Sobhy et al.
Ain-Shams Journal of Anesthesiology (2023) 15:41
https://doi.org/10.1186/s42077-023-00339-1

Ain-Shams Journal of Anesthesiology

ORIGINAL ARTICLE

Open Access

Comparative study between ultrasound-guided erector spinae plane block and thoracic paravertebral block for postoperative analgesia after video-assisted thoracic surgery: an equivalence study

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Abstract

Background It is advised to use a regional block to lower postoperative opioid usage. Therefore, we aimed to compare the analgesic effect of erector spinae plane block (ESPB) and thoracic paravertebral block (TPVB) on the need for morphine following video-assisted thoracic surgery (VATS).

Results The findings revealed that TPVB and ESPB groups were equivalent in analgesic efficacy with postoperative morphine consumption in mg 15.2 ± 2.7 and 14.9 ± 2.4 respectively. statistically significant shorter block time in ESPB was 8.1 ± 1.7 min in contrast to 11.35 ± 1.7 min in TPVB and better patient satisfaction in the ESPB than in TPVB groups (p value < 0.05). No statistically significant differences existed between the two groups in terms of postoperative pain score (VAS) at rest, cough at any time point, or incidence of complications (p value > 0.05). There were significantly lower heart rate (HR) and blood pressure (BP) trends in 15 and 30 min intraoperatively (p value < 0.001) in the TPVB group.

Conclusions ESPB has analgesic efficacy equivalent to TPVB from aspects of equivalent postoperative morphine consumption and VAS at rest and during cough with shorter block time and better patient satisfaction.

Trial registration Pan African Clinical Trial Registry PACTR202109527452994. Registered on 8 September 2021.

Keywords Regional anesthesia and analgesia, Pain control, Erector spinae plane block, Thoracic paravertebral block, Video-assisted thoracic surgery

Background

In lung surgery, acute postoperative pain prevents deep breathing and coughing, with a strong relationship between pain and respiratory problems such as pneumonia and atelectasis (Sengupta 2015) Multimodal pain management has been suggested, including opioids with their known side effects (Nagaraja et al. 2018; Xu et al. 2021). Thoracic paravertebral block (TPVB) has been extensively applied (Copik et al. 2017).

Erector spinae plane block (ESPB) targets the interfacial plane between the erector spinae muscle and the transverse spinal processes (Yao et al. 2020). The simplicity of the procedure, analgesic effectiveness, decreased postoperative pain scores, decreased need for opioids,

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and low risk of complications like pneumothorax, motor weakness, hemi-diaphragmatic paralysis, and local anesthetic toxicity are the main benefits of this technique (Tulgar et al. 2019; Huang et al. 2020).

Methods

This study was conducted after obtaining approval from the Ethical Committee of Scientific Research with approval number (FWA 000017585) and written informed consent from every patient. The study was performed on 80 patients who were scheduled for VATS.

Inclusion criteria

Patients with American Society of Anesthesiology (ASA) I–II physical status, older than 18 years, and either sex.

Exclusion criteria

Exclusion criteria were as follows: a history of medication allergies, a history of coagulopathy (platelet count < 80,000/ml, international normalizing ratio (INR) > 1.5), a local infection, renal dysfunction (glomerular filtration rate (GFR) < 50 ml/min), psychiatric disorders, pregnancy, a VATS procedure that was converted to an open procedure, and a patient with a history of thoracic spine surgery are all contraindications to regional block.

Patient randomization

The patients were randomly allocated by simple randomization using a computer program into two equal groups by closed envelope technique (having 40 patients in each group): (Fig. 1).

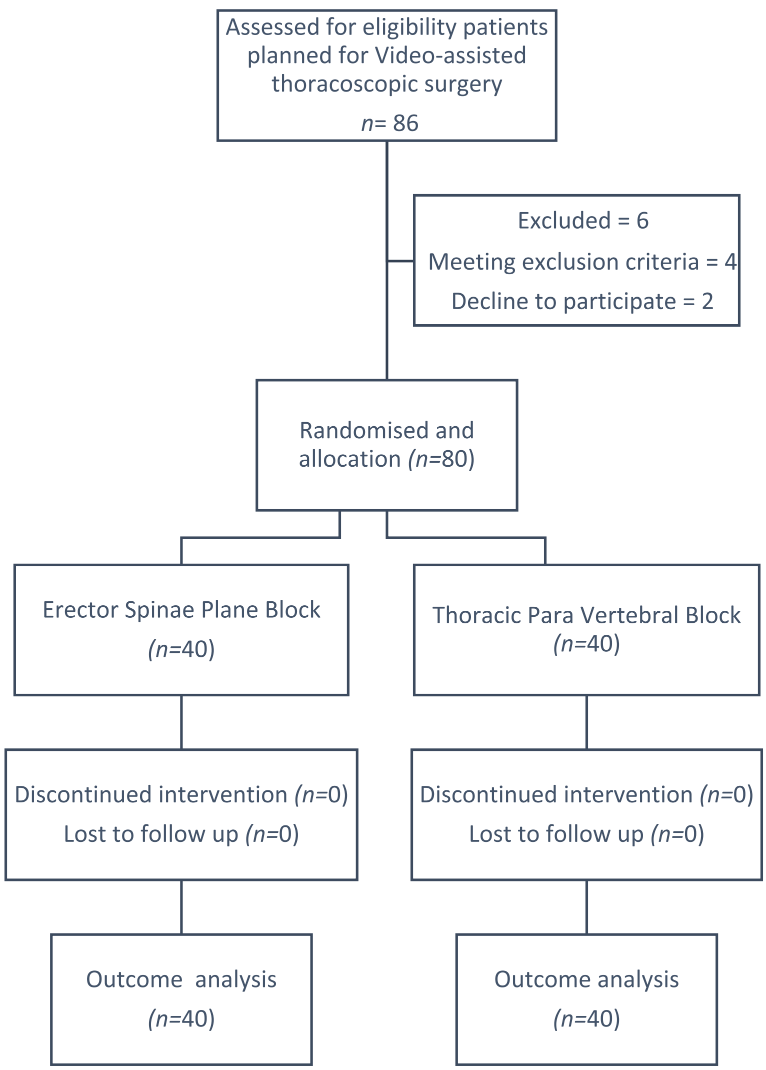

Fig. 1 Diagram of the CONSORT flow showing how patients move through the study

- TPVB group: patients received a single-shot TPVB guided by ultrasonography.
- ESPB group: patients received a single-shot ESPB guided by ultrasonography.

Preoperative settings

Before surgery, each patient underwent a thorough physical examination, comprehensive history taking, laboratory analysis, and other necessary tests.

All patients received instruction on how to assess their pain using a nongraded 100-mm visual analogue scale (VAS) for pain, which has the terms “no pain” and “worst pain possible” at either end (Escalona-Marfil et al. 2020). And the patient will be asked to put a mark indicating the level of pain. The distance between the mark and the “no pain” end will be measured with a ruler in mm and will be taken regarded as the patient’s pain severity.

The regional blocks were performed in the preoperative block area after routine monitoring, such as non-invasive blood pressure (NIBP), electrocardiogram (ECG), and pulse oximetry (SpO_2). A nasal cannula was used to administer oxygen at a rate of 2–3 L/min, and midazolam 0.025 mg/kg was administered intravenously. One of two skilled researchers used ultrasonic guidance to accomplish all of the blocks. The type of block was concealed from the patient and the data collector. The patient was positioned on his or her side. The blocks were carried out utilizing an in-plane technique at the T5 level of the spine. Cold perception in the mid-axillary line at the fifth intercostal space was used to test the sensory block bilaterally, and the commencement of the block was noted. Both groups underwent ultrasound scanning to rule out pneumothorax following the block technique.

In the TPVB group

A linear ultrasonic probe (Sonoscape® SSI 6000, China with 12 6 MHz high-frequency linear probe) with a high frequency and sterile sheath was positioned 2–3 cm laterally and vertically to the midline. Following standard skin disinfection and subcutaneous lidocaine 2% infiltration laterally to medically using a sterile probe cover, a 22-g 100 mm needle (B-Braun Medical Inc., Bethlehem, PA, USA) was inserted once the transverse process, internal intercostal membrane, and parietal pleura were identified. This procedure continued until the tip of the needle was in the thoracic paravertebral space beyond the internal intercostal membrane (Fig. 2). Following injection with normal saline, 20 mL of 0.25% bupivacaine was given for the performance of the block to confirm ventral pressing of the parietal pleura.

In the ESPB group

A longitudinally oriented, high-frequency, sterile-sheathed ultrasonic probe (Sonoscape® SSI 6000, China, with 12 6 MHz high-frequency linear probe) was positioned 3 cm from the midline. Following routine skin disinfection and 2% subcutaneous lidocaine infiltration, a 100-mm, 22 g needle (B-Braun Medical Inc., Bethlehem, PA, USA) was inserted using a sterile probe cover once the erector spinae muscle and transverse processes had been identified. The needle was oriented from caudad to cephalad until the tip was in the interfacial plane deep to

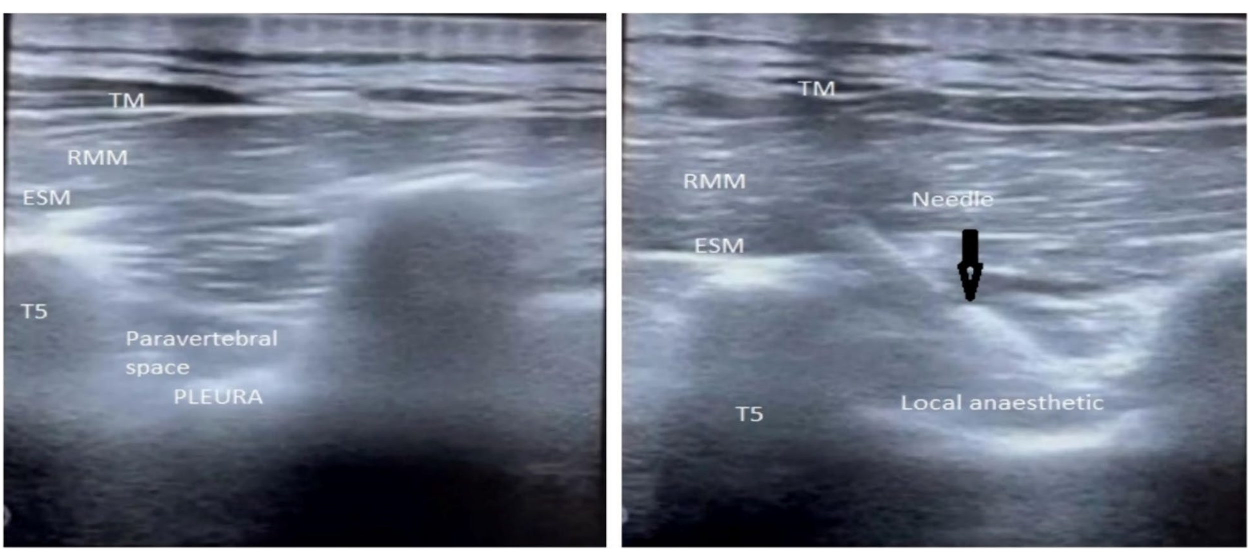

Fig. 2 the paravertebral block in the thorax seen with ultrasound. The T5 transverse process of the T5 vertebra; the TM trapezius muscle; the RMM rhomboid muscle; and the ESM erector spinae muscle

the erector spinal muscle (Fig. 3). This plane was opened after hydro-localization with ordinary saline.

For block performance, 20 mL of 0.25% bupivacaine was given (Forero et al. 2016).

Intraoperative settings

When the patients entered the operating room, an ECG, NIBP, SpO_2, and capnography were used. Additionally, an initial assessment of the HR, arterial oxygen saturation ($PaSO_2$), systolic, diastolic, and mean blood pressures (SBP, DBP, and MBP) was conducted.

Routine general anesthesia according to our institution protocol with double lumen tube (DLT) was used for endotracheal intubation. If the HR or BP increased more than 20% from baseline, or both, intraoperative fentanyl 1–2 μg/kg was administered. At the end of the procedure, the isoflurane was stopped, and the neuromuscular blockade was treated by giving neostigmine 0.04 mg/kg and atropine 0.01 mg/kg after being assessed by a nerve stimulator using a train of four, and these medications were also given to treat the effects of atracurium. Once the trachea was extubated, all patients were transferred to the intensive care unit (ICU).

Postoperative settings

When they arrived at the ICU, all patients received the post-operative pain protocol for the first 48 h following surgery (1 gm paracetamol intravenously then every 6 h, ketorolac tromethamine 30 mg intravenously (Ketolac®, 30 mg/ml, Amirya for pharmaceutical industry, Cairo, Egypt) then every 8 h and intravenous morphine 0.1 mg/kg (Morphine sulfate ®, 10 mg/ml, Misr Pharmaceutical Company, Cairo, Egypt) if the patient requested extra analgesics or if the VAS when at rest or coughing was greater than 30 mm, as rescue analgesia. Granisetron 3 mg was administered intravenously if nausea, with or without vomiting, was present (EM-EX®, 3 mg/3 ml, Amoun Pharmaceutical Company, Cairo, Egypt) and once more if nausea remained (maximum dose of 6 mg per day).

Postoperative nausea and vomiting (PONV) were among the complications, and during hospital stays, other issues with the medication or the procedures (such as procedure-induced pneumothorax, local anesthetic (LA) toxicity, hematoma in the puncture sites, and respiratory depression) were observed.

Outcome measures

- *Primary outcome*

Consumption of postoperative morphine throughout the first 48 hours.

- *Secondary outcome*

1 -Post-operative pain severity assessed by VAS (at 0 points (the full recovery state), 1 h, 2 h, 4 h, 6 h, 12 h, 18 h, 24 h, 36 h, and 48 h at rest and during cough). It is consisted of a “100 mm” line with one end labelled no pain and other end labelled worst

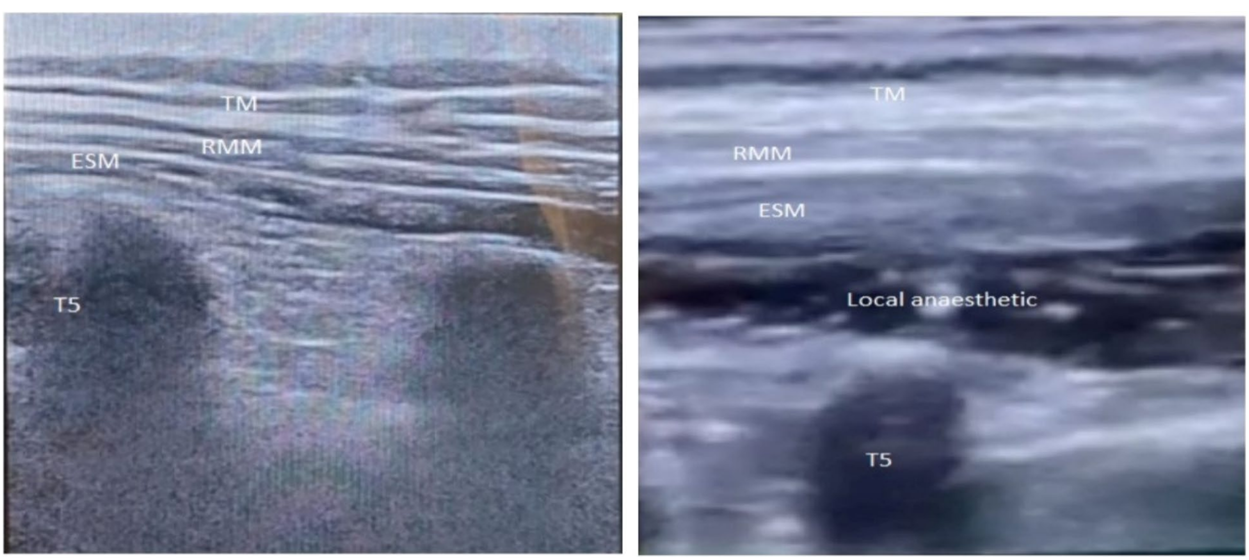

Fig. 3 The block of the erector spinae plane was imaged via ultrasound. The T5 transverse process of the T5 vertebra; the TM trapezius muscle; the RMM rhomboid muscle; and the ESM erector spinae muscle

intolerable pain. The patient will mark the line at the point that best describing the pain intensity. The preoperative assessment included training of the patient about VAS for postoperative pain.

2 -Procedure time from scanning to injection of LA correctly.
3 -The onset of the block.
4 -Patient satisfaction during the procedure (score 1–4 (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, 4 = very satisfied)).
5 -Patient satisfaction after 1st postoperative day (score 1–4 (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, 4 = very satisfied)).
6 -Frequency of PONV.
7 -Incidence of complications (hematoma, procedure-induced pneumothorax, LA toxicity, respiratory depression).

Table 1 Comparison between groups as regards demographic data

Demographic data	TPVB group ($n = 40$)	ESPB group ($n = 40$)	t/χ^2	p value
Age (years)	56.55 ± 7	55.8 ± 6.2	0.52^t	0.6
ASA				
I	18 (45%)	18 (45%)	$0.0^{\chi 2}$	1
II	22 (55%)	22 (55%)		
Sex				
Male	26 (65%)	24 (60%)	$0.21^{\chi 2}$	0.64
Female	14 (35%)	16 (40%)		
BMI (kg/m^2)	25.89 ± 2.7	25.2 ± 2.8	1.1^t	0.28

Data are presented as mean ± SD, proportion, t = Student's t test, χ^2 = chi-square test, *TPVB* Thoracic paravertebral block, *ESPB* Erector spinae plane block, *ASA* American Society of Anesthesiology Physical Status Classification System, *BMI* Body mass index

Table 2 Comparison between groups as regard type of surgery

Type of surgery	TPVB group ($n = 40$)	ESPB group ($n = 40$)	χ^2	p value
Decortication	4 (10%)	3 (7.5%)	1.36	0.998
Drainage of effusion	1 (2.5%)	1 (2.5%)		
Drainage of lung abscess	4 (10%)	3 (7.5%)		
Lobectomy	6 (15%)	9 (22.5%)		
Lung biopsy	9 (22.5%)	8 (20%)		
Lymph node biopsy	2 (5%)	1 (2.5%)		
Pleural biopsy	3 (7.5%)	3 (7.5%)		
Segmentectomy	3 (7.5%)	3 (7.5%)		
Thymectomy	2 (5%)	2 (5%)		
Wedge resection	6 (15%)	7 (17.5%)		

Data represented as a percentage, χ^2 = chi-square test, *ESPB* Erector spinae plane block, *TPVB* Thoracic paravertebral block

Statistical analysis

The Statistical Package for Social Science (SPSS) version 22.0 was used to analyze the data. When indicated, quantitative data were reported as mean, standard deviation (SD), or interquartile range (IQR). Frequency and percentage were used to express qualitative data. Using the chi-square test, the qualitative data were compared between the two groups. In addition, the quantitative parametric data between the two groups were compared using the independent t test, and the non-parametric distributions were analyzed using the Mann–Whitney test. The allowable margin of error was set at 5%, while the confidence interval was set at 95%. The p value was therefore regarded as significant at a level lower than 0.05%.

Results

The demographic data for the two groups did not significantly differ (p value > 0.05) (Table 1) and the type of surgery performed by each of them did not statistically differ from one another (p value > 0.05) (Table 2).

There was a statistically significant difference between the groups when it came to blocking specification in terms of (block time, the onset of block, patient satisfaction during the procedure, and patient satisfaction after 1st postoperative day) (p value < 0.05), except for the onset of the block and patient satisfaction after 1st postoperative day (p value > 0.05) (Table 3).

Regarding the operating statistics (duration of the procedure, duration of anesthesia, and use of intraoperative fentanyl), the two groups were matched, and there was no statistically significant difference between them (p value > 0.05) (Table 3).

Additionally, there were statistically significant differences between groups at 15 and 30 min in terms of MABP and HR as well as 45 min in terms of MABP, according to the intraoperative hemodynamics measured every 15 min (p value < 0.05) (Figs. 4 and 5).

Both groups' VAS scores were assessed at regular intervals for 48 h following surgery while they were at rest and coughing, and there was no statistically significant difference between them (p value > 0.05) (Table 4; Figs. 6 and 7). Also, there was no statistically significant difference between groups when compared for 1st time for rescue analgesia and the total amount of rescue opioids (p value > 0.05) (Table 5).

There was no statistically significant difference between the two groups concerning postoperative consequences (hematoma, pneumothorax, LA toxicity, respiratory depression, and incidence of PONV) (p value > 0.05)) (Table 6).

Table 3 Comparison between groups as regards block specifications and operative data

Block specifications	TPVB group ($n = 40$)	ESPB group ($n = 40$)	t/z	p value
Procedure time (min)	11.35 ± 1.7	8.1 ± 1.7	8.5^t	**< 0.001**
The onset of the block (min)	6.8 ± 1.5	6.75 ± 1.5	0.2^t	0.8
Patient satisfaction during the block	3 (2–3)	3 (3–3)	1.9^z	**0.0488**
Patient satisfaction after 1st postoperative day	3 (3–4)	3 (3–4)	0^z	1
Operative data				
Duration of surgery(min)	99.6 ± 24.1	94.4 ± 22.2	1.0^t	0.3
Anesthesia time (min.)	113.9 ± 27.4	108.2 ± 25.3	0.97^t	0.34
Intraoperative fentanyl use (mic)	111 ± 11.1	107.25 ± 11.3	1.5^t	0.14

Data are shown as mean ± SD, median and interquartile range (IQR), t = Student's t test, Z = Mann–Whitney test, *TPVB* Thoracic paravertebral block, *ESPB* Erector spine plane block

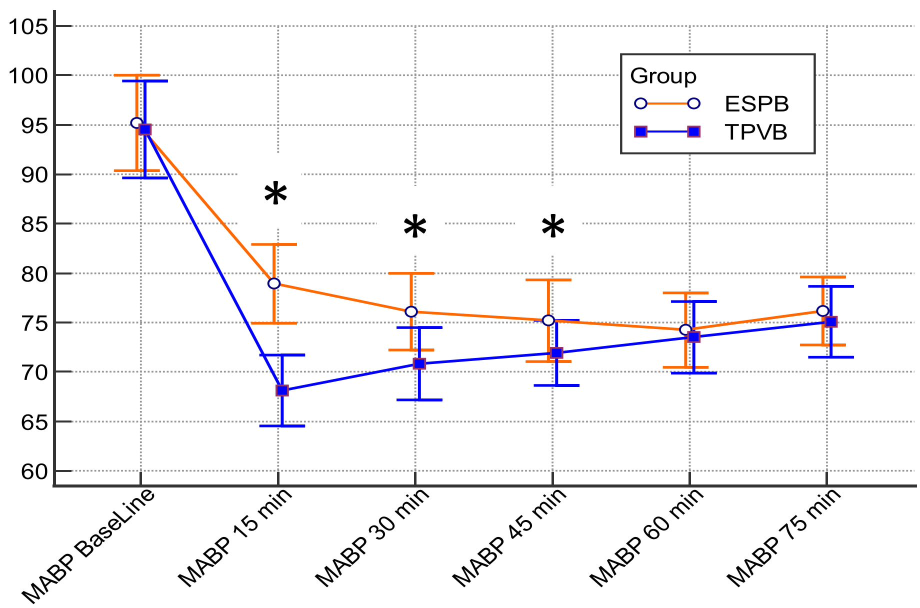

Fig. 4 Bar chart between groups as regards intraoperative MABP. TPVB: thoracic paravertebral block, ESPB: erector spinae plane block, *: the statistically significant difference ($p < 0.01$)

Discussion

Hugo initially described TPVB in 1905 and was refined by Lawen (1911) and Kappis (1919) (Richardson et al. 1998). Then, due to difficulty and concern over complications, TPVB was neglected until the late 1970s, when it a revitalized by Eason and Wyatt (Eason and Wyatt 1979), while ESPB was initially described by Forero et al. (2016) in 2016 for the treatment of postoperative pain and chronic thoracic neuropathic pain in thoracic surgery despite challenging mechanism of action of ESPB and conflicting anatomical and physiologic evidence but paravertebral spread remains the primary mechanism of action (Chin and El-Boghdadly 2021). Although there is no definitive exact approved mechanism for both blocks; but for the TPVB, the thoracic paravertebral space (TPVS) contains adipose tissue within which lie the intercostal (spinal) nerve, the dorsal ramus, intercostal vessels, and rami communicantes and anteriorly the sympathetic chain. The spinal nerves are segmented into small bundles and lie freely in the adipose tissue of the TPVS, which makes them accessible to local anesthetic solutions injected into the TPVS (Murata et al. 2013). Similarly, in ESPB the mechanism of action is not fully understood; some studies suggest that an anterior diffusion of the local anesthetic into the paravertebral space could be one of the explanations, although an interfacial spread toward the posterior rami of spinal nerves is probably the main mechanisms of action (Forero et al. 2016).

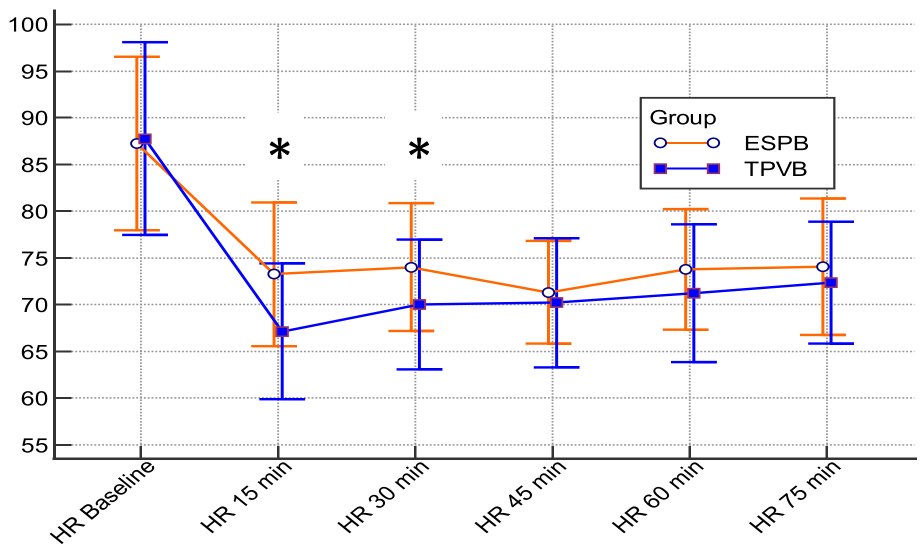

Fig. 5 Bar chart between groups as regards intraoperative HR. TPVB: thoracic paravertebral block, ESPB: erector spinae plane block, *: the statistically significant difference ($p < 0.01$)

Table 4 Comparison between groups as regards VAS at rest and during cough

VAS is at rest	TPVB group ($n = 40$)			ESPB group ($n = 40$)			*z*	*P* value
	Range	Median	IQR	Range	Median	IQR		
PACU	12–23	17	15–20	12–23	17	15–19	0.97	0.33
1 h	14–23	18	16–19	14–24	18	17–20	1.1	0.29
2 h	17–28	22	20–24	16–27	21	19–23	1.2	0.21
4 h	21–32	26	24–29	20–33	25	23–28	0.88	0.38
6 h	18–34	24	22–27	18–34	24	22–27	0.15	0.88
12 h	22–40	30	26–33	19–41	30	26–33	0.03	0.97
18 h	20–34	26	24–29	19–33	25	24–28	0.69	0.49
24 h	19–39	29	26–32	19–41	29	26–32	0.04	0.97
36 h	19–36	27	24–30	19–35	25	24–28	1.5	0.15
48 h	17–38	25	23–29	18–37	27	24–30	1.1	0.27
VAS during cough								
PACU	14–26	20	18–23	14–27	20	17–22	0.55	0.58
1 h	16–26	21	19–22	16–27	21	20–23	1.1	0.26
2 h	1930	25	23–27	19–30	24	22–26	0.8	0.41
4 h	23–35	28	26–30	22–36	28	26–31	0.17	0.86
6 h	21–38	28	26–31	21–39	29	26–31	0.1	0.92
12 h	23–44	32	29–36	21–45	33	28–37	0.05	0.96
18 h	22–37	29	26–32	21–36	28	26–30	0.6	0.55
24 h	22–44	32	29–36	22–46	33	29–36	0.08	0.94
36 h	21–40	30	27–34	21–39	28	27–31	1.57	0.11
48 h	19–43	28	26–32	20–41	30	27–34	1.1	0.28

Data presented as the median and interquartile range (IQR); *Z* Mann–Whitney test, *TPVB* Thoracic paravertebral block, *ESPB* Erector spinae plane block, *PACU* Post-anesthesia care unit

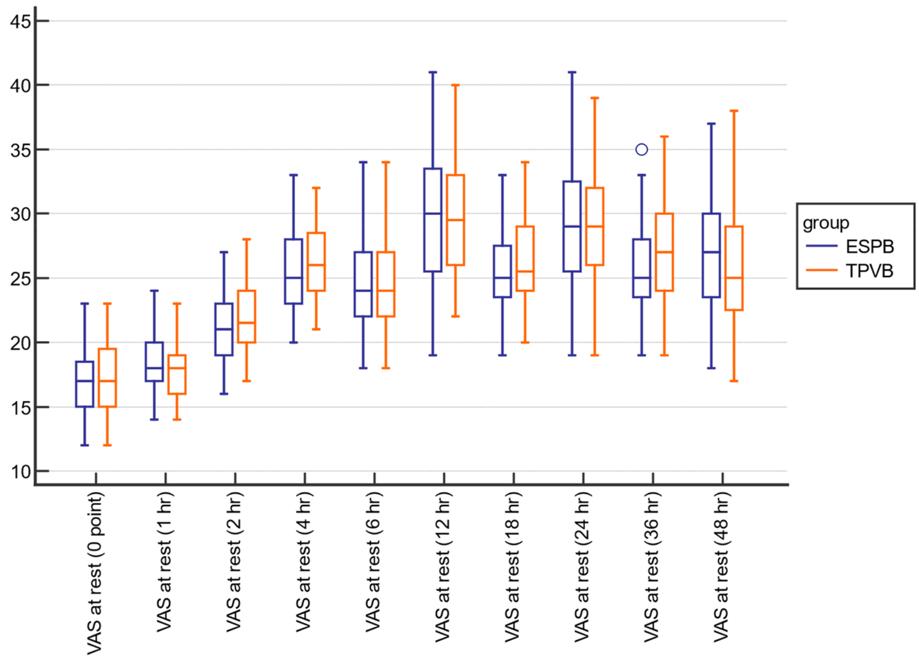

Fig. 6 Box and whisker comparison graph showing VAS at rest between groups. TPVB: thoracic paravertebral block, ESPB: erector spinae plane block

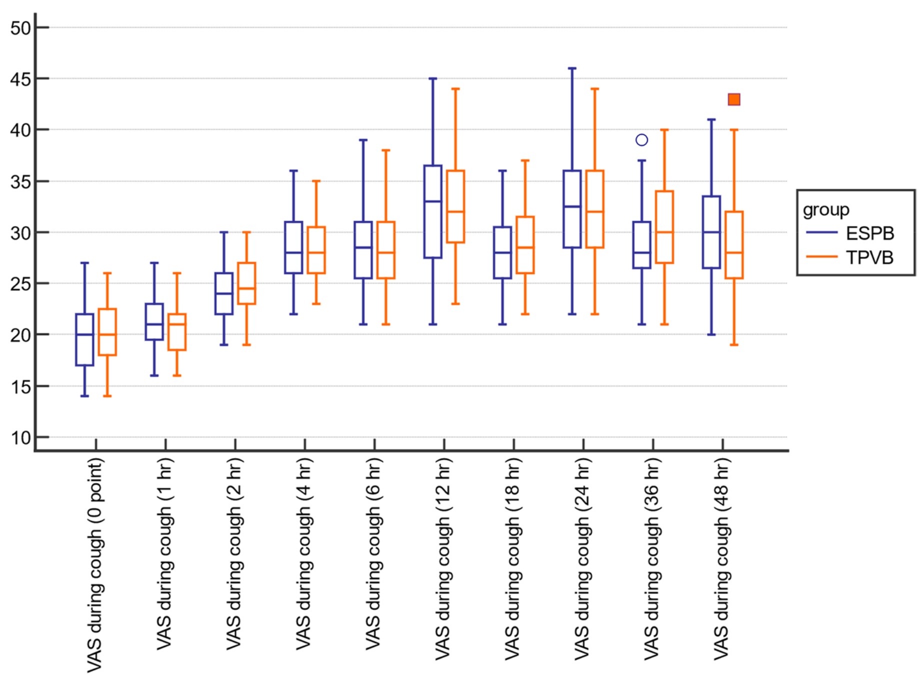

Fig. 7 Box and whisker comparison graph showing VAS during cough for each group. TPVB: thoracic paravertebral block, ESPB: erector spinae plane block

Table 5 Comparison between groups as regards postoperative time and amount of rescue opioids

	TPVB group ($n=40$)	ESPB group ($n=40$)	t	p value
1st time for rescue analgesia (min)	480.8 ± 48.1	477.1 ± 49.2	0.35	0.73
Total morphine consumption (mg)	15.2 ± 2.7	14.9 ± 2.4	0.52	0.6

Data are expressed as mean ± SD, t = Student's t test, *TPVB* Thoracic paravertebral block, *ESPB* Erector spinae plane block

The current study of 80 consecutive adult patients who underwent VATS surgery was randomly assigned to one of two equal groups: receiving ESPB or TPVB before surgery with comparable demographic and baseline data.

No statistically significant difference was found between the ESPB and TPVB groups for postoperative morphine consumption, with the TPVB group consuming 15.2 mg ± 2.7 mg and the ESPB group consuming 14.9 mg ± 2.4 mg. These results are consistent with those of Leong et al. (2021) and Gurkan et al. (2020), who found no difference between the ESP and PVB groups for 24-h morphine consumption. Despite Chang's meta-analysis, (Koo et al. 2022) revealed no discernible changes between PVB and ESPB groups but in subgroup analysis, it was true for the breast surgery subgroup but in the thoracic surgery subgroup, ESPB consumed more opioids than TPVB. But after this meta-analysis, Fu et al. (2022) reported non-statistical significance in ESPB and TPVB in postoperative hydromorphone consumption but Zhang et al. (2022) reported higher postoperative sufentanil consumption in the ESPB group.

According to reports, TPVB (Wei et al. 2020) and ESPB analgesia would last 12–24 h and 10–12 h, respectively (Aydin et al. 2018). When the postoperative first time for rescue analgesia and the total amount of rescue opioids were analyzed between the two blocks, there was no statistically significant difference (p value > 0.05) between them. This supports the findings of Zhao et al. (2020), and Çiftçi et al. (2020), who noted that there was no discrepancy between the ESPB and TPVB rescue analgesia (meperidine) was administered to 10 patients in the ESPB group and 12 patients in the TPVB group, in contrast to Taketa et al. (2019), who found that the ESPB group required more rescue fentanyl. But a meta-analysis of Chang (Koo et al. 2022) observed a higher incidence of further analgesia in the ESPB group in comparison to the PVB group, with a relative risk of 0.53 (95% CI 0.29–0.97), and a P value of 0.04; however, this meta-analysis was dependent on four studies: our findings are in agreement with Çiftçi et al. (2020), Taketa et al. (2019) use of continuous levobupivacaine infusion, and Turhan (2021) use of morphine PCA, all of which are confounders that change the demand for rescue analgesia between the studies.

The VAS was measured for both groups in the current study at rest and while coughing in the post-anesthetic care unit (PACU), 1, 2, 4, 6, 12, 18, 24, 36, and 48 h after surgery. There was no statistically significant difference between the two groups (p value > 0.05). No significant differences were detected between TPVB and ESPB in the median resting or dynamic pain levels at any stage following surgery, according to Stewart et al. (2021) Also, Taketa et al. (2019), Fang et al. (2019), and Çiftçi et al. (2020) did not find a difference. But in contrast to Chen et al. (2020) and Turhan et al. (2021) who found that compared to the ESPB group, the PVB group had considerably lower VAS scores at rest and while coughing and supported by Chang's meta-analysis that showed PVB considerably decreased the postoperative pain scores at different time points, both while at rest and while moving. after this meta-analysis, at 12 h, but not at 6 or 24 h, Fu et al. (2022) discovered a statistically significant difference for VAS when coughing between the PVB and ESPB groups.

The ESPB group required considerably less time to administer the block (8.1 ± 1.7 min) than the TPVB group (11.35 ± 1.7 min). This was similar to Çiftçi et al. (2020) who found that the ESPB group's block procedure time (7.13 ± 1.59 min) was significantly less than that of the TPVB group (13 ± 2.49 min) and confirmed by Chang

Table 6 Comparison between groups as regard complications

Complications	TPVB group ($n=40$)	ESPB group ($n=40$)	χ^2	p value
Pneumothorax	1 (2.5%)	0 (0%)	1	0.3
Hematoma	0 (0%)	0 (0%)	No statistics are computed because no cases were detected	
LA toxicity	0 (0%)	0 (0%)		
Respiratory depression	0 (0%)	0 (0%)		
PONV	3 (7.5%)	2 (5%)	0.2	0.65

Data represented as a percentage, χ^2 = chi-square test, *ESPB* Erector spinae plane block, *TPVB* Thoracic paravertebral block, *LAT* Local anesthetic toxicity

(Koo et al. 2022) meta-analysis of the block procedure time, the time needed for ESPB was significantly less than the time needed for PVB, with a mean difference of 4.05 min (95% CI 2.95 to 5.14). The current study showed that the two groups were statistically different from one another, with better satisfaction in the ESPB group, which may be connected to procedure time. TPVB may generate pressure-like chest discomfort related to pleural displacement and quick paravertebral space distension (Chin and El-Boghdadly 2021).

The intraoperative hemodynamics are concerned (with MABP and HR), This study found statistically significant group differences in MABP and HR at 15 and 30 min, as well as after 45 min in MABP (*p* value 0.05). Moreover, according to Fang et al. (2019), TPVB patients experienced hypotension and bradycardia more frequently than ESPB patients (6.7% and 0%, respectively) (21.7% and 8.7%, respectively). Up to 30% of cases have been described, and evidence points to discrete quantities of local anesthetic disseminating ipsilaterally into the epidural area after TPVB (Luyet et al. 2009).

Theoretically anatomically related structures favor a lower risk of ESPB in terms of pneumothorax, hematoma, nerve injury, and neuraxial spread than TPVB (Xu et al. 2021; Kot et al. 2019). No adverse events, such as hematoma, LA toxicity, or respiratory depression, were found in the current study. Only one patient developed pneumothorax in the TPVB group. the incidence of complications reported by ElGhamry and Amer (1008) Çiftçi et al. (2020), and Zhao et al. (2020) was not statistically significant. Complications of TPVB still occur in 2.6–5% when is blind, Although the use of ultrasound may lower the risk of unintentional pleural puncture, the risk of radiologically visible pneumothorax had occurred according to Niessen et al. (2020) in 3.6 per 1000 procedures (95% CI 0.5–13.6). The incidence of pneumothorax increases with multiple levels of injection (Cooter et al. 2007). Additionally, Chang's meta-analysis (Koo et al. 2022) revealed that the ESPB group had a lower incidence of hematoma than the other groups, with an odds ratio of 0.19 (95% CI 0.05–0.73). Expert clinicians apply guidelines from the American Society of Regional Anesthesia and Pain Medicine for TPVB that would be used for neuraxial anesthesia and consider anticoagulation to be a relative contraindication to TPVB. In addition, deep blocks in non-compressible locations like TPVB may increase the risk of hematoma (Horlocker et al. 2018).

In terms of decreased postoperative pain levels, postoperative opioid consumption, and requirement for rescue analgesia, there are clear patterns in the majority of studies indicating the superior analgesic impact of TPVB over ESPB following thoracic surgery. despite the effects are not apparent in the studies of breast surgery in contrast to thoracic surgery nevertheless it was hypothesized that it might be connected to ESPB's inadequate analgesia for thoracic surgery (Koo et al. 2022).

Conclusions

Given that it is a straightforward technique with superficial anatomical landmarks, has superior patient satisfaction and takes less time to perform than TPVB, US-guided ESPB may be regarded as a safe and effective substitute.

Abbreviations

ESPB	Erector spinae plane block
TPVB	Thoracic paravertebral block
VATS	Video-assisted thoracic surgery
VAS	Visual analogue scale
HR	Heart rate
NIBP	Non-invasive blood pressure
ASA	American Society of Anesthesiology
INR	International normalizing ratio
GFR	Glomerular filtration rate
mm	Millimetre
cm	Centimetres
ECG	Electrocardiogram
SpO_2	Pulse oximetry
T5	Thoracic vertebrae 5
$PaSO_2$	Arterial oxygen saturation
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
MBP	Mean blood pressures
DLT	Double-lumen tube
$EtCO_2$	End-expiratory carbon dioxide
ICU	Intensive care unit
h	Hours
LA	Local anesthetic
PONV	Postoperative nausea and vomiting
SPSS	Statistical Package for Social Science
SD	Standard deviation
IQR	Interquartile range
TPVS	Thoracic paravertebral space

Acknowledgements

Not applicable.

Authors' contributions

AAS: collecting data and performing the practical part. SIS: made substantial contributions to the conception. AMK: design of the work. AHA: the acquisition and analysis. FKA: interpretation of data, performing the practical part and substantively revised the work.

Funding

Not applicable.

Availability of data and materials

All datasets generated or analyzed during this study are included in the manuscript.

Declarations

Ethics approval and consent to participate

This study was conducted after obtaining approval from the Faculty of Medicine at Ain Shams University's Ethical Committee of Scientific Research with approval number (FWA 000017585) and written informed consent from every patient.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Received: 31 August 2022 Accepted: 20 May 2023
Published online: 05 June 2023

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