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Research Article

Intraoperative sedation and postoperative analgesic effects of bupivacaine-dexmedetomidine mixture compared to bupivacaine alone in upper extremity bone surgeries: A randomized comparative study in Vietnam

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ABSTRACT

We aimed to compare intraoperative sedation and postoperative analgesic effects of brachial plexus block using bupivacaine-dexmedetomidine mixture (BD) versus bupivacaine alone (B) in upper extremity bone surgeries. We conducted a randomized comparative study at Can Tho City, Vietnam. We recruited patients aged 15 to 75 years, ASA (American Society of Anesthesiology) I-III grade, indicating bone surgeries of arm or forearm with supraclavicular brachial plexus block by ultrasound guidance. One hundred eight included patients were randomly divided into two groups: the BD group (54 patients) received a 30 ml mixture of 0.25% bupivacaine and 100 mcg dexmedetomidine, and the B group (54 patients) received 30 ml of 0.25% bupivacaine. The BD group had a sedative OAA/S score (Observer Assessment of Alertness/Sedation Scale) of level 4, accounting for 87% more than group B 37%, and an OAA/S score of level 3 in the BD group with 5 cases (9.3%) compared with 9 cases (16.7%) in group B, statistically significant difference with $p<0.05$. The onset and duration of sedative time in group BD was 9.8±3.5 and 92.7±34.1 minutes. The mean of postoperative analgesic time was 970.5±309.5 minutes in group BD statistically significantly longer than group B's with 552.7±231.2 minutes ($p<0.001$). In conclusion, a mixture of bupivacaine-dexmedetomidine in brachial plexus block for arm and forearm surgical fractures had greater sedative and postoperative analgesic effects than that of bupivacaine alone.

Keywords:
Brachial plexus block, Bupivacaine, Dexmedetomidine, Intraoperative sedation, Postoperative pain relief, Ultrasound guidance

1. INTRODUCTION

Upper extremity fractures are common, and they have appeared in every subject. According to the statistics of Nguyen CD et al. from 2016 to 2018, 90,011 patients of accidents at Viet Duc Hospital in Vietnam, the proportion of cases accounted for 53.2% with extremity injuries[1]. In the study of Karl et al. (2015) in the United States, the incidence of upper extremity fractures was 677/100,000[2].

Among anesthesia methods for upper extremity surgery, brachial plexus block is the usual technique due to simple but highly effective anesthesia. To reduce the dose of local anesthetics, increase the anesthetic efficacy, prolong pain relief effect after surgery, especially help patients decrease anxiety during the surgery, many researchers have studied adjuvant analgesics such as sufentanil, fentanyl, morphine, dexamethasone, ketorolac, clonidine, or dexmedetomidine. There has been no research on combining local anesthetic with dexmedetomidine in Vietnam.

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Surgery of bone combination is the most painful in all kinds of upper extremity surgeries. Therefore, we conducted the study to compare intraoperative sedation and postoperative analgesic effects of brachial plexus block using bupivacaine-dexmedetomidine mixture versus bupivacaine alone for these surgeries.

2. MATERIALS AND METHODS

2.1. Study design and setting

We conducted a randomized comparative study to compare the effects of brachial plexus block using bupivacaine-dexmedetomidine mixture versus bupivacaine alone in upper extremity bone surgeries at the Anesthesia and Orthopedics Department of Can Tho Central General Hospital, Can Tho City, Vietnam, from February 2016 to May 2017.

2.2. Study population

Patients who had been undergone elective surgeries of an arm or/and forearm fractures by supraclavicular brachial plexus block, aged 15-75 years, ASA (American Society of Anesthesiology) grade I-III. Exclusion criteria included atrial-ventricular conduction disorders, bradycardia <50 beats/minute, psychiatric disorders, epilepsy, neuromuscular diseases, renal or hepatic failures, history of allergy to local anesthetics, alcoholism or drug abuse, pregnancy, lactation, bodyweight <35 kg, multiple injuries, combined upper extremity surgery with other surgeries, surgical complications, or missing data.

2.3. Sample size and randomization

The sample size of this study was calculated using the formula for comparison of two means:

$$n=\frac{2C}{(ES)^2}$$

ES stands for effect size. α is the probability of type 1 error, α=5%, β is the probability of type 2 error, β=20%, and a constant C=7.85. In a study by Agarwal S et al. (2014)[3], μ1, the postoperative analgesic time of bupivacaine with dexmedetomidine group is 776 minutes and σ1, which is the standard deviation of postoperative analgesic time, is 130.8 minutes. μ2 is the expected postoperative analgesic time in our study when we would use a combination of bupivacaine and dexmedetomidine, increasing about 10% postoperative analgesic time of Agarwal's study, so this time is 850 minutes. After calculating n=49.1, we selected 54 patients for each group.

Randomization: Patients were randomized into two groups according to drawing lots (simple randomization). The BD group received a 30 ml mixture of 0.25% bupivacaine and 100 mcg dexmedetomidine, and the B group received 30 ml of 0.25% bupivacaine.

2.4. Intervention procedures

Devices, facilities, and drugs of research: Ultrasound machine with the linear probe, frequency 6-12 MHz of Ezono AG company, stimuplex A needle for brachial plexus block of B. Braun company. Bupivacaine Aguettant 20 ml 0.5% of Delpharm Tours, France. Dexmedetomidine (Precedex^R), 200 mcg/2ml of Hospira.Inc, North Chicago.

At the operating room: Patients were measured and recorded ECG, blood pressure, breathing rate, SpO2, and administered 3 liters/min oxygen through the nasal tube. We were doing an intravenous line with an 18G needle and infusing ringer lactate about 30 drops/min. To prepare a 30 ml mixture of local anesthetics: B Group: 15 ml of bupivacaine 0.5% plus 15 ml of 0.9% sodium chloride to obtain 30 ml of bupivacaine 0.25%. BD group: 15 ml of bupivacaine 0.5% plus 100 mcg /1ml of dexmedetomidine, and 14 ml of 0.9% sodium chloride to get 30 ml mixture of bupivacaine 0.25% (75 mg) and 100 mcg dexmedetomidine.

Practice supraclavicular brachial plexus block via ultrasound guidance: The patient's position was lying on an operative table, the injured hand was closed to the body, his head was faced to the opposite side of the brachial plexus block. An anesthesiologist used an ultrasound probe to determine the brachial plexus above the clavicle bone-holding the transducer plane in a direction parallel to the body's axis so that the ultrasound beam crossed the brachial plexus and subclavicular artery located on the first rib. Once the brachial plexus was adequately identified, the neural structures as round or oval multiple hypoechoic structures next to the subclavicular artery. An assistant installed the syringe containing a mixture of local anesthetic with a connected needle line. We injected the needle slowly and observed its direction on the screen, kept it below the brachial plexus, next to the subclavicular artery, drew this syringe test if there was no blood, started to inject 5 ml. After that, we moved the needle upwards to the brachial plexus center, continued to inject this mixture of anesthetics, then checked each time after a 3-5ml injection again. Then, the local anesthetic mixture slowly spread around the brachial plexus. All cases are performed by an anesthesiologist with more than 10 years of experience.

To monitor the patient in 30 minutes after brachial plexus block: Surgery would be performed if the patient had completed sensory pain blockage. If the patients were still in moderate pain, we would give them fentanyl 1-2 mcg/kg and midazolam 0.02-0.04 mg/kg in case of anxiety by intravenous injection. Continuing this evaluation after 5 minutes, we would change to general anesthesia if the patients were still in severe pain. All patients in both groups are given paracetamol 1g/100 ml at the end of the surgery.

According to the World Health Organization pro-

tocol, we used pain relief drugs for a postoperative time. We only used paracetamol or non-steroid in level 1 for mild pain (VAS=3), paracetamol combined to non-steroid in level 2 for moderate pain (VAS=4-6), paracetamol combined to non-steroid, and opioids in level 3 for severe pain (VAS=7-10).

2.5. Data collection

We collected and assessed the data including age, gender, height, weight, historical chronic diseases, ASA classification, surgical time, postoperative analgesia efficiency: duration time, VAS score at rest and movement, used analgesics after surgery, sedative effect: onset and duration time, sedative level.

2.6. Study outcomes

Primary outcomes were the intraoperative sedation and postoperative analgesic effects of brachial plexus block using bupivacaine-dexmedetomidine mixture versus bupivacaine alone. Secondary outcomes were the side effects of these therapies. The onset of sedation was defined as a period from the end of local anesthetic administration until the patient had the Observer Assessment of Alertness/Sedation Scale (OAA/S) score=4 and recorded the sedative level (unit in minutes). Duration of sedation was defined as the patient's OAA/S score=4 until recovery with OAA/S score=5 (unit in minutes). Intraoperative sedation was evaluated by the OAA/S score with five levels. OAA/S=5 score: alert; OAA/S=4: light sleep; OAA/S=3: moderate sleep; OAA/S=2: deep sleep; OAA/S=1: very deep sleep, unconscious[4].

Postoperative analgesia time was defined as a period from the end of the surgery to the time of pain appearance (unit in minutes). Postoperative analgesia was evaluated by VAS (Visual Analog Scale) score with four levels. VAS=0: no pain; VAS=1-3: mild pain; VAS=4-6; moderate pain; and VAS=7-10: severe pain[5].

2.7. Statistical analysis

The data was processed and analyzed using the medical statistics method with SPSS 16.0 software for Windows. Quantitative variables were compared the mean value of two independent groups using Student t-test and represented as mean and standard deviation ($\overline{X}\pm$ SD), Min-Max. Qualitative variables were described by frequency and percentage, and the χ^2 test was used to evaluate the difference for qualitative variables. Statistical significance was considered as *p*-values of <0.05.

2.8. Ethical approval

The study was approved by the Thesis Review Committee of the 108 Clinical Medicine and Pharmacy Science Research Institute on September 10, 2015, with the number 276/QĐ-V108. We followed the official instructions for ethical issues according to decision No. 5129/2002/QD-BYT of Vietnam Ministry of Health on December 19, 2002.

Table 1. Patient characteristics.

Characteristics	Group		p
	B Group n=54	BD Group n=54	
Age (years)	38.3±16.3	37±13.3	0.661
(min-max)	(15-72)	(16-64)	
Height (cm)	162.0±7.1	163.4±7.4	0.363
(min-max)	(145-176)	(148-176)	
Weight (kg)	59.9±12.0	59.1±11.0	0.702
(min-max)	(37-105)	(40-90)	
BMI (kg/m^2)	22.7±4.0	22.1±3.4	0.355
(min-max)	(16.6-38.6)	(16.9-31.1)	
ASA (I/II/III)	33/17/4	41/9/4	0.190
Surgical time (min)	81.0±35.7	83.9±42.6	>0.05
(min-max)	(30-200)	(40-190)	

ASA, American Society of Anesthesiology; BMI, Body mass index

Table 2. Sedative time in BD group.

Time of sedation (minutes)	BD Group (n=48)
Onset	9.8±3.5
(min-max)	(4-18)
Duration	92.7±34.1
(min-max)	(50-200)

Table 3. Duration time of postoperative analgesia.

Postoperative analgesic time (minutes)	Group		p
	Group B n=54	Group BD n=54	
Mean (min-max)	552.7±231.2 (170-1215)	970.5±309.5 (375-1660)	<0.001

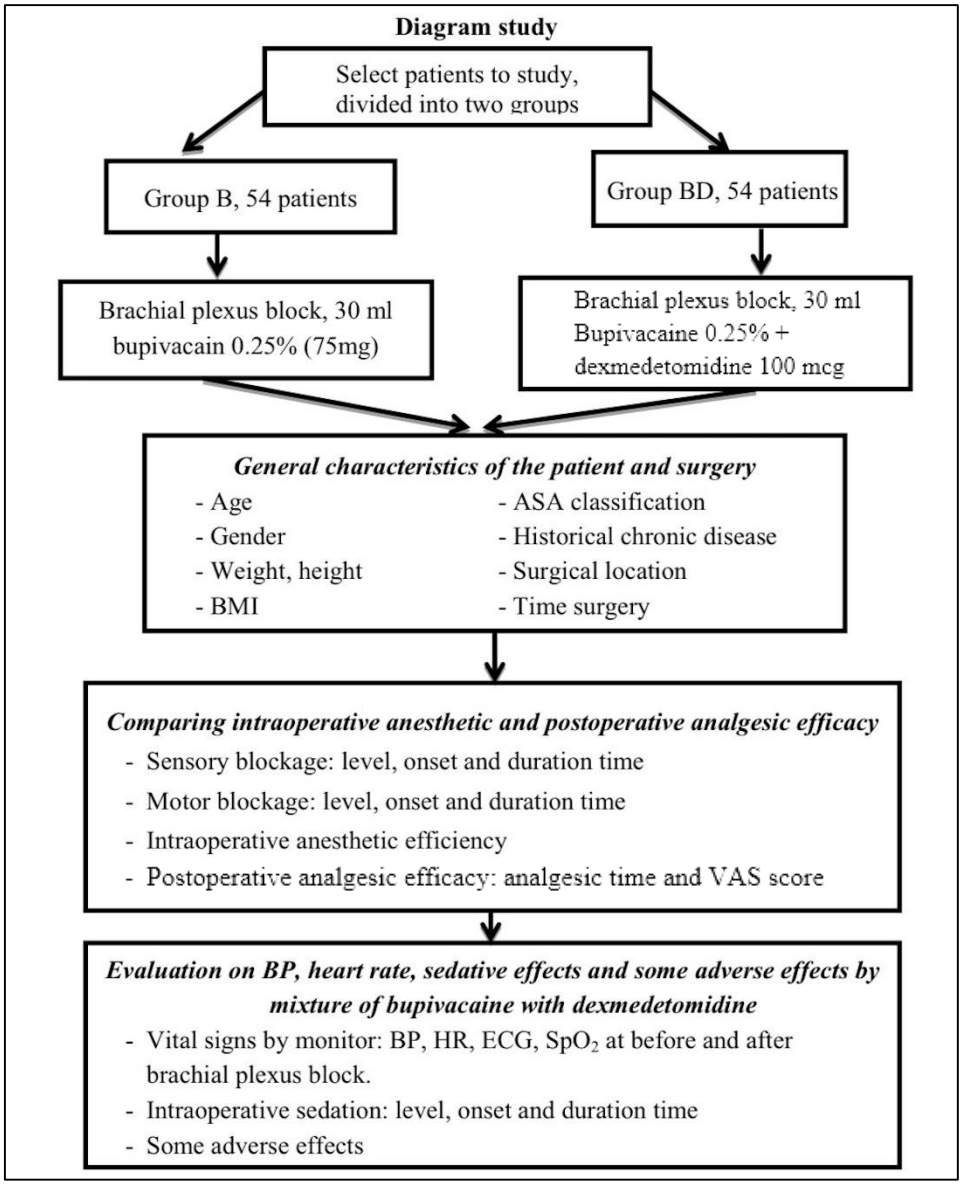

Figure 1. Intraoperative sedative effect.

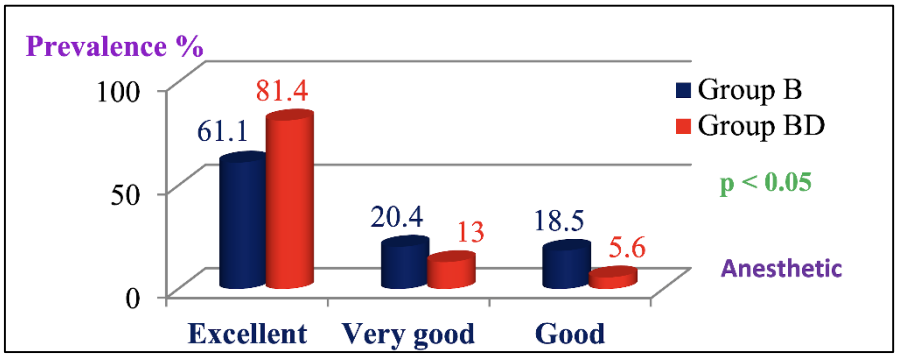

Figure 2. Intraoperative anesthetic efficacy.

3. RESULTS

A total of 108 patients were assessed for eligibility and included in the study. Of those patients, 54 patients in the BD group received a 30 ml mixture of 0.25% bupivacaine and 100 mcg dexmedetomidine, and 54 patients in the B group received 30 ml of 0.25% bupivacaine. There are no significant differences in demographic characteristics such as age, height, weight, BMI, ASA classification, and surgical time of both groups (Table 1).

The onset of sedative time was 9.8±3.5 minutes, and the duration was 92.7±34.1 minutes in the BD group (Table 2).

The OAA/S score=4 accounted for 87% in the BD group and 37% in the B group, and the difference is statistically significant, $p<0.001$ (Figure 1).

The BD group had intraoperative anesthetic efficiency at an excellent and very good level statistically significantly higher than that of the B group with $p<0.05$ (Figure 2).

The duration of postoperative analgesia in the BD group is statistically significantly longer than the B group, $p<0.001$ (Table 3).

The movability VAS score of the BD group is statistically significantly lower than that of the B group at 12, 16, and 24 hours of postoperative time, $p<0.05$ (Figure 3).

Bradycardia and nausea in the BD group are statistically significantly more than the B group, $p<0.05$ (Figure 4).

4. DISCUSSION

The mean age in the B and BD group is 38.3±16.3 and 37±13.3 years old, the youngest is 15 years old, and the oldest is 72 years old according to Table 1. Consequently, both study groups have similar age characteristics, $p>0.05$. This age in our study resembles domestic authors such as in the Do HT et al.'s study. The average age was 33 years old, the youngest was 13 years old, and the oldest was 56 years old. Both research groups have a male ratio of 60% which higher than that of females, about 40%. Thus, there is no difference between the two groups of sex characteristics with $p>0.05$. About 90% of patients in our study are classified as ASA I and II. Most of them are of working age; few have related chronic diseases, and the leading cause of broken bones is road traffic accidents[1]. Similarly, Ammar AS et al. (2012)[6] classified most subjects with ASA I and II in upper extremity bone surgeries. The mean surgical time in both groups is short, about 80 minutes, and the BD group has had intraoperative anesthetic efficiency statistically significantly higher than that of the B group (Figure 2). Thus, there was no case to change general anesthesia in both groups.

About 50% of patients feel anxious during the perioperative time, so sedation is essential, helping patients feel secure and cooperative[7]. Therefore, the BD group in our study has had about 87% of OAA/S=4 points, higher than the B group with only 37%, statistically significant difference, $p<0.05$ (Figure 1). Because of lower intraoperative anesthetic efficiency in the B group, we used additional sedation drugs such as fentanyl or midazolam. The onset and duration of sedative time are 9.8±3.5 minutes and 92.7±34.1 minutes (Table 3). Thus, our sedative time is very suitable with surgical time because of reduces to patient's anxiety during the intraoperative time. In Vietnam, Hoang TQ et al. (2012) evaluated the sedative effect of 0.25 mcg/kg dexmedetomidine by intravenous route in colonoscopy procedure, recording the onset and duration of sedative time were 11±3.3 minutes and 37.2±6.9 minutes, achieved three sedative levels on the Ramsay scale, equivalent to deep sleep but easy to wake up accounting for nearly 80%. Therefore, our study has onset and level of sedation similar to Hoang TQ's, although using different routes[8].

The BD group in Agarwal S et al.'s research[3] had 18 patients with Ramsay 2, cooperatively awake patients and seven patients with Ramsay 3 equivalent to sleeping state and only the following calling, while group B only had Ramsay 1 in all patients were restless and worried, this result is similar to B group in our study. Nazir N et al. (2016) researched group BD which had Ramsay 2 accounting for 83% and Ramsay 3 about 13%, while group B mainly had Ramsay 1 and 2 accounting for 85% and 15%[9]. Nallam et al. (2017) noted that Ramsay sedation above 3 points accounted for 24.5% in the 50 mcg dexmedetomidine group while the 100 mcg group was 53.1%. Consequently, local anesthesia combined with dexmedetomidine, which provides good support for sedation during surgery, is very safe and suitable for use in brachial plexus block[10].

In our research, the BD group has had a statistically significant mean duration of postoperative analgesia longer than the B group, $p<0.05$ (Table 2). In addition, the mean postoperative analgesic time is 970 of our BD group longer than that of Agawal et al.'s research (2014) with 776 minutes[3]. Although both studies used the same dose of 100 mcg dexmedetomidine, we used ultrasound guidance to help better these drugs access the brachial plexus. Besides, research by Ammar AS et al[6]. had a postoperative analgesic time shorter than our study. We can explain the first difference between the stimulator and ultrasound guidance, the second by using a lower dose of dexmedetomidine than our study. Adding, research of Biwas S et al. (2014) recorded a postoperative analgesic time of local anesthetic and 100 mcg dexmedetomidine was 997 minutes[11], it seems similar to our study. During 24 hours postoperative, the B group has had level 2 and level 3 of pain with 75% and 16.7%, which was statistically significantly higher than the BD group's with 57.4% and 9.3%, $p<0.05$. Thus, the combination of dexmedetomidine to local anesthetic in brachial

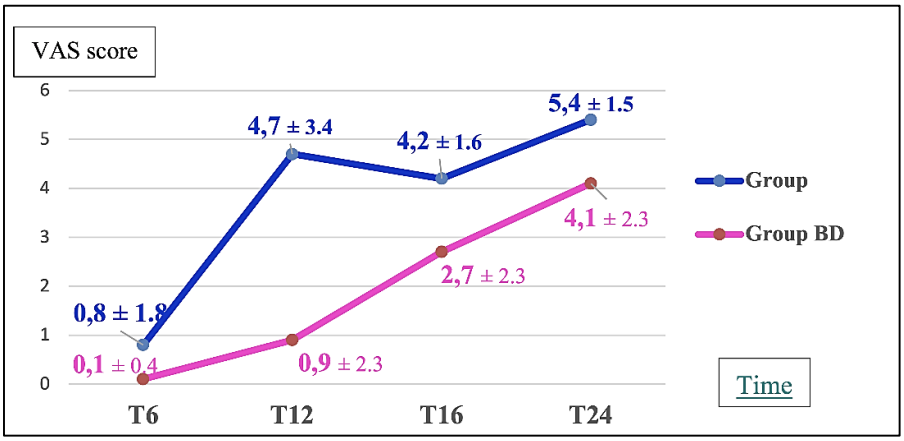

Figure 3. The movability VAS score.

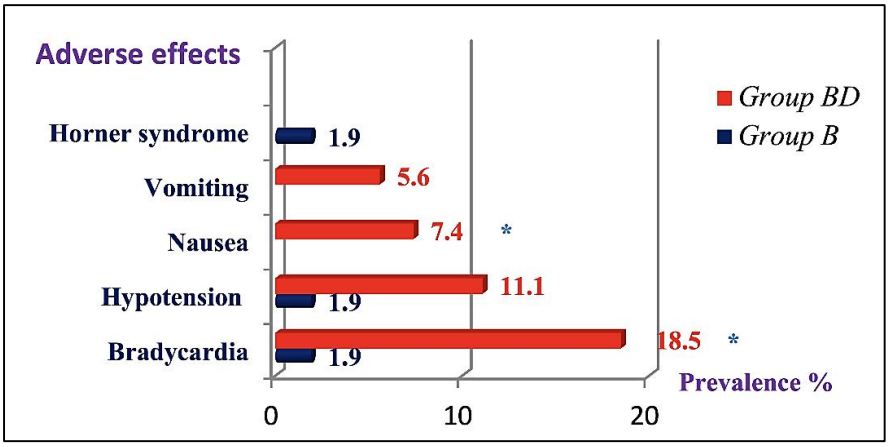

Figure 4. Adverse effects.

plexus block can prolong postoperative analgesia time, as has been shown by many studies.

Studies using dexmedetomidine and other local anesthetics in brachial plexus block were similar to Esmaoglu A et al.'s (2010) study, levobupivacaine combined with dexmedetomidine had 1008 minutes in mean duration analgesia[12], or Kaygusuz et al. study were 1,279 minutes[13]. Nallam et al.'s (2017) study findings were 1,034 minutes, even some patients in this group did not feel pain after surgery, similarly to a few cases in our study[10]. In 2017, a meta-analysis randomized by Vorobeichik et al. showed that using perineural dexmedetomidine of brachial plexus nerve block enhances intraoperative anesthetic efficiency and reduces postoperative anesthesia[14].

Yoshitomi et al. have proposed several hypotheses about the mechanism for the action of dexmedetomidine through its stimulatory effect on the α_2 adrenoceptors agonists for anesthetic management in anticipation sympatholytics as sedative, analgesic, and anesthetic-sparing effects in regional anesthesia. Especially, dexmedetomidine is highly specific to α_2 adrenoceptors, yielding a α_2:α_1 ratio of 1620:1. Firstly, dexmedetomidine causes vasoconstriction around the injection site, which causes direct inhibition of neural impulse conduction due to enhance depolarization by the Na^+/K^+ channel through a repetitive excitation mechanism which increases in the threshold of activity should slow down or inhibit nerve conduction. Secondly, through α_2 adrenoceptors agonists, dexmedetomidine helps release local enkephalins, reducing inflammation and enhancing releasing of anti-inflammatory substances such as cytokines. On the other hand, dexmedetomidine stimulates α_2 receptors at the presynaptic and central nervous systems, causing norepinephrine inhibition, which stops pain signal transmission. Postsynaptic stimulation causes inhibition of sympathetic activity that reduces heart rate and blood pressure[15].

All patients in both groups did not feel pain during the first 6 hours after surgery. Our study has had the mean VAS score at movement in the BD group statistically significantly lower than in the B group at 12, 16, 24 hours postoperative time, $p<0.05$ (Figure 3). Research by Bisui et al. (2017) had a mean VAS score of the group using dexmedetomidine which was 4.3 points, while the group of anesthetics alone was 5.8 points[16]. Bengisun ZK et al. (2014) also concluded that the VAS score in the dexmedetomidine group was lower than in the anesthetics alone group at 1, 2, 4, 6, 12, and 24 hours[17]. In addition, we have found similarities with Liu et al.'s

(2018) study when using dexmedetomidine in the brachial plexus block. The author found that at 8, 12, and 24 hours when VAS score in the 100 mcg dexmedetomidine combination group (VAS=2.4; 2.2 and 2.1 points) was significantly lower than that of the without dexmedetomidine group at the postoperative time (compared with 3.0; 4.2 and 5.4 points)[18].

We have had an incidence of bradycardia and nausea in the BD group accounting for 18.5%, and 7.4% statistically significantly higher than the B group is 1.9% and 0%, $p<0.05$ (Figure 4). Comparing foreign studies with dexmedetomidine, Agawal S. (2014) reported that the BD group had a heart rate slower than B group from 30th minute to 120th minute after brachial plexus block, a statistically significant difference, $p<0.001$. In addition, the research of Nazir N. (2016) also noted that heart rate in the BD group at 30, 60, 90, and 120 minutes was statistically significantly lower than that of the B group, $p<0.05$. Thus, our study was similar to those studies. It was easy to treat bradycardia by atropine with a dose of 0.01 mg/kg.

This study has been the first research about dexmedetomidine at brachial plexus block in our country. Consequently, we were based on foreign studies; we chose only one dose of dexmedetomidine for all BD group cases, which is our main limitation.

5. CONCLUSION

Supraclavicular brachial plexus block under ultrasound guidance using dexmedetomidine adding to bupivacaine, which has had a sedative effect in intraoperative time, less adverse effects. In addition, this combination prolongs the duration of analgesia with a low VAS score in the first 24 hours at the time of postoperation. Consequently, dexmedetomidine should be widely applied to add local anesthetic for brachial plexus block because of many benefits.

6. ACKNOWLEDGEMENT

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Conflict of interest

The authors declare that there are no conflicts of interest.

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None to declare.

Ethical approval

The study was approved by the Thesis Review Committee of the 108 Clinical Medicine and Pharmacy Science Research Institute on September 10, 2015, with the number 276/QĐ-V108.

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REFERENCES

1. Nguyen CD, Tran AT, Do DM. The situation of injury patients admitted in Viet Duc hospital in the period 2016-2018. Vietnam J Prev Med. 2019;29(8):135-40.
2. Karl WJ, Olson RP, Rosenwasser PM. The epidemiology of upper extremity fractures in the United States, 2009. J Orthop Trauma. 2015;29(8):242-4.
3. 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.
4. Chernik DA, Gillings D, Laine H, Hendler J, Silver JM, Davidson AB, et al. Validity and reliability of the Observer's Assessment of Alertness/Sedation Scale: study with intravenous midazolam. J Clin Psychopharmacol. 1990;10(4):244-51.
5. Gould D. Visual Analogue Scale (VAS). J Clin Nurs. 2001;10: 697-706.
6. 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):109-14.
7. Hohener D, Blumenthal S, Borgeat A. Sedation and regional anaesthesia in the adult patient. Br J Anaesth. 2008;100(1):8-16.
8. Hoang TQ, Nguyen TT, Nguyen TN. Evaluation of sedation and analgesia of dexmedetomidine in colonoscopy. Medical J at Ho Chi Minh City. 2012;16(1):300-5.
9. Nazir N, Jain S. A Randomized Controlled Trial Study on the Effect of Adding Dexmedetomidine to Bupivacaine in Supraclavicular Block Using Ultrasound Guidance. Ethiop J Health Sci. 2016;26(6):561-6.
10. Nallam SR, Chiruvella S, Karanam S. Supraclavicular brachial plexus block: Comparison of varying doses of dexmedetomidine combined with levobupivacaine: A double-blind randomised trial. Indian J Anaesth. 2017;61(3):256-61.
11. Biswas S, Das RK, Mukherjee G. Dexmedetomidine an adjuvant to levobupivacaine in supraclavicular brachial plexus block: a randomized double blind prospective study. Ethiop J Health Sci. 2014;24(3):203-8.
12. Esmaoglu A, Yegenoglu F, Akin A. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anaesth Analg. 2010;111:1548-51.
13. Kaygusuz K, Kol IO, Duger C. Effects of adding dexmedetomidine to levobupivacaine in axillary brachial plexus block. Curr Ther Res Clin Exp. 2012;73(3):103-11.
14. 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;118(2):167-81.
15. Yoshitomi T, Kohjitani A, Maeda S. Dexmedetomidine enhances the local anesthetic action of lidocaine via an alpha-2A adrenoceptor. Anesth Analg. 2008;107(1):96-101.
16. Bisui B, Samanta S, Ghoshmaulik S. Effect of locally administered dexmedetomidine as adjuvant to levobupivacaine in supraclavicular brachial plexus block: double-blind controlled study. Anesth Essays Res. 2017;11(4):981-6.
17. Bengisun ZK, Ekmekçi P, Akan B. The effect of adding dexmedetomidine to levobupivacaine for interscalene block for postoperative pain management after arthroscopic shoulder surgery. Clin J Pain. 2014;30(12):1057-61.
18. Liu Z, Jiang M, Xu T. Analgesic effect of Ropivacaine combined with dexmedetomidine on brachial plexus block. BMC Anesthesiol. 2018;18(1):1-6.