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*Research Article*

# Ultrasound-guided Quadratus Lumborum block versus erector spinae block for postoperative analgesia in patients undergoing hepatic surgery: A Randomized controlled clinical study

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## Abstract

**Background:** fascial plane blocks become a popular analgesic technique for thoracic and abdominal procedures. **Objective:** this study aimed to compare the effect of bilateral erector spinae plane block (ESPB) with bilateral quadratus lumborum block (QLB) in decreasing analgesic consumption in patients scheduled for common bile duct exploration (CBD). **Methods:** This prospective randomized single-blind controlled trail included 90 patients with ASA I-II who were scheduled for CBD exploration under general anesthesia in Minia university hospital. Patients ranged in age from 18 to 60. Three parallel, equal groups of patients were assigned: The (ESB) group had bilateral, ultrasound-guided ESP blocks at T7 with 20ml of 0.25 percent bupivacaine injected into each side. (QL) group got the same dosage of an ultrasound guided bilateral QL block. The (C) group did not get any blocks. The computation of total opioid intake was the primary goal, while the timing of the initial analgesic need and the visual analogue pain score (VAS) on the first postoperative day were the secondary outcomes. **Results:** We reported less fentanyl consumption in ESB group 80 (37.5-100) µg than QLB group 150 (120-152.5) µg and both showed lower consumption than c group 250 (200-272.5) mcg. In respect to VAS at rest/dynamic ESB group showed lowest score in the first 8hrs postoperative with longest duration of analgesia. **Limitations:** We didn't follow up the patients for more than 24 hours postoperative. **Conclusion:** Bilateral ultrasound guided erector spinae plane block decreases resting and dynamic pain score, fentanyl consumption and increases postoperative analgesic duration than quadratus lumborum block for patients undergoing CBD exploration.

**Keywords**: Erector spinae, quadratus block, CBD exploration, VAS score

## Introduction

Analgesia is a crucial component of the perioperative care of open laparotomies. Enhanced recovery after surgery (ERAS) milestones which improve outcomes are made possible by optimal postoperative analgesia[(1).] Inadequate pain management after abdominal procedures may result in a longer hospital stay, patient discontent and delayed mobility postoperatively [(2)]. Parenteral analgesics, abdominal field blocks, and epidural analgesia are often used to manage pain after anterior abdominal wall procedures[(3)]. Even though epidural anesthesia is the gold standard for pain treatment, it has substantial side effects that restrict its use in specific situations including epidural hematoma,

urine retention, residual paraesthesia, and decreased blood pressure.

Since its first description by Forero et al. in 2016, ESPB has grown as a standard analgesic approach for thoracic, abdominal, and extremities surgeries because of its speed, ease of execution, minimal risk of hypotension and safety for patients with coagulopathy. Although it is believed that the spinal neurons' ventral and dorsal rami are involved, the exact pathway is yet uncertain [4, 5].

In his presentation at European society of regional anesthesia (ESRA) 2007 in Valencia, Spain, Rafael Blanco first introduced the quadratus lumborum block (QLB) under ultrasound. He described injecting local anesthetic into a potential space between the quadratus lumborum muscle (QL) laterally and the posterior abdominal wall muscles to provide analgesia in a number of abdomino-pelvic surgeries in both children and adults with opioid sparing effects [6].

The purpose of our research was to evaluate the efficacy of bilateral ESPB and bilateral QLB in avoiding postoperative pain and lowering analgesic consumption in patients scheduled for CBD exploration. We determined the total quantity of opiates given in the first 24 hours after surgery as our main result. The timing of the initial analgesic need, the visual analogue pain score on the first postoperative day, and the incidence of any side effects were considered secondary outcomes.

## Patients and methods

After receiving clearance from our faculty of medical ethics committee No. 50:6/ 2021 and registering at clinical trials.gov (NCT04965194), this prospective randomized controlled single-blinded research was conducted at Minia University Hospital between July 2021 and May 2022. In our research, 92 patients of both sexes, ASA physical status I-II, between the ages of 18 and 60, scheduled for CBD exploration under general anesthesia, were recruited. Patients with allergies to local anesthetics, bleeding diathesis, a history of using anticoagulants, mental problems, infection at the site of the needle puncture, BMI more than 40 kg/m$^2$, patients refuse, and failed block were not included in this research.

According to the sample size, patients were randomly divided into three equal groups that ran parallel to one another.

The anesthesiologist who performed the block and did the randomization using computer-generated tables and closed opaque envelopes, which were then opened in the operating room was uninvolved in the follow-up and data collection. Medical personnel who were not aware of the patient grouping performed the postoperative follow-up. Patients in group I (ES group) received an ultrasound-guided bilateral ESP block at T7 by administering 20ml of bupivacaine 0.25 percent by injection on each side, while patients in group II (QL group) received an ultrasound-guided bilateral QL block by administering 20ml of bupivacaine 0.25 percent by injection on each side while patients in group III (C group) didn't receive any nerve block. All subjects had thorough physical exami-nations the day before surgery, and all patients were taught how to interpret the VAS. Additionally, standard laboratories tests were performed, and written infor-med permission was acquired. Standard monitors such as pulse oximetry, ECG, and non-invasive arterial blood pressure were used in the prep area, an intravenous access was established so that patients in both intervention groups may receive 0.02 mg/kg midazolam if necessary. According to the patient's BMI, both blocks were administered under the supervision of ultrasound utilizing the SONOSITE M-TURBO, USA machine's low frequency convex or high frequency linear probe. Lateral decubitus was conducted for both blocks. The cases in the (ESP) group were first positioned on the left side, where the appropriate probe was applied at the level of the T7 spinous process and traced 3 cm laterally to the midline to reach the transverse process (TP) **figure (1).** 3 ml of lidocaine 2 percent was infiltrated, followed by the in-plane insertion of a 22-gauge Quincke needle

(GMS, Egypt) with the goal of recognition of the hypoechoic ellipsoid moving the ES muscle away from the TP indicating that the medication injection was effective. On the other side, the same procedure was performed in the same way. After skin sterilization, patients in the (QL) group were positioned on their left side. A low frequency convex probe was then placed between the iliac crest and subcostal margin in the anterior axillary line, where the three anterior abdominal wall muscles could be seen. The probe was then moved posteriorly to the midaxillary line, where the triple muscles began to taper, and finally at the posterior axillary line, where the transversus abdominis muscle had vanished and the similar method was used to block the opposite side **figure (2).**

The diminution of thermal feeling at the site of the surgical incision, which was checked every five minutes after successful block patients entered the operating room, served as a sign that the block was effective. Patients in the (c) group went straight to the surgery room since they didn't get any block. Standalone monitors were used, preoxygenation of the patient with 100 percent oxygen was done, and 1 mcg/kg of fentanyl and 1-2 ml of propofol were used to induce anesthesia until loss of vocal response. The maintenance of anesthesia was performed with (1 MAC) isoflurane and 0.1mg/kg atricurium every 20 minutes till the completion of the procedure. All patients received 1 gram of paracetamol 10 minutes before the conclusion of surgery. After the operation was finished, isoflorane was stopped, and muscle relaxants were reversed using 0.01 mg/kg atropine mixed to 0.05 mg/kg neostigmine. After completing their recovery, patients were moved to the surgical ward from the post-anesthesia care unit (PACU) until their modified Aldrete score reached nine. All patients got 0.5 mcg/kg of fentanyl if their VAS score was more than three and 1 gm of IV paracetamol every six hours. Both at rest/dynamic VAS scores were assessed 1, 2, 4, 8, 12, 16, and 24 hours after surgery, along with the initial analgesic request time, the total amount of opioid use, and any adverse effects.

**Statistical analysis**

The statistical program for social sciences was used to gather, tabulate, and statistically analyze the data (SPSS software version 25).

In contrast to nonparametric quantitative data, which were given as median and interquartile range, and categorical data as number and percentage, descriptive statistics for parametric quantitative data were expressed as minimum and maximum of range, mean, and standard deviation. The three groups' parametric quantitative data were analyzed using the one-way analysis of variance (ANOVA) test, which was followed by a post hoc turkey correction between each pair of groups and a paired T test between two instances within each group. The Mann-Whitney U test was used between each pair of groups, the Kruskal-Wallis test was used between the three groups under study, and the Wilcoxon Signed Rank test was used between two instances within each group. The Chi-Square test was used to analyze qualitative data between groups. (P 0.05) was chosen as the significant threshold.

**Sample size calculation:**

Following a power analysis using the information from the pilot trial, the number of patients required in each group was determined prior to the research. The mean total analgesic need in the trial was 123±21.09, 114±13.42, and 110.2±10.26 in groups A, B, and C, respectively. 30 patients in each group were chosen as the sample size using G Power 3.1 9.2 software to achieve 90% power for the One-way ANOVA test at the level of 0.05 significance.

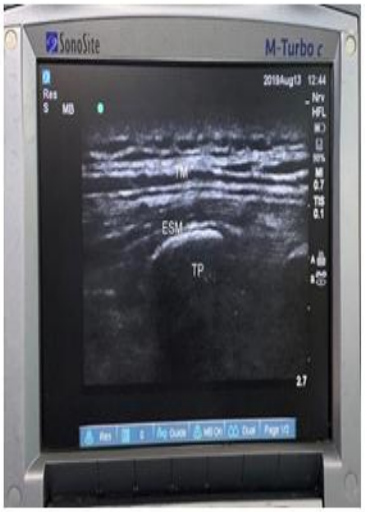


**Fig (1):** Ultrasound image of ESPB (EL-Minia university hospital). TM: trapezius muscle, ESM: erector spinae muscle

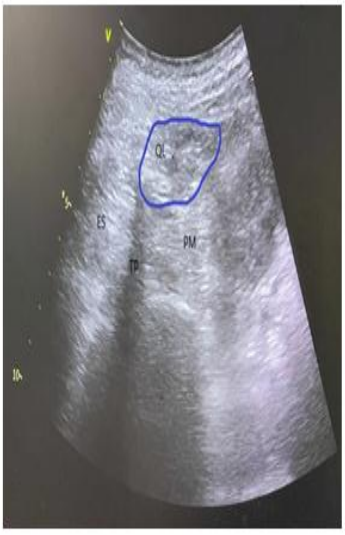


Fig (2): ultrasound image of QLM (EL-Minia university hospital). QL: Quadratus lumborum muscle, PM: psoas major muscle, TP: transverse process, ES: erector spinae muscle.

## Results

In the consolidated Standards of Reporting Trails (CONSORT) diagram of the study 92 patients but 2 patients excluded one due to failed block and the other refused to participate so 90 patients were randomly allocated into 3 parallel equal groups as shown in **figure (3).**

The three studied groups were comparable as regarded to age, weight, sex, and ASA physical status **table (1).** Total fentanyl requirements were lower in ESB group 80(37.5-100) µg than QLB group 150(120-152.5) µg and (C) group 250 (200-272.5) µg **figure (4).** ESB group showed longest time of analgesia 12(10-19.5) h while it

was 6 (6-7.3) h in QLB group and 2 (1-2) h in C group **figure (5).**

Regarding Postoperative VAS at rest in the first postoperative 12 hours, there was a statistically significant difference between the three groups, with the control group scoring worse across the board. The two intervention groups were similar at 1, 2, 10, and 12 hours, however there was a significant difference at 4, 6, and 8 hours, with the QLB group showing higher reading scores of 2 (2-3), 3(2-4), and 3(3-4) compared to the ESB group of 1(1-1), 1(1-2), and 2(1-2), respectively. At 6 and 8 hours, the QLB and control groups were equivalent. The three groups under study were equivalent after 18 and 24 hours. In the first 8 hours, VAS in the ESB group was 3. and grew to 3(2-4) at 10, 12, and 18 hours, before being reduced to 2(2-2) as a result of the action of rescue analgesia. At 6 hours, the VAS in the QLB group began to rise 3(2-4) reduced to 2 (2-3.3) after 10 hours as a result of the action of rescue analgesia, and then climbed to 3(2-4) after 12 and 18 hours. While at 24 hours, the analgesic action brought the number back to 2(2-2). From the first hour, VAS 3 (2-3) in the control group required rescue analgesia **table (2).**

Regarding postoperative dynamic VAS in the first eight hours postoperatively, there were notable differences between the three study groups. A comparison of QLB and ESB groups at 1, 10, 12, 18, and 24 hours was made. In the first four hours, there was a statistically significant difference between the intervention groups and the control group because the intervention groups had lower scores. The ESB group had a lower score than the QLB and control groups at 6- and 8-hours **table (3).** Both the ESB and QLB groups outperformed the control group in terms of performance and patient satisfaction **figure (6).**

No major side effects of complications were noted between the studied groups

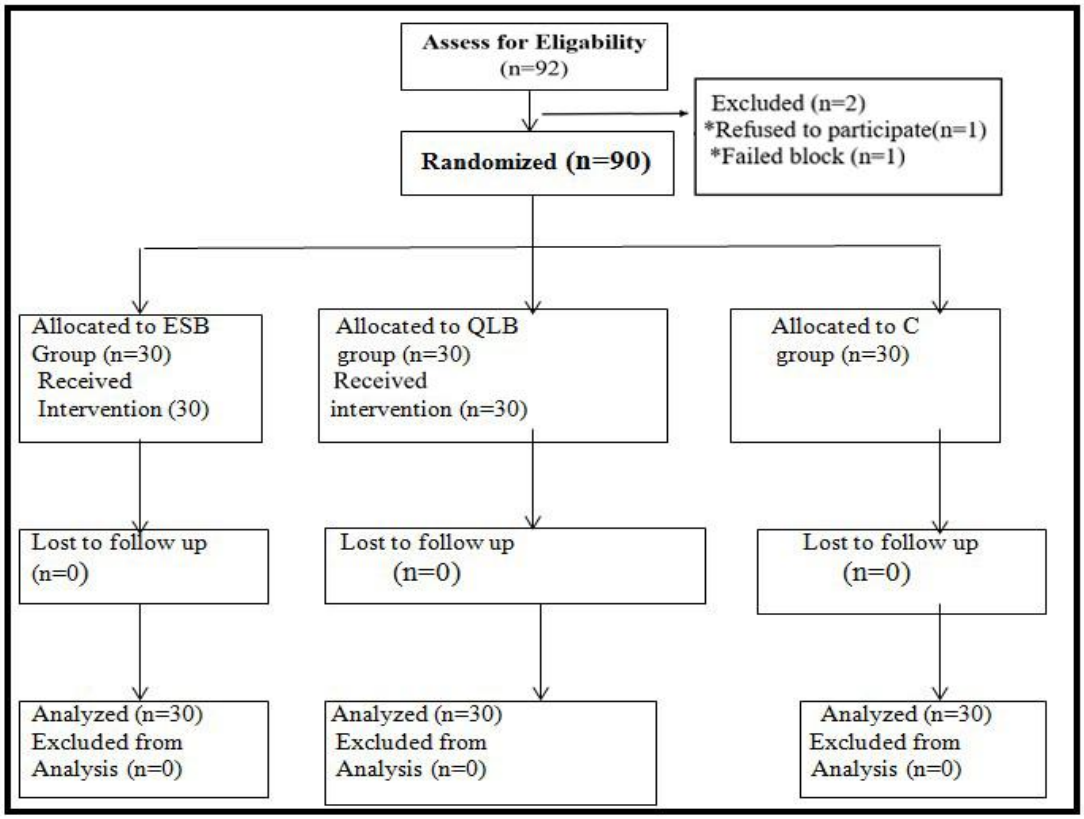


**Fig. (3):** consort diagram of the study.

**Table (1):** Patients characteristics:

| Variable | Group ESB (n=30) | Group QLB (n=30) | Group C (n=30) | P value |
|---|---|---|---|---|
| **Age(years)** | | | | |
| **Range** | (36-62) | (35-60) | (32-60) | 0.952 |
| **Mean± SD** | 49±8.6 | 48.6±7.2 | 48.4±8.4 | |
| **Weight (Kg)** | | | | |
| **Range** | (65-90) | (70-90) | (60-90) | 0.264 |
| **Mean± SD** | 76.1±7.4 | 78.5±6.5 | 75.8±6.9 | |
| **Sex: Male** | 16(53.3%) | 15(50%) | 14(46.7%) | 0.875 |
| **Female** | 14(46.7%) | 15(50%) | 16(53.3%) | |
| **ASA: I** | 23(66.7%) | 19(63.3%) | 18(60%) | |
| **II** | 3(10%) | 7(23.3%) | 8(26.7%) | 0.552 |
| **III** | 4(13.3%) | 4(13.3%) | 4(13.3%) | |

(Data presented as range, mean± SD or number and percentage).

**Table (2):** VAS score at rest between the studied groups.

| VAS at rest (Postop) | Group ESB (n=30) | Group QLB (n=30 | Group C (n=30) | P value | | |
|---|---|---|---|---|---|---|
| **1hr Median (IQR)** | 1 (1-1) | 1 (1-1) | 3(2-3) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | 0.088 |
| **2hr Median (IQR)** | 1 (1-1) | 1 1(1-1) | 3# (2-5) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | 0.160 |
| **4hr Median (IQR)** | 1 1(1-1) | 2# (2-3) | 3# (3-5.3) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | <0.001* |
| **6hr Median (IQR)** | 1# (1-2) | 3# (2-4) | 4# (3-4) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.138 | <0.001* | < 0.001* |
| **8hr Median (IQR)** | 2 # (1-2) | 3# (3-4) | 3# (3-4) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.498 | 0.001* | 0.001* |
| **10hr median (IQR)** | 3# (2-4) | 2# (2-3.3) | 3# (3-4) | 0.010* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.004* | 0.026* | 0.600 |
| **12hr median (IQR)** | 3# (2-4) | 3# (2-4) | 4# (3-5) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | < 0.001* | 0.912 |
| **18hr median (IQR)** | 3# (2-4) | 3# (2-4) | 3# (3-4) | 0.278 | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.539 | 0.107 | 0.349 |
| **24hr median (IQR)** | 2# (2-2) | 2# (2-2) | 2# (2-2) | | 0.588 | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.845 | 0.326 | 0.435 |

Data presented with median interquartile range (IQR).
Kruskal Wallis test for data between the 3 groups. Mann Whitney test for data between each 2 groups. Wilcoxon Signed Rank test for data within the same group.
#: significant difference with basal time at P value <0.05. *: significant level at P value <0.05

**Table (3):** Dynamic VAS score between the studied groups.

| Dynamic VAS (Postop) | Group ESB (n=30) | Group QLB (n=30 | Group C (n=30) | P value | | |
|---|---|---|---|---|---|---|
| **1hr Median (IQR)** | 1 (1-1) | 1 (1-1) | 4 (3-4) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | 0.161 |
| **2hr Median (IQR)** | 1 1(1-1) | 3# (2-3) | 4# (3.8-6) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | <0.001* |
| **4hr Median (IQR)** | 1# (1-2) | 4# (3-4) | 5# (4-7) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | <0.001* | <0.001* | <0.001* |
| **6hr Median (IQR)** | 2# (2-3) | 5# (4-6) | 5# (4-5) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.330 | <0.001* | < 0.001* |
| **8hr Median (IQR)** | 3 # (3-3.3) | 4# (4-5.3) | 4# (4-5) | <0.001* | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.168 | 0.001* | 0.001* |
| **10hr median (IQR)** | 4# (4-5) | 4# (3.8-5) | 4# (4-5) | 0.648 | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.702 | 0.378 | 0.529 |
| **12hr median (IQR)** | 4# (3-5) | 4# (4-5) | 4# (3-5) | 0.888 | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.639 | 0.771 | 0.822 |
| **18hr median (IQR)** | 4# (3-5) | 5# (3-5) | 4# (4-5) | 0.260 | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.607 | 0.196 | 0.143 |
| **24hr median (IQR)** | 3# (3-3) | 3# (3-3) | 3# (3-3) | 0.379 | | |
| | | | | QLB vs C | ESB vs C | QLB vs ESB |
| | | | | 0.261 | 0.993 | 0.174 |

Data presented with median interquartile range (IQR).
Kruskal Wallis test for data between the 3 groups. Mann Whitney test for data between each 2 groups. Wilcoxon Signed Rank test for data within the same group.
#: significant difference with basal time at P value <0.05. *: significant level at P value <0.05

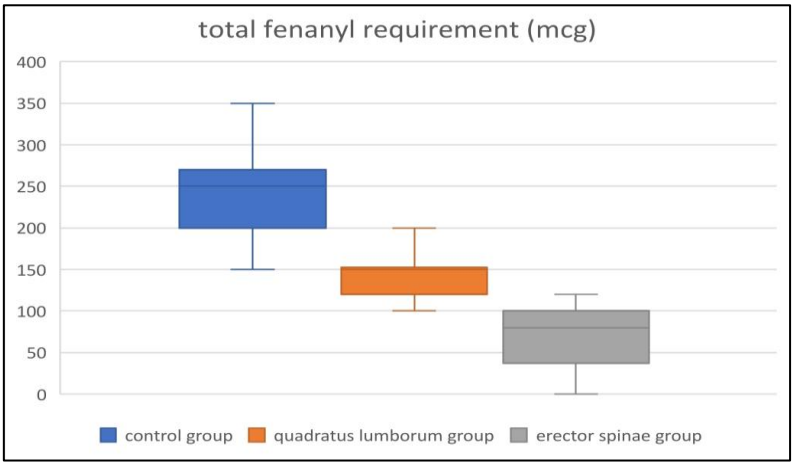


**Fig. (4):** Total fentanyl requirement

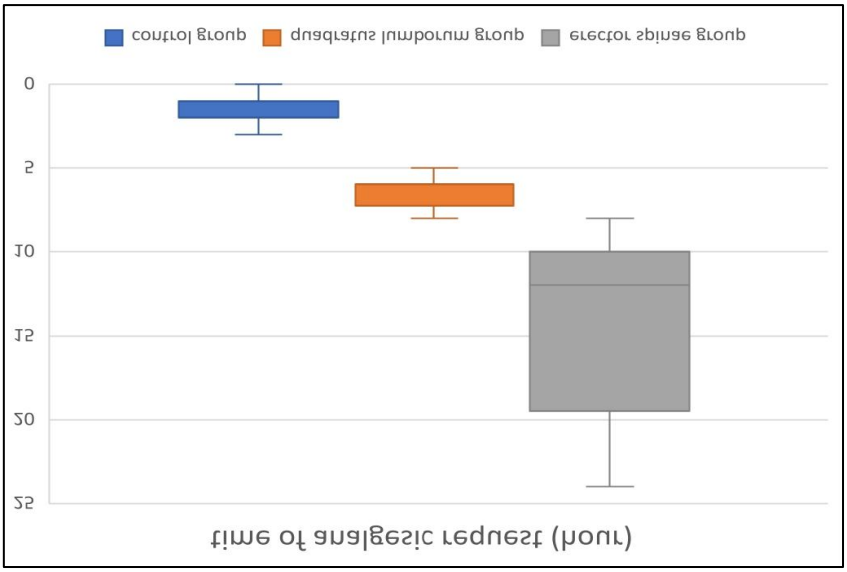

**Fig. (5):** Time of first analgesic requirement

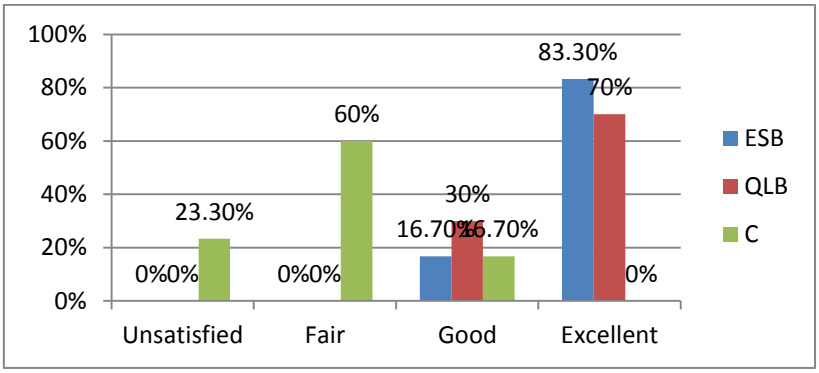


**Fig. (6):** patient satisfaction

## Discussion

Our prospective randomized single-blinded controlled trial compared the impact of bilateral ESPB and bilateral QLB on overall opioid intake and postoperative pain in the first 24 hours after surgery in 90 patients scheduled for CBD exploration. We found that the ESB group consumed less fentanyl than the QLB group, and both groups consumed less than the control group. The ESB group had the lowest VAS at rest/dynamic score and the longest duration of analgesia in the first eight hours postoperatively.

Our study's ESPB was performed at the level of the T7 spinous process under the guidance of a pilot study by Chin et al., which was completed in 2017 and included 4 patients scheduled for laparoscopic repair of ventral hernia. Chin et al. reported that ESB is a promising technique for regional anesthesia for various abdominal procedures after observing the spread of dye to the L2-L3 transverse process caudally in a fresh cadaver and sensory [8].

This is also consistent with Abd-Ellatif and Abd-elnaby findings from 2021, who compared ESP block with QLB block as a postoperative analgesic technique in open nephrectomy and discovered that the two intervention groups had significantly lower 24-hour postoperative opioid requirements and longer duration of analgesia than the control group, while the intervention groups were comparable with higher rest and dynamic VAS in the control group than the other two groups [9].

In their study to evaluate the effectiveness of bilateral ESB as postoperative analgesia in female patients scheduled for abdominal hysterectomy, Hamed et al., 2019 reported a significant decrease in fentanyl requirement in the first postoperative 24 hours with >12 hours of analgesia duration in the ESB group with higher VAS in the control group in the same duration, while VAS score showed insignificant measurements between the 2 groups at 24 hour [5].

The same was true for the findings of the Jung et al. research from 2022, which demonstrated that the use of opioids and the numeric rating scale (NRS) were dramatically decreased after laparoscopic colorectal surgery by bilateral ESP block during induction [10].

In a case report written by Kadam in 2013, a duodenal tumor was planned to be removed by a right-side big subcostal incision, and the patient was given QLB for postoperative analgesia, which resulted to a 24-hour decrease in pain ratings and the need for opioids [11].

The same findings were published by Kwak et al. in 2020 in their double-blinded, randomized controlled research, which found that laparoscopic nephrectomy in 60 patients who had preoperative unilateral QLB decreased opiate use and pain score [12].

The same Alshaimaa et al., at 2020, found that patients who got bilateral ESP blocks after completing abdominal hysterectomy had significantly less pain than those who received TAP blocks after 30 min, 2, 12, 16, and 24 hours postoperatively [13].

When comparing bilateral transverse abdominis plane (TAP) block versus bilateral quadratus lumborum (QL) block in females scheduled for total abdominal hysterectomy in 2018, Naglaa Khalil Yousef also reported that postoperative pain score and morphine requirements were significantly lower in QL group than in TAP group, with shorter duration of analgesia in TAP group [14].

In their meta-analysis from 2020, which comprised 8 RCTs, Xiancun et al. found that the QL group had significantly lower postoperative pain ratings at 2, 4, 6, and 24 hours than the TAP group, with a longer duration of analgesia and a lower 24-hour opioid need [15].

However, Aygun et al. found no statistical difference in NRS between the two groups in their prospective, randomized double-blinded controlled study conducted in 2020 on patients scheduled for laparoscopic cholecystectomy under general anesthesia, while morphine requirements were statistically lower in the ESB group than QLB2 group, which may be related to a different QLB approach from our study [16].

Additionally, according to a study by Tulger et al. (2018), L-ESPB in combination with 40 ml of a LA mixture has the same analgesic effect as QLB-t and significantly reduces both NRS pain scores and analgesic intake during the first 24 hours following surgery when compared to the standard analgesic regimen used in femur and hip surgery. They employed a greater amount of LA [17].

In patients scheduled for caesarean sections under spinal anesthesia, Elkomy et al., 2022 found lower opioid consumption, longer time of analgesia, and better patient satisfaction in the ESB group than in the QLB group, although there was no statistically significant difference; however, this may be due to spinal anesthesia in the first postoperative hours [18].

**Limitations:** We didn't follow up the patients for more than 24 hours postoperative.

**Conclusion**:

In patients scheduled for CBD exploration, both ESPB and QLB were successful in reducing overall opioid use and avoiding postoperative pain in the first 24 hours after surgery. However, ESPB had superior outcomes.

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