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Dexmedetomidine as an adjuvant to bupivacaine in ultrasound-guided serratus anterior plane block in patients undergoing video-assisted thoracoscopic surgeries

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Abstract

Background: The purpose of this study was the assessment of the analgesic and hemodynamic implications of dexmedetomidine used as an additive to bupivacaine in ultrasound-guided serratus anterior plane (SAP) block for patients undergoing video-assisted thoracoscopic surgeries (VATS) under general anesthesia.

Results: The hemodynamic stability was maintained perioperatively with no significant difference of MBP and HR recordings between the two study groups ($P > 0.05$). The time to 1st postoperative analgesic demand was significantly longer in group BD than in group B ($P < 0.05$). The postoperative total nalbuphine and rescue ketorolac requirements were significantly lower in group BD than in group B ($P < 0.05$). The VAS scores were significantly lower in group BD at 8th and 12th h postoperatively than in group B, with no significant difference at 0–6 h and 18–24 h postoperatively ($P > 0.05$). Ramsay sedation scores were significantly higher in the group BD than in group B in the initial 1st h after surgery ($P < 0.05$) with no significant difference at the subsequent postoperative recordings ($P > 0.05$).

Conclusion: Using dexmedetomidine (0.5 $\mu\text{g}/\text{kg}$) as an additive to bupivacaine for SAP block prolongs the duration of postoperative analgesia and reduces the postoperative analgesic requirements in the 1st 24 h after VATS without any significant side effects.

Keywords: Video-assisted thoracoscopy, Serratus anterior plane, Bupivacaine, Dexmedetomidine

Background

Adequate pain relief after thoracic surgeries leads to early mobilization, improves respiratory functions, and decreases global stress response (Alzahrani, 2017). Thoracic epidural analgesia (TEA) and paravertebral block (PVB) are optimal methods for postthoracotomy pain relief, and they are also widely used for pain management after VATS (Vogt et al., 2005; Kaya et al., 2012). However, they have their own adverse effects and limitations (Vig et al., 2019).

SAP block may be considered the transversus abdominis plane (TAP) block of the chest wall. It is a novel ultrasound-guided interfascial plane block technique that provides analgesia to the anterolateral and part of the posterior side of the chest wall as an alternative to TEA and PVB (Alzahrani, 2017; Ohnston et al., 2019). SAP block involves local anesthetic injection in a plane superficial or deep to the serratus anterior muscle which blocks the lateral cutaneous branches of intercostals nerves. Blanco et al. reported a sensory block overlying T2–T9 dermatomes with SAP block (Blanco et al., 2013).

Multiple local anesthesia (LA) adjuvants were used to intensify the quality and increase the duration of

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different regional and peripheral nerve blocks (Grewal, 2011). Dexmedetomidine is a selective α_2 adrenergic receptor agonist which was used as a local anesthetic adjuvant in both peripheral nerve blocks and plexus blocks with a longer duration and improved analgesic efficacy and without neurologic complications (Brummett et al., 2011a; Brummett et al., 2008; Marhofer et al., 2013).

The goal of this prospective, randomized, double blind study was the assessment of the analgesic and hemodynamic implications of dexmedetomidine used as an additive to bupivacaine used for SAP block in patients who underwent VATS under general anesthesia.

Methods

This study was conducted after its protocol was accepted by our institutional research and ethics committee and the informed consents was taken from 52 participants that were in American Society of Anesthesiologist (ASA) physical grade I–II of both sex who underwent VATS at the period between October 2019 and August 2020. Patients that were excluded from this study were those with infection at the site of block, significant chest wall deformity disrupting the local anatomy, study medication allergy, cardiac conduction defects, severe liver or renal impairment, and psychiatric disorders that could interfere with proper postoperative pain assessment and those on chronic adrenoceptor agonists and antagonists or narcotics therapy.

Using standard monitoring protocols in the operating room, all patients who received general anesthesia with intravenous fentanyl 1.5 $\mu\text{g}/\text{kg}$ and propofol 2 mg/kg followed by neuromuscular blockade was achieved using atracurium 0.5 mg/kg then double-lumen endobronchial tube was inserted and confirmed for the proper position using fiberoptic bronchoscopy. A radial artery catheter was inserted for continuous arterial blood pressure monitoring and intermittent arterial blood gasses withdrawing. All patients were turned to lateral position, and one lung ventilation was begun.

After proper sterilization of the proposed injection site on the lateral chest wall, the SAP block was performed while the patient in lateral position by a single anesthesiologist under ultrasound guidance using SonoSite M-Turbo Ultrasound System (FUJIFIM SonoSite, Inc., Bothell, WA, USA), and a 6–13-MHz ultrasound linear transducer which was used to identify the fifth rib at the mid-axillary line. The latissimus dorsi and serratus anterior muscles were then identified at the fifth intercostal space. A 20-gauge spinal needle was introduced in the interfascial space between the two muscles using an in plane technique. After the negative aspiration, the correct positioning of the needle tip was confirmed by injecting normal saline (3 mL) for hydrodissection of the targeted plane for block injection. In this study,

superficial SAP block, targeting the interfascial plane between the serratus anterior and latissimus dorsi muscles, was performed instead of the deep SAP block targeting interfascial plane between the serratus anterior and external intercostals muscles. Both techniques were proved effective, but the superficial one is known to provide a wider dermatomal spread and more extended analgesia (Blanco et al., 2013).

Patients were blindly randomized into two groups by sealed envelopes: the bupivacaine group (group B) and bupivacaine-dexmedetomidine group (group BD). Patients in group B ($n = 26$) received SAP block on surgical side using 32 ml of the study medication which consisted of 30 ml of bupivacaine 0.25% and 2 ml of normal saline, while those in group BD ($n = 26$) received SAP block on surgical side with 32 ml the study medication, in which dexmedetomidine 0.5 mcg/kg was dissolved in 2 ml of normal saline and added to 30 ml of bupivacaine 0.25%. The injectate was given in increments, its spread in the targeted interfascial plane was confirmed under complete ultrasound observation, and the patients remained in the lateral position, then surgery was started 20 min after doing SAP block. The preparation of the drugs was done by a different anesthesiologist who was not involved in performing the SAP block and perioperative anesthetic management.

Sevoflurane was used for anesthesia maintenance, and its dialed concentration was adjusted for keeping bispectral index (BIS) at 40 to 60, and atracurium boluses were administered as required for adequate muscle relaxation. The heart rate (HR) and mean arterial pressure (MBP) were recorded at baseline, every 30 min during surgery, after shifting to PACU, then postoperatively at 1st, 2nd, 4th, 8th, 12th, and 24th h. Intraoperative fentanyl (0.5 $\mu\text{g}/\text{kg}$) top-up doses were administered if MBP and HR raised above 20% of pre-anesthetic values, and the total intraoperative fentanyl requirements were recorded. After the conclusion of surgery, anesthesia was discontinued and residual neuromuscular blockade was reversed. After patients extubation, they were connected to intravenous patient-controlled analgesia (PCA) system (Accufuser) prepared with 100 mL normal saline containing 40 mg of nalbuphine and programmed to give a 1 mL bolus dose, a lockout interval of 15 min, and background infusion of 2 ml/h.

After shifting patients to post anesthesia care unit (PACU), standard monitoring was continued and the extent of sensory blockade of SAP block was assessed by the response to pinprick stimulus using 25-G needle at the midclavicular, midaxillary, and midscapular lines 30 min later. Each patient's pain level was assessed by the visual analog scale (VAS) (Breivik et al., 2008) that was documented after shifting to PACU then at 15, 30 min, 1st, 2nd, 4th, 8th, 12th, 18th, and 24th h postoperative.

If patient complained of pain or VAS score was 4 or higher, patients were encouraged to use the PCA analgesic-demand button which can be repeated until pain relief. Intravenous ketorolac (30 mg) was administered for rescue analgesia if the pain relief was inadequate or VAS score was still 4 or higher which could be administered every 6 h if required to the maximum dose of 120 mg/day. The time to 1st postoperative PCA analgesic demand (primary outcome), the PCA nalbuphine consumption at the 8th, 16th, and 24th postoperative hours, and the rescue ketorolac analgesic requirements and consumption in the 1st 24 h were recorded.

Postoperative sedation was evaluated by Ramsay sedation scale (Ramsay et al., 1974) which was documented at the same time points for VAS recordings. After staying in PACU for 2 h, patients were admitted to the high dependency unit for 24 h observation. PCA was discontinued 24 h after surgery, and oral analgesics began.

Statistical analysis

Patient's data analysis was carried out using Statistical Package for Social Science for Windows version 16.0. The Sample size was determined by G Power[®] version 3.1.5 software [Franz Faul, Universita[†] t Kiel, Germany, 2012] to be 26 patients in each study group, using 95% confidence interval, power of the study being 80% and alpha error of 0.05 with the assumption of possibility of dropout rate of 20%. Quantitative data were expressed as mean and standard deviation or median (min-max). Qualitative data were expressed as number (percentage). Unpaired *t* test was used for intergroup quantitative data comparison while paired *t* test was used for intragroup data comparison. For comparing qualitative data, chi-square (χ^2) test or Fisher's exact test was used. Analysis of sedation scores were done via Mann–Whitney *U* test.

Significance threshold *P* values were determined to be less than 0.05.

Results

Sixty-four patients scheduled for VATS were enrolled in this study. Seven of them were not meeting the inclusion criteria, five refused the participation in the study, and the remaining fifty two patients were equally randomized to either the group B (*n* = 26) or the group BD (*n* = 26).

Patients' and surgery characteristics were comparable between the two studied groups (*P* > 0.05) (Table 1).

The SAP block was successfully done in all patients of the two study groups with no statistically significant difference between both groups as regards the dermatomal distribution of sensory blockade of SAP block in midclavicular/midaxillary/midscapular lines (*P* > 0.05) (Table 2)

The MBP and HR recordings were comparable between the two study groups (*P* > 0.05). In both groups, there was no significant difference at MBP and HR recordings when compared to baseline values (*P* > 0.05) (Table 3 and Table 4). Two patients of group B and two patients of group BD developed intraoperative hypotension (decrease MBP to lower than 60 mmHg) which was treated by fluid boluses and ephedrine increment, while intraoperative bradycardia (decrease HR to lower than 50 bpm) occurred in two patients of group B and three patients of group BD which was treated by intravenous atropine.

The intraoperative fentanyl consumption was comparable between the two study groups (*P* > 0.05) (Table 5).

The VAS scores were not significantly different between both study groups at 0–6th h and at 18th and 24th h postoperative (*P* > 0.05), but they were significantly lower in group BD when compared with group B at 8th and 12th h postoperative (*P* < 0.05) (Table 6).

The duration till the 1st PCA analgesic demand after surgery was significantly longer in group BD than in

Table 1 Patients' and surgery characteristics

	Group B (<i>n</i> = 26)	Group BD(<i>n</i> = 26)	<i>P</i> value
Age (years)	52.44 ± 10.73	50.35 ± 11.55	0.502
Sex (M/F)	15/11	17/9	0.568
Weight (kg)	79.34 ± 8.65	76.88 ± 9.43	0.331
ASA			
I/II	13/13	15/11	0.578
Types of surgery			
Lobectomy	15	13	0.815
Segmentectomy	7	10	
Decortication	4	3	
Surgery duration (minutes)	186.12 ± 33.21	179.23 ± 27.52	0.419
Anesthesia duration (minutes)	216.43 ± 37.54	210.55 ± 31.67	0.544

Values are reported as mean ± SD or numbers

Table 2 Dermatomal distribution of sensory blockade of SAP block

Dermatomal distribution of the SAP block	Anterior chest wall in the mid-clavicular line		P value	Lateral chest wall in the mid-axillary line		P value	Posterior chest wall in the mid-scapular line		P value
	Group B (n = 26)	Group BD (n = 26)		Group B (n = 26)	Group BD (n = 26)		Group B (n = 26)	Group BD (n = 26)	
T2-T6									
T2-T7									
T2-T8	9 (34.61%)	8 (30.76%)	0.767	–	–	–	–	–	–
T2-T9	7 (26.92%)	8 (30.76%)	0.759	–	–	–	–	–	–
	6 (23.07%)	6 (23.07%)	1	5 (19.23%)	4 (15.38%)	0.713	5 (19.23%)	4 (15.38%)	0.713
	4 (15.38%)	4 (15.38%)	1	21 (80.76%)	22 (84.61%)	0.713	21 (80.76%)	22 (84.61%)	0.713

Values are reported as n (percentage)

group B ($P < 0.05$) (Table 7). There was a significant reduction in PCA nalbuphine consumption in group BD than in group B at 8th, 16th, and 24th postoperative hours ($P < 0.05$) (Table 7). The frequency of rescue ketorolac demand and the total ketorolac utilized over postoperative 24 h was significantly lower in group BD than in group B ($P < 0.05$) (Table 7).

Patients in the BD had significantly higher sedation scores in the initial 1 h after surgery than in group B ($P < 0.05$) without any significant difference at the following recordings ($P > 0.05$) (Table 8).

There was no significant difference between both study groups as regards the rate of postoperative complications ($P > 0.05$) (Table 9). Postoperative episode of tachyarrhythmia (atrial fibrillation) occurred in 1 patient in each study group. Respiratory depression (defined as breath rate < 12 bpm or $SpO_2 < 90\%$) did not occur in any patients of both study groups. Finally, we did not encounter block-related complications, such as pneumothorax or local anesthetic toxicity in all patients of both study groups.

Discussion

In this study, the analgesic and hemodynamic effects of dexmedetomidine combined with bupivacaine used in SAP block for patients who underwent VATS under general anesthesia was investigated. The patients' and surgery characteristics were comparable between the two study groups. The SAP block was done successfully

under ultrasound guidance in all patients of both study groups with no statistically significant difference as regards the block sensorial distribution and tendency for more caudal spread of the SAP block at the lateral (mid axillary) and posterior (midscapular) chest wall between both groups. These findings were reported by Blanco et al. (Blanco et al., 2013) who assessed the spread of LA in both superficial and deep SAP block using gadolinium dye and magnetic resonance imaging scan. In their study, they found that superficial SAP block resulted in sensory loss from T2 to (T6-T9) dermatomes at the anterior chest wall and sensory loss from T2 to (T8-T9) dermatomes at the lateral and posterior chest wall, and they concluded that the LA spread in superficial SAP block appeared to be wider and more reliable with tendency of more posterior distribution when compared with deep SAP block. Those results were also in accordance with those described by Sai et al. (Seo et al., 2014) who performed a superficial SAP block for 2 patients to control chronic chest wall pain syndrome and with those of Aly and Abd Ellatif (Aly & Abd Ellatif, 2018) who evaluated the effectiveness of superficial SAP block and PVB for post-thoracotomy pain control.

The hemodynamic adverse events such as hypotension and bradycardia were the most focused points with dexmedetomidine use as LA adjuvant in peripheral nerve blocks which could be attributed to systemic absorption of the drug and the stimulation of the α_2 -receptor in the locus coeruleus of brainstem causing central

Table 3 Perioperative MBP values

	Group B (n = 26)	Group BD (n = 26)
Baseline	81.15 ± 11.35	79.23 ± 13.44
30 min	84.46 ± 9.34	82.27 ± 10.42
60 min	79.24 ± 12.23	76.66 ± 8.74
90 min	77.85 ± 10.57	74.89 ± 9.66
120 min	76.68 ± 12.42	74.21 ± 8.84
150 min	79.25 ± 13.35	76.34 ± 10.24
At PACU	83.47 ± 10.28	80.52 ± 9.53
After 1 h	80.28 ± 11.44	78.63 ± 10.72
After 2 h	80.37 ± 10.36	76.83 ± 9.55
After 4 h	83.75 ± 9.43	80.14 ± 8.63
After 8 h	81.54 ± 12.52	79.94 ± 9.67
After 12 h	84.36 ± 10.44	81.77 ± 9.72
After 24 h	84.23 ± 12.46	80.85 ± 10.34

Values are reported as mean ± SD

Table 4 Perioperative HR values

	Group B (n = 26)	Group BD (n = 26)
Baseline	76.45 ± 9.35	74.44 ± 8.74
30 min	75.87 ± 9.35	74.12 ± 8.66
60 min	73.33 ± 10.67	72.25 ± 10.84
90 min	75.85 ± 8.68	73.83 ± 9.23
120 min	76.22 ± 9.45	73.65 ± 10.22
150 min	74.59 ± 9.52	71.34 ± 10.33
At PACU	78.25 ± 10.22	74.83 ± 8.79
After 1 h	78.74 ± 9.54	76.36 ± 7.76
After 2 h	76.15 ± 7.94	74.88 ± 8.32
After 4 h	79.23 ± 10.47	76.68 ± 7.53
After 8 h	77.31 ± 10.83	75.77 ± 8.54
After 12 h	75.44 ± 9.72	74.75 ± 7.44
After 24 h	78.56 ± 10.38	76.23 ± 8.55

Values are reported as mean ± SD

Table 5 Intraoperative fentanyl consumption

Anesthetic agents consumption	Group B (n = 26)	Group BD (n = 26)	P value
Total intraoperative fentanyl consumption (μg)	121.37 \pm 16.67	114.87 \pm 12.28	0.115

Values are reported as mean \pm SD

sympatholytic effect (Frag et al., 2012) besides its agonist activity on presynaptic α_2 receptors causing inhibition of noradrenaline release from the peripheral nerve endings (Morgan et al., n.d.).

In this study, the hemodynamic stability was maintained perioperatively with no significant difference of MBP and HR values within the study groups or between the groups at all recordings which could be contributed to multiple factors. First, the use of SAP block for thoracic wall analgesia spared the thoracic sympathetic fiber innervations when compared with unilateral and bilateral autonomic block that accompanies PVB and TEA (Tighe & Karmakar, 2013). Second are the relative low vascularity of the interfascial SAP plane (Blanco et al., 2013) and consequently the slower study medication systemic absorption and less hemodynamic affection. Third, the small dose of dexmedetomidine (0.5 $\mu\text{g}/\text{kg}$) used in this study was also used by Santosh et al. (Santosh & Mehandale, 2016) who investigated the effect of addition of dexmedetomidine (0.5 $\mu\text{g}/\text{kg}$) as adjuvant to ropivacaine in superficial cervical plexus block for thyroid surgery, and they documented perioperative hemodynamic stability with insignificant difference between the study groups as regards the MBP and HR values. Similarly, Qin et al. (Qin et al., 2019) assessed the effects of different dexmedetomidine doses 0.25 $\mu\text{g}/\text{kg}$, 0.5 $\mu\text{g}/\text{kg}$, or 1.0 $\mu\text{g}/\text{kg}$ in combination with ropivacaine for TAP block on the hemodynamic and stress response in patients who underwent laparoscopic surgery, and they reported that at a dose of 0.5 $\mu\text{g}/\text{kg}$ of dexmedetomidine provided

Table 6 Postoperative pain scores

	Group B (n = 26)	Group BD (n = 26)	P value
On PACU admission	1.73 \pm 1.28	1.57 \pm 0.88	0.601
After 15 min	1.96 \pm 1.05	1.80 \pm 0.62	0.506
After 30 min	2.51 \pm 0.71	2.23 \pm 0.93	0.228
After 1 h	2.34 \pm 0.98	2 \pm 1.07	0.237
After 2 h	2.11 \pm 0.89	1.84 \pm 1.06	0.324
After 4 h	2.37 \pm 0.67	2.11 \pm 0.95	0.259
After 6 h	2.70 \pm 0.71	2.33 \pm 0.90	0.106
After 8 h	3.12 \pm 0.82	2.48 \pm 0.96 [#]	$P < 0.05$
After 12 h	3.61 \pm 1.07	2.89 \pm 1.23 [#]	$P < 0.05$
After 18 h	3.34 \pm 1.56	2.73 \pm 1.09	0.108
After 24 h	3.14 \pm 1.69	2.67 \pm 0.94	0.221

Values are reported as mean \pm SD). [#] $P < 0.05$ group BD compared to group B

an optimal suppression of stress response with no hemodynamic sequelae when compared with high dose 1 $\mu\text{g}/\text{kg}$. The same findings were also reported by Kataria et al. (Kataria et al., 2019) when they compared dexmedetomidine 0.5 $\mu\text{g}/\text{kg}$ with dexamethasone 8 mg as adjuvant to ropivacaine for interscalene block in patients who underwent shoulder surgery. On the contrary, a higher incidence of hypotension and bradycardia was encountered with the use of higher doses of perineural dexmedetomidine 1 $\mu\text{g}/\text{kg}$ (Rancourt et al., 2012; Swami et al., 2012; Lin et al., 2013; Chinnappa et al., 2017; Neethirajan et al., 2019).

Despite being less invasive when compared to the thoracotomy approach, the postoperative pain after VATS must still be considered moderate to severe (Steinhorsdottir et al., 2014; Khoshbin et al., 2011). In this study, the group that received a combination of bupivacaine and dexmedetomidine (group BD) had a significantly longer duration till the time of first PCA analgesia demand compared with group B (542.34 \pm 114.52 vs. 386.84 \pm 75.96) with significantly lower total nalbuphine and ketorolac consumption than in group B at the 1st 24 h after surgery. The postoperative VAS scores were not significantly different between both study groups at 0–6th h, but they were significantly lower at 8th and 12th h in group BD than in group B. These results suggested a more prolonged analgesia duration with the addition of dexmedetomidine to SAP block.

Similar to our results, several studies reported that dexmedetomidine used as an additive to LA in various types of peripheral nerve blocks resulted in prolongation of their analgesic effect (Santosh & Mehandale, 2016; Rancourt et al., 2012; Swami et al., 2012; Lin et al., 2013; Chinnappa et al., 2017; Neethirajan et al., 2019). This could be attributed to multiple mechanisms. First is the dexmedetomidine central-mediated analgesia after systemic absorption from the injection site. It is thought that central α_2 -receptors located in the locus coeruleus and dorsal horn of the spinal cord are involved in this activity (De Kock et al., 1993; Guo et al., 1996; Ruffolo Jr., 1985). Second is its vasoconstrictor effect around the site of injection mediated by vascular $\alpha_2\text{B}$ adrenoceptors which delays the LA absorption and prolongs its duration of action (Talke et al., 2003; Masuki et al., 2005; Yamane et al., 2015). Third is the inhibitory effect of dexmedetomidine on the neural activity by blocking the hyperpolarization-activated cation current (I_h current). The I_h current is responsible for resetting the nerve from the hyperpolarization state that follows an action potential again to the resting membrane potential state. By blocking the I_h current, dexmedetomidine prolongs the nerve hyperpolarization and delays the restoration of resting membrane potential and subsequently prevents the conduction of a new neural action potential

Table 7 Postoperative analgesia characteristics

	Group B (n = 26)	Group BD (n = 26)	P value
-The duration to 1st PCA analgesic demand after surgery (minutes)	386.84 ± 75.96	542.34 ± 114.52 [#]	P < 0.05
-Postoperative nalbuphine consumption (mg)	10.23 ± 1.28	6.82 ± 0.39 [#]	P < 0.05
Postop. 8 h	22.17 ± 2.97	15.89 ± 1.64 [#]	P < 0.05
Postop. 16 h	32.74 ± 4.25	23.66 ± 2.33 [#]	P < 0.05
Postop. 24 h	1.26 ± 0.65	0.73 ± 0.44 [#]	P < 0.05
-Postoperative rescue ketorolac requirements and consumption	40.38 ± 20.28	19.61 ± 14.27 [#]	P < 0.05
No. of rescue ketorolac requirements over 24 h			
Total postoperative ketorolac consumption (mg) at 24 h			

Values are reported as mean ± SD. [#]P < 0.05 group BD compared to group B

(Dalle et al., 2001; Brummett et al., 2011b; Helal et al., 2016). This effect is more pronounced in the neuronal C and Aδ fibers (nociception) than in Aα fibers (motor) giving the potential to produce a more selective sensory and analgesic effect rather than motor one (Gaumann et al., 1994; Kroin et al., 2004; Lonnqvist, 2012).

The results of this study agree with those described by Gad and Elmetwally (Gad & Elmetwally, 2019) who reported that dexmedetomidine added to levobupivacaine for SAP block resulted in more extended analgesia with significant reduction of postoperative 24 h analgesic consumption compared with SAP block alone. A similar reduction of postoperative VAS scores and analgesic consumption was also reported by Abdallah et al. (Abdallah et al., 2019) who used dexmedetomidine as an adjunctive to levobupivacaine for SAP block in patients undergoing thoracotomy. The same findings were also reported by several studies which assessed the effect of dexmedetomidine used as LA additive for interfascial TAP block (Xiao et al., 2017; Qian et al., 2020).

Another main observation in this study is that postoperative sedation scores were significantly higher in group BD than in group B only at the 1st postoperative hour (P < 0.05) without any significant difference at the

following recordings (P > 0.05). The same finding was also observed in several studies (Almarakbi & Kaki, 2014; Zeng et al., 2020) which reported a significantly higher sedation scores at the early postoperative period in patients who received dexmedetomidine 0.5 mcg/kg as LA adjuvant in TAP block. Despite the longer sedation observed in group BD in this study, no cases of respiratory depression was reported postoperatively in the two study groups. One of the major benefits of dexmedetomidine is that it produces arousable sedation by acting on the α2 adrenoceptors in the locus coeruleus in brainstem where it decreases sympathetic outflow and increases parasympathetic outflow (Nelson et al., 2003) without causing respiratory embarrassment (Hsu et al., 2004). Also, we used nalbuphine in this study for postoperative PCA. It is a mu receptor antagonist and kappa receptor agonist with a ceiling effect in respiratory depression; hence, it is considered to be more safe than morphine (Minai & Khan, 2003).

In this study, the difference in the incidence of perioperative complications such as hypotension, bradycardia, tachycardia, hypoxia, nausea/vomiting, and shivering was statistically insignificant between the two groups. A slightly higher incidence of nausea and vomiting was observed in group B than in group BD. Although it was statistically insignificant, it could be attributed to the significantly higher postoperative opioid consumption in group B than in group BD.

Table 8 Postoperative sedation scores

	Group B (n = 26)	Group BD (n = 26)	P value
On PACU admission	3.5 (3–4)	4.5 (4–5) [#]	P < 0.05
After 15 min	3 (2–4)	4 (3–5) [#]	P < 0.05
After 30 min	3 (2–3)	4 (3–4) [#]	P < 0.05
After 1 h	2 (1–3)	3 (2–4) [#]	P < 0.05
After 2 h	2 (1–3)	2 (2–3)	0.328
After 4 h	2 (1–2)	2 (2–3)	0.147
After 6 h	2 (1–2)	2 (2–3)	0.492
After 8 h	2 (1–2)	2 (2–3)	0.634
After 12 h	2 (1–2)	2 (1–3)	0.747
After 18 h	2 (1–2)	2 (1–2)	0.887
After 24 h	2 (1–2)	2 (1–2)	0.943

Values are reported as median (min-max). [#]P < 0.05 group BD compared to group B

Study limitations

There were several possible limitations in this study. First, there was no control group in this study as it was considered unethical to perform placebo injectate or a sham procedure. Second, the assessment of sensory dermatome blocked with SAP block to ensure its success was done 30 min after shifting to PACU as the blocks were done after induction of general anesthesia so that it was tested ≥ 3 h after the block was done. However, we depended on the proper adjustment of the needle insertion site to be in the targeted plane using ultrasound guidance which was furtherly confirmed by using normal saline (3 mL) injection to hydrodissect the targeted plane, and then the injectate was given in divided doses

Table 9 Postoperative complications

	Group B (n = 26)	Group BD (n = 26)	P value
Respiratory depression	0 (0%)	0 (0%)	–
Tachycardia	1 (3.84%)	1 (3.84%)	1
Nausea/vomiting	4 (15.38%)	2 (7.69%)	0.385
Shivering	3 (11.53 %)	1 (3.84%)	0.297

Values are reported as number (percentage)

with confirmation of its spread in the targeted plane under complete ultrasound observation. Third, the serum level of dexmedetomidine was not measured due to unavailability at our hospitals to determine whether its action was related to systemic absorption or it is a pure local effect. Fourth, different dexmedetomidine doses were not used in order to compare their effects on both analgesic and hemodynamic profiles.

Conclusion

From this study, it can be concluded that using dexmedetomidine 0.5 µg/kg as an additive to bupivacaine for SAP block prolongs the duration of postoperative analgesia and reduces the postoperative analgesic requirements in the 1st 24 h after VATS without any significant side effects.

Abbreviations

ASA: American Society of Anesthesiologists; BIS: Bispectral index; HR: Heart rate; LA: Local anesthetic; MBP: Mean blood pressure; PACU: Post anesthesia care unit; PCA: Patient-controlled analgesia; PVB: Paravertebral block; SAP: Serratus anterior plane; TEA: Thoracic epidural analgesia; VAS: Visual analog scale; VATS: Video-assisted thoracoscopic surgeries

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Authors' contributions

The corresponding author MA contributed to the study conception and design, acquisition of data, and analysis and interpretation of data. Author HM contributed to the drafting of the manuscript and its critical revision. All authors have read and approved the manuscript.

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Not applicable

Availability of data and materials

The datasets generated during and/or analyzed during the current study are not publicly available due to restrictions based on privacy regulations and informed consent of the participants but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The current prospective randomized double-blinded study was conducted on 52 adult patients scheduled to undergo VATS in cardiovascular and thoracic surgery academy at Ain Shams university hospitals through the period from October 2019 to August 2020 after obtaining approval of research ethical committee (REC) of Faculty of Medicine—Ain Shams University (FMASU)

on October 2019 with reference number of FMASU R 46/2019 and patients' written informed consents for acceptance of participation in the study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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