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Erector Spine Block Novel Technique for Laparoscopic Radical Prostatectomy Lessens the Risk for Acute or Chronic Kidney Injury

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Abstract

Introduction. Prostate cancer, the second most common cancer in males globally, frequently requires radical prostatectomy. Laparoscopic radical prostatectomy, a common approach, has uncertainties regarding pain reduction. This study investigates ultrasonography-guided erector spinae plane block for pain management in laparoscopic radical prostatectomy.

Methods. This one-year prospective study involved 50 American Society of Anesthesiology classification I-III male patients (age 40-78) undergoing laparoscopic radical prostatectomy. An ultrasonography-guided erector spinae plane block was performed before surgery after induction of anesthesia. Postoperatively, pain was assessed using a numerical rating scale. Postoperative nausea and vomiting were evaluated using a verbal descriptive scale. Total time for block performance, anesthesia and surgery time, and any complications was noted as well.

Results. The study demonstrated that erector spine block improved pain management in laparoscopic radical prostatectomy patients. At different times after surgery, numerical rating scale scores, rescue analgesia needs, postoperative nausea and vomiting scores were reduced with no adverse effects on the kidney function.

Conclusion. This evaluation supports the beneficial role of ultrasonography-guided erector spine block in enhancing pain control during laparoscopic radical prostatectomy preventing any acute or chronic kidney injury.

Keywords: erector spinae plane block, laparoscopy, radical prostatectomy, pain management, acute kidney injury

Introduction

Globally, prostate cancer ranks as the second most frequent cancer in men [1]. Since it has been demonstrated that radical prostatectomy (RP) improves overall survival, RP is the usual course of action for the majority of patients who have chosen to have surgery as part of their treatment. There are three possible ways to carry out this surgery: open, laparoscopic, or robotic [2]. Laparoscopic radical prostatectomy has higher costs, a longer recovery period, a steeper learning curve, and a larger operating room staffing requirement, and there is no evidence that laparoscopic radical prostatectomy reduces pain [3,4].

The ultrasonography-guided erector spinae plane (ESP) block is a relatively recent trunk block, first described by Forero *et al.* [5]. Areas between the bones are the spots where the local anesthetic (LA) is injected. These are the erector spinae muscles and the thoracic transverse processes. One idea for how the LA works is that it blocks the dorsal-ventral rami of spinal nerves and the sympathetic ganglia by spreading in a straight line from the skull to the tailbone and to the paravertebral area. Consequently, it is possible to induce visceral and somatic sensory blockages [5-9]. When ESP block is applied at the lower thoracic vertebral levels (T7-T9), it has been demonstrated in the literature it produces abdominal analgesia [8]. To our knowledge, ESP is not described in the literature for LRP pain management [10]. Thus, this evaluation sought to determine how ESP block affected perioperative pain management in RP patients, who experience both physical and visceral pain.

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Material and methods

This prospective study was conducted at the University Clinic for Anesthesiology, Reanimation, and Intensive Care and the University Clinic for Urology at the Clinical Center, Mother Theresa, after obtaining the internal Ethical Committee's permission and signed informed consent from all patients. It has been finished for a period of nine months with 50 patients, American Association of Anesthesiology physical status (ASA) I-III patients, ranging in age from 40 to 78, who had laparoscopic radical prostatectomy. The study did not include patients with coagulopathy, allergies to local anesthetic drugs, advanced organ failure, vertebral abnormalities, or mental retardation.

Prior to surgery, all patients underwent standard protocol procedures, which included a complete medical and surgical history, laboratory assessments, a cardiac examination (echocardiography, EKG), and a chest X-ray. All patients underwent standard anesthesia procedures, which included non-invasive blood pressure monitoring, pulse oximetry, and regular non-invasive EKG monitoring with five leads prior to anesthesia induction.

For inducing anesthesia, each patient got the following: 0.01 mg/kg of midazolam, 1 mcg/kg of fentanyl, and 2 mg/kg of propofol. Rocuronium bromide 0.6 mg/kg IV was used to induce muscle relaxation and facilitate endotracheal intubation with a proper endotracheal tube size. EtCO2 was maintained between 35 and 45 mmHg using pressure-controlled volume-guaranteed mechanical ventilation (Datex-Ohmeda S/5 Advance GE Healthcare, Madison, USA) with a tidal volume of 6-8 mL/kg, a frequency of 10-12/min, and 50% FiO2 oxygen in the air. Maintenance of anesthesia was achieved by administering a 0.01-0.03 mcg/kg/min infusion of remifentanil and adjusting the MAC to 0.8-1. For fluid replacement therapy, crystalloid fluids were administered in accordance with urine output, blood loss, and fluid deficits.

After induction of anesthesia before the initiation of surgery, all patients were placed in the lateral decubitus position, and an ESP block was administered. Following the placement of the patient in the lateral position, the transverse processes of the T11 vertebra were seen using a linear probe and an ultrasound machine (Samsung Ultrasound H60; Hampshire, Korea) (Figure 1). A Stimuplex B, 21-gauge 100 mm, Braun R, Melsungen, AG, Germany needle was used to inject bupivacaine 0.5% 20 ml bilaterally above the erector spinae muscles. Afterward, patients were placed back in the supine position, and dexamethasone 4 to 8 mg was administered with gastric protective therapy, and surgery was started. During the procedure, the total amount of remifentanil used was noted. Time for block

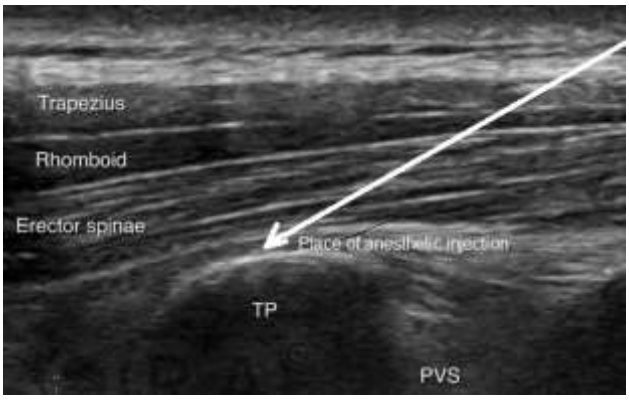

Fig. 1. Ultrasound visualization of the place of hneedle positioning and local anesthetic injection

performance was noted as well. The patients' postoperative pain was assessed using the numerical rating scale (NRS), where 0 represents no pain and 10 represents the most severe pain. Patients who had an NRS of ≤4 in the recovery room were moved to the ward. As a rescue analgesic, patients with an NRS score of 4 or above were scheduled to receive 1 g IV of paracetamol. The verbal descriptive scale (0=none, 1=mild nausea, 2=moderate nausea, 3=vomiting once, 4=multiple vomiting) and metoclopramide were used to assess postoperative nausea and vomiting (PONV). Receiving 10 mg IV was scheduled for when the PONV score was greater than 2.

NRS scores, the requirement for rescue analgesia, and nausea-vomiting scores were noted at the time of the postoperative transfer to the recovery room, as well as at the 1st, 6th, 12th, 18th, and 24th hours. Every patient's postoperative 24-hour tramadol use was noted. Time of anesthesia, surgery and block performance were noted as well.

IBM SPSS 22 (Statistical Package for Social Sciences 22) was used to statistically evaluate the study's data. Numbers and percentages for descriptive statistical categorical variables and mean ± standard deviation (SD) for normally distributed continuous variables were provided throughout the evaluation of the study data.

Results

Fifty male patients who had laparoscopic radical prostatectomy procedures performed at our university clinical center between January and September 2023 were included in our analysis. Table 1 shows the demographic data of the patients, clinical characteristics, analgesia scores and requirements, and PONV scores.

The patient's HR, MAP, and SpO_2 % readings are shown in Table 2. Baseline laboratory findings preoperative and postoperative are shown in Table 3.

Table 1. Patient demographic and clinical characteristics, analgesia scores and requirements, and PONV scores

Parameter		Value
Age (years)		**67±8.7 mean±SD**
BMI	underweight	3(6%)
	normal	37(74%)
	overweight	7(14%)
	obesity	3(6%)
ASA	I	10(20%)
	II	20(40%)
	III	20(40%)
Anesthesia time (min)		320±45.6
Block performance time (min)		7±5
Surgery time (min)		280±40.8
NRS scores	≤4	47(94%)
	>4	3(6%)
Remifentanyl consumption rate (mcg/kg/min)		0.01±0.005
Tramadol consumption (mg)		200±50
PONV scores	≤2	40(80%)
	>2	10(20%)

*BMI – Body mass index; NRS –Numerical rating scale; PONV –Postoperative nausea and vomitus; min- minutes; mcg-micrograms; kg-kilograms; mg-milligrams

Table 2. Hemodynamic parameters of the patient'

Parameter		Value (mean±SD)
HR	baseline	88±35
	perioperative	60±34
MAP	baseline	84±30 mmHg
	perioperative	70±27 mmHg
SaO_2%	baseline	95±2%
	perioperative	98±2%

*HR: heart rate; MAP: mean artery pressure; SaO2: peripheral oxygen saturation; mmHg- millimeters of mercury

Table 3. Laboratory findings

Parameter		Value (mean±SD)
Urea	baseline	4.8±2.7 mmol/L
	postoperative	5.1±3.0 mmol/L
Creatinin	baseline	78±42 umol/L
	postoperative	81±44 umol/L
K^+	baseline	4.2±1.7 mmol/L
	postoperative	3.9±2.0 mmol/L
Na+	baseline	140±4.7 mmol/L
	postoperative	142±4.0 mmol/L

NRS scores were ≤4 in 47 patients (94%); only 3 patients (6%) had a numerical rating score in pain assessment >4 and received rescue analgesia. All three patients received 1 gram of paracetamol in the post-anesthesia care unit. Two patients received tramadol on the ward in the 6^{th} and 18^{th} hours.

Discussion

Regional anesthesia, a component of the multimodal strategy in perioperative pain treatment, is very successful at treating visceral and somatic pain [11]. The ESP block, also known as a field block, has gained popularity in pain management in recent years since it is simple to use and has fewer side effects [6]. ESP block offers the essential benefits of effective analgesia with a single injection and fewer intrusive procedures required over time. A study showed that the local anesthetic used in ESP block can reach the paravertebral area and the ventral branches of the spinal branches through the costa transfer foramen [12,13]. A single spinal level can be the starting point for an ESP block that works at at least five levels [13]. Applying extra volume in the ESP block, like in other volume-dependent area blocks, can result in increased dermatomal spread and block efficiency [9,12].

Literature search: reviled publications on the ESP block for open RP. To our knowledge, this is the first study evaluating his usefulness in LRP. Since no research has been done on the impact of ESP block on LRP in the literature, we compared our results with open RP and abdominal surgery [14-18]. Dost *et al*. carried out a study on open radical prostatectomy procedures [15]. They discovered that ESP block at the T11 level lowered postoperative NRS scores in the first hour, but it had no effect on the amount of morphine taken over the course of a day. Additionally, patients who had block needed less rescue analgesia in the first hour following surgery. These findings are in correlation with the results presented in our investigation. With ESP block at the T9 level, efficient and long-lasting postoperative analgesia for radical retropubic prostatectomy patients was created [9]. According to reports, patients who had laparoscopic cholecystectomy with an ESP block added to the rectus sheath block consumed fewer opioids during and after surgery [16]. In a different study, paravertebral block, a type of field block, was used at T10-11-12 levels during radical retropubic prostatectomy procedures. It effectively relieved pain after surgery [17]. In a study by Beverly *et al*.

ESP block decreased the need for rescue analgesics during laparoscopic cholecystectomy procedures, in addition to lowering 24-hour NRS ratings and tramadol use. Similar findings are presented in our evaluation, showing that patients who have ESP block consume fewer intraoperative and postoperative opioids and analgesics. The side effects of opioid nephrotoxicity are well documented [18]. This evaluation shows that the levels of electrolytes and nitrogenous metabolic products were normal before and after surgery in this group of patients who used fewer opioids and painkillers. This is another benefit of ESP block for people with acute or chronic kidney injury. According to a meta-analysis, there is moderate evidence that ESP block can lower opiate usage, surgical pain, and postnatal pain [19]. Our study demonstrated that postoperative NRS is lower in patients with ESP block, as were intraoperative total remifentanil and postoperative tramadol use. These findings are consistent with other studies in the literature [17,19]. In our group of patients with ESP blocks, fewer patients overall underwent rescue therapy consisting of paracetamol and tramadol. Only three patients needed rescue analgesia, although all of them had an NRS score of 5, and since this is a subjective method, we can conclude that the average pain score was reduced.

The groups' MAP values stayed stable, and their HR values were lower during the surgery. This suggests that ESP block may help in controlling the heart's response to a surgical stimulus and improving hemodynamic stability. Similar results are presented in the study of Turan and coauthors [14].

There are several restrictions on our investigation. Standardization is impossible to achieve because pain is a subjective concept and treatment must be customized for each patient. Furthermore, because the patients were only monitored for the first twenty-four hours, it was not possible to assess the long-term impact of ESP block on pain levels.

Conclusion

As far as we are aware, this is the first study assessing ESP block analgesic effects in LRP surgery. Our evaluation has shown that ultrasound-guided ESP block, as a form of multimodal analgesia, improves pain control by lowering pain scores and the amount of intraoperative and postoperative analgesics used in LRP while at the same time providing hemodynamic stability preventing any acute or chronic kidney injury. Its growing popularity can be attributed to its relative safety and convenience.

Conflict of interest statement. None declared.

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