EGYPTIAN JOURNAL OF ANAESTHESIA
2023, VOL. 39, NO. 1, 731–738
https://doi.org/10.1080/11101849.2023.2247246

Continuous thoracic epidural versus continuous paravertebral analgesia in patients undergoing open renal surgery: Evaluation of pulmonary function; randomized double-blinded clinical trial

Shimaa Abbas Hassan, Khaled Abdelrahman, Ahmed M. Mandor, George Magdy, Mohamed Galal, Fatma Gadelrab Askar and Amr M. A. Thabet

Department of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine Assiut University, Assiut, Egypt

ABSTRACT

Background: This study aimed to assess pulmonary functions after either continuous thoracic paravertebral block (cTPVB) or thoracic epidural block (cTEB) in open renal surgeries.
Methods:**:** The double-blinded, randomized clinical trial included 40 patients scheduled for open renal surgeries at Urology Hospital-Assiut University, equally assigned into group E (n = 20) and group P (n = 20), both at the level of 7th-8th thoracic vertebra. Initially, 7.5–12 mL of bupivacaine 0.25% was started before the induction of general anesthesia, followed by bupivacaine 0.125% continuously at a rate of 5–15 ml/h. Forced vital capacity (FVC) measured every 6 hours postoperatively within the first 24 hours was the primary outcome. Secondary outcomes were peak expiratory flow rate (PEFR), forced expiratory volume in the first second (FEV1), diaphragmatic excursion (DE), postoperative analgesia, total opioid consumption, total local anesthetic dose, hemodynamics and complications.
Results:**:** FVC, FEV1 and DE were better preserved in cTPVB where the lowest postoperative readings as a fraction of preoperative control were 0.7 ± 0.11 vs 0.65 ± 0.11 L, 0.74 ± 0.11 vs 0.64 ± 0.10 L and 0.73 ± 0.1 vs 0.58 ± 0.1 cm, respectively. The lowest postoperative PEFR was reported in cTEB (p-value = 0.128). Analysis of numeric rating pain scale, total opioid consumption and time of first rescue analgesic request revealed a statistical nonsignificant difference. The total infused dose of local anesthetic was significantly higher in cTPVB group. Incidence of sympatholytic complications was higher in cTEB.
Conclusion: cTEB and cTPVB had convergent effect on respiratory function and diaphragmatic motility and equivalent analgesic efficacy after open renal surgeries. Although cTPVB was technically easier and less time-consuming than cTEB, higher dose of local anaesthetic was required in cTPVB.

ARTICLE HISTORY
Received 17 June 2023
Revised 26 July 2023
Accepted 8 August 2023

KEYWORDS
Thoracic epidural; thoracic paravertebral; pulmonary functions; diaphragmatic excursion; renal surgery

1. Introduction

Since open renal procedures are typically accompanied by severe postoperative pain, adequate analgesia is crucial to alleviate coughing, to allow for early mobilization, and to decrease the likelihood of respiratory problems postoperatively. Appropriate postoperative pain management might decrease morbidity and mortality rates because a sizable part of these patients may have concomitant conditions as raised renal chemistry, hypertension, and ischemic heart disorders [1,2].

Following kidney procedures, a range of treatments for postoperative analgesia are used [1,2]. The gold standard for analgesia and lowering complications after kidney surgery has long been recognized as thoracic epidural (TEB) using local anesthetics [3]. However, this block needs highly trained medical personnel for the insertion and removal of the epidural catheter, and also for the administration of the continuous infusion of analgesics and the associated risk of complications [4]. TEB bilaterally blocks positioned nerves and sympathetic nerve block with consequent hypotension as a result of both vasodilation and cardiac depression. As a result, fluid administration in susceptible patients must be done cautiously to prevent fluid overload [5].

On the other hand, thoracic paravertebral block (TPVB) is performed by injecting a local anesthetic into the paravertebral space to block nerves that have exited the spinal cord. TPVB can be administered as a single shot, but it is more commonly administered as a continuous infusion of local anesthetic via catheter. Because TPVB is a one-sided unilateral technique, respiratory and sympathetic functions on the contralateral side are preserved, which may be subsequently associated with less hypotension, fewer pulmonary complications, and less urinary retention [6,7].

The current study was designed to evaluate the effects of both blocks on respiratory function and to

CONTACT Shimaa Abbas Hassan Shimaa.abbas@med.aun.edu.eg Department of Anaesthesia, Intensive Care and Pain Management, Faculty of Medicine Assiut University, University St, Assiut, 71111, Egypt

compare the analgesic effectiveness and safety profile of ultrasound-guided continuous TPVB and TEB on postoperative pain after open renal surgeries.

2. Materials and methods

This double-blinded, randomized clinical trial was conducted at Urology Hospital of Assiut University, Egypt, from June 2020 till March 2022 after approval of the Medical Ethics Committee at Assiut University (reference number 17200315 on 2/4/2019), registered prior to patient enrollment at ClinicalTrials.gov (NCT 03885583, 21 March 2019). The study protocol, the procedure, and any possible side effects were explained to participants during the preoperative consultation, and they had the full right and freedom to withdraw from the study at any time without adversely affecting the medical services provided.

The inclusion criteria were age of 18 years and older, ASA physical status I or II, and BMI between 18.5 and 30 kg/m^2. Exclusion criteria were patient refusal, previous renal surgery in the same side, any contraindication for neuraxial block, or allergy to local anesthetic. Patients were randomly allocated into two equal groups using computer-generated randomization table and allocation ratio 1:1; the group assignments were kept in closed opaque envelopes, which were opened after patient enrollment in the morning before surgery. Data collector in the recovery unit and in the ward were all blinded to the group assignment; also, the attending anesthesiologist was blinded as the catheter was secured to the nondependent shoulder in a manner that conceals its placement. The patient and the surgeon cannot be kept blinded about the grouping because this trial was a protocol-driven process of care.

All patients received premedication with 3 mg midazolam IV. On arrival to the operating room and after applying standard monitoring (electrocardiogram, noninvasive blood pressure, and pulse oximeter), an infusion of Hartmann's solution (500 cc) was started. Both the blocks were performed before induction of general anesthesia according to the patient's group allocation and under complete aseptic precautions. EDAN Digital Ultrasound-DUS60 was used for both regional blocks to identify the correct desired thoracic vertebra with the linear array probe (L743-2, 8 MHz).

In group E (cTEB), ultrasound screening was done to identify the needle insertion point, angle of insertion, and depth of epidural space. The procedure was performed in a sitting position. The needle entry point was situated between T7 and T8 vertebrae. An 18-G, 80-mm Tuohy needle (B. Braun; Perifix® 400) was used and 3–5 cm of a 20-G epidural catheter with flexible tip (B. Braun; Perifix® standard) was inserted into the epidural space using the loss-of-resistance technique. Four ml of lidocaine 1% with 1: 200,000 epinephrine (0.005 mg/ml) were administered as a test dose to rule out intravascular. Initially 7.5–12 mL of Bupivacaine 0.25% was administered via the epidural catheter and bupivacaine 0.125% was continuously infused at a rate of 5 ml/h up to 15 ml/h with 5–10 ml bolus injection of infusion mixture injected for prominent postoperative pain.

In group P (cTPVB), the ultrasound probe was placed in the middle of T8 using the sagittal technique at the transverse process in-plane. An 18-gauge echogenic needle (PAJUNK® GmbH, Medizintechnolgie, Germany) was inserted in-plane with the lower border of the transducer and moved in a cephalic position. Identification of the needle tip was facilitated by injecting 1–2 mL of fluid (hydro-dissection). The same local anesthetic regimen was followed as in the cTEB. Anterior displacement of the pleura was the endpoint of a successful paravertebral block as shown in Figure 1).

After catheter insertion and securing, induction of balanced general anesthesia using 2 mg/kg propofol, 100 µg fentanyl, and Cis-atracurium 0.2 mg/kg initially to facilitate endotracheal intubation was done. After that capnography and temperature monitors were applied. Maintenance of anesthesia was achieved using oxygen/air (FiO_2 50%), sevoflurane, and maintenance dose of Cis-atracurium as appropriate. Intraoperative hourly fluid intake was maintained according to the Holiday and Segar 4-2-1 rule using lactated ringer solution. Blood and plasma substitutes

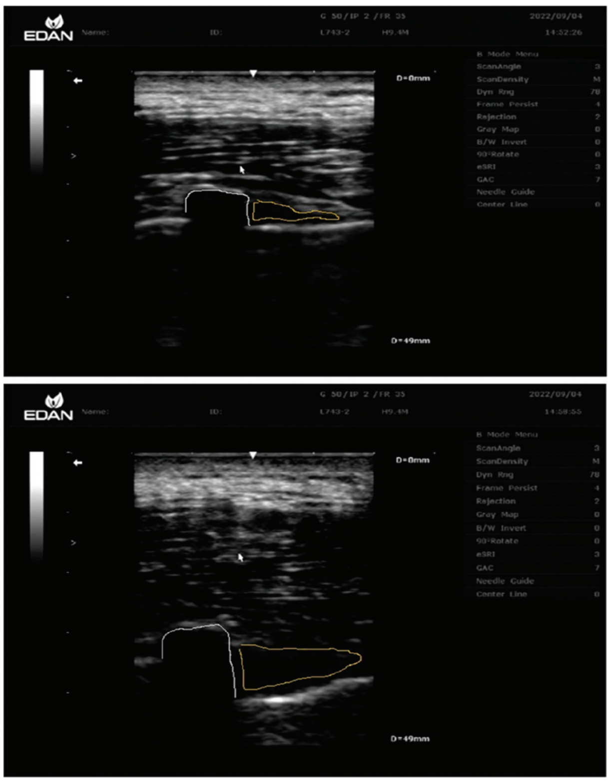

Figure 1. Photorealistic of the paravertebral space showing anterior displacement of the pleural line (hydrodissection).

were used to replace blood loss, when the patient reached the transfusion point according to initial hematocrit level and amount of blood loss. By the end of the procedure, adequate reversal of the residual neuromuscular blockade was accomplished by 0.05 mg/kg neostigmine and 0.01 mg/kg atropine followed by extubation.

Intraoperatively, bradycardia, defined as HR < 50 beat/min, was treated with 0.5 mg atropine. Hypotension with >20% drop from baseline mean arterial blood pressure (MAP) or MAP <50 mm Hg was treated with 6-mg bolus ephedrine. Tachycardia defined as ≥20% increase in baseline or HR >120 beat/min and also hypertension defined as patient's MAP increased by ≥20% of the baseline were treated with bolus dose of 5–10 ml of the infusion mixture and minimum alveolar concentration (MAC) of sevoflurane was increased.

Postoperatively, after full recovery, all patients were transferred to postoperative anesthesia care unit (PACU) fully monitored (pulse oximetry, ECG, and non-invasive blood pressure). The infusion of local anesthetics was continued through the catheters for the first 24 hours postoperatively, and in case of break-through pain (NRS >5) 5-ml bolus infusion was given, if failed another bolus was given, if no response to the second bolus dose, patients received Nalbuphine 6–8 mg intravenously.

3. Data collection

Sociodemographic patient's profile: age, sex, weight, height, and ASA physical status were recorded. HR and MAP were recorded at 0 (baseline), then intraoperatively every 10 min and every 6 h in the first 24 h, postoperatively. Pulmonary function testing was done for all participants using (Enraf-Nonius, Model SPIRO 601), peak expiratory flow rate (PEFR), forced vital capacity (FVC), and forced expiratory volume in the first second (EFV1) were recorded preoperatively as a baseline and then every 6 h for the first 24 h, postoperatively.

Also, right hemidiaphragm was assessed preoperatively during quiet breathing as a baseline. Diaphragmatic excursion (DE) was assessed post-operatively every 6 h using convex-array ultrasound probe (2–5 MHz) of EDAN Digital Ultrasound-DUS60 in the mid-subcostal view between the mid-clavicular and anterior axillary line in the right sub-costal area using liver as acoustic window. Time of first analgesic request, total dose of opioid consumption, and total local anesthetic infused dose were recorded in the first 24 h postoperatively. NRS was recorded immediate postoperatively, then every 6 h in the first 24 h. Any postoperative complications were recorded.

4. Outcome measures

Forced vital capacity (FVC) measured every 6 h post-operatively within the first 24 h was the primary outcome. PEFR, FEV1, diaphragmatic excursion; postoperative analgesia; total opioid consumption; total local anesthetic dose; hemodynamics and complications were the secondary outcomes.

5. Statistical analysis

Sample size was calculated using G*Power software 3.1.9.2 based on a previous study [8], where forced vital capacity after abdominal surgery was 69.4 ± 4.7% of basic spirometry measurements to detect difference of 5% between both groups with alpha error of 0.05 and 90% power of the study we need to include 36 patients; another 4 patients were added to compensate for possible dropouts.

Statistical analysis was performed by the SPSS version 22. Data were presented as number, percentage, mean (SD), and median (range). Normality of continuous data was checked by visual inspection of histograms and Shapiro-Wilk test. For parametric data, independent samples t-tests were used to compare quantitative variables between two groups. For non-parametric data, the Mann-Whitney test was used to compare quantitative variables between two groups, and the Wilcoxon signed-rank test was performed to compare quantitative variables at different times in each group. Qualitative variables were analyzed using the chi-square test and Fisher's exact test. The *p*-value <0.05 reflected statistical significance.

6. Results

In the current study we assessed 50 patients for eligibility to participate, 10 patients were excluded from the study; four of them declined to participate, three of them had previous kidney surgery on the same side, three patients had previous spine surgery. All 40 patients were randomly allocated into either study groups, all patients continued the follow up, and finally all patients were analyzed (Figure 2).

Regarding patients' demographic data (age, weight, height, and body mass index), as also ASA score and surgical data, there was no statistical significance difference between the study groups (Table 1). Analysis of pulmonary function tests including (PEFR, FVC, and FEV1) and diaphragmatic excursion (DE) among the two studied groups showed that there was immediate postoperative reduction in all these parameters from the preoperative baseline, respectively, a statistically nonsignificant difference in the four follow up intervals during the first 24 h, postoperative.

However, FVC was better preserved in cTPVB group as the lowest postoperative FVC as a fraction of

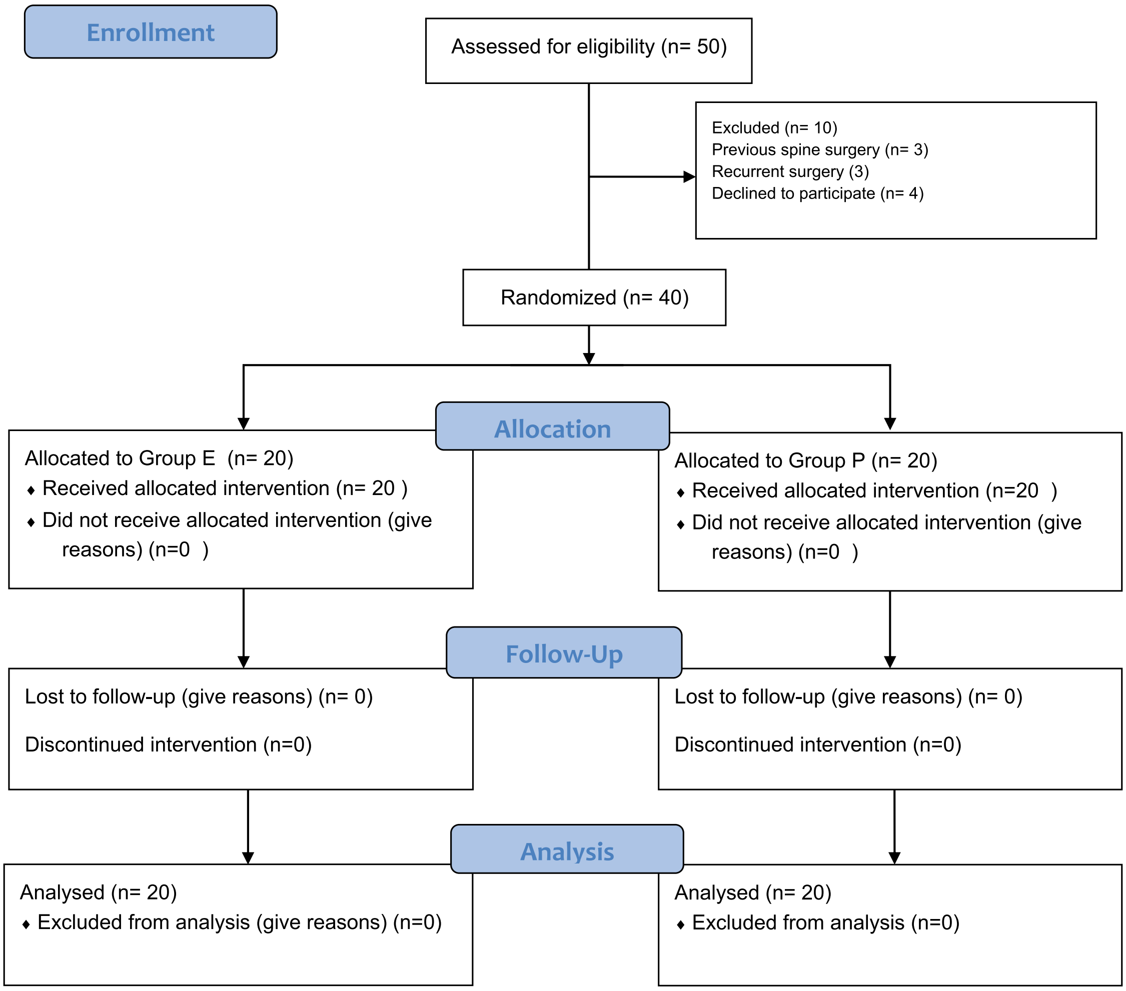

Figure 2. Consort flow chart.

Table 1. Shows differences between group E: epidural and group P: paravertebral regarding demographic data, ASA score, type of surgery, block time, and number of attempts to get a successful block; all expressed as mean±SD. *P*-value <0.05 was considered statistically significant.

	Group E (n = 20)	*Group P (n = 20)*	*P-value*
Age (years)	43.8 ± 9.6	44.4 ± 14.1	0.880
Weight (kg)	75.6 ± 13.1	72.6 ± 10.1	0.430
Height (cm)	166.3 ± 7.3	164.7 ± 5.0	0.424
Body mass index	27.4 ± 2.5	27.1 ± 1.7	0.384
ASA Score (I/II)	16/4	14/6	0.716
Type of surgery			
• *Suprarenal mass*	0	2	0.369
• *Nephrectomy*	7	4	
• *Nephron sparing surgery*	1	2	
• *Exploration*	12	12	
Block time (minutes)	18 ± 2.3	11.1 ± 1.6	<0.001
Number of attempts			
One attempt	15	18	0.407
Two attempts	5	2	

preoperative control was 0.65 ± 0.11 L in cTEB group while it was 0.7 ± 0.11 L in cTPVB group (*p*-value = 0.006). FEV1 is also better preserved in paravertebral group where the lowest postoperative FEV1 as a fraction of preoperative control was 0.64 ± 0.10 L in cTEB group in contrast to 0.74 ± 0.11 L in cTPVB group (*p*-value = 0.008). On the other hand, PEFR showed no significant change between both groups. The lowest postoperative PEFR as a fraction of preoperative control was 0.64 ± 0.15 L/sec in cTEB group in contrast to 0.70 ± 0.11 L/sec in cTPVB group (*p*-value = 0.128) (Figure 3).

Diaphragmatic excursion is better preserved in paravertebral group. The lowest diaphragmatic

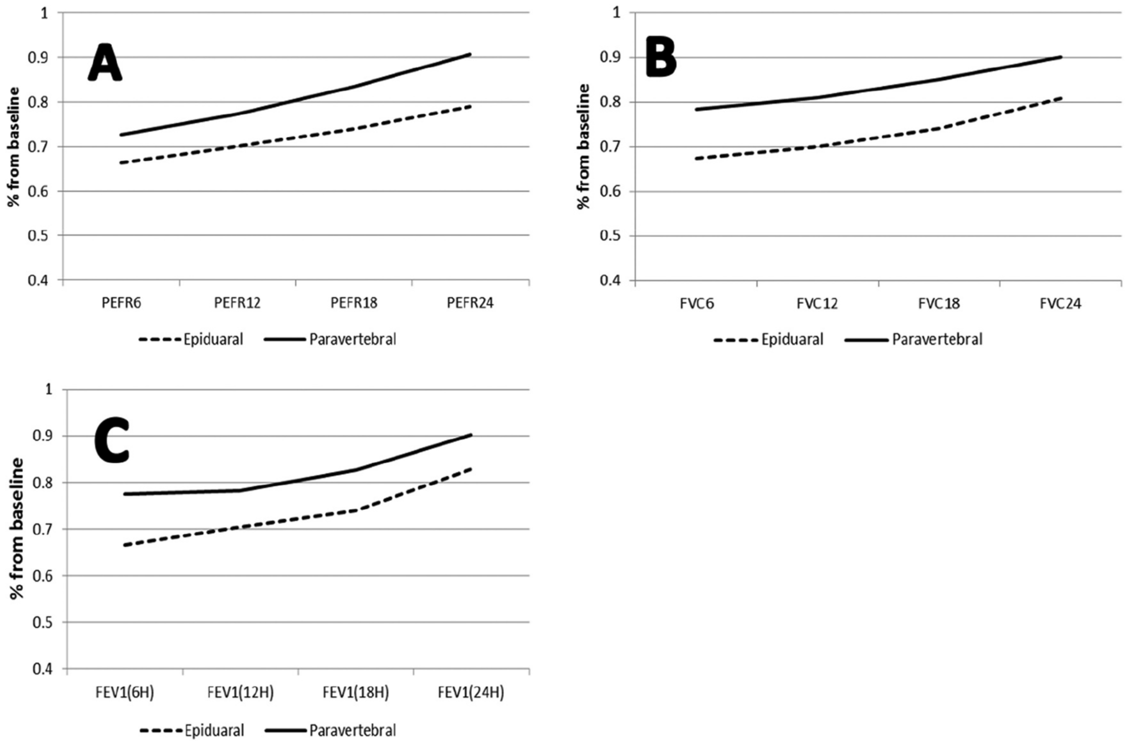

Figure 3. Pulmonary function parameters' changes in both groups as a percentage of baseline values. (A) Peak expiratory flow rate in L/sec, (B) forced vital capacity in liters, and (C) forced expiratory volume in the first second in liters.

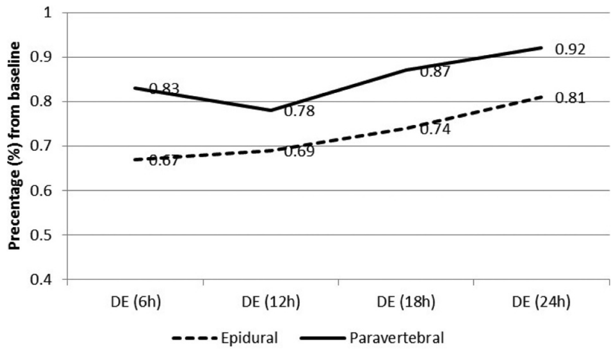

Figure 4. Diaphragmatic excursion expressed as a percentage of change from the baseline at the four time points of follow-up in the first 24 h, postoperatively.

excursion as a fraction of preoperative control was in cTEB group at 0.58 ± 0.1 cm in contrast to 0.73 ± 0.11 cm in cTPVB group (p-value = 0.00012) (Figure 4).

The mean total dose of opioid (nalbuphine) consumed in the two groups in the first 24 h was (6 mg in cTEB group and 10 mg in cTPVB group) a statistically nonsignificant difference. Also, regarding the time to first rescue analgesic request, there was no statistical significance difference. On the other hand, there was a statistically significant difference in the total infused dose of local anesthetic (bupivacaine) during the first 24 h; it was higher in TPVB group 227.8 ± 48.4 mg compared to epidural group 131.2 ± 7.5 mg (p-value < 0.001, Table 2.

Table 2. Differences between group E: and group P: regarding numeric rating pain scale and total dose of the local anesthetic infused; are expressed as mean ± SD. Time of first analgesic request and total opioid consumption expressed as median and range. The reported minor complications and hypotensive events are expressed as frequency. P-value <0.05 was considered statistically significant.

		Group E (n = 20)	*Group P (n = 20)*	*P-value*
Numeric rating pain scale				
	Postoperative	4 [1]	4 (0)	0.678
	6 hours	4 [1]	4 [3]	0.445
	12 hours	3 [2]	3 [2]	0.659
	18 hours	2.5 [2]	3 [1]	0.904
	24 hours	2 [1]	2 [1]	0.201
Time of first analgesic request (hours)		0 [8]	0 [8]	0.989
Total opioid consumption (mg)		0 [6]	0 [10]	0.62
Total local anesthetic dose (mg)		131.2 ± 7.5	227.8 ± 48.4	<0.001*
Reported minor complications	None	13	18	0.082
	Shivering	4	0	
	Vomiting	3	2	
Reported hypotension events		7	3	0.237

Hemodynamic effects of both blocks – either intraoperative or postoperative – were compared; hypotensive episodes occurred more frequently in epidural group (seven patients) compared to paravertebral group (three patients) with no statistical significance difference (p-value > 0.05). Regarding reported minor complications (vomiting, nausea, shivering), it was shown that there was no statistical significance difference (p-value = 0.082) between the two studied groups (Table 2). Analysis of the time taken to perform the blocks showed that ultrasound-guided TEB took longer time (18 ± 2.3 minutes) than ultrasound-guided TPVB, which was 11 ± 1.6 minutes (p-value <0.001). However, both groups were comparable regarding the number of attempts used to perform either block.

7. Discussion

Although our results showed an immediate postoperative reduction regarding pulmonary function tests (PEFR, FVC, and FEV1) and diaphragmatic excursion in the two studied groups at the four follow-up postoperative intervals, they were without a clinically obvious or statistically significant pulmonary complication. FVC, FEV1, and DE were better preserved in cTPVB when compared to cTEB. cTEB and cTPVB had equivalent analgesic efficacy after open renal surgeries as proven by the comparable NRS, total opioid consumption, and the time to first rescue analgesic requested in the first 24 h, postoperative. Despite being technically easier and less time consuming, cTPVB had significantly higher total infused dose of local anesthetic in the first 24 h.

Various variables had been examined by different authors as markers of respiratory function. Perttunen et al. reported no significant differences between cTEB and cTPVB groups in ventilatory parameters measured over 48 h as respiratory rate, arterial oxygen tension (PaO_2), SpO_2, and the percentage of change in FEV1 from preoperative values in 45 patients who underwent anterolateral thoracotomy surgeries [9]. Their local anesthetic protocol started with an initial bolus of 0.25% bupivacaine according to the height of the patient (8 ml for 150–160 cm, 10 ml for 161–180 cm, and 12 ml for over 180 cm) before wound closure and a continuous infusion of bupivacaine 0.25% 4 ml/h, 6 ml/h, and 8 ml/h, respectively, started immediately after the patient had arrived in the recovery room. The power of their study was quite low with 45 patients in three different groups: continuous TPVB, cTEB and intercostal nerve block. Moreover, the ineffectiveness of the continuous blocks in pain control may be also attributed to that they did not reach the recommended daily dose of bupivacaine (400 mg) and that the volume of bupivacaine was too small.

Conflicting with our results, a study conducted by Richardson et al. where they assessed peak expiratory flow rate as a metric of pulmonary function in 100 thoracotomy patients to compare epidural and paravertebral block showed that the paravertebral group had the lowest postoperative PEFR as a fraction of the preoperative control value at 0.73, compared to 0.54 in the epidural group, although the PEFR recovered to within 95% of the perioperative control values in 23 of 46 patients in paravertebral group and in 18 of 49 in epidural group; the difference was statistically insignificant. Difference in opioid use may have contributed to the observed difference in the postoperative PEFR between the two groups [10]

Our results are consistent with Gulbahar and his colleagues, as they found similar postoperative decline in PEFR, FEV1, and SpO_2 in 44 patients assigned into two groups (TEB and PVB) scheduled for posterolateral thoracotomy, where the average FEV1 values at the postoperative days 1–3 were 1.28, 1.24, and 1.44 L, respectively, in cTEB group and were 1.22, 1.28, and 1.48 L in TPVB group. While the PEFR values were 150, 165, and 201 L/min in TEB group, they were 146, 168, and 197 L/min in the group TPVB (p-value > 0.05). Reductions in oxygen saturation rates were not significant in the two groups. Regarding VAS scores, no significant differences were found in the postoperative days 1–3 between the two groups. Besides, the time for catheter placement was shorter in TPVB group at 4.24 ± 0.72 (3–6) min while in TEB, it was 13.21 ± 3.42 (9–20) min [11].

Recently, there has been an imminent use of diaphragmatic inspiratory amplitude (DIA) of the right hemi-diaphragm as a reflection of postoperative pulmonary complications (PPCs). A prospective observational study was carried out by Vanamail et al. on patients who underwent elective upper abdominal oncological operations under combination of general and epidural anesthesia. Their findings revealed a substantial reduction in the absolute values of DIA postoperatively compared to the preoperative baseline test. This drop in DIA was strongly linked to pulmonary problems [12]. Our results revealed statistically and clinically insignificant reduction in either TEB or TPVB groups. Diaphragmatic excursion was better preserved in paravertebral group.

While several aforementioned studies have shown the relative equivalency of analgesia between epidural and paravertebral blocks in thoracic surgery, that same effect has yet to be fully demonstrated in upper abdominal surgeries as open renal, open pancreatic, total or hemicolectomy, and in liver resection procedures as well.

In 2013, Moawad and his colleagues evaluated the analgesic efficacy of single-shot TPVB and TEB on 80 patients who underwent open renal surgeries. With reference to the global view of blood gasometrical changes through measurements of arterial oxygen tension, arterial carbon dioxide tension ($Paco_2$), and pH, TEB had a similar effect compared with the TPVB with no significant changes recorded between the studied groups during or after the procedure at any follow up time point. Postoperative pain using visual analogue scale (VAS) was their primary outcome, which revealed no significant differences between the blocks. Their results showed that there was no significant difference between the two groups in terms of total rescue analgesic consumption or total meperidine consumption at 24 h, postoperatively. Paravertebral block had better hemodynamic stability than the thoracic epidural block [13]. However, they did not use ultrasound guidance, which would further enhance the performance of TPVB. Single-injection techniques are limited by the duration of the local anesthetic used.

In an open label randomized clinical trial conducted by Hutchins and his colleagues, they assessed the effectiveness of thoracic paravertebral catheters guided by ultrasonography and thoracic epidural catheter following open pancreatoduodenectomy surgery in 48 patients. They concluded that cTPVB offers equivalent analgesia and fewer procedure-related adverse events than cTEB in the first five days after surgery. However, cTEB group had consumed significantly less intravenous and oral opioids in the first 24 with no other reported difference in pain scores or total opioids used at any other follow up time points. This can be argued to be based on using two different infusions between the two groups where opioid was used in the epidural analgesia while the continuous paravertebral blocks did not, which may affect the ability to compare the two modalities. Also opioid added to epidural could increase the risk of nausea and vomiting in that group and have impacted the pain scores as well [14]. Unfortunately, they did not assess the impact on respiratory function.

In 2019, a randomized, open label noninferiority study was done by Sondekoppam et al. comparing bilateral cTPVB and cTEB in 68 patients who underwent laparotomy with midline incision for a variety of procedures as total or hemi- colectomy, Whipple, gastrectomy, etc. On movement pain scores at 24 postoperative hours were comparable in cTPVB and cTEB. Due to bilaterality of the block in group TPVB that could have caused a similar autonomic blockade to that of TEB, hemodynamic profile analysis over time did not reveal significant difference between the two blocks [15]. This also could be the reason for longer block procedure duration than TEB. Despite the long follow up, 72 h postoperatively, data about respiratory function were not included. Hypotensive events related to both blocks were compared and showed that these events were higher in epidural block compared to paravertebral one, as a sequel of the more sympathetic block that the epidurals cause. However, there was no statistical significance difference between both blocks regarding the reported minor complications as nausea and vomiting.

Another study done by Małgorzata et al. assessed the arterial blood saturation for the first three postoperative days as a reflection of respiratory function in 60 patients who underwent posterolateral thoracotomy. For both groups, statistically significant decrease in saturation values was observed between the first and the second day and the first and the third day after the surgery. On respective days, the TEB and TPVB groups showed no statistically significant difference in respect of saturation value changes [16].

Our study affirmed that TPVB was easier and needed shorter time for performance by the practitioner than the TEB. This was in line with a study done by Sagiroglu et al. who evaluated postoperative pain associated with thoracotomy surgeries and compared the effectiveness and side effects of paravertebral and thoracic blocks. According to that study, in TEB group catheter insertion, time was noticeably longer than the PVB group [17]. Also the analysis done by Detterbeck et al. on 17 trials supports that the TPVB is an easy and quick technique with low incidence of side effects [18].

The present study has some limitations including the inability to extend the follow-up postoperative period to evaluate the effects of both blocks on postoperative pulmonary function test; patients with some degree of pulmonary dysfunction were excluded in the study. Also, future studies should implement a uniform postoperative active nursing and physiotherapy regimen.

8. Conclusion

cTEB and cTPVB had convergent effect on respiratory function and diaphragmatic motility, and equivalent analgesic efficacy after open renal surgeries. Although cTPVB was technically easier and less time consuming than TEB, higher dose of local anaesthetic was required in cTPVB. cTEB group showed higher incidence of sympatholytic complications.

9. Recommendations

We recommend the use of continuous TPVB technique as a preferred method in postoperative pain management in renal surgeries because of better preservation of respiratory function and because it is applied using sonography at the desired anatomical locations in a shorter time, also with lower adverse effects and complications and less dose of local anesthetic used compared with the TEB technique.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Shimaa Abbas Hassan http://orcid.org/0000-0001-9017-5557

References

[1] Kararmaz A, Kaya S, Karaman H, et al. Intraoperative intravenous ketamine in combination with epidural analgesia: postoperative analgesia after renal surgery. Anesth Analg. 2003;97(4):1092–1096. doi: 10.1213/01.ANE.0000080205.24285.36

[2] Shoeibi G, Babakhani B, Mohammadi SS. The efficacy of ilioinguinal-iliohypogastric and intercostal nerve co-blockade for postoperative pain relief in kidney recipients. Anesth Analg. 2009;108(1):330–333. doi: 10.1213/ane.0b013e31818c1b13

[3] Andreae MH, Andreae DA. Local anaesthetics and regional anaesthesia for preventing chronic pain after surgery. Cochrane Database Syst Rev. 2012;10:Cd007105. doi: 10.1002/14651858.CD007105.pub2

[4] De Cosmo G, Aceto P, Gualtieri E, et al. Analgesia in thoracic surgery: review. Minerva Anestesiol. 2009;75(6):393–400.

[5] Marret E, Bazelly B, Taylor G, et al. Paravertebral block with ropivacaine 0.5% versus systemic analgesia for pain relief after thoracotomy. Ann Thorac Surg. 2005;79(6):2109–2113. doi: 10.1016/j.athoracsur.2004.07.030

[6] Ng A, Swanevelder J. Pain relief after thoracotomy: is epidural analgesia the optimal technique? Oxford University Press; 2007. p. 159–162.

[7] Davies RG, Myles PS, Graham J. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy—a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2006;96(4):418–426. doi: 10.1093/bja/ael020

[8] Ahmed M, Mswhb AE-R, Walid A, et al. Effect of early mobilization on pulmonary functions post upper abdominal surgeries. Med J Cairo Univ. 2017;85:469–474.

[9] Perttunen K, Nilsson E, Heinonen J, et al. Extradural, paravertebral and intercostal nerve blocks for post-thoracotomy pain. Br J Anaesth. 1995;75(5):541–547. doi: 10.1093/bja/75.5.541

[10] Richardson J, Sabanathan S, Jones J, et al. A prospective, randomized comparison of preoperative and continuous balanced epidural or paravertebral bupivacaine on post-thoracotomy pain, pulmonary function and stress responses. Br J Anaesth. 1999;83(3):387–392. doi: 10.1093/bja/83.3.387

[11] Gulbahar G, Kocer B, Muratli SN, et al. A comparison of epidural and paravertebral catheterisation techniques in post-thoracotomy pain management. Eur J Cardiothorac Surg. 2010;37(2):467–472. doi: 10.1016/j.ejcts.2009.05.057

[12] Vanamail PV, Balakrishnan K, Prahlad S. Ultrasonographic assessment of diaphragmatic inspiratory amplitude and its association with post-operative pulmonary complications in upper abdominal surgery: a prospective, longitudinal. Observational Study. 2021;25(9):1031–1039. doi: 10.5005/jp-journals-10071-23962

[13] Moawad HE, Mousa SA, El-Hefnawy AS. Single-dose paravertebral blockade versus epidural blockade for pain relief after open renal surgery: a prospective randomized study. Saudi J Anaesth. 2013;7(1):61–67. doi: 10.4103/1658-354X.109814

[14] Hutchins JL, Grandelis AJ, Kaizer AM, et al. Thoracic paravertebral block versus thoracic epidural analgesia for post-operative pain control in open pancreatic surgery: a randomized controlled trial. J Clin Anesth. 2018;48:41–45. doi: 10.1016/j.jclinane.2018.04.013

[15] Sondekoppam RV, Uppal V, Brookes J, et al. Bilateral thoracic paravertebral blocks compared to thoracic epidural analgesia after midline laparotomy: a pragmatic noninferiority clinical trial. Anesth Analg. 2019;129(3):855–863. doi: 10.1213/ANE.0000000000004219

[16] Wojtyś ME, Wąsikowski J, Wójcik N, et al. Assessment of postoperative pain management and comparison of effectiveness of pain relief treatment involving paravertebral block and thoracic epidural analgesia in patients undergoing posterolateral thoracotomy. J Cardiothorac Surg. 2019;14(1):78. doi: 10.1186/s13019-019-0901-3

[17] Sagiroglu G, Baysal A, Copuroglu E, et al. Anaesthesiology and intensive carethe efficacy of thoracic epidural and paravertebral blocks for post-thoracotomy pain management. Kardiochirurgia i Torakochirurgia Polska/Polish J Thorac Cardiovasc Surg. 2013;2(2):139–148. doi: 10.5114/kitp.2013.36135

[18] Detterbeck FC. Efficacy of methods of intercostal nerve blockade for pain relief after thoracotomy. Ann Thorac Surg. 2005;80(4):1550–1559. doi: 10.1016/j.athoracsur.2004.11.051