Rev Bras Anestesiol. 2019;69(2):144–151

Sociedade Brasileira de Anestesiologia

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

SCIENTIFIC ARTICLE

Addition of dexmedetomidine to bupivacaine in ultrasonography-guided paravertebral blockade potentiates postoperative pain relief among patients undergoing thoracotomy

Cihangir Biçer[a], **Esra Nur Ünalan**[a], **Recep Aksu**[a,*], **Ömer Önal**[b], **Işın Güneş**[a]

[a] *Erciyes University, Medical Faculty, Anesthesiology and Reanimation Department, Kayseri, Turkey*
[b] *Erciyes University, Medical Faculty, Thoracic Surgery Department, Kayseri, Turkey*

Received 26 January 2018; accepted 5 November 2018
Available online 21 December 2018

KEYWORDS
Dexmedetomidine;
Bupivacaine;
Paravertebral blockade;
Thoracotomy

Abstract
Background and objective: Thoracic paravertebral blockade is an alternative regional technique for comforting post-thoracotomy pain, thereby decreasing opioid consumption, postoperative nausea and vomiting, dizziness, respiratory depression and health care costs. The objective of this study was to investigate the effects of bupivacaine and bupivacaine plus dexmedetomidine on postoperative pain score and analgesic consumption in thoracotomy patients who had undergone ultrasonography-guided paravertebral blockade.
Material and method: 93 ASA I–II patients aged 18–65 years were included in the study and scheduled for thoracic surgery. Prior to anesthesia induction, the paravertebral blockade procedure was performed by an anesthetist with ultrasonography. Cases were randomly stratified into three groups. The paravertebral blockade procedure was performed with 20 mL 0.5% bupivacaine injection in Group B ($n = 31$) and 20 mL 0.5% bupivacaine + 1 mL dexmedetomidine (100 μg) injection in Group BD. Group C received postoperative i.v. morphine via patient-controlled analgesia without paravertebral blockade. Post-operative pain scores were recorded in the recovery room and post-operatively using a VAS. Hemodynamic parameters, adverse effects and morphine consumption were also recorded.
Results: No significant difference was determined between Group B and Group C regarding intra-operative adverse effects such as bradicardia and hypotension, while these adverse effects were significantly higher in Group BD ($p = 0.04$). VAS scores with rest and upon movement were significantly lower in Group BD compared to Group C ($p < 0.001$). Total morphine consumption was significantly lower in both Group B and Group BD in comparison with Group C ($p < 0.001$). In Group BD, HR and MAP were lower, but this was not clinically significant ($p < 0.05$).

* Corresponding author.
E-mail: raksu@erciyes.edu.tr (R. Aksu).

https://doi.org/10.1016/j.bjane.2018.12.004

Conclusion: The addition of dexmedetomidine to bupivacaine lowers postoperative pain scores and morphine consumption in thoracotomy patients who receive ultrasonography guided paravertebral blockade.

PALAVRAS-CHAVE
Dexmedetomidina;
Bupivacaína;
Bloqueio paravertebral;
Toracotomia

Adição de dexmedetomidina à bupivacaína em bloqueio paravertebral guiado por ultrassom potencializa o alívio da dor pós-operatória em pacientes submetidos à toracotomia

Resumo
Justificativa e objetivo: O bloqueio paravertebral torácico é uma técnica regional opcional para o alívio da dor pós-toracotomia, deste modo diminui o consumo de opioides, náuseas e vômitos no pós-operatório, tontura, depressão respiratória e custos com saúde. O objetivo deste estudo foi investigar os efeitos de bupivacaína isolada e bupivacaína + dexmedetomidina no escore de dor pós-operatória e no consumo de analgésicos em pacientes submetidos à toracotomia sob bloqueio paravertebral guiado por ultrassom.
Material e método: Noventa e três pacientes, ASA I–II, com idades entre 18 e 65 anos, foram incluídos no estudo e programados para cirurgia torácica. Antes da indução anestésica, o procedimento de bloqueio paravertebral foi realizado por um anestesista com o uso de ultrassom. Os casos foram estratificados aleatoriamente em três grupos. O procedimento de bloqueio paravertebral foi realizado com injeção de 20 mL de bupivacaína a 0,5% no Grupo B (n = 31) e de 20 mL de bupivacaína a 0,5% + 1 mL de dexmedetomidina (100 μg) no Grupo BD. O Grupo C recebeu morfina intravenosa via analgesia controlada pelo paciente sem bloqueio paravertebral. Os escores de dor pós-operatória foram registrados na sala de recuperação e no pós-operatório usando a escala VAS. Parâmetros hemodinâmicos, efeitos adversos e consumo de morfina também foram registrados.
Resultados: Não houve diferença significativa entre os grupos B e C em relação a efeitos adversos intraoperatórios, como bradicardia e hipotensão, enquanto esses efeitos adversos foram significativamente maiores no Grupo BD (p = 0,04). Os escores VAS em repouso e movimento foram significativamente menores no Grupo BD em relação ao Grupo C (p <0,001). O consumo total de morfina foi significativamente menor nos grupos B e BD em comparação com o Grupo C (p <0,001). No Grupo BD, a frequência cardíaca e a pressão arterial média foram menores, mas esse resultado não foi clinicamente significativo (p <0,05).
Conclusão: A adição de dexmedetomidina à bupivacaína reduz os escores de dor pós-operatória e o consumo de morfina em pacientes submetidos à toracotomia sob bloqueio paravertebral guiado por ultrassom.

Introduction

Thoracotomy pain occurs as a result of severe thoracic wall trauma, including rib fracture and peripheral nerve damage.[1] Thoracotomy surgery is directly related to respiratory function disorders due to severe thoracotomy pain.[2] Insufficient pain control may result in various postoperative complications such as mucoid plugs due to long term immobilization, hypoxia, atelectasis and pulmonary infection.[3] Since acute postoperative pain is also a predictor of long-term pain after thoracotomy, early and aggressive treatment of pain may help to reduce the currently high frequency of chronic pain.[4]

Many different pharmacological and non-pharmacological methods are used for the treatment of postoperative pain. These include opioid and non-opioid analgesic agents, sub-anesthetic doses of ketamine, sublingual buprenorphine hydrochloride, intrathecal or epidural drugs, clonidine, midazolam, ketamine and similar non-narcotics, intrapleural local anesthetics or opioids, local anesthetic infiltration to the incision line, inhalation agents such as nitrous oxide, cryoanalgesia, transcutaneous nerve stimulation and acupuncture.[5]

Thoracic epidural analgesia is accepted as a golden standard for post-thoracotomy analgesia.[4,6] However, complications and contraindications related with the

epidural technique may limit its use.[4] Thoracic Paravertebral Blockade (PVB) is an alternative regional technique for comforting post-thoracotomy pain.[1,4,6] Thoracic PVB reduces postoperative pain, thereby decreasing opioid consumption, postoperative nausea and vomiting, dizziness, respiratory depression and health care costs.[1,7] In addition, it reduces postoperative chronic pain at the wound site, thereby making a positive contribution to wound healing.[8]

Single and continuous PVB block techniques have been successfully administered for post-thoracotomy pain control.[2] However, the duration of single-dose administered PVB block is limited to the effect of administered local anesthetics. A single shot technique using bupivacaine, levobupivacaine or ropivacaine can provide analgesia for up to 18 h.[9,10] The addition of an adjuvant to local anesthesia may prolong block duration.[11] Dexmedetomidine is a selective alpha-2 adrenergic agonist with both analgesic and sedative properties.[12] When administered as a perineural adjuvant, dexmedetomidine reduces initial blocking time whilst prolonging sensory and motor blockade duration.[13]

The primary objective of this study was to compare the effects of bupivacaine and dexmedetomidine added to bupivacaine on the consumption of postoperative analgesic consumption in ultrasonography guided paravertebral blockade. The secondary objective was to compare the pain levels evaluated via a Visual Analog Scale (VAS) and reported side effects among the groups.

Materials and methods

Local ethics approval was received for the study (2014/649). After receiving written consent from the patients, 93 ASA I–II patients aged 18–65 years were included in the study and scheduled for thoracic surgery. A controlled, randomized, prospective study was carried out, and blinding was applied both to the patients and data collection team. Patients were excluded if they had a history of allergy to bupivacaine and dexmedetomidine, were or may have been pregnant, had a coagulation disorder, serious cardiac or pulmonary disease, had an administration site infection or were unable to understand the scoring system. Patients were randomized with sealed envelopes. The Control Group (Group C) ($n = 31$), Bupivacaine Group (Group B) ($n = 31$) and Bupivacaine + Dexmedetomidine Group (Group BD) ($n = 31$) were determined. The Groups B and BD were given, respectively, 1 mL 0.9% NaCl solution + 20 mL 0.5% bupivacaine (without epinephrine) (Bustesin® 5 mg.mL^{-1}, Vem Pharmaceuticals, Ankara, Turkey) and 20 mL 0.5% bupivacaine (without epinephrine) + 1 mL (100 μg) dexmedetomidine (Precedex® 100 μg.mL^{-1}, Meditera, ABD). Group C did not receive any block.

As premedication, 0.03 mg.kg^{-1} (maximum 2 mg) midazolam (Dormicum®) and 50 μg fentanyl (Talinat®, Vem, Istanbul) was applied as i.v. to the patients. Needle entry point was determined for the Group B and Group BD patients in the seated position, under sterile conditions at the axial axis with the accompaniment of ultrasonography, 2.5 cm lateral to the spinose process from the intercostal gap between the T5 and T6 ribs, after which 2 mL of 2% lidocaine (Aritmal® 2%, Osel İlaç San., İstanbul) was administered for subcutaneous infiltration. Paravertebral blockade was carried out via a 23 G 100 millimeter (Stimupleks® Ultra, B. Braun, Melsungen, Germany) peripheral blockade needle. The thoracic paravertebral area was determined using the internal intercostal membrane at the top and the pleura at the bottom. Perpendicular entry was made to the skin via a nerve block needle with ultrasonography until the transverse process. Paravertebral blockade was applied by injecting 21 mL of the prepared agent following the verification of the paravertebral region position using 5 mL 0.9% NaCl after intermittent aspiration. None of the patients, the investigators administrating the PVB block and carrying out the postoperative evaluation, or the surgeons performing the operation were given information on the groups.

All patients received standard general anesthesia under standard monitoring. Perioperative Mean Arterial Pressure (MAP) and Heart Rate (HR) values were recorded. Anesthesia was induced by the administration of 2–2.5 mg.kg^{-1} propofol (Lipuro® 1%, B/Braun, Germany), 1 μg.kg^{-1} fentanyl (Talinat®, Vem Pharmaceuticals, Istanbul, Turkey) and 0.6 mg.kg^{-1} rocuronium bromide (Esmeron®, Schering-Plough, Holland). When muscles were sufficiently relaxed, endotracheal intubation was performed with a double-lumen tube. For anesthesia, 1–1.5% sevoflurane (Sevorane® Likid 100%, Abbott, Turkey) was added to 50% oxygen + 50% air mixture. Patients were monitored and ventilated with an electronic anesthesia device (S/5 Avance®, Datex Ohmeda, Finland).

It was planned to administer 1 μg.kg^{-1} intravenous fentanyl in any case where MAP and HR values increased by 20% over basal values before induction. A MAP decrease of more than 20% was considered to be hypotension. In such cases, the sevoflurane concentration would be reduced and 5 mg ephedrine would be intravenously administered, if necessary. A heart rate less than 50 beats.min^{-1} was considered to be bradycardia, and 0.5 mg atropine was planned to be administered in these cases.

Anesthesia was discontinued following surgical operation and residual block was reversed using 0.02 mg.kg^{-1} atropine (atropine sulfate 0.25 mg.mL^{-1}, Biofarma, Istanbul, Turkey) and 0.04 mg.kg^{-1} neostigmine (neostigmine 0.5 mg.mL^{-1}, Adeka, Turkey). When the patient came out of anesthesia and had spontaneously gained sufficient tidal volume and motor function, they were transferred to the Postoperative Care Unit (PCU). Patient-Controlled Analgesia (PCA) was intravenously administered as a standard postoperative anesthesia regime. The PCA (Accumate 1100 Woo Young Medical, Korea) device solution was prepared by adding 100 mg of morphine (morphine 10 mg.mL^{-1}, Galen, Istanbul, Turkey) to 250 mL of 0.9% NaCl. The PCA device was set to have a 10 min lockout time and a 0.5 mg bolus. Patients were transferred to the thoracic surgery service after 2 h of follow-up in the PACU during the postoperative period. The severity of pain at rest and on movement (coughing) was assessed using a 10 cm VAS, scaled from left: 0 = no pain, to right; 10 = worst imaginable pain, and recorded again at post-operative 0, 1, 2, 6, 12, and 24 h. Patients with a VAS score of more than 4 during assessment were given 2 mg i.v. morphine and 50 mg i.v. dexketoprofen (Arveles®, Ufsa, Turkey) follow-up if necessary. The doses of morphine and analgesic consumed were recorded.

Table 1 Demographic characteristics, duration of anesthesia and surgery type.

	Groups			*p*
	Group B ($n = 31$) Mean ± SD	Group BD ($n = 31$) Mean ± SD	Group C ($n = 31$) Mean ± SD	
Age (year)	51.1 ± 15.6	46.3 ± 14.5	50.6 ± 12.8	0.359
Sex (F/M) (*n*)	15/16	17/14	16/15	0.879
BMI ($m^2.kg^{-1}$)	26.4 ± 4.4	25.7 ± 4.6	26.8 ± 5.6	0.635
ASA (I/II)	17/14	22/9	13/18	0.084
Duration of anesthesia (min)	148.2 ± 51.9	149.3 ± 35.9	172.9 ± 59.3	0.096
Surgery type				>0.05
Pneumonectomy	10 (33.3)	4 (12.9)	4 (12.9)	
Lobectomy	7 (22.6)	11 (35.5)	7 (22.6)	
Wedge resection	5 (16.1)	5 (16.1)	5 (16.1)	
Others	9 (28)	12 (35.5)	15 (48.4)	

Data are given as mean (SD) or number (*n*).
B, Bupivacaine; BD, Bupivacain + Dexmedetomidine; C, control.
$p < 0.05$, value is statistically significant.

All patients with nausea, retching or vomiting were planned to be given an antiemetic. In the presence of nausea/vomiting, it was planned to administer 10 mg i.v. metoclopramide HCl (Primperan®, Biofarma, Turkey) first, and then 4 mg i.v. ondansetron (Zofran®, GlaxoSmithKline, Italy) following 1 h of follow-up if necessary.

The primary outcome of this study was to assess morphine consumption for post-operative purposes. The secondary objective was to assess the patient's pain scores assessed with the VAS within the 24 h postoperative period, i.e. the period of hospitalization and side effects.

To calculate the sample size for the study, seven cases were pre-studied and the average 24 h post-operative morphine consumption was calculated. The determined amounts were 26.5 ± 5 mg in the control group, 20.1 ± 4.8 mg in the Bupivacaine group and 17.3 ± 4.5 mg in the Bupivacaine + Dexmedetomidine Group. The minimum number of subjects was determined as 31 for each group when $\alpha = 0.05$ and $\beta = 0.20$.

Statistical analysis

Data were statistically assessed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 21.0, IBM Corp, Armonk, NY). The Shapiro–Wilk normality test was used to determine whether sample the distribution was normal or not. Descriptive statistics with the unit number (*n*) are given as mean ± standard deviation and median (min–max) values. One-way analysis of variance (ANOVA) was used to evaluate whether there was a difference among groups with a normal distribution. The Kruskal–Wallis test, a non-parametric test, was used to evaluate the parameters with an abnormal distribution. Significant results were compared using pair wise comparisons and groups with statistical differences were determined. A value of $p < 0.05$ was accepted as statistically significant.

Results

There were no differences among the groups with regard to patient age, sex, BMI, ASA distribution, duration of anesthesia and surgery type ($p > 0.05$) (Table 1).

Regarding the heart rate comparisons among groups, the difference was statistically significant for Group BD at intra-operative 15 and 45 min ($p = 0.005$ and $p = 0.001$) and at postoperative 0 and 120 min in comparison with Group B and Group C ($p < 0.001$ and $p = 0.003$) (Fig. 1).

Regarding the MBP comparisons among the groups, the MBP of Group BD was significantly lower in comparison with Group B and Group C at intra-operative 30 min and postoperative 30 min ($p = 0.003$ and $p = 0.01$). The MBP in Group BD was significantly lower at intra-operative 60 min and postoperative 120 min in comparison Group C ($p = 0.002$ and $p = 0.003$) (Fig. 2).

Post-operative resting VAS (VASr) values were significantly lower in Group BD at all times in comparison with Group C (at postoperative 0–24 h), and in Group B in comparison with Group C at postoperative 1–24 h ($p < 0.001$). All VASr values in Group BD were significantly lower in comparison with Group B at postoperative 0–2 h and 12–24 h, excluding the postoperative 6 hour VASr values ($p < 0.001$) (Table 2).

VAS on movement (VASm) values was significantly lower in Group BD at all postoperative (0–24 h) time points in comparison with both Group B and Group C ($p < 0.001$). The VASm values of Group B were significantly lower in comparison with Group C at 0–24 h, excluding the 6 h values ($p < 0.001$) (Table 2).

Post-operative 0 min, 12 h and 24 h, dexketoprofen demand was determined to be high at a statistically significant level for Group C in comparison with the other two groups ($p < 0.001$) (Table 3).

Postoperative morphine consumption was significantly lower in Groups B and BD at all postoperative time in

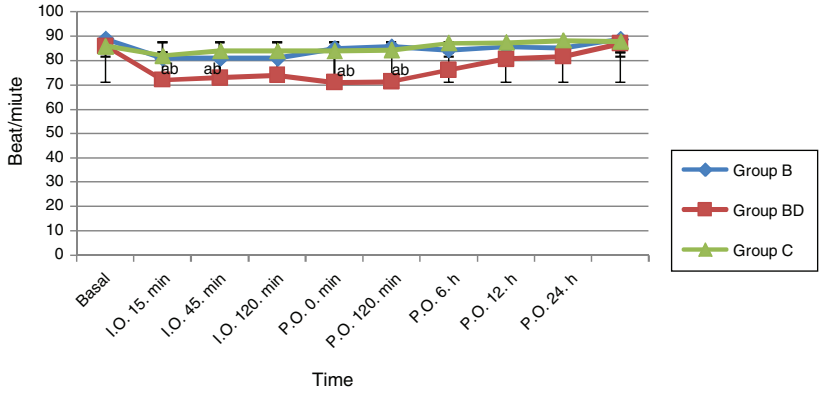

Figure 1 Intraoperative and postoperative heart rate. I.O., intraoperative; P.O., postoperative; B, bupivacaine; BD, Bupivacain + Dexmedetomidine; C, control. [a]Comparison with the Control Group. [b]Comparison with the Bupivacaine Group. $p < 0.05$, value is statistically significant.

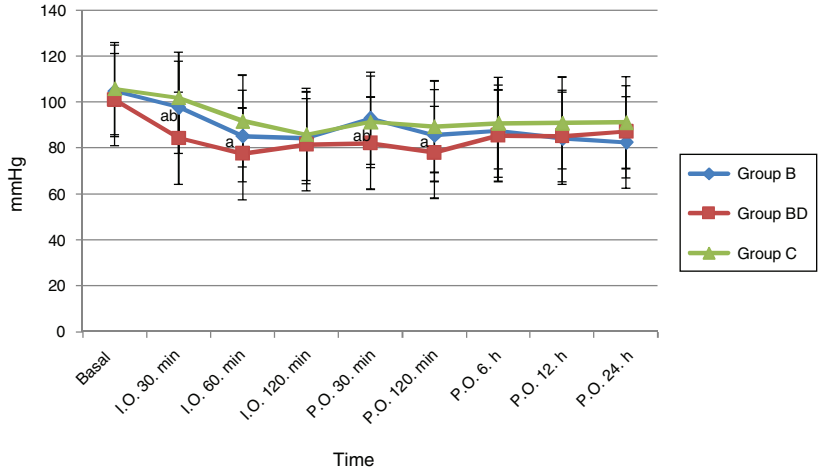

Figure 2 Intraoperative and postoperative mean blood pressure. I.O., intraoperative; P.O., postoperative; B, bupivacaine; BD, Bupivacain + Dexmedetomidine; C, control. [a]Comparison with the Control Group. [b]Comparison with the Bupivacaine Group. $p < 0.05$ value is statistically significant.

comparison with Group C ($p < 0.001$). Postoperative morphine consumption of Group BD was significantly lower in comparison with Group B at 0, 2, and 6 h ($p < 0.001$) (Table 3).

Although no statistically significant differences were determined between Group B and Group C with regard to bradycardia and hypotension, which are side effects observed during the operation, the finding of bradycardia in 5 patients and bradycardia + hypotension in 5 patients in Group BD was determined to be statistically significant ($p = 0.04$). Treatment of patients with bradycardia was carried out with a single dose of atropine (0.5 mg), whereas patients with hypotension were treated with 10 mg of ephedrine.

Discussion

This study revealed that adding dexmedetomidine to bupivacaine can improve the analgesic efficacy of paravertebral block in patients undergoing thoracic surgeries. It was determined in our study that additional analgesic demand (dexketoprofen and morphine) during the 0–24 h postoperative period as a result of paravertebral block applications in thoracic surgery were decreased. The combination of paravertebral dexmedetomidine and bupivacaine can produce better values of VAS scores on rest and movement at postoperative period.

Single injection or continuous infusion techniques may be applied in PVB. Whereas pain scores were determined to be similar in meta-analyses with thoracic surgery and continuous paravertebral-epidural blockade, morphine demand was determined to be higher for the paravertebral blockade groups during the 6–72 h period. However, lung complications, nausea/vomiting, urinary retention and hypotension were observed less in the PVB Group.[2,14]

Cücü et al.[15] carried out a study comparing the effectiveness of continuous thoracic epidural anesthesia and TPVB in which it was put forth that there was no difference between postoperative 24 h VAS scores and morphine consumptions and that both methods are equally effective for stopping pain.

The objective of PVB application is to increase the blockade duration via local anesthetic infusion via catheter. However, it has also been shown that various undesired

Table 2 Resting VAS and movement VAS values in groups.

Time	Groups			*p*
	Group B Med (min–max) (*n* = 31)	Group BD Med (min–max) (*n* = 31)	Group C Med (min–max) (*n* = 31)	
VASr				
0 min	6 (1–9)	0 (0–6)[a,b]	7 (2–9)	<0.001
60 min	4 (1–8)[a]	1 (0–6)[a,b]	4 (1–7)	<0.001
120 min	2 (0–5)[a]	0 (0–3)[a,b]	3 (1–6)	<0.001
6 h	2 (0–8)[a]	2 (0–4)[a]	3 (2–9)	<0.001
12 h	2 (0–5)[a]	0 (0–4)[a,b]	3 (2–8)	<0.001
24 h	2 (0–5)[a]	0 (0–4)[a,b]	2 (1–7)	<0.001
VASm				
0 min	7 (1–10)[a]	2 (0–8)[a,b]	9 (4–10)	<0.001
60 min	5 (2–9)[a]	2 (1–8)[a,b]	6 (4–9)	<0.001
120 min	3 (2–6)[a]	2 (0–4)[a,b]	4 (2–8)	<0.001
6 h	4 (2–9)	3 (0–6)[a,b]	5 (3–8)	<0.001
12 h	4 (1–7)[a]	2 (0–6)[a,b]	5 (3–9)	<0.001
24 h	3 (1–8)[a]	1 (0–4)[a,b]	4 (2–9)	<0.001

Data are given as median (minimum–maximum).
B, bupivacaine; BD, Bupivacain + Dexmedetomidine; C, control; VASr, resting VAS score; VASm, movement VAS score.
[a] Comparison with the Control Group.
[b] Comparison with the Bupivacaine Group.
$p < 0.05$, value is statistically significant.

Table 3 Need for analgesics in the postoperative period.

Time	Groups			*p*
	Group B (*n* = 31)	Group BD (*n* = 31)	Group C (*n* = 31)	
Dexketoprofen, n (%)				
0 min	10 (32.3)[a]	9 (29)[a]	19 (61.3)	<0.001
6 h	10 (32.3)	6 (19.4)	14 (45.2)	0.107
12 h	8 (25.8)[a]	3 (9.7)[a]	16 (51.6)	<0.001
24 h	5 (16.1)[a]	0 (0)[a]	15 (48.4)	<0.001
Morphine (mg)	Mean ± SD			
0 min	1.0 ± 1.0[a]	0.4 ± 0.8[a,b]	1.8 ± 0.7	<0.001
2 h	5 ± 1.4[a]	4 ± 1.7[a,b]	6.1 ± 0.9	<0.001
6 h	10.1 ± 3.2[a]	7.9 ± 3.6[a,b]	13.9 ± 3.6	<0.001
12 h	15.5 ± 5.1[a]	12.9 ± 4.7[a]	21.4 ± 4.9	<0.001
24 h	25.5 ± 8.7[a]	19 ± 6.1[a]	33 ± 5.9	<0.001

B, bupivacaine; BD, Bupivacain + Dexmedetomidine; C, control; *n* (%), number of patients requested medication and percentage to patients in Group.
[a] Comparison with the Control Group.
[b] Comparison with the Bupivacaine Group.
$p < 0.05$, value is statistically significant.

complications can develop due to catheter infusion such as delayed hemothorax, fever, nausea, vomiting and convulsions (68 h later with bupivacaine infusion).[16,17] Single dose blockade application studies are ongoing to eliminate these complications.

Kairaluoma et al.[7] showed that single dose PVB application decreases severe pain at postoperative 6 h after breast surgery at a statistically significant level in comparison with placebo, and also showed that PVB also decreases the minimal pain score within 24 h, the pain score at rest and the continuous pain score. Moawad et al.[9] indicated that VAS scores showed no significant difference between single-dose paravertebral blockade versus epidural blockade, whereas Vogt et al.[18] reported that, after thoracoscopic surgery, pain scores for the postoperative 24 h period with cough and resting for 48 h were lower in comparison than those of the control group. Schnabel et al.[19] carried out a meta-analysis compiling 15 randomized controlled studies with a total of

877 breast surgeries and showed that pain control was better in the PVB groups in comparison with the general anesthesia groups in which other analgesic modalities were applied. Moreover, for groups receiving a single dose of PVB with general anesthesia or PVB alone, the side effects and postoperative chronic pain were lower at postoperative 6 months.

In the present study, resting VAS values were determined to be lower at all postoperative time points (0–24 h) for PVB patients in comparison with the control group. Median rest and VAS on movement values at postoperative 0 min were 6 and 7 cm, respectively, in the Bupivacaine Group, and 0 and 2 cm in the Bupivacaine + Dexmedetomidine Group, whereas they were 7 and 9 cm in the control group. When rest and VAS on movement values were examined at 24 h, they were 2 and 3 cm, respectively, in the Bupivacaine Group, 0 and 1 cm in the Bupivacaine + Dexmedetomidine Group, and 2 and 4 cm in the Control Group. Analgesia at 0 and 24 min was more effective for the Bupivacaine + Dexmedetomidine PVB Group in comparison with the other two groups. There was no significant difference between the groups with respect to the VASr value at time six. It was suprising to see the significant difference between groups in the opioid consumption at the same time point. This may be because: although the medians of VASr values in both groups are same, the min–max range in the Bupivacaine Group is wider (0–8) than the min–max range in the Bupivacaine + Dexmedetomidine Group (0–4).

Adjuvants such as adrenaline, fentanyl and clonidine are added to local anesthetics in order to reduce complications and to provide a more effective and longer post-operative analgesia. Local anesthetics produces analgesia by sodium channel blockade, while dexmedetomidine, a selective α-2 adrenergic agonist, produces analgesia by inhibition of postsynaptic α-2 adrenoreceptors. Thus, analgesia quality increases and local anesthetic use is reduced, and local anesthetics are kept at safe doses and non-toxic levels.[20] Vogt et al.[18] carried out a study comparing a control group of thoracoscopic surgery patients with PVB patients given 0.4 mL.kg^{-1} of a 0.375% bupivacaine + adrenaline (1:200 000) mixture. As a result, it was determined that cumulative morphine consumption at postoperative 30 min, 3 h and 48 h was similar to that of the control group; total morphine consumption median values at 48 h were as 69.3 mg and 78.1 mg, respectively.

Brummett et al.[21] were able to increase sensorial and motor block duration without tissue and nerve damage in perineural application in rats with the addition of high doses of dexmedetomidine to the local anesthetic. It was found in several human studies that the addition of dexmedetomidine to local anesthesia administered to central neuroaxial and peripheral block prolonged the local anesthetic action time and reduced anesthetic request.[22–24] Agarwal et al.[23] indicated in their study that analgesia time was prolonged up to 8 h when they added 100 μg dexmedetomidine to bupivacaine in supraclavicular block. Almarakbi et al.[22] stated in a study in which dexmedetomidine was added to bupivacaine in transversus abdominis plane block for abdominal hysterectomy that the first analgesic administration was significantly longer in comparison with the Dexmedetomidine Group (470 min and 280 min, respectively) and total 24 h morphine consumption was significantly lower in this group (19 mg and 29 mg, respectively).

In our study, morphine consumption was found to be lower in the PVB Groups in comparison with the Control Group, starting immediately after surgery. It was observed that postoperative analgesic demand was lower in the dexmedetomidine added group in comparison with the Bupivacaine Group. In addition, morphine consumption was found to be lower for the Bupivacaine Group and bupivacaine + dexmedetomidine Group at all postoperative time points in comparison with the control group, and morphine consumption was lower in the Bupivacaine + Dexmedetomidine Group at postoperative 0–6 h in comparison with the bupivacaine alone group. When the postoperative 24 h average morphine consumption of patients was examined, it was found to be 25.5 mg for the Bupivacaine Group, 19 mg for the Bupivacaine + Dexmedetomidine Group and 33 mg for the Control Group. This indicates the effective analgesia of PVB in addition to the early and long-term analgesic effect of dexmedetomidine, in addition to a positive effect on both VAS scores and the amount of morphine consumed.

Side effects partially related to sedation may be observed in response to dexmedetomidine, such as hypotension and bradycardia at high doses.[22] It was observed in a study on dexmedetomidine added to levobupivacaine in supraclavicular block that the systolic and diastolic blood pressure values of the Dexmedetomidine Group were higher in comparison with the Control Group and that the incidence of bradycardia was higher in the Dexmedetomidine Group.[25] A significant decrease in post-block HR and MAP values was observed in our study in the Bupivacaine Group and the Bupivacaine + Dexmedetomidine Group in comparison with the pre-block values. However, this effect lasted longer in the Bupivacaine + Dexmedetomidine Group. There was atropine demand in five patients and ephedrine demand in five patients. Postoperative complications such as lung complications, nausea/vomiting and urinary retention were not observed in the PVB patients in our study.

One of the limitations in this study is inability to assess the success of the block. Another limitation was not evaluating the degree of postoperative sedation, which may result as a side effect from dexmedetomidine use, although, we assessed hypotension and bradycardia which may be related to dexmedetomidine.

Conclusion

Good local anesthesia, postoperative morphine consumption without severe side effects and decreased VAS scores along with good pain control were attained following TPVB application on thoracotomy patients with the addition of dexmedetomidine to bupivacaine.

Funding

This research was supported by Erciyes University BAP Unit.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgments

This work was supported by Research Fund of the Erciyes University. Project Number: TTU-2015-5705.

References

1. Richardson J, Sabanathan S, Jones J, et al. A prospective, randomized comparison of preoperative and continuous balanced epidural or paravertebral bupivacaine on post-thoracotomy pain, pulmonary function and stress responses. Br J Anaesth. 1999;83:387–92.
2. Messina M, Boroli F, Landoni G, et al. A comparison of epidural vs. paravertebral blockade in thoracic surgery. Minerva Anestesiol. 2009;75:616–21.
3. Ochroch EA, Gottschalk A, Augostides J, et al. Long-term pain and activity during recovery from major thoracotomy using thoracic epidural analgesia. Anesthesiology. 2002;97:1234–44.
4. Joshi GP, Bonnet F, Shah R, et al. A systematic review of randomized trials evaluating regional techniques for postthoracotomy analgesia. Anesth Analg. 2008;107:1026–40.
5. Surange PN, Venkata Rama Mohan BC. Comparative evaluation of continuous lumbar paravertebral versus continuous epidural block for postoperative pain relief in hip surgeries. Anesth Pain Med. 2012;1:178–83.
6. Komatsu T, Sowa T, Takahashi K, et al. Paravertebral block as a promising analgesic modality for managing post-thoracotomy pain. Ann Thorac Cardiovasc Surg. 2014;20:113–6.
7. Kairaluoma PM, Bachmann MS, Korpinen AK, et al. Single-injection paravertebral block before general anesthesia enhances analgesia after breast cancer surgery with and without associated lymph node biopsy. Anesth Analg. 2004;99:1837–43.
8. Buggy DJ, Kerin MJ. Paravertebral analgesia with levobupivacaine increases postoperative flap tissue oxygen tension after immediate latissimus dorsi breast reconstruction compared with intravenous opioid analgesia. Anesthesiology. 2004;100:375–80.
9. Moawad HE, Mousa SA, El-Hefnawy AS. Single-dose paravertebral blockade versus epidural blockade for pain relief after open renal surgery: a prospective randomized study. Saudi J Anaesth. 2013;7:61–7.
10. Bondár A, Szucs S, Iohom G. Thoracic paravertebral blockade. Med Ultrason. 2010;12:223–7.
11. Ammar AS, Mahmoud KM. Effect of adding dexamethasone to bupivacaine on transversus abdominis plane block for abdominal hysterectomy: a prospective randomized controlled trial. Saudi J Anaesth. 2012;6:229–33.
12. Coursin DB, Coursin DB, Maccioli GA. Dexmedetomidine. Curr Opin Crit Care. 2001;7:221–6.
13. Brummett CM, Norat MA, Palmisano JM, et al. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nevre block without inducing neurotoxicity in rat. Anesthesiology. 2008;109:502–11.
14. Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs. epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2006;96:418–26.
15. Cucu O, Karaca P, Enc Y, et al. Comparison of epidural anesthesia and paravertebral nerve block in patients undergoing thoracotomy (Internet). J Anesthesiol. 2005;11:1–8.
16. Mohta M, Ophrii EL, Sethi AK, et al. Continuous paravertebral infusion of ropivacaine with or without fentanyl for pain relief in unilateral multiple fractured ribs. Indian J Anaesth. 2013;57:555–61.
17. Mohta M, Verma P, Saxena AK, et al. Prospective, randomized comparison of continuous thoracic epidural and thoracic paravertebral infusion in patients with unilateral multiple fractured ribs – a pilot study. J Trauma. 2009;66:1096–101.
18. Vogt A, Stieger DS, Theurillat C, et al. Single-injection thoracic paravertebral block for postoperative pain treatment after thoracoscopic surgery. Br J Anaesth. 2005;95:816–21.
19. Schnabel A, Reichl SU, Kranke P, et al. Efficacy and safety of paravertebral blocks in breast surgery: a meta-analysis of randomized controlled trials. Br J Anaesth. 2010;105:842–52.
20. Burlacu CL, Frizelle HP, Moriarty DC, et al. Pharmacokinetics of levobupivacaine, fentanyl, and clonidine after administration in thoracic paravertebral analgesia. Reg Anesth Pain Med. 2007;32:136–45.
21. Brummett CM, Norat MA, Palmisano JM, et al. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nerve block without inducing neurotoxicity in rat. Anesthesiology. 2008;109:502–11.
22. Almarakbi WA, Kaki AM. Addition of dexmedetomidine to bupivacaine in transversus abdominis plane block potentiates post-operative pain relief among abdominal hysterectomy patients: a prospective randomized controlled trial. Saudi J Anaesth. 2014;8:161–6.
23. Bharti N, Kumar P, Bala I, et al. The efficacy of a novel approach to transversus abdominis plane block for postoperative analgesia after colorectal surgery. Anesth Analg. 2011;112:1504–8.
24. Akin S, Aribogan A, Arslan G. Dexmedetomidine as an adjunct to epidural analgesia after abdominal surgery in elderly intensive care patients: a prospective, double-blind, clinical trial. Curr Ther Res. 2008;69:16–28.
25. Biswas S, Das RK, Mukherjee G, et al. Dexmedetomidine an adjuvant to levobupivacaine in supraclavicular brachial plexus block: a randomized double blind prospective study. Ethiopian J Health Sci. 2014;24:203–8.