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Erector Spinae Plane block Versus Transversalis Fascia Plane Block Guided by Ultrasound for Pain Control Following Unilateral Abdominal Surgeries under Subarachnoid Anesthesia

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ORIGINAL ARTICLE

Erector Spinae Plane Block Versus Transversalis Fascia Plane Block Guided by Ultrasound for Pain Control Following Unilateral Abdominal Surgeries Under Subarachnoid Anesthesia

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Abstract

Background: **Postoperative complications are increased if postoperative pain is uncontrolled. This can be improved with regional blocks, especially in the postoperative period. Moreover, complications are reduced using the one analgesia technique.**

Aim of the work: **Our purpose was to compare the transversalis fascia plane block (TFP) and the erector spinae plane block (ESP).**

Patients and methods: **Sixty patients who had unilateral abdominal surgery and fulfilled the inclusion criteria were divided into two equal groups. Group I received ultrasound (US)-guided unilateral transversalis fascia plane (TFP) block and group II received US-guided unilateral erector spinae plane (ESP) block. Primary outcomes were visual analogue scale (VAS) score, block duration, total pethidine use on the first day, number of patients required postoperative pethidine, frequency of analgesic requested in the first postoperative 24 h, and patient satisfaction scale. The secondary outcome was the recoding of any adverse effects or complications.**

Results: **VAS was lower in group II compared with group I at 8 h, 12 h, and 24 h postoperatively both at rest and movement. The frequency of analgesic doses and use of analgesics on the first day postoperatively were lower in group II compared with group I. Analgesic periods (hrs) were more prolonged in group II compared with group I. No complications were reported in both groups.**

Conclusion: **ESP was superior to TFP block as it produces less VAS, less frequency of analgesic request, less analgesic consumption, and longer analgesic period.**

Keywords: Abdominal surgery, Erector spinae plane block, Transversalis fascia plane block, Ultrasound-guided

1. Introduction

There are many procedures that are used regarding postoperative analgesia after abdominal surgeries. These include systemic opioids, injection in the subarachnoid space, abdominal nerve blocks, and block in the fascial planes such as the quadratus lumborum plane (QLP), transversus abdominis plane (TAP) block, and the erector spinae plane (ESP) block.[1,2]

The spread of anesthetics through the paravertebral space is considered the cause of anesthesia through the erector spinae plane (ESP) block.[3] The optimal site for injection depends on the desired dermatomal coverage. Regarding abdominal surgeries, the erector spinae muscle is injected with local anesthesia at the levels of the T7-T9 transverse processes to make an impact on T7-T11 dermatomes.[4]

Transversalis fascia plane block (TFPB) was observed as compared with the anterior TAP in one

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clinical study in which the comparison was in inguinal herniorrhaphy.[5]

Therefore, we aimed to assess the effect of TFPB guided with US compared with ESP guided with US as well for analgesia postoperatively in unilateral abdominal surgeries under spinal anesthesia.

2. Materials and methods

After approval of the local ethics committee and taking a written informed consent from each patient, this study was performed at Al-Azhar University Hospitals in Cairo for Boys starting from January 2022 until June 2022.

The primary outcome was to compare the erector spinae plane block and the transversalis fascia plane block following unilateral abdominal surgeries under spinal anesthesia regarding relief of postoperative pain (by visual analogue scale (VAS) score), the first request of postoperative analgesia, and total morphine consumption in the first 24 h postoperatively. Furthermore, the secondary outcome was any adverse effects or complications.

Sixty individuals were included in this study. Inclusion criteria included: Participants accepting to join the study, aged 21–60 years, with body mass index (BMI) of less than 30 kg/m^2, have an ASA physical status I and II, and patients undergoing unilateral abdominal surgeries under spinal anesthesia with an expected duration of 1–1.5 h. Exclusion criteria: patient refusal, coagulation disorders, infection at the site of injection, sensitivity to used drugs, patients undergoing bilateral abdominal surgery, emergency operations, history of analgesics dependence, and duration of surgery >1.5 h.

Initially, venous access was performed. Then, all patients received medication of 0.01 mg/kg atropine, 8 mg of ondansetron, and 20 mg of famotidine intravenously (IV) as a premedication. A measure of 15 ml/kg of Ringer's lactate solution was started over 30 min and used as a preload. Preoperative monitoring and baseline HR, MAP, and oxygen saturation (SPO_2) were monitored.

All participants received standard spinal anesthesia (15–20 mg of 0.5% hyperbaric bupivacaine based on the patient's built (height and weight)) under a complete aseptic technique and then immediately moved to be in a supine position with around 15° for head elevation. After making sure of the anesthesia level, abdominal surgery was performed with continuous monitoring of blood pressure and heart rate. If the systolic blood pressure reached up to 20% below the baseline or even less than 90 mm Hg, 6 mg of ephedrine was injected IV. Moreover, if the heart rate reduced to 50 bpm or even less, 0.6 mg of atropine was injected through IV.

After completion of surgery, the included 60 patients were randomly allocated to either of the two equal groups:

Group 1 who received US-guided unilateral TFP block.

Group II who received US-guided unilateral ESP block.

2.1. The technique of the TFP block

TFP block was performed after completion of surgery under ultrasonographic guidance using a low-frequency convex transducer. The patient was moved to a lateral position. The probe was introduced to orientation just above the iliac crest transversely; and the three abdominal muscle layers were identified. Then the probe was moved posteriorly to show the point at which the transversus abdominis muscle and the internal oblique muscle connected into a common fascia, which is just near the quadratus lumborum muscle. The tip of a 22-gauge 80-mm block needle was used just to pierce the transversalis fascia. Aspiration was performed in order to be safe from vascular puncture, followed by injecting 20 ml of 0.25% bupivacaine (Fig. 1) (which demonstrated ultrasound-guided transversalis fascia plane block. IO: internal oblique muscle, EO: external oblique muscle, and transversus abdominis muscle).

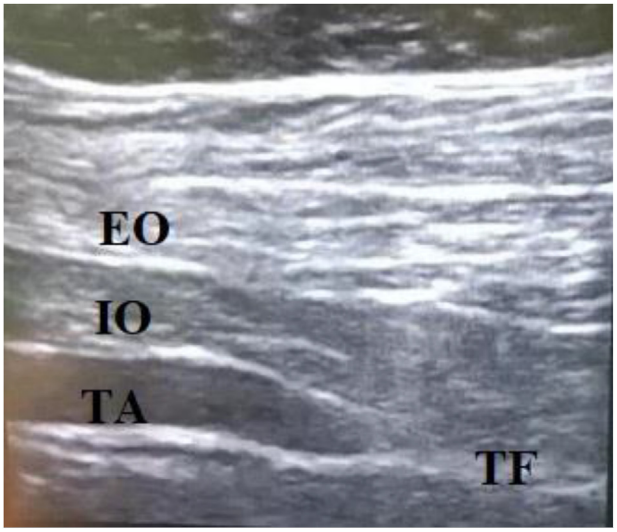

Fig. 1. Ultrasound-guided transversalis fascia plane block. IO: internal oblique muscle, EO: external oblique muscle, Transversus abdominis muscle.

2.2. The technique of the ESP block

The patients were turned into the lateral position with skin sterilization at the ninth thoracic transverse process level; moreover, a linear ultrasound probe was placed vertically 3 cm lateral to the spinous process to visualize the trapezius and erector spinae muscles.

A 22-G short-bevel needle was introduced into the in-plane method with the direction of the needle cranio-caudally until it reached the transverse process. We then inserted 1 ml saline to confirm the needle position perfectly just above the transverse process below the erector spinae muscles. Furthermore, aspiration was done to make sure that there is no vascular puncture. Finally, we injected 20 ml of 0.25% bupivacaine (Fig. 2) (which demonstrated ultrasound-guided erector spinae plane block. ESM: erector spinae muscle; TP: transverse process; LA: local anesthetics).

The block was considered a failed procedure if the patient asked for more than two analgesic doses as a rescue in the first 4 h postoperatively and this patient was replaced by another one.

Heart rate (beats/min) and mean arterial blood pressure (mmHg) were measured on arrival at PACU and at 30, 60, and 90 min; 2, 4, 6, 8, 12, and 24 h postoperatively (H_0, H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8, respectively, for HR and M_0, M_1, M_2, M_3, M_4, M_5, M_6, M_7, and M_8, respectively, for MAP).

Postoperative pain was shown by the VAS score, which is a 10-cm line with 0 at one end representing no pain and 10 at the other end representing the worst pain imaginable, at rest and after cough at 2, 6, 8, 12, and 24 h (V_0, V_1, V_2, V_3, V_4, respectively). Patients with a VAS of more than 3 received titration of 10 mg intravenous pethidine every 10 min, until VAS became equal or less than 3, provided that the respiratory rate was more than 10/min.

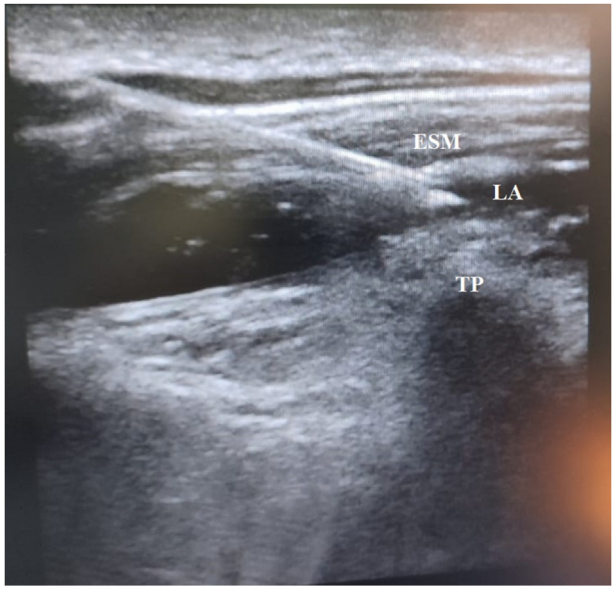

Fig. 2. Ultrasound-guided erector spinae plane block. ESM: erector spinae muscle; TP: transverse process; LA: local anesthetics.

The number of patients who required postoperative pethidine, frequency, and total postoperative pethidine consumption (mg) during the first postoperative 24 h were recorded.

The analgesic period (considered as the time between starting the block until the time of first analgesia is ordered) was documented.

We assessed the patient satisfaction based on a four-point scale which is 1 as excellent, 2 as good, 3 as fair, and 4 as poor).

Manifestations of systemic toxicity of local anesthetics, such as numbness at either circumoral or tongue, disturbance at visual function or auditory function, tinnitus, or dizziness were recorded.

2.3. Statistical analysis

The required sample size was calculated using the G power program 3.1.9.4. Based on previous studies on the duration of both blocks,[6–8] the minimal sample size in each group is 27 patients to get a power level of 0.80, an alpha level of 0.05 (two-tailed), and an effect size of 0.78 for the duration (mean ± SD in the TFP block group and the ESP group is 8 ± 4 and 12 ± 6, respectively). The calculated sample size was increased by 10% to reach 30 in each group to allow for dropouts.

We analyzed the study's data using the SPSS software statistical computer package (IBM Corp., Armonk, NY, USA). We used mean ± standard deviation as an expression of numerical variables. Regarding comparing means between both groups, we used the independent *t*-test. We used median and interquartile range (IQR) as an expression to data without normal distribution; and a further test of Mann–Whitney *U* test was performed. Regarding qualitative data that was presented as number and percentage, we used the chi-squared test. Significance was considered when the *P*-value is less than 0.05.

3. Results

Demographic and characteristic data did not show any significant difference between both groups (Table 1). Moreover, there is no difference between both groups regarding the type of surgery.

Table 1. Demographic and characteristic data.

Characteristic data	Group I ($N = 30$)	Group II ($N = 30$)	
	Mean ± SD, N (%)	Mean ± SD, N (%)	P
Age (year)	31.46 ± 2.17	30.93 ± 3.48	0.482
Weight (kg)	74.61 ± 5.84	72.39 ± 7.53	0.207
Height (cm)	163.4 ± 5.43	164.70 ± 5.32	0.353
BMI (kg/m2)	22.91 ± 2.73	23.22 ± 2.64	0.657
Duration of Surgery (min)	49.27 ± 5.60	50.33 ± 4.49	0.422
Sex (males/females)	17 (56.7%)/13 (43.3%)	14 (46.7%)/16 (53.3%)	0.606
ASA (I/II)	22 (73.4%)/8 (26.6%)	26 (86.6%)/4 (13.4%)	0.333

Variables are presented as mean ± standard deviation (SD), number (%), Group I = TFP block, Group II = ESP block, *P*-value <0.05 is considered significant, chi-square test is used along with independent *t*-test.

Postoperative HR did not show any difference between the two groups regarding different time points of assessment (Table 2).

Postoperative MAP did not show any difference between the two groups regarding different time points of assessment (Table 3).

The VAS was lower in group II compared with group I at V2, V3, and V4 both at rest and movement (Table 4).

The analgesic period was more prolonged in group II compared with group I (Table 5).

Analgesic use was lower in group II compared with group I (Table 6).

Table 2. Heart rate (beats/min) between both groups.

	Group I ($N = 30$)	Group II ($N = 30$)	T	P
H_0				
Mean ± SD	79.31 ± 4.01	78.1 ± 3.29	0.834	0.407
H_1				
Mean ± SD	77.32 ± 3.87	76.42 ± 4.97	1.65	0.104
H_2				
Mean ± SD	75.78 ± 4.67	77.73 ± 5.03	1.56	0.125
H_3				
Mean ± SD	74.56 ± 4.52	75.20 ± 6.17	0.458	0.648
H_4				
Mean ± SD	77.36 ± 6.36	79.80 ± 5.32	1.611	0.112
H_5				
Mean ± SD	78.86 ± 2.27	79.10 ± 5.67	0.215	0.830
H_6				
Mean ± SD	79.83 ± 5.65	80.16 ± 4.93	0.241	0.810
H_7				
Mean ± SD	80.25 ± 6.16	78.43 ± 6.28	1.133	0.261
H_8				
Mean ± SD	77.73 ± 5.43	78.26 ± 4.21	0.422	0.674

Variables are presented as mean ± standard deviation (SD). Group I = TFP block, Group II = ESP block, *P*-value <0.05 is considered significant; independent *t*-test was used.

Table 3. Mean arterial blood pressure (MAP) (mm Hg) between both groups.

	Group I ($N = 30$)	Group II ($N = 30$)	T	P
M_0				
Mean ± SD	70.40 ± 3.30	70.60 ± 5.09	−0.180	0.858
M_1				
Mean ± SD	70.77 ± 2.64	70.20 ± 4.31	0.159	0.874
M_2				
Mean ± SD	69.67 ± 5.99	70.77 ± 2.64	0.919	0.362
M_3				
Mean ± SD	70.60 ± 5.09	68.20 ± 5.94	1.679	0.099
M_4				
Mean ± SD	71.60 ± 3.22	71.17 ± 2.64	0.159	0.874
M_5				
Mean ± SD	72.40 ± 3.09	73.47 ± 2.34	0.149	0.833
M_6				
Mean ± SD	70.60 ± 5.09	71.30 ± 5.09	0.00	1.00
M_7				
Mean ± SD	70.77 ± 2.64	71.16 ± 5.09	0.159	0.874
M_8				
Mean ± SD	71.60 ± 3.09	72.77 ± 2.34	0.119	0.751

Variables are presented as mean ± standard deviation (SD), Group I = TFP block, Group II = ESP block, *P*-value <0.05 is considered significant; independent *t*-test was used.

The frequency of analgesic doses in the first postoperative 24 h was specifically lower in group II compared with group I (Table 7).

Overall patient satisfaction on the first postoperative day was better in Group II compared with Group I (Table 8).

There were no complications reported in both groups.

Table 4. Average VAS score for both groups at rest and in motion.

VAS score	Group I ($N = 30$)		Group II ($N = 30$)		
	Median	IQR	Median	IQR	P
V_0					
At rest	1	(1–1)	1	(1–1)	0.954
With movement	2	(2–2)	1.4	(1–2)	0.194
V_1					
At rest	2	(2–2)	2	(2–2)	0.060
With movement	2	(2–3)	2	(1–2)	0.587
V_2					
At rest	3	(2–3)	2	(1–2)	<0.001[a]
With movement	3	(2–3)	2	(2–2)	<0.002[a]
V_3					
At rest	4	(4–5)	2	(2–3)	<0.001[a]
With movement	4	(4–5)	3	(2–3)	<0.001[a]
V_4					
At rest	6	(5–6)	4	(3–4)	<0.001[a]
With movement	7	(6–7)	4	(4–4)	<0.001[a]

[a] Means statistically significant difference. Variables are presented as median and interquartile range (IQR), Group I = TFP block, Group II = ESP block, *P*-value <0.05 is considered significant, Mann–Whitney *U* test was used.

Table 5. Duration of analgesia (hrs) in both groups.

Duration of analgesia (hr)	Group I ($N = 30$)	Group II ($N = 30$)	P
Mean ± SD	16.46 ± 0.82	30.26 ± 3.19	<0.001[a]

[a] Means statistically significant difference between the two groups. Variables are presented as mean ± standard deviation (SD). Group I = TFP block, Group II = ESP block, P-value <0.05 is considered significant; independent t-test was used.

Table 6. Total analgesic consumption (pethidine in mg) in the first postoperative 24hrs between both groups.

Total consumption of pethidine (mg) in 24hrs	Group I ($N = 30$)	Group II ($N = 30$)	P
Median Range	30 (20–50)	20 (0–30)	<0.001*

Variables are presented as median and interquartile range (IQR). Group I = TFP block, Group II = ESP block, P-value <0.05 is considered significant; independent t-test was used.

Table 7. Frequency of analgesic doses consumption between both groups in the first postoperative 24hrs

Doses N (%)	Group I ($N = 30$)	Group II ($N = 30$)	P
0	0 (0%)	5 (16.7%)	<0.001*
1	0 (0%)	7 (23.3%)	
2	1 (3.3%)	14 (46.6%)	
3	17 (56.7%)	4 (13.3%)	
4	11 (36.7%)	0 (0%)	
5	1 (3.3%)	0 (0%)	

Variables are presented as number and percent of patients per number of doses.
Group I = TFP block, Group II = ESP block, P-value <0.05 is considered significant; chi-square test was used.

4. Discussion

Transversalis fascia plane block is considered as injecting analgesics in the transversalis fascia, which will spread in the quadratus lumborum muscle.[6] The mechanism of this block is through blocking L1 roots and branches, especially iliohypogastric and ilioinguinal nerves. Moreover, TFP is presented lateral along with the lumbar plexus plane. Injecting through this fascia is considered a similar block as the lumbar plexus block.[9]

The ESP block is first described in 2016, which is used as an efficient management for pain at thoracic neuropathic operations.[3] There were two procedures that were described regarding injecting LA. The first approach is described as injecting between the ESM and the rhomboid major, while the second approach was injecting deep into the ESM. It was reported that the first approach is not efficient as the second approach which is injecting below the ESM.[3]

Table 8. Patient satisfaction in both groups.

Patient satisfaction	Group I N (%) ($N = 30$)	Group II N (%) ($N = 30$)	P
Poor	0 (0%)	0 (0%)	
Fair	8 (26.6%)	4 (13.3%)	0.005*
Good	14 (46.6%)	6 (20%)	
Excellent	8 (26.6%)	20 (66.6%)	

Variables are presented as number and percent. Group I = TFP block, Group II = ESP block, P-value <0.05 is considered significant; chi-square test was used.

Rahimzadeh et al. (2018)[10] conducted a study comparing the TFP and the transversus abdominis plane (TAP) block guided by US for analgesia postoperatively in pregnant patients scheduled for cesarean section (CS) and showed that the TFP has equal pain control as the TAP after CS with a similar decrease of analgesia required.

Boules et al. (2020)[11] compared the analgesic effect of the ESP block and the TAP block after a cesarean section and observed that the ESP block is more efficient pain analgesia, has a more prolonged analgesic period, longer time to start analgesia request, with less opioid use, and further used as a part of multimodal analgesia and regimens without opioids for CS.

Lopez-Gonzalez et al. (2016)[12] started a study on the US-guided TFP block versus the TAP block anterior approach in inguinal hernia surgeries and showed that both blocks achieved efficient analgesia for inguinal hernia surgeries, an applicable approach which is easy to perform and with fewer complications. TFP achieved the best level of sensory block, but there were not any differences regarding analgesic requirements.

Fouad *et al.* (2021)[9] conducted a study on the US-guided TFP block versus QLP regarding postoperative analgesia in inguinal hernia surgery and showed that the TFP block was efficient as a QL block in decreasing pain sensation and analgesic consumption.

For general knowledge, this study is considered the first study designed for evaluating and comparing the analgesic applicability and safety of ESP and TFP in unilateral abdominal surgery.

Our study demonstrated that postoperative HR (beats/min) and MAP (mmHg) do not have differences among both groups at different assessment times.

The current study observed that the VAS was significantly higher in TFP than ESM after 6, 8, and 24 h postoperatively both at rest and in motion.

The present study demonstrated that the analgesic period was more prolonged in the ESP group than in the TFP group.

This study showed that the total analgesic consumption (pethidine in mg/day) in the first postoperative 24 h was considered as lower significantly in the ESP group than in the TFP group.

The current study observed that the frequency of analgesic doses in the first postoperative 24 h was considered as significantly lower in the ESP group than in the TFP group.

The present study demonstrated that the overall patient satisfaction in the first postoperative 24 h was considered as significantly higher in the ESP group than in the TFP group.

This study showed that there were no complications reported in both groups.

4.1. Conclusion

The ESP block was superior to the TFP block as it produces less VAS, less frequency of analgesic request, less analgesic consumption, longer analgesic period, and better satisfaction for the patients.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

There are no conflicts of interest.

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