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Original Research Article

A Comparative Evaluation of Effects of Dexmedetomidine and Butorphanol with Ropivacaine in Ultrasound Guided Brachial Plexus Block

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Conflict of interest: Nil

Abstract

Background: Adjuvants are added to local anesthetics in peripheral nerve blocks to improve block quality and prolong postoperative analgesia. Dexmedetomidine and butorphanol have both been used as adjuvants, but comparative evidence remains limited.

Methods: This prospective comparative observational study included 60 patients aged 18–60 years undergoing upper-limb surgery under ultrasound-guided supraclavicular brachial plexus block. Patients were divided into two groups of 30 each. Group D received dexmedetomidine 1 µg/kg with 30 mL of 0.5% ropivacaine, whereas Group B received butorphanol 30 µg/kg with the same volume and concentration of ropivacaine. Onset and duration of sensory and motor blockade, time to first rescue analgesia, hemodynamic parameters, respiratory variables, sedation, and adverse effects were compared.

Results: The onset of sensory block was significantly faster in Group D than in Group B (4.90 ± 0.94 versus 10.82 ± 0.98 minutes; $p<0.001$). Motor block onset was also faster with dexmedetomidine (9.88 ± 1.02 versus 15.26 ± 1.47 minutes; $p<0.001$). Sensory block duration, motor block duration, and time to first rescue analgesia were significantly longer in Group D. Hemodynamic parameters, oxygen saturation, and respiratory rate remained comparable between groups. Sedation scores were higher with dexmedetomidine, although sedation remained mild.

Conclusion: Dexmedetomidine was superior to butorphanol as an adjuvant to ropivacaine by providing faster block onset, prolonged sensory and motor blockade, and longer postoperative analgesia without clinically significant hemodynamic or respiratory adverse effects.

Keywords: Dexmedetomidine, Butorphanol, Ropivacaine, Supraclavicular Brachial Plexus Block, Ultrasound Guidance, Postoperative Analgesia.

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Introduction

Peripheral nerve blocks have become an integral component of modern anesthetic practice for upper limb surgeries because they provide excellent intraoperative anesthesia, prolonged postoperative analgesia, reduced opioid consumption, early mobilization, and fewer systemic adverse effects compared with general anesthesia.

Among the various approaches, the supraclavicular brachial plexus block is considered one of the most reliable techniques for surgeries involving the upper limb distal to the shoulder due to its rapid onset and dense blockade of the brachial plexus.[1] The introduction of ultrasound guidance has significantly improved the safety and success of supraclavicular brachial plexus blocks.

Direct visualization of the brachial plexus, surrounding vascular structures, pleura, and needle trajectory allows precise deposition of local

anesthetic, resulting in faster block onset, improved block quality, reduced local anesthetic requirement, and a lower incidence of complications such as pneumothorax and inadvertent vascular puncture.[2,3]

Ropivacaine, a long-acting amide local anesthetic, is widely preferred for peripheral nerve blocks because of its favorable safety profile, lower cardiotoxicity, and reduced motor blockade compared with bupivacaine. However, the duration of postoperative analgesia produced by ropivacaine alone may not be sufficient for prolonged postoperative pain relief, prompting the use of various adjuvants to enhance block characteristics.[4]

Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, has emerged as an effective adjuvant for peripheral nerve blocks. When combined with local anesthetics, dexmedetomidine accelerates the onset of sensory and motor blockade, prolongs the duration of anesthesia and postoperative analgesia, decreases analgesic requirements, and provides mild sedation without significant respiratory depression.[5] Several clinical studies have demonstrated that dexmedetomidine added to ropivacaine significantly improves the quality and duration of ultrasound-guided brachial plexus block compared with local anesthetic alone.[6]

Butorphanol is a synthetic opioid with agonist-antagonist activity that has also been investigated as an adjuvant in peripheral nerve blocks. It prolongs postoperative analgesia through peripheral opioid receptor activation while producing minimal respiratory depression and acceptable hemodynamic stability. Comparative evaluation of butorphanol and dexmedetomidine as adjuvants may help identify the more effective agent for improving block quality and patient comfort.[7] Although both dexmedetomidine and butorphanol have shown promising results as adjuvants to ropivacaine, evidence directly comparing their efficacy in ultrasound-guided supraclavicular brachial plexus block remains limited. Therefore, the present study was undertaken to compare the effects of dexmedetomidine and butorphanol as adjuvants to ropivacaine with respect to onset and duration of sensory and motor blockade, duration of postoperative analgesia, sedation, hemodynamic stability, and adverse effects in patients undergoing upper limb surgeries.

Materials and Methodology

Study Design: This was a prospective, comparative, observational study.

Study Setting: The study was conducted in the Department of Anaesthesiology, G.M.E.R.S. Medical College and Hospital, Valsad, Gujarat.

Study Duration: The study was carried out from November 2020 to April 2022.

Sample Size: The sample size was calculated using a pilot study involving 10 patients. Based on the mean onset time of motor blockade between the two groups, the calculated minimum sample size was 28 patients per group. To compensate for possible dropouts, 30 patients were included in each group, giving a total sample size of 60 patients.

Study Population: Sixty adult patients scheduled for elective upper limb surgeries under ultrasound-guided supraclavicular brachial plexus block were enrolled and allocated into two groups of 30 patients each.

Group D: Patients received Dexmedetomidine 1 μg/kg added to 30 mL of 0.5% ropivacaine.

Group B: Patients received Butorphanol 30 μg/kg added to 30 mL of 0.5% ropivacaine.

Inclusion Criteria

- Patients aged 18–60 years.
- Either sex.
- American Society of Anesthesiologists (ASA) physical status I, II, or III.
- Patients undergoing elective upper limb surgeries under supraclavicular brachial plexus block.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Refusal to participate.
- Bleeding disorders or anticoagulant therapy.
- Local infection at the injection site.
- Known allergy or contraindication to ropivacaine, dexmedetomidine, or butorphanol.
- Pregnancy and lactation.
- Pre-existing neurological, psychiatric, or neuromuscular disorders.
- Severe bradycardia, heart block, severe ventricular dysfunction (ejection fraction <30%), or decompensated heart failure.
- Inadequate block requiring supplementation with general anesthesia.

Preoperative Assessment: After obtaining Institutional Ethics Committee approval and written informed consent, all patients underwent a detailed pre-anesthetic evaluation including history, clinical examination, and routine investigations comprising complete blood count, random blood sugar, renal function tests, liver function tests, serum electrolytes, HIV and HBsAg screening, chest radiograph, and 12-lead electrocardiogram.

Study Procedure: Standard monitoring including electrocardiography, non-invasive blood pressure,

pulse oximetry, and respiratory rate was instituted. An intravenous line was secured with a 20G cannula, and crystalloid infusion was commenced.

Ultrasound-guided supraclavicular brachial plexus block was performed under strict aseptic precautions with the patient in the supine position and head turned to the opposite side. A high-frequency (5–10 MHz) linear ultrasound transducer was placed in the supraclavicular fossa to identify the brachial plexus lateral to the subclavian artery. Using an in-plane technique, a 23G, 1.5-inch needle was advanced under real-time ultrasound guidance, and the allocated drug solution was injected after negative aspiration with adequate spread around the plexus. Completion of drug injection was considered time zero. (Figure 1).

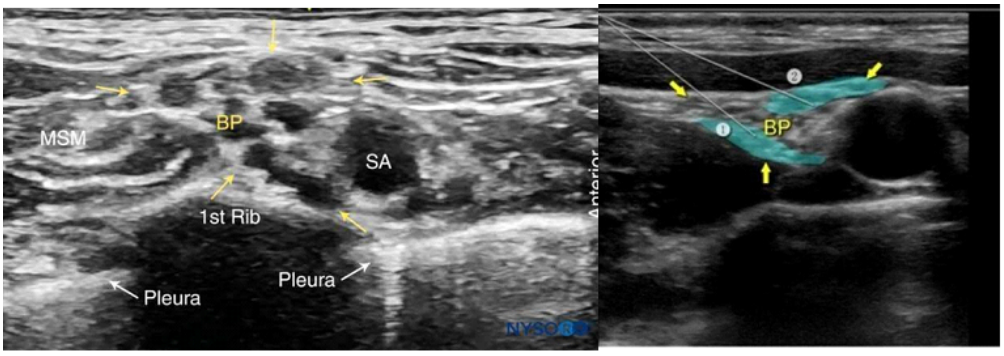

Figure 1: Proper dispersion of the local anaesthetic agents (areas shaded in blue) within the tissue sheath containing the brachial plexus through two different needle position

Outcome Measures

Primary Outcomes

- Onset of sensory blockade.
- Onset of motor blockade.
- Duration of sensory blockade.
- Duration of motor blockade.
- Duration of postoperative analgesia.
- Time to first rescue analgesic.

Secondary Outcomes

- Hemodynamic parameters (heart rate, systolic and diastolic blood pressure, oxygen saturation, respiratory rate).
- Sedation score using the Filos four-point sedation scale.
- Intraoperative and postoperative complications.
- Requirement for rescue analgesia.

Block Assessment: Sensory blockade was assessed by the pin-prick method over the distributions of the median, ulnar, and radial nerves using a three-point scale (0 = normal sensation, 1 = analgesia, 2 = complete anesthesia).

Motor blockade was evaluated using the Modified Bromage Scale for the upper limb. Surgery commenced only after complete sensory (Grade 2) and motor blockade (Grade 2) had been achieved. Postoperative pain was assessed using the Visual Analogue Scale (VAS).

Rescue analgesia with intravenous tramadol (1 mg/kg) was administered when the VAS score reached 4 or more. (Figure 2).

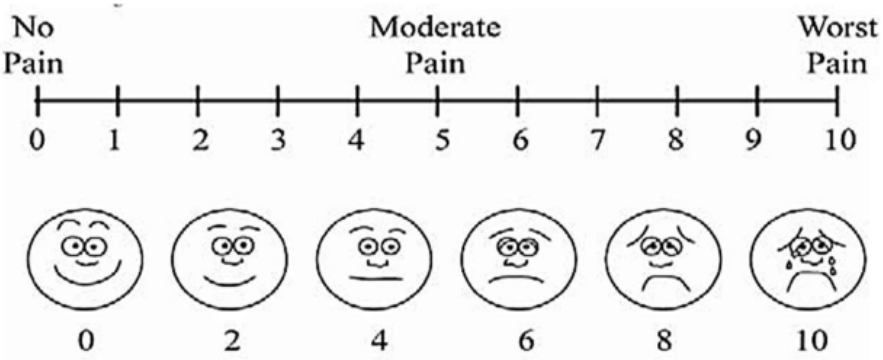

Figure 2: Wong–Baker FACES Pain Rating Scale depicting pain intensity from 0 (No Pain) to 10 (Worst Pain), with corresponding facial expressions to facilitate subjective pain assessment

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version

26.0. Quantitative variables were expressed as mean ± standard deviation (SD) and compared using the independent Student's t-test.

Qualitative variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test, wherever appropriate.

A p-value <0.05 was considered statistically significant with a 95% confidence interval.

Results

A total of 60 patients aged 18–60 years undergoing upper-limb surgery under ultrasound-guided supraclavicular brachial plexus block were included.

Patients were divided into two equal groups:

- **Group B:** 30 patients received butorphanol 30 µg/kg with 30 mL of 0.5% ropivacaine.
- **Group D:** 30 patients received dexmedetomidine 1 µg/kg with 30 mL of 0.5% ropivacaine.

The two groups were comparable regarding demographic characteristics, ASA physical status, and duration of surgery. Dexmedetomidine produced a faster onset and longer duration of sensory and motor blockade and prolonged the time to first rescue analgesia compared with butorphanol.

Table 1: Comparison of Baseline Characteristics

Variable	Group B (n=30)	Group D (n=30)	Test statistic	p-value
Age, years, mean ± SD	43.50 ± 10.88	40.30 ± 12.75	t=1.046	0.300
Weight, kg, mean ± SD	62.20 ± 6.84	64.60 ± 6.50	t=1.411	0.163
Male, n (%)	25 (83.3)	27 (90.0)	—	0.706
Female, n (%)	5 (16.7)	3 (10.0)	—	
ASA grade I, n (%)	23 (76.7)	23 (76.7)	Fisher's exact=0.286	1.000
ASA grade II, n (%)	6 (20.0)	6 (20.0)		
ASA grade III, n (%)	1 (3.3)	1 (3.3)		
Surgery duration 1–1.5 hours, n (%)	3 (10.0)	5 (16.7)	—	0.783
Surgery duration 2–2.5 hours, n (%)	26 (86.7)	24 (80.0)		
Surgery duration 3 hours, n (%)	1 (3.3)	1 (3.3)		

The mean age and weight were comparable between the two groups. There were no statistically significant differences in gender distribution, ASA physical status, or duration of surgery between Group B and Group D. Therefore, both groups were comparable at baseline.

Table 2: Comparison of Block Characteristics and Duration of Analgesia

Parameter	Group B Mean ± SD	Group D Mean ± SD	t-value	p-value
Onset of sensory block, minutes	10.82 ± 0.98	4.90 ± 0.94	23.819	<0.001*
Onset of motor block, minutes	15.26 ± 1.47	9.88 ± 1.02	16.404	<0.001*
Duration of sensory block, hours	7.08 ± 0.60	9.85 ± 0.83	14.748	<0.001*
Duration of motor block, hours	6.38 ± 0.65	7.67 ± 0.51	8.462	<0.001*
Time to first rescue analgesia, hours	8.07 ± 0.64	11.48 ± 1.14	14.261	<0.001*

*Statistically significant.

The onset of sensory and motor blockade was significantly faster in the dexmedetomidine group. Group D also demonstrated significantly longer durations of sensory and motor blockade. The time to first rescue analgesia was prolonged by approximately 3.4 hours in Group D compared with Group B. Thus, dexmedetomidine provided a faster, longer-lasting block and superior postoperative analgesia.

Table 3: Comparison of Perioperative Heart Rate and Blood Pressure

Time point	Group B Mean ± SD	Group D Mean ± SD	p-value
Heart rate, beats/min			
Preoperative	81.17 ± 6.28	82.50 ± 6.36	0.420
Immediately after block	81.97 ± 8.38	81.70 ± 7.62	0.900
15 minutes	82.27 ± 8.77	80.97 ± 9.05	0.580
30 minutes	81.40 ± 8.34	82.27 ± 9.38	0.710
1 hour	81.37 ± 7.90	80.77 ± 7.76	0.770
2 hours	83.27 ± 8.71	82.64 ± 6.84	0.760
4 hours	80.84 ± 7.16	81.47 ± 8.37	0.760
Systolic blood pressure, mmHg			
Preoperative	123.27 ± 8.55	123.54 ± 6.26	0.900
Immediately after block	122.77 ± 7.93	125.07 ± 9.71	0.320

15 minutes	124.37 ± 8.70	123.27 ± 7.67	0.610
30 minutes	124.54 ± 9.57	124.70 ± 7.99	0.950
1 hour	122.54 ± 9.41	124.00 ± 7.46	0.510
2 hours	123.34 ± 9.43	124.27 ± 8.06	0.690
4 hours	123.70 ± 9.82	122.94 ± 7.37	0.740
Diastolic blood pressure, mmHg			
Preoperative	79.64 ± 8.37	81.44 ± 7.26	0.380
Immediately after block	80.64 ± 8.92	77.54 ± 7.81	0.160
15 minutes	80.94 ± 9.19	79.07 ± 7.68	0.400
30 minutes	79.50 ± 9.32	79.10 ± 8.19	0.870
1 hour	79.07 ± 8.53	79.40 ± 7.53	0.880
2 hours	79.34 ± 8.72	79.50 ± 6.80	0.940
4 hours	79.10 ± 7.74	79.90 ± 7.92	0.700

Heart rate, systolic blood pressure, and diastolic blood pressure remained stable throughout the perioperative period in both groups. No statistically significant differences were observed between the groups at any recorded time point, indicating comparable hemodynamic stability.

Table 4: Comparison of Oxygen Saturation, Respiratory Rate, and Sedation

Parameter	Group B Mean ± SD	Group D Mean ± SD	p-value
Preoperative SpO_2, %	98.10 ± 0.89	98.44 ± 0.68	0.110
Immediate SpO_2, %	98.17 ± 0.80	98.54 ± 0.87	0.090
SpO_2 at 1 hour, %	97.97 ± 0.72	98.17 ± 0.88	0.340
SpO_2 at 4 hours, %	98.30 ± 0.71	98.24 ± 0.68	0.710
Preoperative respiratory rate/min	12.60 ± 1.04	12.84 ± 0.80	0.330
Immediate respiratory rate/min	12.54 ± 1.01	12.77 ± 0.78	0.320
Respiratory rate at 1 hour/min	12.54 ± 1.01	12.77 ± 0.78	0.320
Respiratory rate at 4 hours/min	12.54 ± 1.01	12.77 ± 0.78	0.320
Sedation score	1.00 ± 0.00	1.33 ± 0.47	0.001*

*Statistically significant.

Oxygen saturation and respiratory rate remained within normal limits and were comparable between the two groups throughout the observation period. No evidence of clinically significant respiratory depression was observed. The mean sedation score was significantly higher in Group D, indicating greater but mild sedation with dexmedetomidine. Patients remained responsive, and no excessive sedation was reported.

Discussion

The present study compared dexmedetomidine and butorphanol as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. The main findings were that dexmedetomidine produced a significantly faster onset of sensory and motor blockade, prolonged the duration of both blocks, and delayed the requirement for first rescue analgesia compared with butorphanol. Both groups remained hemodynamically and respiratory stable, although dexmedetomidine produced a higher but clinically acceptable level of sedation. The mean onset of sensory and motor blockade was significantly shorter in Group D. Similar findings have been reported by Singh et al., who observed that dexmedetomidine used with ropivacaine improved block characteristics and accelerated the onset of sensory and motor blockade.[8] Swami et al. also demonstrated that α2-adrenergic agonists enhance the quality of supraclavicular brachial plexus block by facilitating earlier and denser neural blockade.[9]

The duration of sensory and motor blockade was significantly longer in the dexmedetomidine group. Kumar et al. reported that dexmedetomidine added to ropivacaine prolonged sensory and motor blockade and improved postoperative analgesia.[10] Similar observations were made by Gupta et al., who found that perineural dexmedetomidine increased block duration and reduced postoperative analgesic requirements without causing major adverse effects.[11]

The prolonged effect of dexmedetomidine may be attributed to peripheral α2-receptor-mediated vasoconstriction, reduced local anesthetic absorption, inhibition of hyperpolarization-activated cation currents, and suppression of action potential propagation in peripheral nerves. Systematic evidence has also shown that dexmedetomidine is among the most effective perineural adjuvants for prolonging peripheral nerve block duration.[12]

In the present study, the mean time to first rescue analgesia was significantly longer in Group D than in Group B. Although butorphanol provided

satisfactory analgesia, dexmedetomidine produced a more prolonged analgesic effect. Butorphanol acts mainly through κ-opioid receptor agonism and partial μ-receptor antagonism and may enhance analgesia when combined with local anesthetics, but its effect on the onset and duration of neural blockade appears less pronounced than that of dexmedetomidine.[13,14]

Marhofer et al. demonstrated that perineural dexmedetomidine significantly prolonged ropivacaine-induced peripheral nerve blockade.[15] Similarly, the systematic review and meta-analysis by Vorobeichik et al. concluded that perineural dexmedetomidine prolongs sensory block, motor block, and analgesia in brachial plexus blocks, although mild bradycardia and sedation may occur.[16]

Heart rate, systolic and diastolic blood pressure, oxygen saturation, and respiratory rate remained comparable between the two groups throughout the perioperative period. No clinically significant respiratory depression was observed. The sedation score was higher in the dexmedetomidine group, which was consistent with its central α2-agonist action. However, the sedation was mild, and patients remained responsive. The four-point sedation scale used in this study has been applied in previous anesthetic research for assessing clinically relevant sedation.[17]

Postoperative pain assessment using the Visual Analogue Scale allowed standardized determination of rescue analgesic requirements. The VAS is a validated and widely used tool for measuring pain intensity and evaluating analgesic efficacy.[18] The findings indicate that dexmedetomidine was more effective than butorphanol in improving block characteristics when added to ropivacaine. However, the study was limited by its single-center design, relatively small sample size, and observational methodology. Larger randomized controlled studies are required to confirm these findings and evaluate the optimal dose of both adjuvants.

Conclusion

Dexmedetomidine 1 μg/kg added to 0.5% ropivacaine provided a significantly faster onset of sensory and motor blockade, prolonged the duration of both blocks, and extended postoperative analgesia compared with butorphanol 30 μg/kg in ultrasound-guided supraclavicular brachial plexus block. Both adjuvants maintained satisfactory hemodynamic and respiratory stability. Dexmedetomidine produced mild but clinically acceptable sedation. Therefore, dexmedetomidine appeared to be a more effective adjuvant than butorphanol for upper-limb surgeries under supraclavicular brachial plexus block.

References

1. Bruce BG, Green A, Blaine TA, Wesner LV. Brachial plexus blocks for upper extremity orthopedic surgery. J Am AcadOrthop Surg. 2012;20(1):38-47. doi:10.5435/JAAOS-20-01-038.
2. Chan VW, Perlas A, Rawson R, Odukoya O. Ultrasound-guided supraclavicular brachial plexus block. Anesth Analg. 2003;97(5):1514-1517. doi:10.1213/01.ANE.0000062519.61520.14.
3. Choi S, McCartney CJL. Evidence base for the use of ultrasound for upper extremity blocks: 2014 update. Reg Anesth Pain Med. 2016;41(2):242-250. doi:10.1097/AAP.0000000000000155.
4. Brummett CM, Hong EK, Janda AM, Amodeo FS, Lydic R. Perineural dexmedetomidine added to ropivacaine causes a dose-dependent increase in the duration of thermal antinociception in sciatic nerve block in rats. Anesthesiology. 2011;115(4):836-843. doi:10.1097/ALN.0b013e318221fcc9.
5. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Eur J Anaesthesiol. 2010;27(12):1119-1123. doi:10.1097/EJA.0b013e32833b6d5c.
6. 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. doi:10.4103/1658-354X.152841.
7. 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;34(3):357-361. doi:10.4103/joacp.JOACP_182_17.
8. Singh N, Gupta S, Kathuria S. Dexmedetomidine vs dexamethasone as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. J Anaesthesiol Clin Pharmacol. 2020;36(2):238-243. doi:10.4103/joacp.JOACP_176_19.
9. Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine as an adjuvant to local anesthesia in supraclavicular brachial plexus block: A randomized double-blind prospective study. Indian J Anaesth. 2012;56(3):243-249. doi:10.4103/0019-5049.98767.
10. Kumar P, Monteiro G, Kanchan T, et al. Effect of dexmedetomidine as adjuvant in ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded randomized controlled study. Saudi J Anaesth.

2014;8(Suppl 1):S72-S77. doi:10.4103/1658-354X.144082.
11. Gupta K, Singh S, Agarwal S, et al. Dexmedetomidine as an adjuvant to ropivacaine in ultrasound-guided brachial plexus block: A randomized controlled study. Indian J Anaesth. 2016;60(10):709-714. doi:10.4103/0019-5049.191686.
12. El-Boghdadly K, Brull R, Sehmbi H, et al. Perineural adjuncts for peripheral nerve block: A systematic review and network meta-analysis. Anaesthesia. 2017;72(10):1240-1252. doi:10.1111/anae.13925.
13. Abdelhamid SA, El-Lakany MH. Intrathecal and perineural butorphanol as an adjuvant to local anaesthetics: Current evidence. Ain-Shams J Anaesthesiol. 2013;6(3):324-331. doi:10.4103/1687-7934.117050.
14. Tripathi A, Verma R, Kumar S, et al. Comparison of butorphanol and dexmedetomidine as adjuvants to ropivacaine in supraclavicular brachial plexus block. Anesth Essays Res. 2019;13(3):533-538. doi:10.4103/aer.AER_73_19.
15. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: A randomized controlled trial. Br J Anaesth. 2013;110(3):438-442. doi:10.1093/bja/aes400.
16. 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. Br J Anaesth. 2017;118(2):167-181. doi:10.1093/bja/aew411.
17. Filos KS, Goudas LC, Patroni O, Polyzou V. Hemodynamic and analgesic profile after intrathecal clonidine in humans: A dose-response study. Anesthesiology. 1994;81(3):591-601. doi:10.1097/00000542-199409000-00012.
18. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken). 2011;63(S11):S240-S252. doi:10.1002/acr.20543.