A Prospective Study of Dexmedetomidine as an Adjuvant to Local Anaesthetic Used in Supraclavicular Block

L.R.N.N. Paidikondala[1], Kommula Gopala Krishna[2], P. Subhamani[3], P. Sudhir Sirkar[4]

[1, 2, 3, 4] Department of Anaesthesiology, Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram, Andhra Pradesh, India.

ABSTRACT

BACKGROUND

To improve the quality of block (sensory and motor characteristics), postoperative pain management and reduce large doses of local anaesthetics, various adjuvants are used with local anaesthetic agents. We have evaluated dexmedetomidine as an adjuvant to 0.5 % ropivacaine in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block & duration of postoperative analgesia.

METHODS

This is a prospective randomised comparative study. 60 patients who were admitted for elective surgeries of the lower arm, at the level of elbow, forearm & hand were enrolled. They were divided in to two groups of 30 patients each as follows - group RD: supraclavicular brachial plexus block given with 30 mL of 0.5 % ropivacaine + 1 mL (100 µg) of dexmedetomidine. Group RC: supraclavicular brachial plexus block given with 30 mL of 0.5 % ropivacaine + 1 mL of normal saline. Various parameters like onset times and durations of sensory and motor block, duration of analgesia, total analgesic needed, and side-effects were recorded for each patient.

RESULTS

The time of onset of sensory and motor block was significantly early in dexmedetomidine group than in control group. The duration of sensory and motor block was significantly prolonged in group RD as compared to group RC. The duration of sensory block was 724.18 + 73.26 min in group RD (GD) and 582.16 + 93.12 min. in group RC (GC). The duration of analgesia was significantly prolonged in group RD.

CONCLUSIONS

Addition of dexmedetomidine as an adjuvant to ropivacaine is associated with early onset of sensory and motor block. The duration of sensory and motor block was prolonged. The duration of analgesia was prolonged and patients required less rescue analgesia. The use of dexmedetomidine was associated with reversible bradycardia and sedation score was less.

KEYWORDS

Ropivacaine, Dexmedetomidine, Adjuvant, Supraclavicular Brachial Plexus Block

Corresponding Author:
Dr. Kommula Gopala Krishna,
Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram, Andhra Pradesh, India.
E-mail: dr.gkkommula@gmail.com

DOI: 10.18410/jebmh/2021/67

How to Cite This Article:
Paidikondala LRNN, Krishna KG, Subhamani P, et al. A prospective study of dexmedetomidine as an adjuvant to local anaesthetic used in supraclavicular block. J Evid Based Med Healthc 2021;8(07):345-349. DOI: 10.18410/jebmh/2021/67

Submission 16-10-2020,
Peer Review 23-10-2020,
Acceptance 27-12-2020,
Published 15-02-2021.

BACKGROUND

Kulenkampff in 1911 performed first percutaneous supraclavicular block. With his colleague Persky he published his experience of more than thousand blocks in annuls of surgery in 1928.[1,2] After that supraclavicular brachial plexus block evolved as safe alternative to general anaesthesia. Surgeries of upper limb below the shoulder joint are mostly performed under the brachial plexus block. With the use of nerve stimulators and ultrasound, supraclavicular brachial plexus block became more safe and effective. To provide safe and effective block various amide local anaesthetics are used, among them bupivacaine is more popular. But bupivacaine is a racemic compound associated with cardiac and central nervous system toxicity in some patients, when it is used in high concentration or accidentally administered intravascularly.[3,4] Ropivacaine is a pure S (-) enantiomer, long-acting regional amide anaesthetic agent with reduced potential toxicity and better relative sensory and motor block profiles but it is less potent than bupivacaine.[5] To improve the quality of block (sensory and motor characteristics), postoperative pain management and to reduce large dose of local anaesthetic agents various adjutants are used with these local anaesthetic agents. These adjuvants are clonidine, opioids, neostigmine and tramadol etc.

Dexmedetomidine is highly potent, selective and specificα_2-adrenoreceptor agonist. It has been found effective in prolonging the duration of the block and post-operative analgesia when used along with local anaesthetic in various regional blocks.[6,7] Kathuria S, Gupta S, Dhawan I. et al.[8] has concluded in his study that dexmedetomidine as an adjuvant to 0.5 % ropivacaine shortens the sensory as well as motor block onset time, prolongs block and duration of analgesia. Rancourt MP, Albert NT, Côté M, Létourneau DR, Bernard PM[9] has also reported the same. Chinnappa Jithendra, Shivanna Shivakumar et al. has concluded that perineural dexmedetomidine with ropivacaine provides prolonged postoperative analgesia, hastens the onset of sensory and motor block and prolongs the duration of the supraclavicular brachial plexus block.[10] We have started this study with a hypothesis that dexmedetomidine potentiate the regional block of ropivacaine. We wanted to evaluate dexmedetomidine as adjuvant to 0.5 % ropivacaine in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block & duration of postoperative analgesia and secondarily to know sedation score and occurrence of any side effects & complications.

METHODS

This is a prospective randomised, and comparative study conducted in the Department of Anaesthesia, Konaseema Institute of Medical Science and Research, from March 2018 to June 2020. Approval from institutional ethics committee was taken before start of study (Sl. No of IEC / PR / 2017: 37 / 12 / 2 / 2018). A written informed consent was obtained from all patients before enrolling them for study.

Selection of Patients

Patients admitted for elective surgeries of lower arm, at the level of elbow, forearm & hand with American Society of Anesthesiologists (ASA) score grade I & II, were included for this study as per exclusion and inclusion criteria.

Inclusion Criteria

Age between 18 to 60 years
Patients with ASA I & II.

Exclusion Criteria

Cardiopulmonary, renal and hepatic abnormality, peripheral neuropathy, hypersensitivity to drug, refusal to give consent, bleeding disorder pregnancy and lactation.

Sample Size

Based on above mentioned criteria 60 patients were included in this study and using a computer generated randomisation, patients were randomised into two groups of 30 patients each as follows:

Group RD: Supraclavicular brachial plexus block given with 30 mL of 0.5 % ropivacaine + 1 mL (100 µg) of dexmedetomidine (total volume 31 mL)

Group RC: Supraclavicular brachial plexus block given with 30 mL mg of 0.5 % ropivacaine + 1 mL normal saline (total volume 31 mL).

Drug under study was prepared by residents who were not involved in this study and handed over to the concerned anaesthesiologist for administration, both were blinded to the study drugs. In the preparation room the procedure of block and VAS score was explained to the patients after that they were shifted to the operating table. Intravenous access achieved with by 20G I.V cannula in the non-operating arm. Standard anaesthesia monitor for vitals was attached and basal parameters like heart rate, arterial blood pressure, and oxygen saturation (SpO_2) recording was started.

Under strict aseptic conditions supraclavicular brachial plexus block was performed under ultrasound guidance. After real time ultrasonographic visualisation of brachial plexus, needle was placed and following negative aspiration of blood, 36 mL of drug was injected around the brachial plexus.

At the end of injection, time was taken as zero min. Sensory and motor block was assessed every 3 minutes until complete sensory and motor block or 30 min, whichever was earlier. Sensory block onset was assessed by using pinprick test with a blunt 23 G hypodermic needle in the cutaneous distribution of radial, ulnar, median and musculocutaneous nerve on a 3-point scale as grade 0: sharp pain, grade 1: analgesia, dull sensation and grade 2: analgesia, no sensation. "Motor block was evaluated on a 3-point modified Bromage scale for upper limbs. Grade 0: normal motor function, grade 1: decreased motor strength, grade 2: complete motor block.[11] The time interval from end of administration of drug to complete sensory or motor block was defined as onset time for sensory or motor block. Analgesia or grade 2 sensory blocks was defined as complete

sensory block. Complete motor block was defined as the inability to move finger. In the postoperative recovery room patients was observed by anaesthesiologist who was blinded about the drug used. Patients were asked to rate their pain on 11 point visual analogue scale (VAS) which was repeated every 30 min for first 4 hour then hourly for next 24 hour. If VAS score reaches ≥ 4 rescue analgesia was given in the form of inj. diclofenac 1.5 mg / Kg I.M. Assessment of regression of sensory and motor block was done every 15 min till recovery. The time interval from end of administration of drug to complete resolution of sensation on all nerves was defined as complete sensory block. The time interval from end of administration of drug to the recovery of complete motor power of the hand and forearm was defined as complete motor block. The time interval from end of administration of drug to first rescue analgesic administration was noted as duration of analgesia. The amount of analgesic used in first 24 was calculated.

Patients were monitored for complications like bradycardia (heart rate below 50), tachycardia (> 20 % below baseline value), hypotension (> 20 % below baseline value) and hypertension (20 % above the normal value). Patients were asked for nausea, vomiting drug rashes or any possible drug reactions during first 24 hours. "Patient's sedation score was assessed by Ramsay sedation score at every 5 min during surgery till it reached maximum and at every 30 min in postoperative period till the patient was awake completely.[12]

Statistical Analysis

Data were recorded in Excel sheet and statistical analysis was done with software SPSS-14 version. Qualitative data were calculated as percentage and proportions and were analysed by chi-square test. Quantitative data were expressed as mean ± SD and these data were analysed by unpaired student t test. The P value less than 0.05 were taken as significant.

RESULTS

We have enrolled 30 patients in each group and both groups were comparable to each other with respect to age, body mass index, sex ratio, duration of surgery and the ASA score (Table 1).

Variables		GD	GC	P-Value
Age (Mean ± SD)		40.6 ± 12.82	39.83 ± 10.45	0.40
Sex [n (%)]	Males	18 (60 %)	16 (53.3 %)	0.60
	Females	12 (40 %)	14 (46.7 %)	
BMI (Kg / m^2) (Mean ± SD)		23.90 ± 2.19	23.55 ± 2.05	0.26
Duration of surgery (Mean ± SD)		83.93 ± 18.35	86.9 ± 13.99	0.24
ASA score (I / II) [n (%)]		22 (73.3 %) / 8 (26.7 %)	20 (66.67 %) / 10 (23.67 %)	0.57

Table 1. Comparison of Demography between the Two Groups

The time of onset of sensory and motor block was significantly early in dexmedetomidine group than control group. The mean of time of onset of sensory block in group RD was 10.46 ± 3.05 min as compared to 15.4 ± 4.79 min in group RC. The mean time of onset of motor block in group RD was 13.06 ± 2.92 min as compared to 19.5 ± 3.84 min in group RC (Table 2).

Parameters	GD	GC	P-Value
Time of onset of sensory block (min)	10.46 ± 3.05	15.4 ± 4.79	0.001*
Time of onset of motor block (min)	13.06 ± 2.92	19.5 ± 3.84	0.001*

Table 2. Comparison of Onset of Block

*indicates statistically significant difference at P < 0.05

Parameters	GD	GC	P-Value
Duration of sensory block (min)	724.18 ± 73.26	582.16 ± 93.12	0.001
Duration of motor block (min)	689.75 ± 78.76	405.53 ± 102.84	0.001

Table 3. Comparison of Duration of Block

*indicates statistically significant difference at P < 0.05

The duration of sensory and motor block was significantly prolonged in group RD as compared to group RC. The duration of sensory block was 724.18 ± 73.26 min in group RD and 582.16 ± 93.12 min in group RC. The duration of motor block was 689.75 ± 78.76 min in group RD and 405.53 ± 102.84 min in group RC (Table 3).

Parameters		GD	GC	P-Value
Mean duration of analgesia (min)		809.96 ± 78.45	475.37 ± 78.93	0.001*
Rescue analgesic requirement (no. of I.M. Inj.) (Fisher's exact test used)	1	9	3	0.0012
	2	2	16	

Table 4. Characteristics of Analgesia

*indicates statistically significant difference / association at P < 0.05

The duration of analgesia was significantly prolonged in group RD as compared to group RC. The duration of analgesia was 809.96 ± 78.45 min in group RD and 475.37 ± 78.93 min in group RC. Group RD required lesser number of diclofenac sodium injection for rescue analgesia as compared to group RC which was significant statistically (Table 4).

Parameters	GD (%)	GC (%)
Nausea	2 (6.67 %)	4 (13.33 %)
Vomiting	0	2 (6.67 %)
Headache	1 (3.34 %)	2 (6.67 %)
Hypotension	-	1 (3.34 %)
Bradycardia	3 (10 %)	-

Table 5. Reported Side Effects among the Groups

Nausea and vomiting were common in group RC as compared to group RD (6.67 % vs 13.33 %). Bradycardia was found in three patients in group RD (6.67 %) which was absent in group RC. No episode of hypotension and respiratory depression was seen in patients of group RD (Table 5).

Time Assessment	Group RD (N = 30)	Group RC (N = 30)	P-Value
15 min	1.62 ± 0.24	2.11 ± 0.421	0.001*
30 min	1.74 ± 0.43	2.67 ± 0.54	0.001*
45 min	1.67 ± 0.54	1.92 ± 0.33	0.001*
60 min	1.56 ± 0.22	1.81 ± 0.23	0.001*
120 min	1.43 ± 0.12	1.76 ± 0.12	0.001*

Table 6. Intraoperative Sedation Score

*indicates statistically significant difference / association at P < 0.05

Sedation score of patients was maximum at 30 min in RC group, 2.67 ± 0.54 min and in RD group, 1.74 ± 0.43 min. After that sedation score was decreased. The sedation score was significantly higher in group RC as compared to group RC (P = 0.001) (Table 6).

DISCUSSION

The local anaesthetics are associated with potential to produce cardiac arrhythmias, central nervous system depression, seizures, respiratory depression and hypertension due to its ability to blocking ion channels in cell membranes.[13] To improve the block characteristics and reduce the need of local anaesthetic agents various adjuvants are used to achieve quick, dense and prolonged block.[14] Dexmedetomidine is α2-AR agonist producing clinical effects after binding to G-Protein-coupled α2-AR which is of three subtypes and each individual subtype have different physiological and pharmacological function. Dexmedetomidine is about 10 times more selective towards α2-AR than clonidine.[15,16] Dexmedetomidine use as adjuvant with local anaesthetic agent has been associated with prolonged duration of block and improved post-operative analgesia.[17,18]

In this randomised double blind placebo-controlled study we have compared the effect of 1 mL (100 µg) dexmedetomidine and same volume of placebo as adjuvant to 30 mL of 0.5 % ropivacaine onset and duration of sensory and motor block & duration of postoperative analgesia. In present study both groups were comparable to each other with respect to demographic profile. The difference between them was not significant statistically significant. A study conducted by Das A, Majumdar S, Halder S, et al. about dexmedetomidine as adjuvant to ropivacaine had supported our study.[6] Study of Murthy, V.S.S.N.; Hari Kiran Verma, N.; Acharya, Anand et al. has also reported same.[19]

In our study the time of onset of sensory block was 724.18 ± 73.26 min in group RD and 582.16 ± 93.12 min in group RC, which is significantly early in group RD. Marhofer D, Kettner SC et al. and Das A, Majumdar S, Halder S, et al. has reported that there is no significant difference between two groups regarding onset of sensory block which does not support our study.[6,20] But our study corroborates with the finding of Kathuria S, Gupta S, Dhawan I et al. and Chinnappa Jithendra, Shivanna Shivakumaretal.[8,10] The mean of time of onset of motor block in group RD was significantly early than group RC. This finding is supported by study of Marhofer D, Kettner SC et al. and Mangal V, Mistry T, Sharma G, Kazim M, Ahuja N, Kulshrestha A et al.[20,21]

The duration of sensory and motor block was significantly prolonged in group RD in comparison to group RC. The duration of sensory block was 724.18 ± 73.26 min in group RD and 582.16 ± 93.12 min in group RC. The duration of motor block was 689.75 ± 78.76 min in group RD and 405.53 ± 102.84 min in group RC. Hemant Kumar, Archana Tripathi, Mukesh Somvanshi et al. in his study has concluded in his study that sensory and motor block durations (613.34 ± 165.404 min and 572.7 ± 145.709 min) were longer which supports our study.[22] Ping Y, Ye Q, Wang W, Ye P, You Z et al. in his meta-analysis has also concluded that dexmedetomidine prolonged both sensory and motor block duration which corroborates with our finding.[23]

In our study the duration of analgesia was significantly prolonged and requirement of rescue analgesic was significantly less in group RD as compared to group RC which is supported by the work of Rojas González A et al. Ammar AS, Mahmoud KM et al. and Zhang Y, Wang CS, Shi JH, et al.[24,25,26]

The adverse drug reaction like nausea, vomiting and headache was less frequent in group RD but bradycardia was more common in group RD in comparison to group RC which is similar to the finding of Das A, Majumdar S, Halder S, et al. and Chinnappa Jithendra, Shivanna Shivakumar.[6,10]

Sedation score of patients was maximum at 30 min in RC group, 2.67 ± 0.54 min and in RD group, 1.74 ± 0.43 min. The sedation score was significantly higher in group RC as compared to group RD. This finding concurs with the study of Agarwal S, Aggarwal R, Gupta Pet al. and Nazir O., Bhat, A.H. Sharma, T. Khatuja, A. and Misra R et al.[27,28]

In present study we have used 0.5 % ropivacaine and 100 mcg dexmedetomidine. The rationale for the selection of this dose is based on study done by Das A, Majumdar S, Halder S, et al. and Kathuria S, Gupta S, Dhawan I et al.[6,10]

CONCLUSIONS

Addition of dexmedetomidine as an adjuvant to ropivacaine is associated with early onset of sensory and motor block. The duration of sensory and motor block was prolonged. The duration of analgesia was prolonged and patients required less rescue analgesia. The use of dexmedetomidine was associated with reversible bradycardia and lower sedation score.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

REFERENCES

[1] Kulenkampff D. Die Anästhesierung des plexus brachialis. Beitr Klin Chir 1912;79:550-552.
[2] Kulenkampff D. Brachial plexus anaesthesia: its indications, technique and dangers. Ann Surg 1928;87(6):883-891.
[3] Kuthiala G, Chaudhary G. ropivacaine: a review of its pharmacology and clinical use. Indian J Anaesth 2011;55(2):104-110.
[4] Clarkson CW, Hondeghem LM. Mechanism for bupivacaine depression of cardiac conduction: fast block of sodium channels during the action potential with slow recovery from block during diastole. Anesthesiology 1985;62(4):396-405.
[5] Scott DB, Lee A, Fagan D, et al. Acute toxicity of ropivacaine compared with that of bupivacaine. Anesth Analg 1989;69(5):563-569.
[6] Das A, Majumdar S, Halder S, 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;8(Suppl 1):S72-S77.

[7] Huang R, Hertz L. Receptor subtype and dose dependence of dexmedetomidine-induced accumulation of [14C] glutamine in astrocytes suggests glial involvement in its hypnotic-sedative and anesthetic-sparing effects. Brain Res 2000;873(2):297-301.
[8] Kathuria S, Gupta S, Dhawan I. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Saudi J Anaesth 2015;9(2):148-154.
[9] Rancourt MP, Albert NT, Côté M, et al. Posterior tibial nerve sensory blockade duration prolonged by adding dexmedetomidine to ropivacaine. Anesth Analg 2012;115(4):958-962.
[10] Jithendra C, Shivakumar S, Seenappa PV, et al. Efficacy of dexmedetomidine with ropivacaine in supraclavicular brachial plexus block for upper limb surgeries. Journal of Anaesthesiology and Clinical Pharmacology 2017;33(1):81-85.
[11] Bromage PR. Epidural analgesia. Philadelphia: WB Saunders 1978: p. 144.
[12] Ramsay MA, Savege TM, Simpson BR, et al. Controlled sedation with alphaxalone-alphadolone. Br Med J 1974;2(5920):656-659.
[13] Swain A, Nag DS, Sahu S, et al. Adjuvants to local anesthetics: current understanding and future trends. World J Clin Cases 2017;5(8):307-323.
[14] McCaughey W. Adverse effects of local anaesthetics. Drug-Safety 1992;7(3):178-189. https://doi.org/10.2165/00002018-199207030-00003
[15] Kaur M, Singh PM. Current role of dexmedetomidine in clinical anesthesia and intensive care. Anesth Essays Res 2011;5(2):128-133.
[16] Kamibayashi T, Maze M. Clinical uses of alpha2 - adrenergic agonists. Anesthesiology 2000;93:1345-1349.
[17] Niu XY, Ding XB, Guo T, et al. Effects of intravenous and intrathecal dexmedetomidine in spinal anesthesia: a meta-analysis. CNS Neurosci Ther 2013;19(11):897-904.
[18] Fritsch G, Danninger T, Allerberger K, et al. Dexmedetomidine added to ropivacaine extends the duration of interscalene brachial plexus blocks for elective shoulder surgery when compared with ropivacaine alone: a single-center, prospective, triple-blind, randomized controlled trial. Reg Anesth Pain Med 2014;39(1):37-47.
[19] Murthy VSSN, Verma HKN, Acharya A. A randomised prospective comparative study of evaluation of dexmedetomidine an adjuvant to ropivacaine for ultrasound guided supraclavicular block. International Journal of Clinical Trials 2018;5(3):127-131.
[20] Marhofer D, Kettner SC, Marhofer P, et al. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. Br J Anaesth 2013;110(3):438-442.
[21] Mangal V, Mistry T, Sharma G, et al. 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;34(3):357-361.
[22] Kumar H, Tripathi A, Somvanshi MY. Efficacy of dexmedetomidine as an adjuvant to ropivacaine in femoral nerve block for acute pain relief in patients with fracture of femoral shaft and neck. Indian Journal of Pain 2018;32(2):86-90.
[23] Ping Y, Ye Q, Wang W, et al. Dexmedetomidine as an adjuvant to local anesthetics in brachial plexus blocks: a meta-analysis of randomized controlled trials. Medicine (Baltimore) 2017;96(4):e5846.
[24] González RA. Dexmedetomidine as an adjuvant to peripheral nerve block. Rev Soc Esp Dolor 2019;26(2):115-117.
[25] 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;6(2):109-114.
[26] Zhang Y, Wang CS, Shi JH, et al. Perineural administration of dexmedetomidine in combination with ropivacaine prolongs axillary brachial plexus block. Int J Clin Exp Med 2014;7(3):680-685.
[27] Agarwal S, Aggarwal R, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. J Anaesthesiol Clin Pharmacol 2014;30(1):36-40.
[28] Nazir O, Bhat AH, Sharma T, et al. Comparison of clonidine and dexmedetomidine as adjuvants for ropivacaine in supraclavicular brachial plexus block. SriLankan Journal of Anaesthesiology 2019;27(1):53-58.