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Original Article

Ultrasound-guided erector spinae plane block versus trocar site local anesthetic infiltration for laparoscopic colorectal resection: A prospective, randomized study

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Abstract

Aim: Colorectal resection is a procedure that might cause severe pain in the postoperative period. Erector Spinae Plane Block (ESPB) is a interfascial plane block technique used frequently in recent years to provide postoperative analgesia. The study aimed to compare the ESPB and trocar site infiltration on pain scores and postoperative fentanyl consumption in patients undergoing Laparoscopic Colorectal Resection (LCRR).

Materials and Methods: ASA I-III, 48 patients scheduled for LCRR were randomly assigned into two groups. Bilateral ultrasound-guided ESPB with 0.25% bupivacaine 20 ml was administered to Group ESPB (n=24) at T7 level on each side. Trocar Site Group (n=24) was injected with peri-incisional 20 ml 0.25% bupivacaine subcutaneously in trocar sites after surgery. Intravenous (iv) dexketoprofen and iv 0.1mg/kg morphine were injected into both groups half an hour before the surgery ended. At the postoperative 12th hour, 50 mg iv dexketoprofen was repeated, and analgesia was achieved with Patient Controlled Analgesia (PCA) with fentanyl. Postoperative pain scores, fentanyl consumption, opioid-related side effects, and need for rescue analgesia were noted.

Results: The twenty-four hour fentanyl consumption was significantly lower in the ESPB group than the trocar site group (438.96 ± 297.99 mcg vs. 738.33 ± 247.35 mcg, respectively p=0.001). Compared with the trocar site, the pain scores were statistically higher in the trocar site group during all time period (P < 0.05). Rescue analgesia requirement was statistically higher in the trocar site group than the ESPB group (20/24 vs. 8/24 respectively, p=0.001).

Conclusions: ESPB reduced postoperative opioid consumption and pain scores by providing effective analgesia in LCRR.

Keywords: Erector Spinae Plan Block; laparoscopic colorectal resection; oostoperative analgesia

INTRODUCTION

Colorectal cancers are one of the leading causes of cancer-related mortality, and the incidence is increasing day by day. For this reason, colorectal cancer surgery and postoperative analgesia have gained more importance in recent years (1). Laparoscopic surgery, a minimally invasive technique in reducing postoperative pain and hospital stay, is considered as standard operative technique today (2). However, postoperative pain, especially the one stemming from the laparoscopic trocar area, is a severe problem. Using opioids and NSAIDs may be required to control this pain.

Colorectal resection inevitably disrupts normal gastrointestinal function in each patient, and the return of gastrointestinal function to normal is the main indicator of recovery (1,2). The excessive use of opioids and pain can cause paralytic ileus. Vomiting, nausea, and constipation are other undesirable side effects of opioids (3). Like opioids, NSAIDs might also have side effects on the GI tract.

Neuraxial analgesia and paravertebral blocks are the most commonly used regional anesthesia techniques for analgesia after colorectal resection. On the other hand, there might be situations where these techniques are difficult to apply with contraindications. There are also some complications of neuraxial anesthesia, including hypotension, bradycardia, motor blockage, urinary retention, and total spinal anesthesia (4,5).

In recent years, it has become common to use regional anesthesia techniques applied ultrasonography (US) guidance for postoperative pain management. With this technique, the block's success increased, and complication rates and the need for systemic analgesics needed for the postoperative period decreased. ESPB

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is a new and popular interfacial plane block that can be used for postoperative pain. It is easy to apply since it is US-guided and highly reliable because of its distance from critical anatomical structures (i.e., pleura and neurological and vascular structures). ESPB, which was first defined by Forero, has been used for postoperative analgesia in many surgical procedures, such as spinal decompression, cardiac, thoracic, breast, cesarean, and abdominal surgeries since 2016 (6-10). ESPB can be a good alternative for postoperative analgesia in colorectal resection surgeries. This prospective and randomized study is the first that examines postoperative analgesic effect of ESPB in laparascopic colorectal surgeries to the best of our knowledge.

In this study, our primary aim was to compare the ESPB and trocar site infiltration on pain scores and postoperative fentanyl consumption following colorectal surgery.

MATERIALS and METHODS

After the Faculty Ethics Committee's approval was received (Ataturk University Ethic Committee, B.30.2.ATA.0.01.00/1, 16.01.2020/1-1) 48 patients with ASA I-II-III, scheduled for LCRR, were included in the study. Patients were between the ages of 18 and 65, did not have a known history of heart, kidney, liver, hematological disease, allergies, chronic disease pain, did not use analgesics routinely or in the last 24 hours agreed to participate in the study.

Pregnant women and patients with neurological diseases and coagulopathy or who used anticoagulant drugs, who were not cooperative, who had local anesthetic drug allergies, who had problems in injection sites (e.g., infection and structural anomalies), patients with contralateral phrenic nerve paralysis, who were Class II and III obese (BMI>35), and those who could not use PCA (Patient Controlled Analgesia) device were excluded from the study.

The patients who accepted to participate in the study were randomly divided into two equal groups with a computer program. Group 1 was the Erector Spinae Plane Block Group (Group 1, n=24), and Group 2 was the Trocar Site Infiltration Group (Group 2, n=24).

Group1 (Erector Spinae Plane Block Group): ESPB was performed preoperatively with 20 ml 0.25% bupivacaine at the T7 level bilaterally.

Group 2 (Trocar Site Infiltration Group): Subcutaneous infiltration was performed with a total of 20 ml of 0.25 % bupivacaine, 3 ml for four trocar site, and 8 ml for the five cm incision site.

Study Protocol

Standard electrocardiography, oxygen saturation, and blood pressure monitoring were performed on both patient groups. Before induction, 0.9% NaCl infusion was started and was oxygenized with 100% O2. During anesthesia induction, patients were administered propofol (2-3mg/kg), fentanyl (2 µcg/kg), Rocuronium (0.6mg/kg); and anesthesia was maintained with 1-2% Sevoflurane, 50% O2, and 50% air mixture. During the procedure, the crystalloid infusion was continued (8ml/kg/h). Decurarization was achieved with neostigmine and atropine. For postoperative analgesia, 50 mg dexketoprofen and 0.1 mg/kg morphine were administered intravenously to all patients 30 minutes before the end of the operation. In addition, dexketoprofen was repeated every 12 hours postoperatively. Postoperative pain control was provided with the iv PCA device as described below. The same analgesic procedure was applied for postoperative analgesia in both groups. Postoperative follow-up and evaluation of patients were performed by a researcher who was blind to the study group.

Surgical Procedure: Pneumoperitoneum was created with 12-14 mmHg CO_2 after a 12-mm paraumbilical trocar's entry during the surgery. Then, 5 mm and 12 mm three trocars were placed around the paraumbilical and suprainguinal region. For remove the surgical specimens, a 5 cm incision was performed from the left paramedian, right paramedian, or suprapubic region.

Postoperative Analgesia Management and Outcomes: The pain assessment of patients was performed after colorectal surgery by an anesthesiologist blind to the grouping. Postoperative analgesia was evaluated with Visual Analog Scale (VAS) (VAS 0=no pain, VAS 10=the most severe pain that can be felt); and was noted in the first, second, fourth, eighth, twelfth, and twenty-fourth hours.. The side effects of opioids, such as nausea, vomiting, antiemetic need, constipation, itching, and urinary retention, were questioned during the two-hour post-analgesic follow-up.

PCA Device was programmed in the postoperative recovery room with a concentration of 10 µcq/ml, loading dose: 50µcq, 15 minutes locking time, 25 µcq bolus and no basal infusion, and was continued for twenty-four hours. In the recovery room, 25 mg meperidine was administered to patients with ≥4 VAS scores. The same analgesic procedure was applied to all patients for postoperative analgesia. Patients with an Aldrete Score of 9 and above were sent to the intensive care unit. The initial time for needing analgesia after surgery and the total dose of analgesia used in PCA was recorded at the end of the 24th hour.

Block Application

Patients were taken to the regional anesthesia room, monitored, and vascular access was established half an hour before the surgery started. The patient was given a lateral decubitus position. The linear ultrasound probe was prepared in a sterile condition. The skin was sterilized transverse process, and erector spinae muscle was displayed with linear US probe (Esaote MyLab 30 Genova-Italia) on longitudinal parasagittal orientation at the 3 cm lateral of the midline. T7 transverse process was touched with a 22-gauge sonovisible peripheral nerve block needle (Braun Sonoplex, Melsungen, Germany) with the out of plane needle orientation. When it was seen with the aspiration that no blood or air was coming, a test dose

was performed with 1-2 ml normal saline; and 20 ml 0.25 % bupivacaine was applied into the fascia under erector spinae muscle on each side.

Sample size and Statistical Analysis

IBM SPSS 20.0 software (SPSS Inc., Chicago, Illinois, USA) was used for statistical analyses. Kolmogorov-Smirnov and histogram tests were used to determine the normal distributions of data. Descriptive data are given as mean ± standard deviation (SD). Categorical variables were evaluated with the chi-square test. While Student's t-test was used in normally distributed data statistics, the Mann-Whitney U test was used to evaluate non-normally distributed data. P <0.05 is considered statistically significant.

The primary outcome of the study was the total amount of fentanyl consumption in the 24-hour postoperative period. In our preliminary study, fentanly consumption was around 625 ± 225 mcg in the Trocar Site Infiltration Group (n = 8) and 380 ± 225 mg in the Erector Spinae Plane Block Group (n = 7). For the 24 h fentanly consumption, a total sample size of 22 was calculated using GPower version 3.1.9.2 (Düsseldorf, Germany) with an alpha probability of 0.05 and a power of 0.95, and with a large effect size (1.1). Considering possible dropouts, and to attain higher power, we decided to include at least 24 patients in each group.

RESULTS

Sixty patients were included in the study. Eight patients in the trocar site group and four patients in the ESPB group were not performed from the study because the planned surgical procedure was excluded. Data were analyzed for two groups of 24 patients each.

Demographic and intraoperative data are shown in Table 1. There was no statistically significant difference between the groups in terms of age, weight, height, duration of surgery, duration of anesthesia, and operation type (p> 0.05).

VAS score was statistically significantly lower in Group ESPB than Group Trocar site at all postoperative times (p <0.05) (Table 2).

Twenty-four-hour fentanyl consumption was statistically significantly lower in the Group ESPB compared to the Trocar Site Group. (438.96 ± 297.99 vs. 738.33 ± 247.35, respectively, p = 0.001) (Table 3).

Table 1. Demographic characteristics of the participants

	Group Trocar Site (n=24)	Group ESPB (n=24)	P
Age	48.96 ± 14.17	57.29 ± 10.27	**0.21**[1]
Weight	76.46 ± 11.06	69.54 ± 18.21	**0.11**[2]
BMI	25.58 ± 2.99	24.67 ± 4.29	**0.39**[2]
Gender (F/M)	5/19	10/14	**0.21**[3]
ASA (I/II)	17/7	16/8	**0.75**[3]
Surgery duration	208.21 ± 53.85	213.33 ± 62.76	**0.98**[1]
Anesthesia duration	229.96 ± 55.70	314.58 ± 388.47	**0.71**[1]
Colectomy Operation			
Right	5	10	
Left	17	12	**0.282**[4]
Total	2	2	

[1]Mann Whitney U-Test, [2]Independent Sample t-test, [3]Yates' Continuity Correction, [4]Chi Square

Table 2. Comparison of VAS scores at postoperative time points

	Group Trocar Site (n=24)	Group ESPB (n=24)	P
PACU	4.54 ± 2.55	2.29 ± 2.29	**0.002**
VAS 1hr	4.33 ± 2.35	1.83 ± 1.79	**<0.001**
VAS 2hr	4.04 ± 1.73	1.71 ± 1.37	**<0.001**
VAS 4hr	3.71 ± 1.16	1.54 ± 0.98	**<0.001**
VAS 8hr	3.21 ± 0.98	1.87 ± 1.03	**<0.001**
VAS 12hr	2.88 ± 0.74	1.96 ± 1.33	**0.003**
VAS 24hr	2.25 ± 0.68	1.50 ± 1.10	**0.014**

[1]Mann Whitney U-Test, VAS: Visual Analogue Scale, p < 0.05 statistically significant

Table 3. Fentanyl consumption and Additional anesthetics requirement

	Group Trocar Site (n=24)	Group ESPB (n=24)	P
Fentanyl Consumption (mcg)	738.33 ± 247.35	438.96 ± 297.99	**0.001**[1]
Rescue analgesic requirement (Y/N)	20/4	8/16	**0.001**[2]

[1]Mann Whitney U-Test, [2]Yates' Continuity Correction

The rescue analgesic requirement was present in 20 patients in the Group Trocar Site and eight patients in the Group ESPB, and there was a statistically significant difference between Goup ESP and Group trocar site (p = 0.001).

There was no statistically significant difference between the groups in terms of postoperative nausea, vomiting, and other side effects (p> 0.05) (Table 4).

Table 4. Frequent side effects

	Group Trocar Site (n=24)	Group ESPB (n=24)	P
Nausea (Y/N)	6/18	3/21	**0.46[1]**
Vomiting (Y/N)	5/19	3/21	**0.70[1]**

[1] Fisher's Exact Test

DISCUSSION

The study aimed to examine the effect of ESPB on postoperative pain scores and opioid consumption following colorectal surgery. As a result of our study, postoperative VAS scores were lower in the group ESPB than in the trocar site infiltration group. Also, ESPB reduced postoperative opioid consumption and rescue analgesic usage.

LCRR has been performed with increasing frequency in the past two decades and has become the most preferred method in many colorectal resections after several studies reported the laparoscopic approach's benefits and safety (11).

Colorectal surgery causes severe and widespread postoperative pain (12,13). Effective postoperative pain control increases patient early mobilization, thus preventing the development of thromboembolic complications and pulmonary complications such as the atelectasis. In addition, providing effective analgesia increases postoperative patient satisfaction (14,15).

In the literature, many different methods have been used for postoperative analgesia in LCRR. Thoracic Epidural Anesthesia (TEA) and analgesia have been preferred mostly. PCA, multimodal analgesia, iv lidocaine, and ketamine infusions were among the other methods applied (16-21). Plane blocks are very safe regional anesthesia techniques. Quadratus Lumborum Block and Transversus Abdominis Plane Block are recently used methods for postoperative analgesia (22,23).

In the esp block, local anesthetic solution is applied between the erector spina muscle fascia and the transverse process of the vertebra. After the injection, the local anesthetic agent spreads cranially and caudally, affecting a wide dermatomal area. The purpose of this block for abdominal surgery is to provide somatic and visceral analgesia by affecting the ventral rami of the spinal nerves (24,25).

ESP block provides analgesic effects similar to the paravertebral block. However, easy sonographic identification of landmarks provided advantages to ESPB over its paravertebral block and other variants. Also, its complications are less than these blocks. Only two complications regarding this new and popular block technique have been reported so far. These were pneumothorax and motor weakness related to a lower thoracic ESP (26,27).

ESPB was performed at different levels for different pathologies. This block was preferred for chronic shoulder pain (T2), thoracic surgery (T4-5), and upper abdominal surgery (T7-8) (24,28-30). Although other abdominal fascial plane blocks provide mere somatic analgesia, ESPB provides somatic and visceral analgesia when applied at the lower thoracic level by the potential spread of local anesthetic to the rami communicants that transmit sympathetic fibers (31,32).

Analgesia should block visceral pain and at least T8-L2 abdominal dermatomes for Laparoscopic Colorectal Surgery. Most incisions are paraumbilical or sub umbilical. Although ESPB, which is applied at T7 level for abdominal surgeries, spreading from T6 to T12, injected at the same level in cadavers as 20 ml contrast material distributed as craniocaudally between the levels of the C5-T2 and L2-L3 transverse processes (33,34).

Bilateral ESPB was applied in laparoscopic cholecystectomy and bariatric surgeries from T7 level for postoperative analgesia as in our study, and decreases were detected in VAS, visceral, and somatic abdominal pain scores (33,34). Again, the visceral analgesic effect of ESPB applied for renal colic and acute pancreatitis pain in the emergency clinic was shown (31,32).

Local anesthetic infiltration is applied to the incision area alone or other anesthetic methods in many surgeries. It is used for postoperative analgesia because it is simple, fast, and do not have complications (35). It was shown in previous studies that pain healed in patients with infiltration, opioid use and side effects decreased, patient satisfaction increased, and hospital stay decreased (36). However, the short duration of its effect is a disadvantage. Trocar area infiltration was used for postoperative pain control and TAP block following laparoscopic colorectal surgery (11). In our study, ESPB provided longer and more effective analgesia compared to the infiltration group. Wound infiltration provides only somatic analgesia, in the ESP block, local anesthetic spreads from the transforaminal region to the paravertebral and epidural space, therefore providing both visceral and somatic analgesia (37).

ESPB was applied bilaterally in this study before the surgery to ensure that ultrasound was not disrupted, and a more precise image was obtained. According to previous studies in the literature, the block was applied with 20-ml volume at T7 level for both sides. Despite the bilateral application, no complications related to the block developed.

LIMITATIONS

This study had some limitations. Firstly, the data on pre-surgical pain scores of patients were not available. Preoperative pain can affect analgesic consumption after surgery. Secondly, we did not evaluate patients' sensory block distribution in the present study because our purpose was not to evaluate sensory block distribution but to evaluate such blocks' effect on pain and analgesia need. Thirdly, the study had a single-blind design. No sham block were administered to the Group trocar site, and no sham injection was applied to the Group ESPB, therefore the placebo effect of injection could not be evaluated.

CONCLUSION

ESP block contributed significantly to the treatment of postoperative pain following colorectal resection. We believe that ESPB can be used in multimodal analgesia procedure to reduce fentanyl consumption and relieve acute postoperative pain in laparoscopic colorectal surgeries.

Competing Interests: The authors declare that they have no competing interest.

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Ethical Approval: Faculty Ethics Committee's approval was received (Ataturk University Ethic Committee, B.30.2.ATA.0.01.00/1, 16.01.2020/1-1).

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