthesiol Reanim. 2018;46(3):208-13.
20. Das A, Majumder S, Halder S, Chattopadhyay S. Effect of dexmedetomidine as adjuvant in ropivacaine induced supraclavicular brachial plexus block: A prospective, double-blinded and randomized controlled study. Saudi J Anaesth. 2014;8(Supp 1):72-7.
21. 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;110(3):438-42.

Cite this article as: Debnath M, Singh TH, Thokchom RS, Kirha N, Das M, Pious P. A comparative study of dexmedetomidine and fentanyl as adjuvants to ropivacaine on analgesic efficacy in supraclavicular brachial plexus block. Int J Res Med Sci 2023;11:2483-7.