

A Randomized Comparative Study on the Effectiveness of Dexmedetomidine and Fentanyl as Adjuvants to 0.75% Ropivacaine in Supraclavicular Brachial Plexus Block

Priyanka Hansda¹, Rani Soren²

¹Associate Professor, Department of Anaesthesiology, Phulo Jhano medical College, Dumka, Jharkhand, India.

²Associate Professor, Department of Obstetrics and gynaecology, Phulo Jhano medical College, Dumka, Jharkhand, India.

Received: 13-01-2026 / Revised: 20-02-2026 / Accepted: 26-03-2026

Corresponding Author: Dr. Priyanka Hansda

Conflict of interest: Nil

Abstract:

Background: Adjuvants are frequently added to local anesthetics to improve the efficacy of regional anesthesia and extend postoperative analgesia. Dexmedetomidine, an α_2 -adrenergic agonist, and fentanyl, a μ -opioid receptor agonist, are commonly used adjuvants. Their comparative effectiveness in supraclavicular brachial plexus block remains a subject of ongoing investigation.

Aim: To compare the onset, duration, and analgesic efficacy of dexmedetomidine versus fentanyl as adjuvants to 0.75% ropivacaine in ultrasound-guided supraclavicular brachial plexus block.

Methods: A randomized, prospective clinical study was conducted on 92 ASA I/II patients aged 18–60 years undergoing upper limb surgeries. Patients were divided into two groups: Group D received 0.75% ropivacaine with 1 μ g/kg dexmedetomidine, and Group F received 0.75% ropivacaine with 1 μ g/kg fentanyl. Block characteristics, analgesia duration, hemodynamic parameters, and adverse effects were recorded and analyzed.

Results: Group D showed significantly faster onset and prolonged duration of sensory and motor blocks, along with longer analgesia duration (736.5 ± 32.8 min vs. 654.2 ± 25.6 min, $p < 0.001$). Hemodynamic changes were mild and manageable in both groups.

Conclusion: Dexmedetomidine is more effective than fentanyl as an adjuvant to ropivacaine in supraclavicular brachial plexus block, offering superior block quality and extended postoperative analgesia.

Keywords: Brachial Plexus Block, Dexmedetomidine, Fentanyl, Regional Anesthesia Ropivacaine.

DOI: 10.25258/ijpqa.17.3.40

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Regional anesthesia techniques have changed the landscape of perioperative pain management, particularly in upper limb surgeries for which supraclavicular brachial plexus block (SCBPB) is often preferred for its rapid onset, dense anesthesia, and an intraoperative environment that is reliable [1]. The supraclavicular approach to the brachial plexus provides the advantage of blocking the brachial plexus when it is compactly arranged in the supraclavicular space, which favors providing sensory and motor blockade in a uniform fashion [2]. When comparing regional anesthesia to general anesthesia, peripheral nerve blocks have theoretical and clinical advantages such as allowing the avoidance of airway instrumentation or airway management, reduced systemic medications needed, decreased incidence of nausea and vomiting, and improved postoperative pain control. The introduction of ultrasound guidance has also improved the accuracy and safety of

SCBPB and ultrasonography has improved our placement success rate and reduced adverse events, such as pneumothorax and inadvertent vascular puncture, from the SCBPB. In the group of long-acting amide local anesthetics, ropivacaine is a common choice because of its pharmacologic attributes (such as differential blockade favoring sensory over motor fibers) along with less cardiotoxic characteristics than bupivacaine [3,4].

To increase the effectiveness and duration of nerve blocks, a variety of adjuncts can be co-administered with local anesthetics. Dexmedetomidine, a selective α_2 -adrenergic receptor agonist, has emerged as a popular perineural adjunct because of its sedative, anxiolytic, and analgesic effects without significant respiratory depression [5]. It works by hyperpolarizing nerve fibers, inhibiting release of norepinephrine, and reducing sympathetic outflow, thereby improving the quality and duration of sensory and

motor block. Fentanyl, a strong μ -opioid receptor agonist is another common adjunct that increases postoperative analgesia through the periphery at nerve endings and central modulation of nociceptive pathways [6]. However, assessing the comparative efficacy of these agents when used in conjunction with ropivacaine in SCBPB is in the midst of a continuing clinical investigation with both similarities and divergence in regards to onset times, duration of block, analgesic effects, and side effect profiles.

Recent clinical trials have focused on assessing the best adjuvants for regional blocks to improve patient outcomes [7]. Evidence from previous randomized controlled trials suggests that dexmedetomidine may provide a faster onset, and prolonged duration of sensory and motor block, compared to fentanyl as an adjuvant when they are added to ropivacaine [8]. Such differences are important enough to warrant comparison for anesthetic practice. The current study was undertaken to assess and compare dexmedetomidine versus fentanyl as adjuvants to 0.75% ropivacaine with ultrasound guided supraclavicular brachial plexus block clinical effectiveness. The main outcome was to assess and compare the onset time of sensory block, onset time of motor block, duration of block and duration of postoperative analgesia between the adjuvant's groups.

Methodology

Study Design and Setting: This study was a prospective, randomized, comparative clinical trial, conducted in the Department of Anaesthesiology, Phulo Jhano Medical College, Dumka, Jharkhand, India, over a period of one year.

Study Population: A total of 92 patients scheduled to undergo elective upper limb orthopedic surgeries under supraclavicular brachial plexus block were included in the study. All patients belonged to the American Society of Anesthesiologists (ASA) physical status I or II and were aged between 18 and 60 years.

Eligibility Criteria

Inclusion Criteria

- Patients aged 18–60 years
- ASA physical status I or II
- Scheduled for upper limb orthopedic surgery under supraclavicular brachial plexus block
- Weight between 50–85 kg
- Duration of surgery not exceeding 2 hours

Exclusion Criteria

- Known allergy or hypersensitivity to ropivacaine or study adjuvants
- Local infection at the site of injection
- Pre-existing neurological deficit in the upper limb

- Coagulation disorders or patients on anticoagulant therapy
- Severe hepatic or renal dysfunction
- Refusal to give informed consent

Randomization and Group Allocation: Patients were randomized into two equal groups (n = 46 per group) using a computer-generated randomization table. Group allocation was concealed using sealed opaque envelopes. The study was double-blinded; both the patient and the investigator assessing outcomes were unaware of the group allocation.

- **Group D (Dexmedetomidine Group):** Received 20 mL of 0.75% ropivacaine + 1 μ g/kg of dexmedetomidine
- **Group F (Fentanyl Group):** Received 20 mL of 0.75% ropivacaine + 1 μ g/kg of fentanyl

The total volume of the drug mixture was standardized across both groups.

Procedure: In the operating theatre, standard monitors (ECG, non-invasive blood pressure, pulse oximeter) were attached. An intravenous line was secured, and preloading was done using Ringer lactate (10 mL/kg). Under full aseptic precautions, an ultrasound-guided supraclavicular brachial plexus block was administered using a high-frequency linear transducer. The brachial plexus was identified, and the drug solution was injected after negative aspiration for blood.

Outcome Measures

Primary Outcomes:

- Onset time of sensory block (time from injection to loss of pinprick sensation)
- Onset time of motor block (time to complete motor paralysis)
- Duration of sensory block (time from onset to return of pinprick sensation)
- Duration of motor block (time from onset to return of motor function)
- Duration of analgesia (time from block to first request for rescue analgesia)

Secondary Outcomes:

- Hemodynamic stability (heart rate, blood pressure, SpO₂)
- Sedation scores
- Adverse effects (bradycardia, hypotension, nausea, vomiting, respiratory depression)

Statistical Analysis: Data were recorded and analyzed using SPSS version 27.0 (software version to be specified). Quantitative data were expressed as mean \pm standard deviation and analyzed using independent sample t-test or Mann-Whitney U test depending on normality of distribution. Categorical data were expressed as frequencies and compared

using Chi-square test. A p-value < 0.05 was considered statistically significant.

Results

A total of 92 patients were enrolled and equally randomized into two groups. Both groups were comparable in baseline demographic and clinical parameters. The results were analyzed to compare block characteristics, duration of analgesia, sedation, and hemodynamic changes between the dexmedetomidine and fentanyl groups. Table 1 represents the demographic profile of patients in Group D (dexmedetomidine) and Group F (fentanyl), each consisting of 46 participants. The groups were statistically comparable across all baseline characteristics. The

mean age was 37.4 ± 11.6 years in Group D and 36.9 ± 12.1 years in Group F ($p = 0.78$), indicating no significant difference. Gender distribution (M/F) was similar between groups (28/18 in Group D vs. 27/19 in Group F, $p = 0.84$). The average body weight was 65.1 ± 7.9 kg in Group D and 64.7 ± 8.2 kg in Group F ($p = 0.69$), and the average height was 165.8 ± 6.9 cm and 166.3 ± 7.1 cm in Groups D and F, respectively ($p = 0.75$). Additionally, the distribution of ASA physical status I and II was comparable (26/20 in Group D and 27/19 in Group F, $p = 0.81$). These findings confirm that the two groups were demographically well matched, ensuring the internal validity of the comparative analysis.

Table 1: Demographic Data of Patients in Both Groups (n = 92)

Parameter	Group D (n=46)	Group F (n=46)	p-value
Age (years)	37.4 ± 11.6	36.9 ± 12.1	0.78
Gender (M/F)	28 / 18	27 / 19	0.84
Weight (kg)	65.1 ± 7.9	64.7 ± 8.2	0.69
Height (cm)	165.8 ± 6.9	166.3 ± 7.1	0.75
ASA Physical Status (I/II)	26 / 20	27 / 19	0.81

Table 2 represents the comparison of onset and duration of sensory and motor block between Group D (dexmedetomidine) and Group F (fentanyl). The onset of sensory block was significantly faster in Group D (6.30 ± 1.15 minutes) compared to Group F (9.95 ± 1.22 minutes), with a p-value < 0.001. Similarly, the onset of motor block occurred earlier in Group D (9.75 ± 0.90 minutes) than in Group F (12.85 ± 1.76 minutes), also showing high statistical significance ($p < 0.001$). In terms of block duration,

Group D demonstrated a longer sensory block duration (541.3 ± 47.9 minutes) compared to Group F (489.8 ± 45.6 minutes), and a prolonged motor block duration (530.1 ± 46.8 minutes vs. 462.4 ± 35.2 minutes in Group F), both with p-values < 0.001. These findings indicate that dexmedetomidine as an adjuvant to ropivacaine significantly accelerates the onset and prolongs the duration of both sensory and motor block compared to fentanyl.

Table 2: Onset and Duration of Sensory and Motor Block

Parameter	Group D (n=46)	Group F (n=46)	p-value
Onset of sensory block (min)	6.30 ± 1.15	9.95 ± 1.22	< 0.001
Onset of motor block (min)	9.75 ± 0.90	12.85 ± 1.76	< 0.001
Duration of sensory block (min)	541.3 ± 47.9	489.8 ± 45.6	< 0.001
Duration of motor block (min)	530.1 ± 46.8	462.4 ± 35.2	< 0.001

Table 3 represents the comparison of analgesia duration and hemodynamic changes between Group D (dexmedetomidine) and Group F (fentanyl). The duration of analgesia was significantly longer in Group D (736.5 ± 32.8 minutes) compared to Group F (654.2 ± 25.6 minutes), with a highly significant p-value < 0.001. Intraoperative bradycardia was observed in 3 patients (6.5%) in Group D and none in Group F, though this difference was not statistically significant ($p = 0.08$). Similarly, hypotension episodes occurred in 2 patients (4.3%) in Group D and

1 patient (2.1%) in Group F ($p = 0.56$). Nausea or vomiting was slightly more common in Group F (6.5%) compared to Group D (2.1%), but this difference was not significant ($p = 0.31$). Sedation scores greater than 2 were reported in 4 patients (8.7%) in Group D and 1 patient (2.1%) in Group F ($p = 0.17$). These results suggest that while dexmedetomidine provides significantly longer postoperative analgesia, it may be associated with a slightly higher, though not statistically significant, incidence of sedation and bradycardia.

Parameter	Group D (n=46)	Group F (n=46)	p-value
Duration of analgesia (min)	736.5 ± 32.8	654.2 ± 25.6	< 0.001
Intraoperative bradycardia (%)	3 (6.5%)	0	0.08
Hypotension episodes (%)	2 (4.3%)	1 (2.1%)	0.56
Nausea/Vomiting (%)	1 (2.1%)	3 (6.5%)	0.31
Sedation score >2 (%)	4 (8.7%)	1 (2.1%)	0.17

Table 4 represents the block success rate and the requirement for supplemental intraoperative analgesia in both study groups. A complete block was achieved in 97.8% of patients in Group D and 95.6% in Group F, with no statistically significant difference ($p = 0.56$). Partial block occurred in 2.2% of patients in Group D and 4.4% in Group F, also showing no significant variation ($p = 0.56$). Notably, none

of the patients in Group D required supplemental intraoperative analgesia, while 2 patients (4.4%) in Group F did; however, this difference was not statistically significant ($p = 0.15$). These findings indicate that both adjuvants provided high block success rates, but dexmedetomidine may offer slightly more consistent block efficacy with reduced need for intraoperative analgesic intervention.

Outcome Measure	Group D (n = 46)	Group F (n = 46)	p-value
Complete block achieved (%)	45 (97.8%)	44 (95.6%)	0.56
Partial block (%)	1 (2.2%)	2 (4.4%)	0.56
Supplemental intraoperative analgesia required (%)	0 (0%)	2 (4.4%)	0.15

Table 5 represents the distribution of sedation scores between Group D (dexmedetomidine) and Group F (fentanyl) based on the Modified Ramsay Sedation Score. In Group D, a higher proportion of patients exhibited deeper levels of sedation, with 13.0% reaching Score 4 (brisk response to stimuli) and 39.1% at Score 3 (responds to commands), compared to only 2.2% and 19.6%, respectively, in Group F. Conversely, lighter sedation (Score 2 –

cooperative and oriented) was more prevalent in Group F (71.7%) than in Group D (43.5%). Mild agitation or anxiety (Score 1) was noted in a small number of patients in both groups—4.3% in Group D and 6.5% in Group F. These findings suggest that dexmedetomidine produced a more pronounced sedative effect than fentanyl, which may contribute to better intraoperative patient comfort without compromising responsiveness.

Sedation Score	Group D (n = 46)	Group F (n = 46)
Score 1 (Anxious, agitated)	2 (4.3%)	3 (6.5%)
Score 2 (Cooperative, oriented)	20 (43.5%)	33 (71.7%)
Score 3 (Responds to commands)	18 (39.1%)	9 (19.6%)
Score 4 (Brisk response to light glabellar tap or loud noise)	6 (13.0%)	1 (2.2%)

Table 6 represents the requirement for postoperative rescue analgesia in the first 24 hours following surgery. None of the patients in Group D required analgesia within the first 6 hours, whereas 4 patients (8.7%) in Group F did, a difference that was statistically significant ($p = 0.04$). Between 6 to 12 hours postoperatively, 13.0% of patients in Group D required analgesia compared to 47.8% in Group F ($p < 0.001$), and after 12 hours, 87.0% of Group D patients required analgesia, whereas only 43.5% of

Group F patients reached this time point before needing intervention ($p < 0.001$). Additionally, the mean number of analgesic doses required in the first 24 hours was significantly lower in Group D (1.1 ± 0.3) than in Group F (2.4 ± 0.6), with a highly significant p -value of < 0.001 . These findings indicate that dexmedetomidine as an adjuvant to ropivacaine provides more prolonged and effective postoperative analgesia, significantly reducing the need for early rescue analgesia compared to fentanyl.

Time After Surgery	Group D (n = 46)	Group F (n = 46)	p-value
Within 6 hours	0 (0%)	4 (8.7%)	0.04
Within 6–12 hours	6 (13.0%)	22 (47.8%)	<0.001
After 12 hours	40 (87.0%)	20 (43.5%)	<0.001
Mean number of analgesic doses (first 24 hrs)	1.1 ± 0.3	2.4 ± 0.6	<0.001

Table 7 represents the intraoperative hemodynamic parameters in both study groups. The mean heart rate was significantly lower in Group D (68.5 ± 6.1 bpm) compared to Group F (75.2 ± 7.4 bpm), with a p-value < 0.001 , indicating a statistically significant difference. Similarly, the mean arterial pressure (MAP) was slightly lower in Group D (82.4 ± 5.6 mmHg) than in Group F (85.1 ± 6.2 mmHg), with a p-value of 0.02, also showing statistical

significance. However, oxygen saturation remained stable and comparable between the groups, with Group D at $98.3 \pm 0.6\%$ and Group F at $98.4 \pm 0.5\%$ ($p = 0.45$). These findings suggest that dexmedetomidine is associated with modest but statistically significant reductions in heart rate and blood pressure, likely due to its sympatholytic effects, while maintaining adequate oxygenation throughout the procedure.

Parameter	Group D (n = 46)	Group F (n = 46)	p-value
Mean Heart Rate (bpm)	68.5 ± 6.1	75.2 ± 7.4	<0.001
Mean Arterial Pressure (mmHg)	82.4 ± 5.6	85.1 ± 6.2	0.02
Oxygen Saturation (%)	98.3 ± 0.6	98.4 ± 0.5	0.45

Discussion

This randomized, prospective clinical investigational study aimed to assess and compare the value of dexmedetomidine to fentanyl as adjuvants to 0.75% ropivacaine in the setting of an ultrasound-guided supraclavicular brachial plexus block. Using dexmedetomidine versus fentanyl provided clear evidence that dexmedetomidine improved block characteristics and prolonged analgesia while having an acceptable safety profile.

Table 1 shows that patient baseline characteristics were no different between groups, thereby eliminating demographic pre-bias. Although the onset of sensory and motor block was significantly quicker in the dexmedetomidine group, our results corroborate Esmoğlu et al., who found the addition of dexmedetomidine (in levobupivacaine) led to a quicker onset of sensory and motor block, and block quality was also enhanced in brachial plexus anesthesia [9]. The most likely explanation rests on dexmedetomidine's ability to work synergistically with local anesthetics through hyperpolarization-activated cation current inhibition, which increases sodium channel blockade and the delay of nerve conduction.

Furthermore, the duration of sensory and motor blocks and postoperative analgesia were statistically longer in the dexmedetomidine group, consistent with the work of Natarajan et al., (2022), who identified that perineural dexmedetomidine hyperbaric ropivacaine for supraclavicular block could prolong block duration and decrease rescue analgesia use [10]. Swami et al., (2012) also noted comparable findings where when dexmedetomidine was added to bupivacaine in brachial plexus block duration of analgesia was far better than that of clonidine [11]. There was a markedly decreased utilization of supplemental analgesia in the dexmedetomidine group also highlighting that dexmedetomidine in the perineural local anesthetic setting can provide prolonged analgesic effects. Abdallah et al., (2015) showed from their systematic reviews and meta-analysis, and the conclusions can provide strong evidence. for

us. We found that dolorous utilization of post-operative opioids was seen to be lower, free playing had extraordinarily prolonged toxic effects when the dexmedetomidine was employed in peripheral nerve block in all comparisons [12].

Although both groups achieved a high block success rate, the dexmedetomidine group had a slightly higher complete block rate, along with no use of intraoperative rescue analgesia. The sedation profile of dexmedetomidine encouraged a higher proportion of patients to experience mild to moderate sedation (Ramsay Scores 3 and 4), which could be helpful with intraoperative comfort. These effects are consistent with findings reported by Brummett et al., (2011) who demonstrated that dexmedetomidine was able to provide sedation and anxiolysis without considerable respiratory depression in regional anesthesia [13]. There were hemodynamic effects such as statistically significant decreases in heart rate and mean arterial pressure, although these were tolerated clinically in the dexmedetomidine group. These findings are in keeping with the sympatholytic effects observed with α_2 -agonists. There are studies such as Memiş et al., (2004) that have observed comparable hemodynamic profiles to ours when dexmedetomidine was added to lidocaine for intravenous regional anesthesia [14].

In summary, our results strongly confirm sufficient evidence in the literature that dexmedetomidine is a better adjuvant to ropivacaine versus fentanyl with considerations for block characteristics, postoperative analgesia, and patient preference, with acceptable hemodynamic stability. In addition, it provides significant reduction in postoperative analgesic requirements as such may be a future opportunity to improve regional anesthesia quality.

Conclusion

The results of this study show that dexmedetomidine appears to be a more adjunct as compared to fentanyl when combined with 0.75% ropivacaine for a supraclavicular brachial plexus block. Dexmedetomidine significantly reduced the onset time of both sensory

and motor blocks, prolonged the duration of the blocks, and extended postoperative analgesia with little need for rescue analgesia. Additionally, dexmedetomidine provided mild sedation and stable hemodynamic parameters without serious complications or adverse effects. These clinical findings support the use of dexmedetomidine in brachial plexus block to improve block quality and postoperative patient comfort in upper limb surgery. Further large-scale studies are warranted to determine the level of safety associated with the use of dexmedetomidine and its postoperative effects on outcomes in the surgical population.

References

1. Jones MR, Novitch MB, Sen S, Hernandez N, De Haan JB, Budish RA, Bailey CH, Ragusa J, Thakur P, Orhurhu V, Urits I. Upper extremity regional anesthesia techniques: A comprehensive review for clinical anesthesiologists. *Best Practice & Research clinical anaesthesiology*. 2020 Mar 1;34(1):e13-29.
2. Kaye AD, Allampalli V, Fisher P, Kaye AJ, Tran A, Cornett EM, Imani F, Edinoff AN, Motlagh SD, Urman RD. Supraclavicular vs. infraclavicular brachial plexus nerve blocks: clinical, pharmacological, and anatomical considerations. *Anesthesiology and Pain Medicine*. 2021 Oct 31;11(5): e120658.
3. Graf BM. The cardiotoxicity of local anesthetics: the place of ropivacaine. *Current topics in medicinal chemistry*. 2001 Aug 1;1(3):207-14.
4. Leone S, Di Cianni S, Casati A, Fanelli G. Pharmacology, toxicology, and clinical use of new long-acting local anesthetics, ropivacaine and levobupivacaine. *Acta Biomed*. 2008 Aug 1;79(2):92-105.
5. Liu X, Li Y, Kang L, Wang Q. Recent advances in the clinical value and potential of dexmedetomidine. *Journal of Inflammation Research*. 2021 Dec 30:7507-27.
6. Martínez V, Abalo R. Peripherally acting opioid analgesics and peripherally-induced analgesia. *Behavioural pharmacology*. 2020 Apr 1;31(2&3):136-58.
7. Prabhakar A, Lambert T, Kaye RJ, Gaignard SM, Ragusa J, Wheat S, Moll V, Cornett EM, Urman RD, Kaye AD. Adjuvants in clinical regional anesthesia practice: A comprehensive review. *Best Practice & Research Clinical Anaesthesiology*. 2019 Dec 1;33(4):415-23.
8. Sumitha B. A Comparative Study of Dexmedetomidine Versus Fentanyl as an Additive to 0.75% Ropivacaine in Ultrasound Guided Infraclavicular Brachial Plexus Block-A Randomized Clinical Study (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
9. Esmoğlu A, Yeğenoglu F, Akin A, Türk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anesthesia & Analgesia*. 2010 Dec 1;111(6):1548-51.
10. Natarajan NA, Kuppusamy GO, Ramanathan AI, Dave SM. A comparative study of dexmedetomidine and clonidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. *Asian J Pharm Clin Res*. 2022;15(2):119-22.
11. Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α_2 agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. *Indian journal of anaesthesia*. 2012 May 1;56(3):243-9.
12. Abdallah FW, Brull R. Facilitatory effects of perineural dexmedetomidine on neuraxial and peripheral nerve block: a systematic review and meta-analysis. *British journal of anaesthesia*. 2013 Jun 1;110(6):915-25.
13. Brummett CM, Norat MA, Palmisano JM, Lydic R. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nerve block without inducing neurotoxicity in the rat. *Anesthesiology*. 2008 Sep;109(3):502.
14. Memis D, Turan A, Karamanoglu B, Pamukçu Z, Kurt I. Adding dexmedetomidine to lidocaine for intravenous regional anesthesia. *Anesthesia & Analgesia*. 2004 Mar 1;98(3):835-40.