Original Article

Comparison of Epidural Analgesia with Ultrasound-Guided Bilateral Erector Spinae Plane Block in Aorto-Femoral Arterial Bypass Surgery

Ragavendran S, Raghu C, Prasad S R, Thanigai Arasu, Nagaraja P S, Naveen G Singh, Manjunath N, Muralikrishna N[1], Yogananth N[2]

Departments of Anaesthesiology, and [1]Vascular surgery, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Jaya nagar, Bangalore, Karnataka, [2]Department of Public Health and Preventive Medicine, Vector Borne Disease Control Division, Chennai, Tamil Nadu, India

ABSTRACT

Objective: Thoracic Epidural Analgesia (TEA) was compared with ultrasound-guided bilateral erector spinae plane (ESP) block in aorto-femoral arterial bypass surgery for analgesic efficacy, hemodynamic effects, and pulmonary rehabilitation.

Design: Prospective randomized.

Setting: Tertiary care centre.

Participants: Adult patients, who were scheduled for elective aorto-femoral arterial bypass surgery.

Interventions: It was a prospective pilot study enrolling 20 adult patients who were randomized to group A (ESP block = 10) and group B (TEA = 10). Monitoring of heart rate (HR) and mean arterial pressure (MAP) and pain assessment at rest and deep breathing using visual analog scale (VAS) were done till 48-h post-extubation. Rescue analgesic requirement, Incentive spirometry, oxygenation, duration of ventilation and stay in Intensive Care Unit (ICU) were reported as outcome measures. Statistical analysis was performed using unpaired Student T-test or Mann-Whitney U test. A value of $P < 0.05$ was considered significant.

Results: HR was lower in group B than group A at 1 and 2 h post- surgery and at 0.5, 16, 20, and 32 h post-extubation ($P < 0.05$). MAP were lower in group B than A at 60, 90, 120, 150, 180, 210, 240, 270 minutes and at 0 hour post-surgery and at 4 hours, every 4 hours till 32 hours post-extubation ($P < 0.05$). Intraoperative midazolam and fentanyl consumption, ventilatory hours, VAS at rest, incentive spirometry, oxygenation, and ICU stay were comparable between the two groups. VAS during deep breathing was more in group A than B at 0.5, 4 hours and every 4 hours till 44 hours post-extubation. The time to receive the first rescue analgesia was shorter in group A than B ($P < 0.05$).

Conclusion: Both ESP block and TEA provided comparable analgesia at rest. Further studies with larger sample size are required to evaluate whether ESP block could be an alternative to TEA in aorto-femoral arterial bypass surgery.

Keywords: Erector spinae plane block, thoracic epidural analgesia, visual analogue scale

Address for correspondence: Dr. Raghu C, Flat No. 105, A – Block, Vishwendra Apartments, JP Nagar 8th Phase, Kothanur, Bangalore - 560 076, Karnataka, India.
E-mail: ramc.raghu@gmail.com

Submitted: 18-Jan-2020 **Revised:** 22-Aug-2020 **Accepted:** 30-Oct-2020 **Published:** 21-Jan-2022

Access this article online	
Quick Response Code:	Website: www.annals.in
	DOI: 10.4103/aca.ACA_23_20

How to cite this article: Ragavendran S, Raghu C, Prasad SR, Arasu T, Nagaraja PS, Singh NG, *et al.* Comparison of epidural analgesia with ultrasound-guided bilateral erector spinae plane block in aorto-femoral arterial bypass surgery. Ann Card Anaesth 2022;25:26-33.

INTRODUCTION

Prevalence of occlusive arterial diseases involving descending aorta, iliac and femoral vessels leading to critical limb ischemia is increasing worldwide. Aorto-iliac occlusive disease (AIOD) is treated by the management of risk factors, endovascular intervention, and/or surgical revascularization.[1] Surgical revascularization of the lower limb is often established by bypass grafting procedures like aorto-femoral bypass unilaterally or bilaterally requiring midline laparotomy. Revascularization in peripheral vascular diseases (PVD) is associated with significant cardiac-related morbidity and mortality, because of the associated coronary artery diseases (CAD), diabetes, renal, respiratory and cerebro-vascular diseases, and also the nature and duration of surgery.[2]

Pain following laparotomy consists of both visceral pain and somatic pain from the abdominal wall. The visceral pain is conducted to the spinal cord through the sympathetic chain, whereas somatic pain is conducted through the T7–L1 spinal nerves.[3] The most commonly used regional techniques such as thoracic epidural analgesia (TEA) and paravertebral blocks (PVB), have been extensively investigated for perioperative analgesia in major open abdominal surgeries.[4,5] General anesthesia along with epidural analgesia as a part of multimodal analgesia is known to be very useful in minimizing the perioperative hemodynamic fluctuations and surgical stress response and at ensuring effective analgesia and rapid recovery.[6] But TEA and PVB are associated with procedure-related concerns such as technical difficulty and chronic use of anticoagulants and antiplatelet medications in vascular surgical patients.[7-9]

Abdominal wall blocks such as transversus abdominis plane (TAP) block and rectus sheath block, have been used as alternatives to TEA and PVB.[3,10] Limitations of these blocks include limited dermatomal coverage, no visceral analgesia, the requirement of multiple injections and a large volume of local anesthetics. However, analgesic efficacy of these blocks has not yet been established in laparotomy.[3,11-13]

Forero *et al*. described a novel paraspinal plane block, erector spinae plane (ESP) block, for the treatment of chronic thoracic neuropathic pain. When performed at the T5 level, it provided effective analgesia for thoracotomy, sternotomy and breast surgery.[14-17] Recently, it has been shown that ESP block when performed at a lower thoracic level of T7–T9 can also be used to provide extensive somatic and visceral abdominal analgesia extending up to the C7-T2 transverse processes cranially and down to the L2-3 transverse processes caudally[18-20] with a lower risk of complications than TEA or PVB.[14,15,19] Cadaveric studies showed a range of the ESP block to spread to the dorsal and ventral rami, rami communicates, neural foramina, paravertebral and epidural spaces.[14,21-23]

A pilot study was conducted to compare analgesic efficacy of bilateral ESP block with thoracic epidural block in patients undergoing aorto-femoral arterial bypass surgery. Hemodynamics in the perioperative period, ventilatory hours, length of intensive care unit (ICU) stay, incentive spirometry and oxygenation were also compared.

METHODOLOGY

ASA physical status III-IV patients aged 18-70 years scheduled for elective aorto-femoral arterial bypass surgeries were recruited for this pilot study. Written informed consent was taken from all the patients. Pain scoring based on the Visual Analog Scale (VAS) and use of incentive spirometer were explained to the subjects in both the groups. Twenty patients were randomized to two groups namely ESP block group (Group A: 10 patients) and the TEA group (Group B: 10 patients) by the closed envelope method.

Patients scheduled for elective aorto-femoral arterial bypass surgeries in the age group of 18-70 years were included in the study. Exclusion criteria were patient refusal, allergy to local anesthetics, localized infection, bleeding diathesis, patients on anticoagulants, pre-existing neurological deficit**,** spinal deformities, left ventricular ejection fraction (EF) <40%, cognitive impairment, an active psychiatric condition, inability to understand pain scoring and emergency surgery.

After obtaining approval from the institutional ethics committee, the study was conducted at a tertiary care centre. We registered the study in WWW.CTRI.NIC.IN. prior to the start of the study (CTRI/2019/03/017922 on 06/03/2019). On the day of surgery, intravenous access, and standard monitoring such as pulse oximetry, continuous 5-lead electrocardiography, central venous catheterization and radial artery catheterization were established in both the groups.

In group A, bilateral ESP block was performed in the left lateral decubitus position under strict aseptic precautions. A high-frequency 12-MHz linear ultrasound transducer (Philips En Visor CHD, Bothell, WA, USA 98041) was placed in a longitudinal orientation 3 cm lateral to the T8 spinous process corresponding to the T7 transverse process. Two muscles trapezius (superior)

and erector spinae (inferior) were identified superficial to the hyperechoic transverse process. Local infiltration with 2% of lignocaine at the site of needle insertion was administered. Using in-plane approach an 18G Tuohy needle was inserted in caudal–cephalad direction, until the tip is placed deep to erector spinae muscle. Hydrodissection was demonstrated upon injection of 5 ml of normal saline. A 20G epidural catheter was threaded 5 cm in cephalad direction. Same procedure was followed on the opposite side. In group A, catheter position on both sides was confirmed by visualizing the catheter floating in the interfascial plane while moving the ultrasound probe up and down after saline administration. Hydrodissection was demonstrated from T6-L1 bilaterally.

In group B, under strict aseptic precautions, 18G Tuohy's needle with Huber's tip was inserted via median approach after local infiltration with 5 ml of 2% lignocaine at the level of T9-T10 or T10-T11 intervertebral space in the sitting position. After identifying epidural space using loss of resistance technique, 5 ml of saline was administered after negative aspiration for blood or cerebrospinal fluid and 20G epidural catheter was threaded 5 cm cranially.

After negative aspiration for blood, patients in group A were administered with 15 ml of 0.25% bupivacaine through each catheter followed by continuous infusion of 0.125% bupivacaine at the rate of 0.1ml/kg/hour through each catheter till 48 hours post-extubation. After negative aspiration for blood or CSF, the patients in group B were administered with a bolus dose of 15 ml of 0.25% bupivacaine through epidural catheter followed by continuous infusion of 0.125% bupivacaine at the rate of 0.1 ml/kg/hour till 48 hours post-extubation. After 30 minutes of bolus administration of local anesthetic in either group, sensory blockade was assessed with pinprick test. Patients in either group with inadequate analgesia would be excluded from the study.

Patients in both groups were administered standard general anesthesia protocol as follows: midazolam 0.05 mg/kg IV, fentanyl 2 mcg/kg IV, titrated dose of propofol IV, vecuronium 0.1 mg/kg IV (0.02 mg/kg repeated every 40 min till end of surgery) and lignocaine 1.5mg/kg IV (90 seconds before intubation). Patients in both groups were intubated orotracheally with a cuffed endotracheal tube after adequate muscle relaxation and mechanically ventilated with intermittent positive pressure ventilation (IPPV). Anesthesia was maintained with isoflurane, air, and oxygen.

In both groups, hemodynamics such as heart rate (HR) and mean arterial pressure (MAP) were monitored before induction (baseline), 1 min after induction, 1 min after skin incision, every 30 mins till the end of the surgery, every hourly post-surgery till extubation, at 0.5 h every fourth hourly till 48 hours post-extubation. In both the groups, any increase in HR and/or BP more than 20% from the baseline were treated with IV fentanyl 1 mcg/kg. Intraoperative midazolam consumption, total consumption of fentanyl, duration of aortic cross-clamping and surgery were noted. After the surgical procedure, patients were shifted to postoperative surgical intensive care unit. Patients in both groups were extubated once criteria for extubation were met. Duration of mechanical ventilation was noted.

Postoperative pain assessment was performed using 10 cm visual analog scale (VAS) (10 cm: maximum pain; 0: no pain). VAS at rest and during deep breathing and monitoring of partial pressure of arterial oxygen (PaO_2) using arterial blood gas analysis were performed at 0.5h after extubation and every fourth hourly till 48 hours post-extubation. Simultaneously, peak inspiratory flow spirometry (incentive spirometry) was performed post-extubation to assess the number of balls raised in the spirometer as an indicator of peak inspiratory flow rate (1 ball = 600 ml, 2 balls = 900 ml, and 3 balls = 1200 ml).

Breakthrough pain was defined as VAS score >4 at rest or on patient's demand, despite basal analgesia. IV paracetamol 1 g was given as the first rescue analgesic. If VAS score was persistently more than 4 after 30 minutes of first rescue analgesia, IV tramadol 1 mg/kg (diluted in 100 ml of normal saline) was infused over 30 minutes as the second rescue analgesia. Patients in either group whose VAS score was persistently more than 4 after 30 minutes of second rescue analgesia would be excluded from study. Dynamic pain was defined as the difference in VAS >2 points between rest and cough. The pain was classified as mild (VAS 0-4), moderate (VAS 5-7), and severe (VAS 8-10). Duration of ICU stay and any complications were recorded.

Data were expressed as a mean ± standard deviation. Parametric data were analyzed using the Student t-test. Mann–Whitney U-test was used to analyze non-parametric data. A two-tailed value of $P < 0.05$ was considered statistically significant. Statistical analysis was performed using Epi Info version 7.2.3.1 (Centers for Disease Control and Prevention (CDC) in Atlanta, GA, USA).

RESULTS

All 20 male patients enrolled in either group completed the study. None of the patients in either group had inadequate

analgesia. Both the groups were comparable with respect to age, gender, height, weight, intraoperative consumption of intravenous midazolam and fentanyl, duration of aortic cross-clamping, surgery, mechanical ventilation, and ICU stay [Table 1].

HR was comparable between the two groups from baseline to till the end of the surgery, at 0.5, 3, and 4 hours post-surgery and at 4, 8, 12, 24, 28, 36, 40, 44, and 48 hours post-extubation. HR was lower in group B than group A at 1 and 2 hours post-surgery and at 0.5, 16, 20 and 32 hours post-extubation ($P < 0.05$) [Table 2a]. MAP was lower in group B than A at 60, 90, 120, 150, 180, 210, 240 and 270 minutes during surgery and at 0 hour post-surgery and at 4, 8,12, 16, 20, 28, 32 hours post-extubation ($P < 0.05$) [Table 2b].

VAS scores at rest were comparable between the two groups till 48 hours post-extubation [Table 3]. VAS scores during deep breathing were significantly more in group A than B at 0.5, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, and 44 hours post-extubation ($P < 0.05$) [Table 3]. Time to receive first rescue analgesia was significantly shorter in group A compared to B (10.0 ± 10.5409 min vs. 35.5 ± 35.1544 min) ($P < 0.05$). Total consumption of first rescue analgesia was comparable (1585.5 ± 490.41 mg in group A vs. 1231.5 ± 425.11 mg in group B [Table 1]. There were 17 breakthrough pain episodes required first rescue analgesia in group A, whereas 13 in group B [Figure 1a]. Group A patients had three breakthrough pain episodes that required second rescue analgesia. None of the patients in group B required second rescue analgesia [Figure 1b].

Incentive spirometry and PaO_2 were comparable between the two groups till 48 hours post-extubation [Table 4]. There were no regional anesthetic-related complications and adverse effects observed in either group.

DISCUSSION

Optimal pain management plays an important role in the recovery of patients following major open abdominal surgery. In the present study, VAS ≤4 at rest in both the groups signified effective analgesia, with comparable ventilator duration. Both the groups were compliant with chest physiotherapy in the form of incentive spirometry with an acceptable peak inspiratory flow of around 800 ml and better oxygenation. TEA group had greater MAP reduction than ESP block group from the first hour till the completion of surgery. A similar reduction of MAP was seen during immediate post-operative and post-extubation at 4, 8, 12, 16, 20, 28 and 32 hours in TEA group. However, HR and MAP were found to be within 20% of the baseline values in either group.

As reviewed by Block *et al*.,[24] Hughes *et al*.,[25] Nishimori *et al*.,[26] and Popping *et al*.,[27] TEA provides better analgesia at rest and with activity, reduced opioid consumption, decreased duration of mechanical ventilation and ICU stay, early mobilization, improved cough and sympathetic block in major abdominal surgeries. In the present study, TEA resulted in improved VAS scores at rest and during deep breathing, reduced consumption of opioid, with better incentive spirometry scores. Even though earlier and many rescue analgesia were required in ESP block group compared to TEA, total rescue analgesic consumption was statistically comparable.

An epidural block is known to produce denser sympathetic blockade compared to superficial nerve blocks and truncal blocks. The authors of this study believe the reduction in MAP and the differences in VAS scores during deep breathing between the two groups occur for the denser sympathetic blockade in TEA group than in ESP block group.

Table 1: Demographic and perioperative data

Indicators	Group A (ESP block)	Group B (TEA)	*P*
Age (years)	50.2±10.6228	54.9±10.4504	0.33179
Gender	Male-10 Female-0	Male-10 Female-0	1.00000
Height (cm)	164.6±7.0427	164.8±6.1246	0.94672
Weight (kg)	67.0±9.3095	63.9±7.9784	0.43439
Total IV midazolam (mg)	2 (1-2)	2 (1-2)	1.00000
Total IV fentanyl consumption (mcg)	240.0±21.0819	230.0±34.9603	0.5485
Duration of aortic cross clamping (min)	59.4±16.7611	60.2±17.7376	0.91858
Duration of surgery (min)	243.5±13.5503	250.5±8.3166	0.18080
Duration of mechanical ventilation (min)	143.0±31.6403	146.0±36.5756	0.84668
Time to receive first rescue analgesia (mins)	10.0±10.5409	35.5±35.1544	0.04134
Total consumption of first rescue analgesia (mg)	1585.5±490.41	1231.5±425.11	0.1017
Time to receive second rescue analgesia (mins)	8.8±14.8234	0.0±0.0	0.07678
Duration of ICU stay (hours)	60.4±8.3693	58.6±9.3595	0.65571

ESP- Erector Spinae Plane . TEA- Thoracic Epidural Analgesia . IV – Intravenous . ICU- Intensive care unit

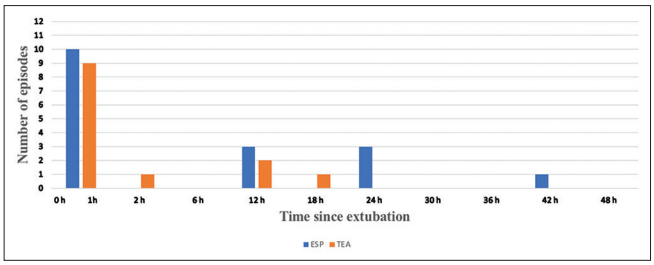

Figure 1a: Breakthrough pain episodes requiring first rescue analgesia

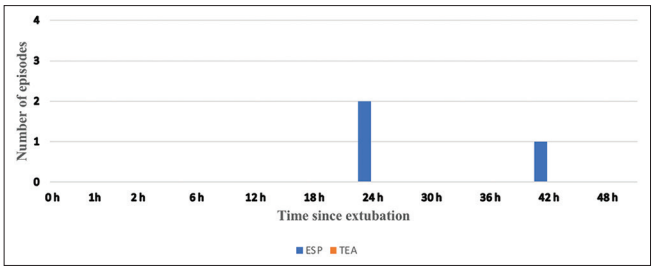

Figure 1b: Breakthrough pain episodes requiring second rescue analgesia

Table 2a: Heart rate (HR) changes in the perioperative period

Time	Group A (ESP block)	Group B (TEA)	*P*
HR during surgery			
Baseline	84.6±5.7388	82.6±8.2219	0.53611
1 min before induction	85.0±5.2705	84.0±6.6165	0.71290
1 min after induction	87.1±5.3841	84.2±8.4827	0.37343
1 min after skin incision	83.7±3.0569	82.9±4.8178	0.66277
30 min	85.6±5.2536	84.9±5.1088	0.76606
60 min	83.2±6.1246	82.7±5.1218	0.84523
90 min	76.1±6.3149	77.3±5.4171	0.65377
120 min	77.2±5.0067	77.3±4.9227	0.96457
150 min	79.6±8.6820	79.9±5.6657	0.9281
180 min	77.2±7.7287	77.6±6.8832	0.90408
210 min	77.9±8.9623	77.7±9.1779	0.96122
240 min	82.4±7.6333	80.0±6.6165	0.46218
270 min	83.0±8.9691	83.0±8.4853	0.00000
HR post-surgery			
0 h	82.4±7.6333	80.0±6.6165	0.46218
1 h	91.4±4.4020	82.3±6.8646	0.00240
2 h	92.6±8.1268	82.2±5.5337	0.00360
3 h	87.0±4.9216	83.5±5.9675	0.16960
4 h	86.5±4.9497	83.8±5.2026	0.24989
HR post-extubation			
0.5 h	90.1±4.0125	83.5±5.9675	0.00950
4 h	87.2±4.2635	83.8±5.2026	0.12735
8 h	87.1±7.1407	81.5±5.9861	0.07350
12 h	88.7±9.3577	81.7±7.0246	0.07472
16 h	90.5±7.8067	81.3±9.0437	0.02551
20 h	88.2±4.8259	78.8±8.3772	0.00653
24 h	88.6±9.3476	84.1±6.2796	0.22247
28 h	87.1±7.7810	83.5±6.3289	0.27126
32 h	88.8±5.9777	81.8±6.3736	0.02082
36 h	88.4±4.3256	82.5±8.9225	0.07616
40 h	88.5±3.7193	84.3±6.5836	0.09601
44 h	85.9±4.6536	82.7±7.8747	0.28316
48 h	86.9±3.7253	83.1±5.1305	0.07423

ESP- Erector Spinae Plane . TEA- Thoracic Epidural Analgesia . HR – Heart Rate

Guay and Kopp[28] reviewed 15 trials involving adult elective open abdominal aortic surgery and concluded that TEA provided improved pain scores, decreased duration of mechanical ventilation and ICU stay compared with systemic opioid-based analgesia. In the present study, TEA resulted in a decrease in VAS scores, duration of ventilation and length of ICU stay.

In vascular surgical patients, a major concern in using neuraxial techniques is their safety in patients with chronic use of anti-platelets and perioperative systemic anticoagulation. Various studies showed TEA is associated with technical difficulties and complications such as hypotension, bradycardia, motor blockade, urinary retention, total spinal anesthesia and epidural hematoma or abscess.[6-9]

Forero *et al*., introduced ESP block, an inter-fascial plane block for providing thoracic and abdominal analgesia. ESP block has been described as a successful perioperative pain management strategy for various surgeries involving thoracic and abdominal regions.[14,29] Bilateral ESP block at T7-T9 level provides effective and long-lasting postoperative analgesia following abdominal surgery.[3] Owing to the less risk of injury to the vessel, pleura, or neuraxis, it is relatively safer than TEA and PVB.[19,30] The exact volume and concentration of the infusion drug required in ESP block are not well established from the limited literature available. ESP block has been described as an effective alternative when TEA and PVB are contraindicated due to thrombocytopenia, antiplatelet or anticoagulant treatments, or coagulopathy.[31-34]

Restrepo-Garces *et al*.,[35] reported bilateral ESP block at T7, in a patient with recurrence of a bladder adenocarcinoma, who underwent open radical cystoprostatectomy with the ureter and neobladder reconstruction and reported resting and dynamic pain scores 3/10 and 1–2/10, respectively, during the first 72 hours with dermatomal coverage from T5-L2. Bang *et al*.,[36] reported ESP block at T8 transverse process in a 35-year-old female who underwent excision of a larger ovarian mass via laparotomy along with multimodal analgesia. There were resting or dynamic pain scores <4, with no rescue analgesics needed during the first five post-operative days. Hamed *et al*.[37] in a prospective study involving 60 patients showed that bilateral ESP block provided effective postoperative analgesia and markedly decreased postoperative fentanyl consumption in abdominal hysterectomy.

In the present study, bilateral ESP block at T7 resulted in improved VAS ≤4 at rest and 3-5 during deep breathing in the first 48 hours. There was a comparable first rescue analgesic requirement.

Table 2b: Mean arterial pressure (MAP) changes in the perioperative period

Time	Group A (ESP block)	Group B (TEA)	*P*
MAP during surgery			
Baseline	102.7±3.8887	103.1±5.1521	0.84684
1 min before induction	101.4±6.8832	101.2±6.1968	0.94631
1 min after induction	91.3±5.9451	86.3±7.4543	0.11458
1 min after skin incision	88.7±7.1500	83.7±6.5498	0.12034
30 min	87.9±8.9125	82.5±6.6207	0.14143
60 min	93.6±6.8832	82.7±4.5959	0.00058
90 min	94.2±5.7310	80.2±6.4256	0.00007
120 min	92.5±11.7118	81.7±5.4579	0.01653
150 min	92.4±10.6479	82.3±8.1520	0.02848
180 min	91.1±5.4457	80.8±9.1384	0.00672
210 min	91.6±3.5653	81.7±7.3643	0.00124
240 min	90.2±6.8443	81.5±6.5362	0.00940
270 min	88.6±3.7771	81.0±3.9158	0.00033
MAP post-surgery			
0 h	90.3±6.9769	81.3±6.6841	0.00865
1 h	88.1±12.7580	80.5±6.4507	0.11001
2 h	85.2±8.8418	80.7±5.4579	0.18768
3 h	88.5±13.2518	84.4±9.8002	0.44173
4 h	91.6±13.9220	85.7±7.1032	0.24808
MAP post-extubation			
0.5 h	93.0±8.8944	84.4±9.8002	0.05470
4 h	96.5±10.4695	85.7±7.1032	0.01467
8 h	96.7±7.4543	84.4±13.6398	0.02220
12 h	96.0±7.1181	86.4±12.3576	0.04734
16 h	97.5±9.0952	84.9±9.2670	0.00662
20 h	95.3±5.3135	86.1±7.8944	0.00678
24 h	93.6±4.8351	87.0±11.3235	0.10729
28 h	92.8±3.3599	86.2±6.0332	0.00732
32 h	95.9±3.7845	87.0±5.5578	0.00056
36 h	92.4±5.8916	89.5±7.5609	0.35137
40 h	93.2±7.8145	86.4±10.1346	0.11017
44 h	92.9±6.0636	88.0±12.2656	0.27229
48 h	92.3±5.2292	87.8±8.7025	0.17804

ESP- Erector Spinae Plane . TEA- Thoracic Epidural Analgesia . MAP - Mean arterial pressure

Table 3: Visual Analog Scale (VAS) post-extubation

Time since extubation	Group A (ESP block)	Group B (TEA)	*P*
a) VAS at rest			
0.5 h	2.9±0.7379	2.6±0.5164	0.30611
4 h	3.1±0.7379	3.0±0.6667	0.75415
8 h	3.0±0.0000	3.0±0.0000	1.0000
12 h	2.7±0.4830	2.7±0.4830	1.0000
16 h	2.6±0.5164	2.5±0.5270	0.67332
20 h	2.6±0.5164	2.6±0.5164	1.0000
24 h	3.2±1.0328	3.0±1.0541	0.67332
28 h	3.3±0.4830	3.2±0.4216	0.62784
32 h	2.5±0.5270	2.5±0.5270	1.0000
36 h	2.3±0.4830	2.3±0.4830	1.0000
40 h	2.9±0.8756	2.8±0.7888	0.79150
44 h	2.6±0.5164	2.9±0.8756	0.36304
48 h	2.5±0.5270	2.5±0.5270	1.0000
b) VAS during deep breathing			
0.5 h	5.2±0.4216	3.3±0.9487	0.00002
4 h	5.0±0.0000	3.1±0.3162	0.00000
8 h	4.7±0.4830	3.1±0.7379	0.00002
12 h	4.8±0.4216	3.1±0.3162	0.00000
16 h	4.6±0.5164	2.8±0.4216	0.00000
20 h	4.8±0.9189	3.2±0.4216	0.00009
24 h	5.9±0.8756	3.0±0.4714	0.00000
28 h	5.1±0.7379	3.0±0.4714	0.00000
32 h	4.5±0.5270	2.9±0.5676	0.00000
36 h	4.3±0.4830	3.2±0.4216	0.00004
40 h	4.8±0.4216	3.1±0.3162	0.00000
44 h	4.6±0.5164	3.1±0.8756	0.00019
48 h	3.4±0.6992	3.3±0.4830	0.71416

ESP- Erector Spinae Plane . TEA- Thoracic Epidural Analgesia . VAS – Visual Analog Scale

Table 4: Pulmonary data

	Incentive spirometry		
Time since extubation	Group A (ESP block)	Group B (TEA)	*P*
0.5 h	660.0±126.4911	660.0±126.4911	1.0000
4 h	735.0±110.6797	765.0±110.6797	0.55202
8 h	825.0±79.0569	840.0±77.4597	0.67332
12 h	825.0±79.0569	840.0±77.4597	0.67332
16 h	825.0±79.0569	840.0±77.4597	0.67332
20 h	825.0±79.0569	840.0±77.4597	0.67332
24 h	825.0±79.0569	840.0±77.4597	0.67332
28 h	825.0±79.0569	840.0±77.4597	0.67332
32 h	825.0±79.0569	840.0±77.4597	0.67332
36 h	870.0±63.2456	855.0±72.4569	0.62784
40 h	870.0±63.2456	855.0±72.4569	0.62784
44 h	885.0±85.1469	885.0±85.1469	1.0000
48 h	960.0±104.8809	975.0±106.0660	0.75415
b) PaO_2			
0.5 h	107.2±7.9972	110.0±8.4063	0.45527
4 h	93.7±6.8484	92.0±5.0990	0.53685
8 h	94.7±5.6970	92.8±5.2239	0.44706
12 h	95.1±6.6742	91.1±6.8872	0.20373
16 h	94.0±10.0664	92.2±6.8767	0.64617
20 h	99.0±9.6494	94.3±9.6959	0.29159
24 h	94.0±9.7183	90.4±4.7889	0.30727
28 h	92.3±9.2742	90.5±4.3525	0.58532
32 h	94.4±11.2368	93.2±5.9591	0.76885
36 h	90.3±6.3078	90.8±5.3292	0.85030
40 h	91.6±7.6913	92.5±7.8634	0.79877
44 h	95.2±7.0048	93.3±6.0009	0.52302
48 h	94.3±4.2177	93.4±4.2216	0.63915

ESP- Erector Spinae Plane . TEA- Thoracic Epidural Analgesia . PaO_2- Partial pressure of oxygen in arterial blood

Chin *et al*.,[18] Hacibeyoglu *et al*.,[38] Tulgar*et al*.,[39] and Luis-Navarro *et al*.,[40] reported ESP block in various laparoscopic and open abdominal surgeries and showed improved pain scores and reduced rescue analgesic consumption. In the present study, bilateral ESP block resulted in improved VAS ≤4 at rest and 3-5 during deep breathing in the first 48 hours with comparable first rescue analgesic requirement.

Nagaraja *et al*.[16] compared TEA with bilateral ESP block at T5 in median sternotomy and showed ESP block facilitated early extubation, improved pain scores, reduced consumption of opioid and rescue analgesics, better incentive spirometry scores and shorter ICU stay, which were comparable with TEA. In the present study, bilateral ESP block at T7 level in laparotomy has provided good analgesia comparable with TEA. ESP block and TEA were comparable with respect to opioid analgesic consumption, ventilatory hours and duration of ICU stay, PaO_2 and incentive spirometry scores.

CONCLUSION

Both ESP block and TEA provided comparable analgesia at rest. Further studies with a larger sample size are required to evaluate whether ESP block could be an alternative to TEA in aorto-femoral arterial bypass surgery.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Neisen MJ. Endovascular management of aortoiliac occlusive disease. Semin Intervent Radiol 2009;26:296-302.
2. Vartanian SM, Conte MS. Surgical intervention for peripheral arterial disease. Circ Res 2015;116:1614-28.
3. Chin KJ, McDonnell JG, Carvalho B, Sharkey A, Pawa A, Gadsden J. Essentials of our current understanding: Abdominal wall blocks. Reg Anesth Pain Med 2017;42:133-83.
4. Guay J, Nishimori M, Kopp S. Epidural local anaesthetics versus opioid-based analgesic regimens for postoperative gastrointestinal paralysis, vomiting and pain after abdominal surgery. Cochrane Database Syst Rev 2016;7:CD001893.
5. Manion SC, Brennan TJ. Thoracic epidural analgesia and acute pain management. Anesthesiology 2011;115:181-8.
6. Clemente A, Carli F. The physiological effects of thoracic epidural anesthesia and analgesia on the cardiovascular, respiratory and gastrointestinal systems. Minerva Anestesiol 2008;74:549-63.
7. Wildsmith JA. Continuous thoracic epidural block for surgery: Gold standard or debased currency? Br J Anaesth 2012;109:9-12.
8. Chilvers CR, Nguyen MH, Robertson IK. Changing from epidural to multimodal analgesia for colorectal laparotomy: An audit. Anaesth Intensive Care 2007;35:230-8.
9. Rawal N. Epidural technique for postoperative pain: Gold standard no more? Reg Anesth Pain Med 2012;37:310-7.
10. Ganapathy S, Sondekoppam RV, Terlecki M, Brookes J, Das Adhikary S,

Subramanian L. Comparison of efficacy and safety of lateral-to-medial continuous transversus abdominis plane block with thoracic epidural analgesia in patients undergoing abdominal surgery: A randomised, open-label feasibility study. Eur J Anaesthesiol 2015;32:797-804.
11. Niraj G, Kelkar A, Hart E, Kaushik V, Fleet D, Jameson J. Four quadrant transversus abdominis plane block and continuous transversus abdominis plane analgesia: A 3-year prospective audit in 124 patients. J Clin Anesth 2015;27:579-84.
12. Baeriswyl M, Kirkham KR, Kern C, Albrecht E. The analgesic efficacy of ultrasound-guided transversus abdominis plane block in adult patients: A meta-analysis. Anesth Analg 2015;121:1640-54.
13. Charlton S, Cyna AM, Middleton P, Griffiths JD. Perioperative transversus abdominis plane (TAP) blocks for analgesia after abdominal surgery. Cochrane Database Syst Rev 2010;12:CD007705.
14. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: A novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med 2016;41:621-7.
15. Forero M, Rajarathinam M, Adhikary S, Chin KJ. Continuous erector spinae plane block for rescue analgesia in thoracotomy after epidural failure: A case report. A A Case Rep 2017;8:254-6.
16. Nagaraja PS, Ragavendran S, Singh NG, Asai O, Bhavya G, Manjunath N, *et al*. Comparison of continuous thoracic epidural analgesia with bilateral erector spinae plane block for perioperative pain management in cardiac surgery. Ann Card Anaesth 2018;21:323-7.
17. Bonvicini D, Tagliapietra L, Giacomazzi A, Pizzirani E. Bilateral ultrasound-guided erector spinae plane blocks in breast cancer and reconstruction surgery. J Clin Anesth 2018;44:3-4.
18. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. Anaesthesia 2017;72:452-60.
19. Chin KJ, Malhas L, Perlas A. The erector spinae plane block provides visceral abdominal analgesia in bariatric surgery: A report of 3 cases. Reg Anesth Pain Med 2017;42:372-6.
20. De Cassai A, Bonvicini D, Ruol M, Correale C, Furnari M. Erector spinae plane block combined with a novel technique for selective brachial plexus block in breast cancer surgery. Korean J Anesthesiol 2019;72:270-4.
21. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector spinae plane block versus retrolaminar block: A magnetic resonance imaging and anatomical study. Reg Anesth Pain Med 2018;43:756-62.
22. Ivanusic J, Konishi Y, Barrington MJ. A cadaveric study investigating the mechanism of action of erector spinae blockade. Reg Anesth Pain Med 2018;43:567-71.
23. Yang HM, Choi YJ, Kwon HJ, O J, Cho TH, Kim SH. Comparison of injectate spread and nerve involvement between retrolaminar and erector spinae plane blocks in the thoracic region: Acadaveric study. Anaesthesia 2018;73:1244-50.
24. Block BM, Liu SS, Rowlingson AJ, Cowan AR, Cowan JA Jr, Wu CL. Efficacy of postoperative epidural analgesia: A meta-analysis. JAMA 2003;290:2455-63.
25. Hughes MJ, Ventham NT, McNally S, Harrison E, Wigmore S. Analgesia after open abdominal surgery in the setting of enhanced recovery surgery: A systematic review and meta-analysis. JAMA Surg 2014;149:1224-30.
26. Nishimori M, Low JH, Zheng H, Ballantyne JC. Epidural pain relief versus systemic opioid-based pain relief for abdominal aortic surgery. Cochrane Database Syst Rev 2012;7:CD005059.
27. Popping DM, Elia N, Marret E, Remy C, Tramer MR. Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: A meta-analysis. Arch Surg 2008;143:990-9;discussion 1000.
28. Guay J, Kopp S. Epidural pain relief versus systemic opioid-based pain relief for abdominal aortic surgery. Cochrane Database Syst Rev 2016;2016:CD005059.
29. Ueshima H, Otake H. Clinical experiences of ultrasound-guided erector spinae plane block for thoracic vertebra surgery. J Clin Anesth 2017;38:137.
30. Ahiskalioglu A, YayikAM, Celik EC, Ahiskalioglu EO, Emsen M. Two plane two block for surgical anesthesia: Ultrasound-guided serratus and Erector Spinae Plane Blocks. J Clin Anesth 2018;47:19-20.
31. Kot P, Rodriguez P, Granell M, Cano B, Rovira L, Morales J, *et al*. The erector spinae plane block: A narrative review. Korean J Anesthesiol 2019;72:209-20.
32. De Cassai A, Iepparielloo G, Ori C. Erector spinae plane block and dual antiplatelet therapy. Minerva Anestesiol 2018;84:1230-1.
33. Adhikary SD, Prasad A, Soleimani B, Chin KJ. Continuous erector spinae plane block as an effective analgesic option in anticoagulated patients after left ventricular assist device implantation: A case series. J Cardiothorac Vasc Anesth 2019;33:1063-7.
34. Wyatt K, Elattary T. The erector spinae plane block in a high-risk Ehlers-Danlos syndrome pediatric patient for vascular ring repair. J Clin Anesth 2019;54:39-40.
35. Restrepo-Garces CE, Chin KJ, Suarez P, Diaz A. Bilateral continuous erector spinae plane block contributes to effective postoperative analgesia after major open abdominal surgery: A case report. A A Case Rep 2017;9:319-21.
36. Bang S, Chung J, Kwon W, Yoo S, Soh H, Lee SM. Erector spinae plane block for multimodal analgesia after wide midline laparotomy: A case report. Medicine (Baltimore) 2019;98:e15654.
37. Hamed MA, Goda AS, Basiony MM, Fargaly OS, Abdelhady MA. Erector spinae plane block for postoperative analgesia in patients undergoing total abdominal hysterectomy: A randomized controlled study original study. J Pain Res 2019;12:1393-8.
38. Hacibeyoglu G, Topal A, Arican S, Kilicaslan A, Tekin A, Uzun ST. USG guided bilateral erector spinae plane block is an effective and safe postoperative analgesia method for living donor liver transplantation. J Clin Anesth 2018;49:36-7.
39. Tulgar S, Selvi O, Kapakli MS. Erector spinae plane block for different laparoscopic abdominal surgeries: Case series. Case Rep Anesthesiol 2018;2018:3947281.
40. Luis-Navarro JC, Seda-Guzmán M, Luis-Moreno C, Chin KJ. Erector spinae plane block in abdominal surgery: Case series. Indian J Anaesth 2018;62:549-54.