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

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Dr Manish Kumar	Junior resident, Dept. of anaesthesia and critical care, Jaipur National University Institute of Medical Science & Research Centre (JNUIMSRC), Jaipur, Rajasthan
Dr Puneetpal Kaur	Assistant Professor, Dept. of Anaesthesia & Critical Care, Jaipur National University Institute of Medical Science & Research Centre (JNUIMSRC), Jaipur, Rajasthan
Dr Geetanjali Singhal*	Associate Professor, Dept. of Anaesthesia & Critical Care, Jaipur National University Institute of Medical Science & Research Centre (JNUIMSRC), Jaipur, Rajasthan*Corresponding Author
Dr Suman Kumari	Junior resident.

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ABSTRACT

INTRODUCTION: Perioperative pain management is very important to achieve patient satisfaction. The ultrasound-guided brachial plexus blocks like inter scalene block, supra and infra clavicular blocks have evolved as safe alternative techniques to general anaesthesia in upper limb surgeries. Long acting local anaesthetic agents like ropivacaine along with adjuvants such as dexmedetomdine have been routinely used in supraclavicular brachial plexus block. **MATERIAL & METHODS:** Sixty adult patients scheduled for upper limb surgeries were randomised into group A and Group B of 30 patients each. Patients in group A received 0.5% Ropivacaine 20ml + 5 ml normal saline and group B received 0.5% ropivacaine 20ml + 0.5ml (50µg) dexmedetomidine + 4.5ml normal saline. 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. 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 the group A compared to the 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. Total duration of analgesia was slightly higher in group A compared to group B. The mean NRS was significantly lower in group B compared to group A at all time intervals till 24 hrs. 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.

INTRODUCTION

Perioperative pain management is very important to achieve patient satisfaction; It relieves suffering and achieves early mobilization after surgery, thus reducing the duration of hospital stay1. The peripheral nerve blocks have several benefits like better pain control, lesser side effects, and reduced hospital stay over general anaesthesia, thus providing a superior outcome2. The pain sensation generated and transmitted from a specific body area is blocked by injecting the local anaesthetic agent near a specific peripheral nerve or nerve bundle. The ultrasound-guided brachial plexus blocks like inter scalene block, supra and infra clavicular blocks have evolved as safe alternative techniques to general anaesthesia. The supraclavicular brachial plexus block is given at the C5-T1 level of the brachial plexus trunks confined to a small surface area. The standard approaches used nowadays are blind techniques3,4 and rely on surface landmarks before needle insertion and evoke paraesthesia or nerve-stimulated muscle contraction after needle insertion. Multiple trial and error needle pricking attempts are necessary in blind techniques resulting in pain and other complications5. As compared to conventional techniques, Ultrasound can determine the depth and exact location of the brachial plexus along with its neighbouring structures.

The local anaesthetic drugs block the transmission of pain signals from surgical site to the brain. Long acting local anaesthetic agents like bupivacaine and ropivacaine have been routinely used for upper limb surgeries in supraclavicular brachial plexus block. Ropivacaine is frequently used because it produces quick, dense, and prolonged block and has lesser side effects6. Due to the possibility of the local anaesthetic effect wearing out before the surgical period leading to severe pain, the volume of the local anaesthetic drug can be increased but it leads to systemic side effects, particularly on the cardiovascular and nervous system7. Therefore, several drugs like non steroidal anti-inflammatory drugs, opioids and a2-agonists have been researched as adjunct agents to local anaesthetics and are termed as analgesic adjuvants. They increase the efficacy and duration of local anaesthetics and decrease the systemic side effects of a higher dose of local anaesthetic. However, the adjuvant itself may exhibit its own side effects such as hypotension, sedation, bradycardia, etc.

Dexmedetomidine is an α2 –adreno receptor agonist that has sedative, anxiolytic, and analgesic properties. Various studies have reported prolonged block and better pain management postoperatively with administration of dexmedetomidine as an adjuvant to other local anaesthetics like bupivacaine or levobupivacaine8,9,10. The current study compared the anaesthetic effects of dexmedetomidine and plain ropivacaine as an adjuvant to ropivacaine for upper limb surgeries in the supraclavicular brachial plexus block in terms of quality of block, onset and duration of sensory and motor block, and post-operative pain management.

MATERIAL AND METHODS

After obtaining approval of Institutional Ethics Committee, this randomised double blind controlled interventional study was registered prospectively with 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 Anaesthesiology, JNUIMSRC, Jaipur. Patients of ASA grade1 and 2, age 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 anaesthesia or elective surgery. Two study groups were made each consisting of 30 patients. One group was given a name R, in which only ropivacaine is 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 OT. Pre anaesthetic checkup was done a day before the surgery and investigations such as routine complete blood count, PTI/INR, renal function tests, liver function tests, serum markers, ECG, chest x-ray etc were obtained as per hospital protocols and patients were scheduled for surgery. Patients were kept fasting as per standard guidelines.

After receiving patient into the operating room. Informed written consent was obtained from all the participants after the complete study protocol and procedure was explained to them. A 18G IV cannula was secured in opposite hand, and monitors such as pulse oximetry, non-invasive BP monitor, and ECG machine was attached. Baseline parameters were recorded. The medication under study were 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 ultrasound 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 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 in order to visualize the subclavian artery and brachial plexus in the transverse sectional view lying at approx. 90°. The brachial plexus and 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 anaesthesia 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 ultrasound. Real time needle movement was observed. Thereafter, patients in Group A(n=30) received 0.5% Ropivacaine 20ml + 5 ml normal saline and group B (n=30) received 0.5% ropivacaine 20ml + 0.5ml (50µg) dexmedetomidine + 4.5ml 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 successful block. The evaluation was done every 2 mins till 45 mins. If at the end of 45 mins, complete sensory, or motor blockade was not achieved, such patients were excluded from the analysis, and further anaesthetic management was changed accordingly.

The test of sensory block was confirmation 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 (RN).

Similarly, 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 the hand actively. After the surgery was complete, the patient was then transferred to post anaesthesia care room where reversal of the block as well as postoperative 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 examiners hand. Duration of motor block was also noted. For the current study purpose, the total duration between onset of sensory block and patient's pain score (VNRS) >4 resulting in administration of rescue analgesia was termed as 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 hrs to look for any residual block or neurological deficit.

Adverse events comprised of hypotension, bradycardia, hypoxemia (SpO2<90%) or nausea and vomiting. Hypotension, defined as ^{3}20% decrease of MAP in relation to the baseline value, was managed with i.v fluid bolus and blood products as indicated. A Heart Rate of less than 50 beats per minute (bradycardia) was treated with IV Atropine 0.6 mg. Nausea and vomiting was 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 analyse it. A free third-generation statistical programme that is simple to use is called JAMOVI 2.2.5.91 The two groups initial baseline characteristics were compared. The unpaired t-test was utilised to compare the continuous variables, whereas the X2 test was employed to compare the categorical variables. For all intents and purposes, a p value of less than 0.05 was deemed statistically significant in both circumstances.

RESULTS

The current study was done in 60 patients divided into two groups with a strength of 30 each. Group A was the group which was administered Ropivacaine alone and Group B was the group which 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, BMI, ASA class distribution, duration of surgery, and the distribution of comorbidities. The baseline pre-operative vitals viz., Heart Rate, Systolic and Diastolic Blood Pressure, Spo2 as well as Mean arterial pressure in both the groups were comparable with a statistically non-significant difference (p value>0.05).

Table 2 shows the comparison of the onset time of sensory and motor block in both the groups. The time taken in the onset of the sensory as well as motor block in both the groups was significantly more in the group A compared to the group B (p value=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 the group A and group B considering the maximal motor block at the commencement of surgery. It was observed that the maximum study participants in both the groups experienced grade II of the maximal motor block. However, their difference of the proportions of study participants in the three grades between the two groups was not statistically significant (p value>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 value=0.00) Table 5 compares the two groups based upon 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 value>0.05)

Table 6 compares the two groups in terms of Numeric Rating Score which determines the level of the pain post anaesthesia in terms of score 0 to 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 hrs to 24 hrs (p value=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 Female	17(56.67%) 13(43.33%)	25(83.33%) 5(16.67%)	0.024
Mean Weight ±SD	56.9 ±8.04	55.6 ±9.30	0.565
ASA Status Grade I Grade II	24(80%) 6(20%)	23(76.67%) 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 Spo2 ±SD	97.03 ±6.18	97.9 ±1.56	0.442
Mean MAP ±SD	98.93 ±9.84	94.27 ±11.04	0.085

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 hr	0	0	-
3 hrs	0	0	-
6 hrs	1.76±0.77	0.36±0.55	0.00
9 hrs	2.1±0.75	0.4±0.62	0.00
12 hrs	1.6±1.24	0.63±0.61	0.00
18 hrs	1.63±1.11	0.59±0.48	0.00
24 hrs	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 value=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 J et al[11] in their meta-analysis too found the 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 in 16.67% and that in Group B patients were in 20%. Consequently, Grade 2 of sensory block in group A patients were in 83.33% and that in group B patients were in 80%. The grade wise comparison of the group A and group B considering the maximal sensory block at the commencement of surgery. It was observed that the maximum study participants in both the 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 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%. Also 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 value was 0.741). Our study showed the grade wise comparison of the group A and group B considering the maximal motor block at the commencement of surgery and the maximum study participants in both the 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 hours and that in Group B, it was 775.2 ±180.68 min, approximately 12.9 hours. 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 hours and that in Group B, it was 732.47 ±159.96 min, roughly about 12.2 hours. 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 value=0.00). Our results were quite similar to that of Murthy VSSN et al12 where the duration of sensory block in group A and group B were around 10.7 hrs and 12.1 hrs with p value 0.00354. Whereas the duration of motor block was 11.0 hours in group A and it was 9.3 hours in Group B with P value 0.0001. Another similar study by Dharmarao PS et al13, Akhondzadeh R et al8 and Kathuria S et al14 revealed that the dexmedetomidine in their study too prolonged the duration of sensory and motor block significantly. Bangera A et al[15] and Koraki E et al[16] 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 N et al17 and Vorobeichik L et al[18] 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 value>0.05). Murthy VSSN et al[82]-12 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 L et al18 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 anaesthesia. The mean NRS was observed lower in group B compared to group A at all the time intervals starting from 6 hrs to 24 hrs, 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. And that is why the need of the rescue analgesia was much lesser. Maximum studies were in support of our findings such as Balakrishnaiah M et al19, Li Y et al20, Dharmarao PS et al21, Akhondzadeh R et al8, Zhao J et al[11], Liu. Z. et al[22], etc. There were no major side effects or complications documented in the current study which makes 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 was found to be statistically non-significant.

LIMITATIONS

This study included a small sample size. More RCTs with larger sample size are needed to substantiate our findings. The patients of age group between 18 to 60 yrs 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 anaesthetic 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 the motor block thereby, significantly reduces the post operative pain in the upper limb surgeries.

Conflict of interest- None

REFERENCES

1. Joshi GP, Kehlet H, Beloeil H, Bonnet F, Fischer B, Hill A, et al. Guidelines for perioperative pain management: need for re-evaluation. Br J Anaesth. 2017 Oct 1;119(4):720–2.
2. Jakobsson J, Johnson MZ. Perioperative regional anaesthesia and postoperative longer-term outcomes. F1000Research. 2016;5:F1000 Faculty Rev-2501.
3. Moorthy SS, Schmidt SI, Dierdorf SF, Rosenfeld SH, Anagnostou JM. A supraclavicular lateral paravascular approach for brachial plexus regional anesthesia. Anesth Analg. 1991 Feb;72(2):241–4.
4. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: anatomic analysis of a method to prevent pneumothorax. Anesth Analg. 1993 Mar;76(3):530–4.
5. 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. Study Group on Regional Anesthesia. Anesth Analg. 1999 Apr;88(4):847–52.
6. Markham A, Faulds D. Ropivacaine. A review of its pharmacology and therapeutic use in regional anaesthesia. Drugs. 1996 Sep;52(3):429–49.
7. Agarwal A, Kishore K. Complications And Controversies Of Regional Anaesthesia: A Review. Indian J Anaesth. 2009 Oct;53(5):543–53.
8. Akhondzadeh R, Rashidi M, Gousheh M, Olapour A, Baniahmad A. The Effect of Adding Dexmedetomidine as an Adjuvant to Lidocaine in Forearm Fracture Surgeries by Supraclavicular Block Procedure Under Ultrasound-Guided. Anesthesiol Pain Med. 2018 Jul 25;8(4):e74355.
9. 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;7(3):680–5.
10. Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, et al. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand. 2006 Feb;50(2):222–7.
11. Zhao J, Liao C, Wu Q, Wang L, Deng F, Zhang W. Evaluation of ropivacaine combined with dexmedetomidine versus ropivacaine alone for epidural anesthesia: A meta-analysis. Medicine (Baltimore). 2021 Apr 9;100(14):e25272. doi: 10.1097/MD.0000000000025272. PMID: 33832091; PMCID: PMC8036061
12. Murthy VSSN, Verma NHK, Acharya A.A randomised prospective comparative study of evaluation of dexmedetomidine an adjuvant to ropivacaine for ultrasoundguided supraclavicular block. Int J Clin Trials2018;5(3):127-31.
13. Dharmarao PS, 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 Jun;46(3):208-213. doi: 10.5152/TJAR.2018.98058. Epub 2017 Jun 1. PMID: 30140517; PMCID: PMC6097859.
14. Derbyshire DR, Chmielewski A, Fell D, Vater M, Achola K, Smith G. Plasma catecholamine responses to tracheal intubation. BJA Br J Anaesth. 1983;55(9):855–60.
15. 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.
16. Koraki E, Stachtari C, Kapsokalyvas I, Stergiouda Z, Katsanevaki A, Trikoupi A. Dexmedetomidine as an adjuvant to 0.5% ropivacaine in ultrasound-guided axillary brachial plexus block. J Clin Pharm Ther. 2018 Jun;43(3):348-352. doi: 10.1111/jcpt.12657. Epub 2017 Nov 28. PMID: 29193234.
17. Hussain N, Grzywacz VP, Ferreri CA, Atrey A, Banfield L, Shaparin N, Vydyanathan A. Investigating the Efficacy of Dexmedetomidine as an Adjuvant to Local Anesthesia in Brachial Plexus Block: A Systematic Review and Meta-Analysis of 18 Randomized Controlled Trials. Reg Anesth Pain Med. 2017 Mar/Apr;42(2):184-196. doi: 10.1097/AAP.0000000000000564. PMID: 28178091.
18. Vorobeichik L, Brull R, Abdallah FW. Evidence basis for using perineural dexmedetomidine to enhance the quality of brachial plexus nerve blocks: a systematic review and meta-analysis of randomized controlled trials. Br J Anaesth. 2017 Feb;118(2):167-181. doi: 10.1093/bja/aew411. PMID: 28100520.
19. Balakrishnaiah M, Sheshadri K, Ramegowda S, Hosalli S, Kumar K, Ahmed S. Dexmedetomidine as an Adjuvant to Ropivacaine in Ultrasound Guided Brachial Plexus Block Using Supraclavicular Parasagittal Approach for Upper Limb Orthopedic Surgeries. Arch Anesth & Crit Care. 2022;8(3):230-235.)
20. Li Y, Wang H, Deng Y, Yao Y, Li M. [Effect of dexmedetomidine on supraclavicular brachial plexus block: a randomized double blind prospective study]. Beijing Da Xue Xue Bao Yi Xue Ban. 2018 Oct 18;50(5):845-849. Chinese. PMID: 30337746.
21. Liu Z, Jiang M, Xu T, Hua H. Analgesic effect of Ropivacaine combined with Dexmedetomidine on brachial plexus block. BMC Anesthesiol. 2018 Aug 16;18(1):107.