ORIGINAL ARTICLE

https://doi.org/10.1590/1806-9282.20230867

The effectiveness of erector spina plane, quadratus lumborum blocks, and intrathecal morphine for analgesia after cesarean: a randomized study

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SUMMARY

OBJECTIVE: This prospective randomized study was conducted at Ataturk University Medical Faculty Hospital, Department of Anesthesia and Reanimation, from June 2022 to May 2023. The aim of this study was to compare the effectiveness of ultrasound-guided erector spinae plane block, quadratus lumborum block, and intrathecal morphine to decrease postoperative pain after cesarean section.

METHODS: Sixty-term pregnant women who were scheduled for elective cesarean sections with spinal anesthesia were included. Patients were randomly divided into three groups (n=20 for each group): Group 1: Patients were administered intrathecal morphine during spinal anesthesia; Group 2: Patients performed bilateral erector spinae plane block postoperatively; and Group 3: Patients performed bilateral quadratus lumborum block postoperatively. In the postpartum care unit, patients received intravenous Patient-Controlled Analgesia. The Patient-Controlled Analgesia devices were set to administer an intravenous bolus of 25 μg fentanyl, with a lockout interval of 10 min. Opioid consumption and maximum pain score in the 24 postoperative hours were recorded.

RESULTS: Patients in Group 1 had a longer time to first analgesic requirement compared to Group 2 (p=0.017). Opioid consumption and resting and moving visual analog score scores in the first 24 h postoperatively were similar between groups.

CONCLUSION: All three methods, including intrathecal morphine, erector spinae plane block, and quadratus lumborum block, are efficacious and comparable in providing postoperative analgesia after cesarean under spinal anesthesia.

KEYWORDS: Anesthesia. Analgesia. Cesarean section. Morphine.

INTRODUCTION

Cesarean delivery is associated with severe postoperative pain[1]. The most important benefits of optimizing postoperative pain control are early mobilization, ease of newborn care, early discharge from the hospital, and better patient satisfaction[2,3]. Combining systemic and regional techniques, a multimodal approach is recommended for postoperative pain management in patients undergoing cesarean surgery[4,5].

Abdominal wall fascial plane blocks under ultrasound guidance have been widely used in pain management after cesarean sections in recent years[6,7]. These techniques allow the deposition of high-volume local anesthetic within a fascial plane. The most commonly used fascial plane blocks are the erector spinae plane (ESP), transversus abdominis plane (TAP), transversalis fascia plane (TFP), and quadratus lumborum (QL) blocks. The erector spinae plane block (ESPB) is a para-spinal regional anesthesia technique that leads to local anesthetic distribution to the interfascial plane between the transverse process and the erector spinae muscles and reveals both somatic and visceral analgesia. It was shown that ESP block provides effective postoperative analgesia in patients undergoing cesarean delivery[8].

Quadratus lumborum block (QLB) has gained popularity as an effective analgesic method in patients undergoing cesarean sections and provides the spreading of the local anesthetic agent into the thoracolumbar fascia. The analgesic efficacy of QLB administration after a cesarean section was first demonstrated by Blanco et al.[9]. They reported a significant reduction in postoperative opioid consumption in patients who injected

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Conflicts of interest: the authors declare there is no conflicts of interest. Funding: This study was supported by the Research Fund of Ataturk University, Project Number: TSA-2022-10801, ID: 10801.
Received on August 17, 2023. Accepted on August 22, 2023.

0.125% bupivacaine on the posterolateral border of the QL muscle compared with the control group.

This prospective randomized study aimed to compare the effectiveness of ultrasound-guided ESPB, QLB, and intrathecal morphine to decrease postoperative pain after a cesarean section.

METHODS

After clinical ethics committee approval (protocol number: B.30.2.ATA.0.01.00/2079, date: March 31, 2022), this prospective randomized study was conducted at Ataturk University Medical Faculty Hospital, Department of Anesthesia and Reanimation, from June 2022 to May 2023. After obtaining written consent from the participants, the study was performed on 60 ASA I-II women aged 18–45 years with a term singleton pregnancy who were scheduled for an elective cesarean section because of a previous cesarean section with a Pfannenstiel incision under spinal anesthesia. Patients with complicated pregnancies, body mass index (BMI) >30 kg/m^2, contraindications to regional anesthesia such as bleeding diathesis, additional diseases such as diabetes, the need for emergency cesarean section, and history of allergy to drugs to be used in the study were excluded from the study. Before the operation, patients were informed about the study procedure and visual analog score (VAS). Patients were fasted for 8 h before surgery. A computer-generated table of random numbers and concealed, opaque envelopes were used for randomization. An anesthetist opened the envelopes, and patients were randomly divided into three groups (n=20 for each group): Group 1: Patients were administered intrathecal morphine during spinal anesthesia; Group 2: Patients performed bilateral ESPB block postoperatively; and Group 3: Patients performed bilateral QLB postoperatively.

Intravenous (IV) vascular access was provided to the patient in the operating room using a 20-gauge branule. Routine monitoring consisting of an electrocardiogram (ECG), peripheral oxygen saturation (SpO_2), and noninvasive blood pressure was performed on all participants. All participants received spinal anesthesia with a weight- and height-adjusted 0.5% isobaric bupivacaine dosage regimen and 15 μg of fentanyl solution at L_3-L_4 or L_2-L_3 levels with a 26 G Quincke spinal needle in a sitting position after the skin was prepared sterile. Patients in Group 1 were administered intrathecal morphine (150 μg) in addition to standard spinal anesthetic drugs.

After the spinal anesthesia procedure, the patient was placed in the supine position. It was controlled by the loss of cold sensation in the patients, and the operation was started when the sensory block levels reached T4. IV midazolam was planned for patients with complaints of pain or discomfort during the operation. However, if pain and discomfort persisted, IV fentanyl or ketamine was planned, and these patients were excluded from the study. In all cases, surgery was performed with a Pfannenstiel incision. Blood pressure was measured at 1-min intervals, and hypotension was defined as a decrease in systolic blood pressure below 20% of the basal value. When hypotension occurred, it was treated with norepinephrine or ephedrine (initial dose: 5 μg norepinephrine or 5 mg ephedrine IV) and a rapid infusion of colloids or crystalloids until blood pressure returned to baseline. Bradycardia was defined as a heart rate of 50 beats per minute and was treated with 1 mg of intravenous atropine. After the operation was completed and the skin was closed, while the patients were still lying on the operating table, ultrasound-guided QL and ESP block applications were performed. Patients in Group 2 received bilateral ESP block, and patients in Group 2 received QL block bilaterally by injecting 20 mL of 0.25% isobaric bupivacaine bolus on both sides. All block applications were performed using an aseptic technique, accompanied by ultrasound, by an anesthesiologist with at least 3 years of block application experience.

To perform QLB, the mid-axillary line was detected, and the linear probe (Esaote MyLab30®, CA631 high-frequency probe, United Kingdom) was placed in the transverse axial plane just above the iliac crest. After the QL muscle was confirmed, a 22-gauge, 100-mm needle (Stimuplex®; B. Braun, Melsungen, Germany) was introduced throughout the anterolateral border of the QL muscle. The local anesthetic was injected at the junction of QL with the transversal fascia, and the spread of the anesthetic drug along the lateral side of the quadratus lumborum muscle at the union with the transversal fascia was visualized[10]. The same block procedure was done on the other side.

To perform ESPB, an ultrasonography curvilinear probe was placed at the sagittal plane of the paravertebral region to identify the transverse process corresponding to T9. The local anesthetic was injected in the plane of the erector spinae at the T9 level, and the spread of the anesthetic drug along the long spinal axis was confirmed[11]. This block procedure was performed on both sides.

After surgery, patients with stable clinical status were transferred to the postpartum-care unit. Notably, 1 g of paracetamol and 50 mg of dexketoprofen were administered intravenously to the patients 30 min before the end of the operation. In the postoperative period, all patients were given intravenous 15 mg/kg paracetamol every 6 h and 50 mg dexketoprofen every 12 h for 24 h. An anesthesiologist blinded to group allocation visited the patients and recorded the postoperative data. In the postpartum care unit, patients received intravenous Patient-Controlled Analgesia (PCA). The PCA devices were set to administer an intravenous bolus of 25 μg fentanyl, with

a lockout interval of 10 min. The pain was evaluated using the VAS (0 to 10; 0=no pain and 10=as much pain as possible) during movement (forward-backward movement in bed) and at rest (lying motionless in bed) at 2, 4, 6, 12, and 24 h postoperatively. Opioid consumption at 24 h, the total amount of opioids consumed up to 24 h, and the maximum pain score at 24 h were recorded. The presence of nausea and/or vomiting, shivering, and itching was recorded. In case of nausea and vomiting, 4 mg intravenous ondansetron was administered.

Age, weight, height, BMI, gestational week, parity, operation time, time to the first analgesic requirement, time to the first ambulation, and time to the return of bowel movements were recorded.

Statistical analysis

The sample size calculation was based on the study by Krohg et al.[10] on postoperative opioid consumption between the QL block group and the placebo group in cesarean section surgery. The sample size calculation was performed using the G*Power sample size calculator[11]. An estimated sample size of 18 patients in each study group achieved a power of 80% to detect a 40% reduction in opioid consumption, assuming a type I error of 0.05. A sufficient sample size was thought to be 20 in each group, considering potential dropouts.

The SPSS 20 package program was used for the statistical analysis. Numerical data were expressed as mean and standard deviation, and categorical data were expressed as numbers (n) and percentages (%). Statistical analysis was performed with one-way analysis of variance (ANOVA) if the data conformed to the normal distribution and with the Kruskal-Wallis test if they did not comply with the normal distribution. In group comparisons, analysis of repeated measures was done with ANOVA, and analysis of categorical data was done using a chi-square test and a t-test. Test results were considered statistically significant when $p<0.05$.

RESULTS

Data collection was completed in 60 patients (n=20 in each group; Figure 1). The patients in the three groups were comparable in terms of sociodemographic and surgical characteristics. Ambulation time, time for a bowel movement, and time to T4 level were similar between groups. Patients in Group 1 had a longer time to first analgesic requirement compared to Group 2 (p=0.017). There was no difference between the groups in terms of atropine and ephedrine requirements, frequency of nausea-vomiting, shivering, and itching (Table 1). Opioid consumption in the first 24 h postoperatively was similar between groups (Table 2). There were no significant differences between the groups in terms of mean arterial blood pressure and heart rate values during the operation and postoperative period. The resting and moving VAS scores in the postoperative period were similar between the groups (Table 3).

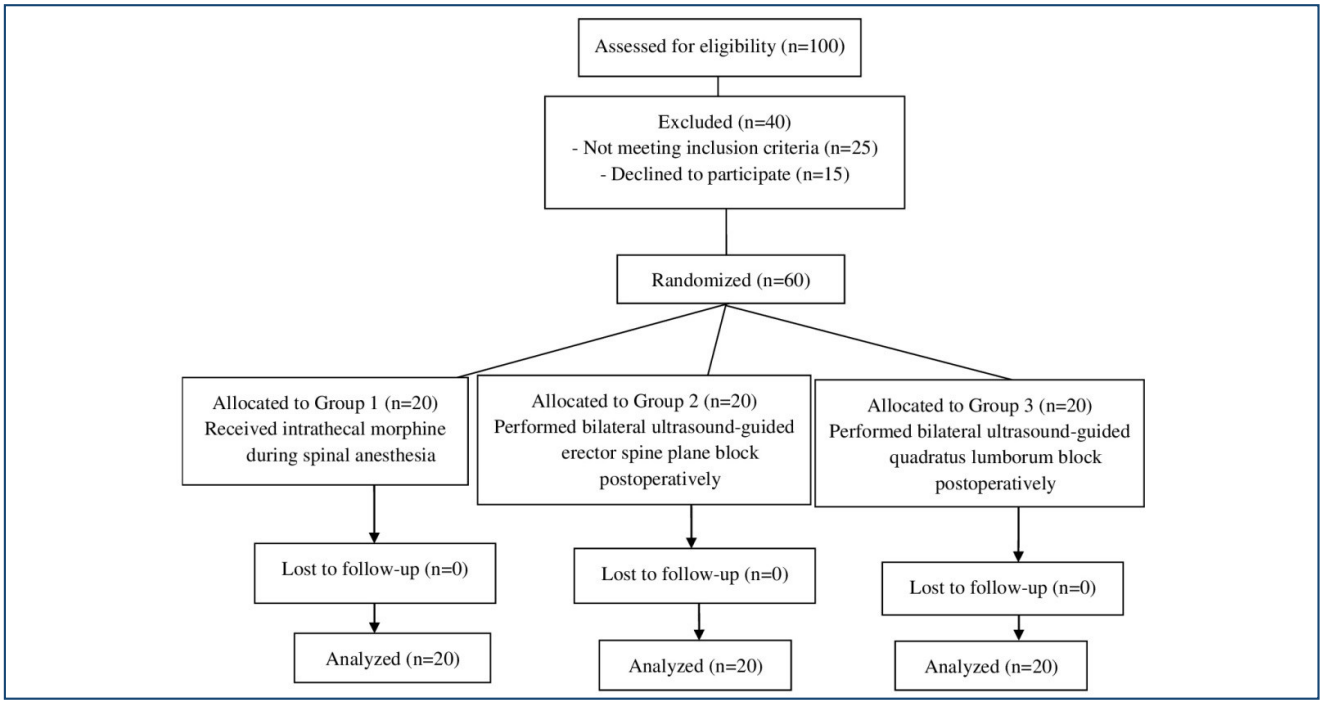

Figure 1. Consort flowchart of study participants.

Table 1. Demographic and anesthetic characteristics of the groups.

	Group 1 (n=20)	Group 2 (n=20)	Group 3 (n=20)	p-value
Age (years)	29.70±5.13	30.50±5.31	33.60±6.09	0.071
BMI (kg/m²)	26.69±2.44	27.00±1.36	27.90±1.95	0.141
Operation time (min)	38.75±11.80	38.55±13.44	41.30±9.58	0.711
First analgesic (s)	396.25±291.95[λ]	234.50±137.34	267.05±157.25	0.040*
Ambulation time (s)	400.00±154.28	327.50±95.98	355.90±151.45	0.248
Bowel movement (s)	820.75±325.44	636.00±343.52	817.95±409.29	0.189
Ephedrine requirement, n (%)	13 (65.0)	14 (70.0)	9 (45)	0.233
Atropine requirement, n (%)	2 (10)	3 (15)	1 (5)	0.504
Nausea-vomiting, n (%)	2 (10)	2 (10)	1 (5)	0.804
Shivering, n (%)	2 (10)	1 (5)	0 (0)	0.349
Itching, n (%)	1 (5)	2 (10)	1 (5)	0.153

Group 1: patients were administered intrathecal morphine during spinal anesthesia; Group 2: patients performed bilateral ESP block postoperatively; and Group 3: patients performed bilateral QL block postoperatively. Data were expressed as mean±SD or n (%). Using the ANOVA test, *p<0.05 was considered statistically significant. [λ]p=0.017, compared to Group 2.

Table 2. Postoperative fentanyl consumption (μg) in groups.

	Group 1 (n=20)	Group 2 (n=20)	Group 3 (n=20)	p-value
0–2 h	5.50±15.38	13.75±24.96	22.50±36.18	0.145
2–4 h	27.70±42.84	42.00±40.60	34.93±53.39	0.619
4–6 h	32.10±41.94	36.25±34.86	51.09±54.88	0.375
6–12 h	110.10±100.46	101.25±110.16	115.14±122.88	0.924
12–24 h	175.52±171.42	121.00±151.96	231.55±240.96	0.199
During 24 h	370.42±324.19	326.00±311.30	455.45±449.53	0.530

Group 1: patients were administered intrathecal morphine during spinal anesthesia; Group 2: patients performed bilateral ESP block postoperatively; and Group 3: patients performed bilateral QL block postoperatively. Results were presented as mean±SD.

Table 3. Postoperative pain scores for groups at rest and in motion.

	Group 1 (n=20)	Group 2 (n=20)	Group 3 (n=20)	p-value
At rest				
2 h	0 (0–40)	10 (0–50)	0 (0–50)	0.090
4 h	0 (0–30)	10 (0–60)	0 (0–70)	0.307
6 h	10 (0–40)	10 (0–40)	10 (0–50)	0.769
12 h	10 (0–50)	10 (0–40)	20 (0–30)	0.537
24 h	10 (0–50)	10 (0–30)	10 (0–30)	0.332
In motion				
2 h	10 (0–50)	20 (0–60)	0 (0–50)	0.117
4 h	10 (0–40)	20 (10–70)	10 (0–80)	0.173
6 h	10 (0–50)	10 (0–50)	20 (0–70)	0.196
12 h	20 (10–50)	30 (0–50)	30 (0–60)	0.545
24 h	20 (10–60)	30 (0–40)	30 (0–50)	0.789

Values are presented as median (min-max). Group 1: patients were administered intrathecal morphine during spinal anesthesia; Group 2: patients performed bilateral ESP block postoperatively; and Group 3: patients performed bilateral QL block postoperatively.

DISCUSSION

This prospective randomized study showed that all three techniques, namely, QLB, ESPB, and intrathecal morphine, were effective in reducing postoperative pain and had comparable analgesic efficacy with respect to postoperative resting and moving VAS scores, hemodynamic parameters, side effects, and postoperative opioid consumption.

There are studies demonstrating the effectiveness of ESP and QLB blocks in the management of postoperative pain following cesarean surgery[9-13]. In agreement with their findings, this present study showed that all three techniques, namely, QLB, ESPB, and intrathecal morphine, effectively reduced the postoperative pain score at all time points from 2 to 24 h during rest and in motion. Similarly, Bakshi et al.[14] reported that QLB and ESPB are effective techniques for providing analgesia after cesarean with similar postoperative pain scores, duration of analgesia, and use of rescue analgesia. In a recent study, Bakshi et al.[14] compared the analgesic efficacy of ultrasound-guided transmuscular quadratus lumborum block (TQLB) and thoracic erector spinae plane block (TESPB) in parturients under cesarean with subarachnoid block. They reported the duration of first-rescue analgesia as 11.90±2.49 h in Group TESPB and 12.56±3.38 h in Group TQLB. In another study, Hamed et al.[15] reported a similar duration (12±2.81 h) for rescue analgesia in parturients who performed ESPB following cesarean surgery under spinal anesthesia. In this present study, the duration of first-rescue analgesia was less (234.50±137.34 s for patients who applied ESPB and 267.05±157.25 s for patients who applied QLB) compared to the above studies[14,15]. In this present study, we included only participants with previous cesarean sections. These participants may have higher pain scores due to associated peritoneal adhesions caused by previous cesarean surgery, which might have influenced the outcome.

The QLB is a deep block and must be performed very carefully by experienced anesthesiologists to avoid complications[5,9]. On the other hand, ESPB is considered a simple and safe block. However, intrathecal administration of morphine is an easier and less invasive procedure than block methods. Moreover, it is easily performed during the spinal anesthesia procedure and does not require additional time. In this present study, we did not observe any serious complications in any patient in any of the three groups. Moreover, the mean time to the first analgesic request in the intrathecal morphine group was longer compared to the ESPB group. We thought that it would be safer to use the intrathecal morphine method instead of the block method, as it takes longer time and has a higher risk of complications.

To the best of our knowledge, no previous studies have compared the analgesic efficacy of all three methods, namely, QLB, ESPB, and intrathecal morphine, for postoperative pain relief after cesarean. There is a limitation to this present study. It would be valuable to create a control group with only standard spinal anesthesia. However, Salama[13] reported that both QLB block and intrathecal morphine provide longer-lasting analgesia with lower postoperative morphine requirements compared to standard spinal anesthesia after cesarean. We demonstrated that QLB and ESPB are equivalent to intrathecal morphine in terms of the consumption of opioids during 24 h postoperatively. The results of this present study also showed that during 24 h after surgery, there were no significant differences in terms of VAS scores at rest or in motion and the incidence of nausea-vomiting and shivering among the three groups. But Salama[13] reported a higher incidence of pruritus and nausea-vomiting in the intrathecal morphine group compared to the control and the QLB groups. We thought that the low morphine-related side effects in our study population may be associated with less postoperative opioid consumption due to routine additional analgesics, including intravenous paracetamol and dexketoprofen.

CONCLUSION

All three methods, namely, intrathecal morphine, ESPB, and QLB, are efficacious and comparable in providing postoperative analgesia after a cesarean section under spinal anesthesia. The intrathecal morphine technique may be recommended due to the longer duration of postoperative analgesia, its relatively low risk of technical complications or failure, and its simple and quick application.

AUTHORS' CONTRIBUTIONS

MA: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **ANA:** Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **HO:** Conceptualization, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review &

editing. **EPTY:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **GNCS:** Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **AD:** Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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