

## A Comparative Study of Analgesic Effect of Ultrasound Guided Erector Spinae Plane Block Versus Serratus Anterior Plane Block for Thoracoscopic Sympathectomy Surgeries

Ahmed Mohamed Hamed Abozeid<sup>1\*</sup>, Doaa Galal Diab, Mohamed Younis Makharita, Mohamed Younes Yousef Abd-Allah

Department Anesthesia and Surgical Intensive Care, Faculty of Medicine, Mansoura University, Egypt

\*Corresponding author: Ahmed Mohamed Hamed Abozeid, Mobile: (+20) 01065217484, E-Mail: ahmedabozeid37@gmail.com

### ABSTRACT

**Background:** In the realm of thoracic surgery, video-assisted thoracoscopic surgery (VATS) is a well-established minimally invasive approach. The objective of the current study is to compare the analgesic effects of erector spinae plane blocks guided by ultrasound vs serratus anterior plane blocks guided by ultrasound in patients undergoing thoracoscopic sympathectomy for palmer hyperhidrosis.

**Patients and methods:** A total of 110 patients, aged between 21 and 40 years old planned for sympathectomy, were randomly allocated into 55 patients who were subjected to erector spinae plane block (ESPB) and 55 patients who were subjected to serratus anterior plane block (SAPB). All patients with VAS more than 30 were received i.v. ketorolac 30 mg every 8 hours. Up to the end of the first 24 hours following surgery, the total amount of fentanyl and paracetamol used was tracked, along with the length of analgesia, the occurrence of side effects during the first 24 hours following surgery, and the patient satisfaction score after 12 and 24 hours.

**Result:** The total analgesic (fentanyl) consumption in 24 h was significantly lower in ESPB group compared with SAPB group. Significantly lower VAS was observed with ESPB. Significantly longer time for the first request to rescue analgesia was recorded with ESPB. Significantly longer time of block performance was observed in ESPB group. Significantly delayed onset of sensory block and less number of fentanyl doses were recorded in ESPB group. No significant difference between ESPB and SAPB as regards to patient satisfaction score and side effects.

**Conclusion:** ESPB shows superior analgesic effect to SAPB in sympathectomy surgeries

**Keywords:** Analgesic, Serratus anterior plane block, Thoracoscopic sympathectomy, Ultrasound guide, Erector spinae plane block.

### INTRODUCTION

In the realm of thoracic surgery, VATS, or video-assisted thoracoscopic surgery, is a well-known minimally invasive technique. Chest drains are clearly superior to open surgery and other minimally invasive procedures in terms of discomfort, length of stay (LOS), duration, and morbidity, according to comparative studies and meta-analyses<sup>(1)</sup>. It is indicated in several diseases either they were malignant or benign, esophageal operations, major as well as minor thorax surgeries, distal airway operations as cranial resections, pleural causes like empyema as well as sympathectomy for managing hyperhidrosis<sup>(2)</sup>. Primary palmar hyperhidrosis (PPH), which is frequently accompanied with head, face, or plantar hyperhidrosis, is the excessive production of exocrine glands on the palms. PPH has no clear organic etiology, although some patients may experience significant psychologic, social, and vocational dysfunction because they feel anxious and experience excessive palm sweating<sup>(3)</sup>.

Treatment for palmar hyperhidrosis focuses mostly on symptoms. Injections of botulinum toxin, aluminum salts, systemic anticholinergics, percutaneous radiofrequency ablation, and endoscopic thoracic sympathectomy are a few of the therapy options<sup>(4)</sup>.

Endoscopic thoracic sympathectomy eliminates eccrine sweating in all regions supplied by the postganglionic fibres, but it comes with a number of risks, including post-sympathetic neuralgia, which is the most serious, wound infection, pneumothorax,

Horner syndrome, hemorrhage, no response to the procedure, and compensatory hyperhidrosis in non-denervated areas<sup>(5)</sup>.

In the current study, patients undergoing thoracoscopic sympathectomy for palmer hyperhidrosis were compared to the effects of ultrasound guided erector spinae plane block (ESPB) and ultrasound guided serratus anterior plane block (SAPB).

### PATIENTS AND METHODS

A prospective randomized controlled clinical trial was conducted at Mansoura University Hospital from May 2020 to 2021. This single blind clinical trial was carried out after being approved from Anesthesia, ICU and Pain Management Department then the Institutional Review Board (IRB).

**Study Design and Patients:** The current study comprised adult American Society of Anesthesiologists (ASA) I-II patients who were scheduled to have thoracoscopic sympathectomy procedures and who consented to sign the informed consents. The research excluded patients with coagulopathies, local infections, neuropathies, neuromuscular diseases, mental illnesses, and a history of thoracic surgery. Patients who had a history of local anesthetic allergies, were on chronic pain medications, were drug users, or refused treatment were also eliminated.

A total of 110 patients were randomly allocated by a computer-generated randomization table and group

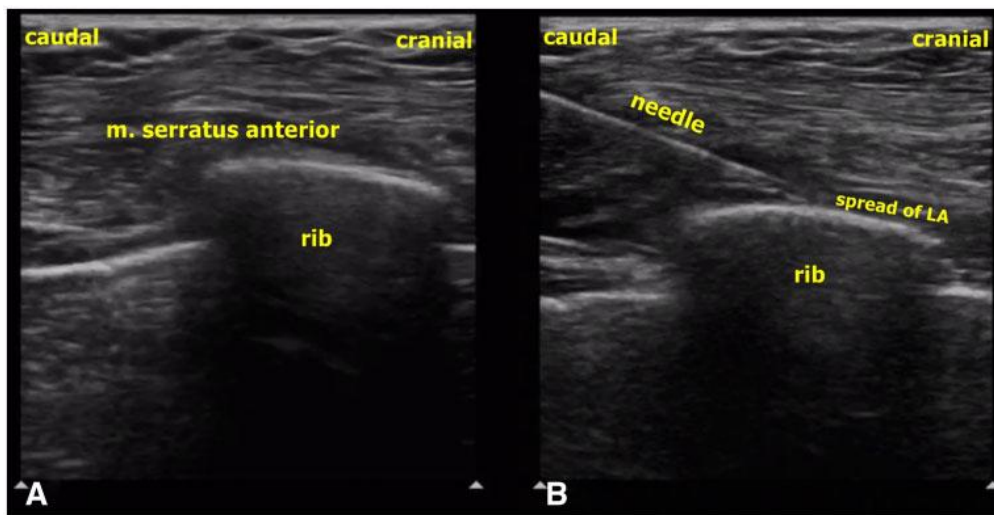
assignment will be concealed in sealed opaque envelopes into ESPB group (55 patients) and SAPB group (55 patients). Prior to surgery, patients got routine evaluations and received training in using the visual analogue scale (VAS).

#### Anesthetic management:

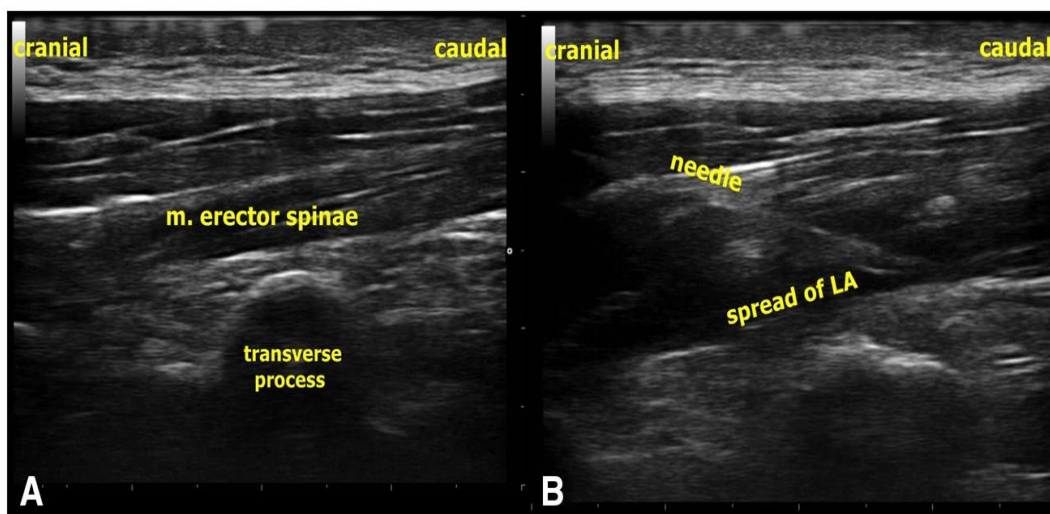
Preoperative evaluation of the patients included taking their medical history, performing a physical exam, and completing routine laboratory tests like a complete blood count (CBC), coagulation profile (INR, prothrombin concentration), serum creatinine and liver function tests (serum albumin, SGOT, SGPT), as well as electrocardiography. Each patient was informed about VAS, which uses a horizontal range of 0–100 mm (where 0 represents no pain and 100 represent the greatest possible agony). Before participating in the trial, each patient provided a written informed permission. Standard monitoring tools, such as a 5-lead ECG, a pulse oximeter, and

blood pressure monitors, were linked to the patients in the anesthetic room. The measures of heart rate (HR), mean arterial pressure (MAP), systolic and diastolic blood pressure, and oxygen saturation were reported as baseline values.

A 20 gauge intravenous cannula was inserted, an intravenous drip of 500ml crystalloids was started and an oxygen flow of 3 liter/minute via a face mask was administered. Every patient received 3 mg midazolam for sedation, A 110 patients were randomly allocated into two equal groups, 55 patients for Erector Spinae Group (Group E) was received bilateral ultrasound guided erector spinae plane block using 30 ml isobaric bupivacaine 0.25% in each side (15 ml bupivacaine 0.5% plus 15 ml saline) and Serratus anterior Group (Group S) was received bilateral ultrasound guided serratus anterior plane block with 30ml isobaric bupivacaine 0.25% in each side (15 ml bupivacaine 0.5% plus 15 ml saline).



**Figure (1): US guided Serratus Anterior Plane Block. A) Serratus anterior plane block sonographic anatomy. The rib and serratus anterior muscle are visible. B) When blocking the serratus anterior plane, the local anesthetic is distributed craniocaudally by the needle. Muscle is m. Local anesthesia<sup>(6)</sup>.**



**Figure (2): US guided Erector Spinae Plane Block. A) The sonographic erector spinae plane block. One can observe the transverse process and the erector spinae muscle. B) During an erector spinae plane block, local anesthetic was distributed craniocaudally and in the needle's direction. Muscle is M. Local anesthetics, or LA<sup>(7)</sup>.**

A well-trained anesthesiologist, who was not present in the scene during the injection and blinded to group allocation assessed the sensory block, provided the intraoperative and postoperative patients' care and collected the data. Sensory blockade was evaluated every 5 min for 30 minutes after injection. The sensory block was evaluated over the area extend between D2 to D6 by pinprick and touch test.

All intraoperative hemodynamic measurements, such as the patient's heart rate (HR), oxygen saturation (SPO2), ETCO2, and systolic, diastolic, and mean blood pressures, were evaluated and recorded every 10 minutes until the surgery was finished. Hemodynamic instability treatment was recorded. If the heart rate or blood pressure increased by 20% or more over the pre-induction levels, 0.5 mcg/kg of fentanyl was IV given, and/or the isoflurane concentration was increased. limit of 1.5 percent.

**Postoperative Assessment:**

The degree of discomfort was assessed in the post-anesthesia care unit (PACU) every two hours for a period of 12 hours, as well as at 16-, 20-, and 24-hours following surgery. VAS was used to ask patients to assess their degree of pain, with 0 signifying no pain and 100 denoting the most excruciating suffering conceivable. The patient with VAS greater than 30 got 30 mg of ketorolac intravenously every eight hours. If the VAS was remained higher than 30 after 30 minutes of ketolac injection, i.v. Fentanyl 0.5g/kg was offered. When at least 4 hours had gone since the previous dose, the fentanyl injection was repeated. After 15 minutes after administering fentanyl, if the patient was still in pain, the patient was given 15 mg/kg of IV paracetamol. Up to the end of the first 24 hours following surgery, the total amount of fentanyl and paracetamol used was documented, and the length of analgesia (from the end of the block until the time for the first analgesic necessity (ketorolac) was noted. The first 24 hours postoperatively were when adverse effects were initially documented. Metoclopramide 10 mg IV was administered when the patient reported feeling sick or vomiting.

5-Excellent, 4-Very Good, and 3-Good are the patient satisfaction ratings. After 12 hours and 24 hours, 2-Fair and 1-Poor were noted<sup>(8)</sup>.

**Ethical consent:**

An approval of the study was obtained from Mansoura University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

**Statistical analysis**

In order to analyze the data acquired, Statistical Package of Social Science (SPSS) version 20 was used to execute it on a computer. In order to convey the

findings, tables and graphs were employed. The quantitative data was presented in the form of the mean, median, standard deviation, and confidence intervals. The information was presented using qualitative statistics such as frequency and percentage. The student's t test (T) was used to assess the data while dealing with quantitative independent variables. Pearson Chi-Square and Chi-Square for Linear Trend (X<sup>2</sup>) were used to assess qualitatively independent data. The significance of a p value of 0.05 or less was determined.

**RESULTS**

There was no significant statistical difference between the two studied groups as regards demographic data (Table 1).

**Table (1): Patients characteristics of the studied groups**

Variable	ESPB group N=55	SAPB group N=55	Test of significance
Age (years)	30.3 ± 6.1	29.2 ± 5.6	P=0.317
Gender Male Female	36 (65.5%) 19 (34.5%)	30 (54.5%) 25 (45.5%)	P=0.243
ASA 1 2	37 (67.3%) 18 (32.7%)	40 (72.7%) 15 (27.3%)	P=0.533
BMI(Kg/m <sup>2</sup> )	25 ± 2.4	25.1 ± 2.4	P=0.875

Parameters described as mean ± SD, number (percentage). P is significant when ≤0.05. ESPB: Erector spinae plane block. SA: Serratus anterior plane block. BMI: Body mass index. ASA: American society of anesthesiologists. Kg: kilogram. Cm: centimeter. Kg/m<sup>2</sup>:kilogram-meter squared.

As regards to time of block performance on Rt side, and Lt side, it was significantly more in ESPB group (4.7±1.5 min) (4.7±1.5 min) than SAPB group (3.5±1.2) (3.6±1.7). Also as regards to onset of sensory block, it was significantly more in ESPB group (16.6±5.3 min) than SAPB group (13.7±4.1). Considering the time of first request to rescue analgesia was significantly prolonged in ESPB group (9.0±5.1 h) than in SAPB group (6.2 ± 3.9 h). Also the total analgesic (fentanyl) consumption in 24 h was significantly lower in ESPB group (74.7 ± 54.2 ug) than in SAPB group (99.0 ± 67.3 ug) (Fig.3)

As regards the postoperative pain using the visual analogue scale (VAS) for 24 hrs postoperatively, VAS significantly decreased among ESPB cases in comparison to SAPB cases at 2h (12.7 ± 2.7) vs (16.2 ± 3.7), 4h (21.0 ± 5.01) vs (29.2 ± 7.3), 6h (27.4 ± 6.4) vs (33.7 ± 8.1), 12h (27.9 ± 6.3) vs (32.9 ± 7.6), and 20h postoperative (30.2 ± 6.4) vs (35.6 ± 8.3) (Figure 4).

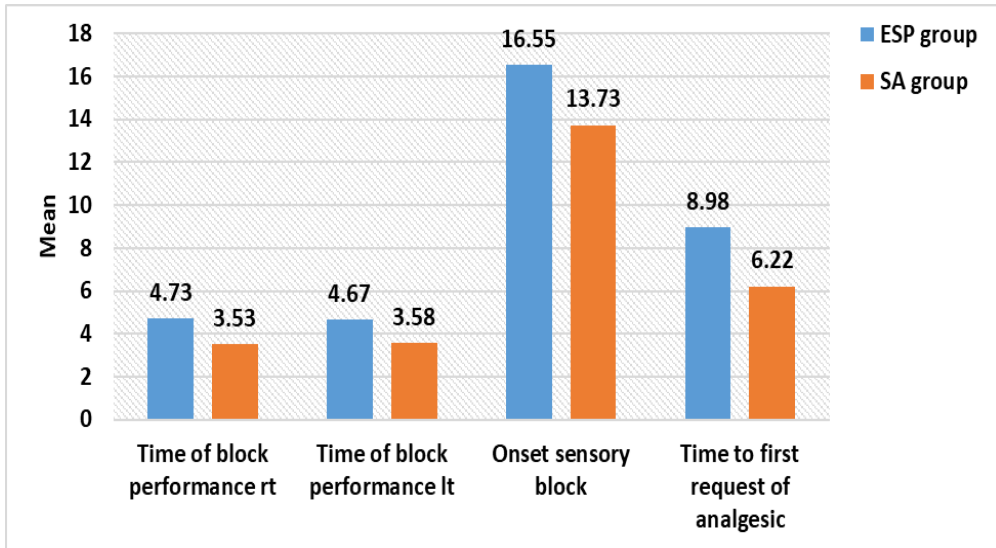


Figure (3): Mean time of block performance, onset of sensory block and time to first analgesic among studied groups.

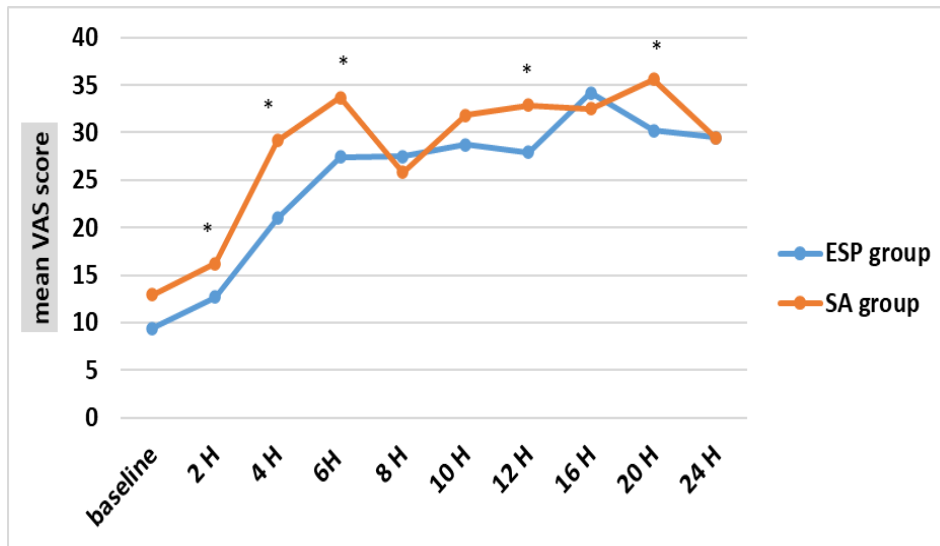


Figure (4): Line chart of mean VAS score between studied groups.

The hemodynamics (heart rate and mean blood pressure) of the both groups were not statistically significantly different before, during, or after surgery, according to this study (Figures 5 & 6).

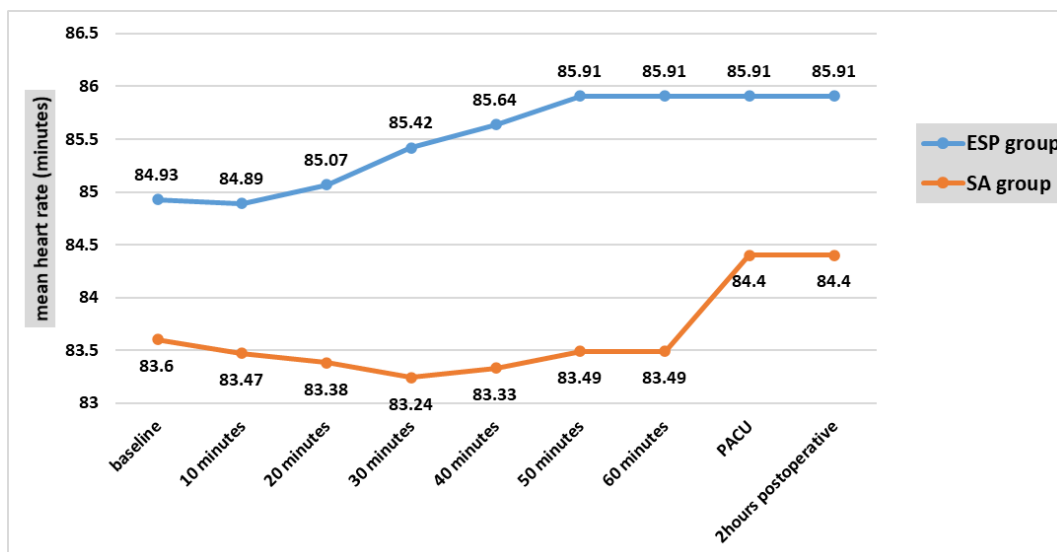


Figure (5): Line chart of mean heart rate between studied groups.

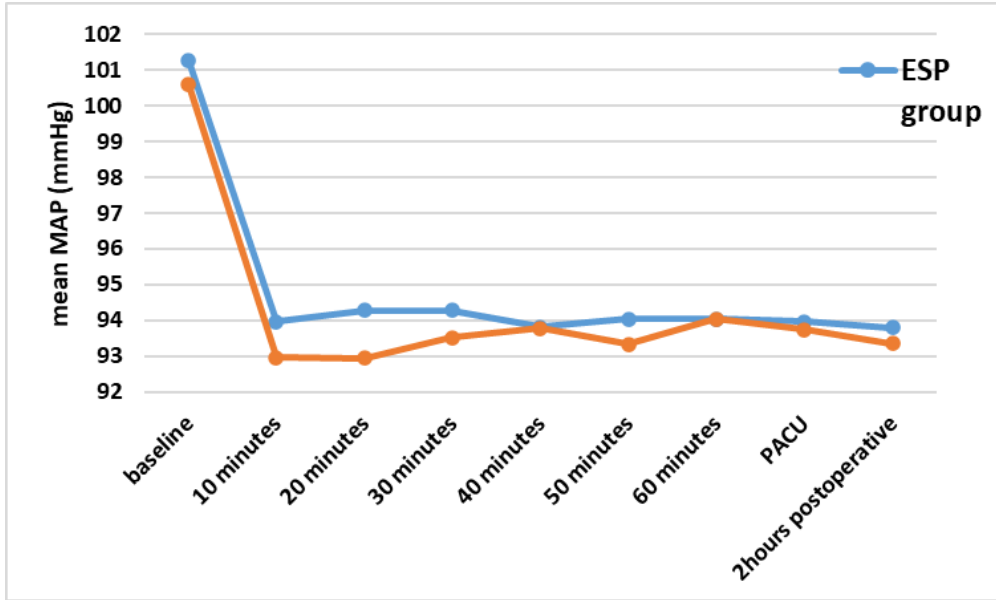


Figure (6): Line chart of mean MAP between studied groups.

The amount of fentanyl doses administered differently between the two study groups in a substantial way, number of doses was significantly less in ESPB group 3.0 (0.0-4.0) than in SAPB group 3.0 (0.0-5.0). As regards to number of ketolac doses and number of paracetamol doses, no statistical significance was found (Table 2).

Table (2): Comparison of number of ketolac, fentanyl and Paracetamol doses between the studied groups.

Number of doses	ESPB group N=55	SAPB group N=55	Test of significance
Number of ketolac doses	3.0 (1.0-3.0)	3.0 (1.0-3.0)	P=0.095
Number of fentanyl doses	3.0 (0.0-4.0)	3.0 (0-5.0)	P=0.01*
Number of paracetamol doses	0 (0-3.00)	0.0 (0.0-3.0)	P=0.895

Data is expressed as median and range. P is significant when  $\leq 0.05$ . \* indicates significant difference between both groups. ESPB: Erector spinae plane block. SA: Serratus anterior plane block.

There was no discernible statistical difference between the two study groups' patient satisfaction scores at 12 and 24 hours (Table 3).

Table (3): Patient satisfaction score at 12h,24h in the studied groups.

Variable	ESPB group n=55(%)	SAPB group n=55(%)	Test of significance
<b>Patient satisfaction score at (12 h)</b>			p=0.872
Fair	8 (14.5%)	8 (14.5%)	
Good	22 (40.0%)	18 (32.7%)	
Very good	15 (27.3%)	17 (30.9%)	
Excellent	10 (18.2%)	12 (21.8%)	
<b>Patient satisfaction score at(24 h)</b>			p=0.958
Fair	8 (14.5%)	8 (14.5%)	
Good	24 (43.6%)	22 (40%)	
Very good	15 (27.3%)	15 (27.3%)	
Excellent	8 (14.5%)	10 (18.2%)	

Data is expressed as number (percentage). P is significant when  $< 0.05$ . ESPB: Erector spinae plane block. SA: Serratus anterior plane block.

Side effects and negative impacts did not differ in a statistical significant way between the studied groups (Table 4).

Table (4): Postoperative side effects between the studied groups

Variable	ESPB group N=55	SAPB group N=55	Test of significance
Nausea	7(12.7%)	12(21.8%)	p=0.207
Vomiting	2(3.6%)	4(7.3%)	P=0.679
Bradycardia	0	0	---
Hypotension	0	0	---

Data is expressed as number (percentage). P is significant when  $\leq 0.05$ . ESPB: Erector spinae plane block. SA: Serratus anterior plane block.

## DISCUSSION

Thoracoscopy is a less invasive thoracic surgery, yet there is still a lot of pain afterward. ESPB and SAPB, as opposed to systemically delivered opioids, offer effective thoracic analgesia<sup>(9)</sup>.

The current study compared the total amount of analgesics consumed in the first 24 hours after surgery as the primary outcome, the severity of postoperative pain as measured by the visual analogue scale (0-100), the time for the 1st request of analgesia, and any associated side effects in patients undergoing thoracoscopic sympathectomy for palmer hyperhidrosis.

After receiving approval from the anesthesia and intensive care unit department and then the institutional review board, this prospective randomized single-blind study was carried out on a total of 110 patients who underwent thoracoscopic sympathectomy surgeries at Mansoura University Hospital from May 2020 to 2021.

According to the current study, there were no demographic differences that were statistically different between the two groups that were being compared.

This demonstrated that the two groups were equivalent and that the factors did not affect the study's overall findings.

As regards to time of block performance on right side, it is significantly more in ESPB group ( $4.7 \pm 1.5$  min) than SAPB group ( $3.5 \pm 1.2$  min). As regards to time of block performance on left side, it is significantly more in ESPB group ( $4.7 \pm 1.5$  min) than SAPB group ( $3.6 \pm 1.7$  min). As regards to onset of sensory block, it is significantly more in ESPB group ( $16.6 \pm 5.3$  min) than SAPB group ( $13.7 \pm 4.1$  min). Considering the time of first request to rescue analgesia was significantly prolonged in ESPB group ( $9.0 \pm 5.1$  h) than in SAPB group ( $6.2 \pm 3.9$  h). Also the total analgesic (fentanyl) consumption in 24 h was significantly lower in ESPB group ( $74.7 \pm 54.2$  ug) than in SAPB group ( $99.0 \pm 67.3$  ug). Between the two groups, the aggregate amount of analgesic (paracetamol) use showed no statistically significant difference.

In the same line, **Forero et al.**<sup>(10)</sup>, have reported that According to the original observation of the ESPB, which showed a block length of around 24 hours, the ESPB delivers a longer period of analgesia than the SAPB.

In contrast, the initial description of the SAPB using the "deep" approach (which we utilized) indicated that the average block time for participants was 386 (160) minutes<sup>(11)</sup>.

In the context of the postoperative pain, the current study demonstrated that; VAS was significantly decreased in ESPB group when compared to SAPB group at 2h ( $12.7 \pm 5.2$ ) vs ( $16.2 \pm 5.7$ ), 4h ( $21.0 \pm 8.8$ ) vs ( $29.2 \pm 11.3$ ), 6h ( $27.4 \pm 9.3$ ) vs ( $33.7 \pm 12.3$ ), 12h ( $27.9 \pm 6.9$ ) vs ( $32.9 \pm 9.1$ ), 20h

postoperative ( $30.2 \pm 6.4$ ) vs ( $35.6 \pm 9.3$ ) with a highly statically significant differences ( $P < 0.001$ ).

In the same line, **Gaballah et al.**<sup>(12)</sup>, have shown that the VAS dynamic score was considerably lower in the ESPB group than the SPPB group because the patients were alert, and the VAS static score was significantly lower in the ESPB group than the SPPB group from the fourth hour ( $p = 0.04$ ) to the sixth hour ( $p = 0.002$ ), and postoperatively ( $p = 0.001$ ). This pattern lasted into the twentieth postoperative hour.

Likewise, **Finnerty et al.**<sup>(9)</sup>, the research involved 60 adult patients having minimally invasive thoracic surgery who were randomized to receive a single-shot ESP or SAP block with levobupivacaine 0.25 percent, 30 ml, before to surgery. Time (min) to the first intravenous opioid analgesia was seen to be 32.6 (20.6) in ESPB and 12.7 (9.5) in SABP, with statistically significant differences ( $P = 0.003$ ). In ESPB and SABP, the median (25–75%) VRS pain on movement was 4 (2-4) vs. 5 (3-6), respectively ( $P = 0.04$ ). AUC at rest in ESPB and SABP was 112 (35) mm h1 versus 92 (31) mm h1 ( $P = 0.03$ , respectively), as well.

Moreover, **Ekinci et al.**<sup>(13)</sup>, have said that the static/dynamic VAS scores were consistently considerably lower in the ESPB group as compared to the SAPB group when reporting the visual analogue scale (VAS) data in the results section. At hour 4, there was no discernible difference between the two groups' static VAS scores ( $P > 0.05$ ), nevertheless.

**Hassan and Wadod**<sup>(14)</sup> have demonstrated that Scale of numerical ratings At rest, the pain levels were comparable between the groups, but after 30 minutes, two hours, and four hours of coughing, the pain scores in the ESPB and SAPB groups were considerably lower than those in the control group. At 8, 12, and 24 hours, there was no longer much of a difference between the control and SAPB groups, but the ESPB group still had the smallest difference.

As regards analgesic requirement, both groups demonstrated insignificant differences regarding ketolac and paracetamol doses, In contrast to the SAPB group, the ESPB group was linked to a considerable drop in fentanyl dosage ( $p < 0.05$ ).

In the same line, **Gaballah et al.**<sup>(12)</sup>, have displayed that the ESPB group's initial analgesic requirement was met after a noticeably longer period ( $p < 0.001$ ).

In accordance, **Hassan and Wadod**<sup>(14)</sup>, have illustrated Both the ESPB and SAPB groups consumed considerably less postoperative morphine than the control group [ESPB ( $8.52 \pm 4.29$  mg) SAPB ( $19.57 \pm 7.63$  mg) control ( $36.37 \pm 8.27$  mg)] ( $p < 0.001$ ).

Additionally, several investigations have shown that following a thoracotomy and video-assisted thoracoscopy, ESPB had better analgesia than SAPB<sup>(13)</sup>.

One of SAPB's drawbacks is that, because it is superficial, the block is less efficient at reducing visceral pleural discomfort, particularly after pleural decortication procedures <sup>(15)</sup>. Researchers have shown that SAPB can successfully manage post-thoracotomy discomfort in heart surgery <sup>(16)</sup>. According to a meta-analysis, SAPB reduced postoperative pain and opioid use in the first 24 hours compared to the control group <sup>(17)</sup>.

According to hemodynamic measures, neither the intra-operative nor postoperative hemodynamics (heart rate and mean blood pressure) of the two groups were significantly different from one another.

Similarly, **Finnerty *et al.*** <sup>(9)</sup>, have demonstrated that, no significant difference was recorded among both groups regarding.

With regard to adverse events, no significant differences were recorded among both groups regarding all adverse events (Vomiting, Nausea, Bradycardia and Hypotension).

Similarly, **Ekinci *et al.*** <sup>(13)</sup>, have demonstrated that, no significant difference was recorded among both groups regarding all adverse events.

In conclusion, SABP has a worse analgesic profile than ESPB, which is a safe and effective option with similar side effects.

**Financial support and sponsorship:** Nil.

**Conflict of interest:** Nil.

## REFERENCES

1. **Yang X, Li M, Yang X *et al.* (2018):** Uniport versus multiport video-assisted thoracoscopic surgery in the perioperative treatment of patients with T1–3N0M0 non-small cell lung cancer: a systematic review and meta-analysis. *Journal of Thoracic Disease*, 10:2186-95.
2. **Gonzalez-Rivas D, Fieira E, Delgado M *et al.* (2013):** Uniportal video-assisted thoracoscopic lobectomy. *Journal of Thoracic Disease*, 5:234-45.
3. **Chen J, Liu Y, Yang J *et al.* (2019):** Endoscopic thoracic sympathectomy for primary palmar hyperhidrosis: A retrospective multicenter study in China. *Surgery*, 166:1092-8.
4. **Lau R, Ng C, Wong R *et al.* (2014):** Single port video-assisted thoracic surgery VasoView sympathectomy for palmar hyperhidrosis. *Chest*, 145:44-9.
5. **Tang H, Wu B, Xu Z *et al.* (2014):** A new surgical procedure for palmar hyperhidrosis: is it possible to perform endoscopic sympathectomy under deep sedation without intubation? *European Journal of Cardio-Thoracic Surgery*, 46:286-90.
6. **Wang L, Wang Y, Zhang X *et al.* (2019):** Serratus anterior plane block or thoracic paravertebral block for postoperative pain treatment after uniportal video-assisted thoracoscopic surgery: a retrospective propensity-matched study. *Journal of Pain Research*, 12:2231-8.
7. **Ekinci M, Ciftci B, Gölboynu B *et al.* (2020):** A randomized trial to compare serratus anterior plane block and erector spinae plane block for pain management following thoracoscopic surgery. *Pain Medicine*, 21:1248-54.
8. **Kaur H, Singh G, Rani S *et al.* (2015):** Effect of dexmedetomidine as an adjuvant to levobupivacaine in supraclavicular brachial plexus block: a randomized double-blind prospective study. *Journal of Anaesthesiology, Clinical Pharmacology*, 31:333-8.
9. **Finnerty D, McMahan A, McNamara J *et al.* (2020):** Comparing erector spinae plane block with serratus anterior plane block for minimally invasive thoracic surgery: a randomised clinical trial. *British Journal of Anaesthesia*, 125(5):802-10.
10. **Forero M, Adhikary S, Lopez H *et al.* (2016):** The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. *Regional Anesthesia & Pain Medicine*, 41(5):621-7.
11. **Blanco R, Parras T, McDonnell J *et al.* (2013):** Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. *Anaesthesia*, 68:1107-13.
12. **Gaballah K, Soltan W, Bahgat N (2019):** Ultrasound-guided serratus plane block versus erector spinae block for postoperative analgesia after video-assisted thoracoscopy: a pilot randomized controlled trial. *Journal of Cardiothoracic and Vascular Anesthesia*, 33(7):1946-53.
13. **Ekinci M, Ciftci B, Gölboynu B *et al.* (2022):** Serratus Anterior Plane Block versus Erector Spinae Plane Block for Thoracoscopic Surgery: Response to Sun *et al.* *Pain Medicine*, 23(4):870-71. doi: 10.1093/pm/pnac004.
14. **Hassan M, Wadod M (2022):** Serratus anterior plane block and erector spinae plane block in postoperative analgesia in thoracotomy: A randomised controlled study. *Indian Journal of Anaesthesia*, 66(2):119-25.
15. **Semyonov M, Fedorina E, Grinshpun J *et al.* (2019):** Ultrasound-guided serratus anterior plane block for analgesia after thoracic surgery. *Journal of Pain Research*, 12:953-60.
16. **Magoon R, Kaushal B, Chauhan S *et al.* (2020):** A randomised controlled comparison of serratus anterior plane, pectoral nerves and intercostal nerve block for post-thoracotomy analgesia in adult cardiac surgery. *Indian Journal of Anaesthesia*, 64(12):1018-24.
17. **Liu, X, Song, T, Xu H *et al.* (2020):** The serratus anterior plane block for analgesia after thoracic surgery: a meta-analysis of randomized controlled trials. *Medicine*, 99(21):e20286. doi: 10.1097/MD.00000000000020286.