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Quadratus Lumborum Block for Analgesia after Cesarean Section with Spinal Anesthesia: A Randomized Controlled Study

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ABSTRACT

Background: Quadratus lumborum block (QLB) was introduced to provide postoperative analgesia.

Objective: This randomized controlled, double-blind study aimed to evaluate bilateral posterior QLB for analgesia after cesarean section (CS) using spinal anesthesia without intrathecal morphine.

Methods: One hundred ASA-II women with singleton, full-term pregnancy undergoing CS using spinal anesthesia were randomized into 2 groups (Quadratus Lumborum and Control; 50 subjects each). After completing CS, bilateral posterior QLB (20 mL bupivacaine 0.25% on each side) was performed in Quadratus Lumborum group, and bilateral sham procedure was performed in Control group.

Results: The median (range) of pain score at rest at 6 h was 2 (1-6) in Quadratus Lumborum group and 5 (2-8) in Control group; median difference (95% CI) was -3 (-3.000007 to -2.99995); P <0.00001. Pain score at rest at 12 h and pain scores on movement at 6 and 12 h were lower in Quadratus Lumborum group. No significant differences in pain scores at rest and pain scores on movement at 24 h were detected between the groups. The number of subjects requesting morphine was smaller, time to the first request of morphine was longer, and total morphine dose was smaller in Quadratus Lumborum group. Patient satisfaction was greater in Quadratus Lumborum group. No significant differences in the incidence of pruritus and nausea/vomiting were detected between the groups.

Conclusions: QLB provides adequate postoperative analgesia after CS using spinal anesthesia without intrathecal morphine.

Keywords: Analgesia; Cesarean Section; Quadratus Lumborum Block.

INTRODUCTION

Adequate analgesia after cesarean section (CS) increases women satisfaction and improves maternal outcomes[(1)], and is usually accomplished with multimodal analgesic regimens including neuraxial opioids. Various local/regional techniques can be utilized for post-CS analgesia including intraperitoneal local anesthetic instillation, wound infiltration, transversus abdominis plane (TAP) block, and quadratus lumborum block (QLB)[(2)].

The QLB is a block of the fascial plane that involves injecting local anesthetic adjacent to the quadratus lumborum (QL) muscle to anesthetize the thoracolumbar nerves, and includes 3 types: lateral (QLB type I), posterior (QLB type II), and transmuscular (QLB type III) approaches[(3-5)], all of them were successfully utilized for post-CS analgesia. The QLB improves post-CS analgesia in the absence of spinal morphine, but the proper approach after CS is yet to be determined[(6-11)].

This study aimed to examine the efficacy of ultrasonography-guided posterior approach of the QLB (QLB type II) to provide analgesia after CS performed with spinal anesthesia without intrathecal morphine. The hypothesis was that bilateral QLB would decrease the pain scores at rest and pain scores on movement and the total morphine requirement compared to sham procedure.

PATIENTS AND METHODS

The study was conducted from May 2, 2020 to April 1, 2021.

Ethical considerations:

The study was approved by the Ethics Board of the Mansoura Faculty, and an informed written consent was taken from each participant in the study. The study has been executed according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Patients:

Inclusion criteria were ASA-II women, ≥ 37 weeks of gestation, singleton pregnancy, presenting for CS utilizing spinal anesthesia. Exclusion criteria included women less than 19 years old, with body mass index (BMI) ≥40 kg/m^2, weight less than 60 kg, height less than 150 cm, contraindications to spinal anesthesia, active labor, recent administration of opioid, hypersensitivity to any utilized drug, or significant cardiovascular, hepatic, or renal pathologies.

The study participants (100 subjects) were randomized into 2 groups (QL and Control; 50 subjects in each group) utilizing the permuted block randomization method (block size = 4). The codes denoting patients` group were hidden in sequentially numbered, sealed,

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opaque envelopes. The study participants and the investigators evaluating the outcomes did not know the specific patients` group.

The first investigator evaluated the participants for eligibility, took the consent, recorded the baseline data, and opened the envelopes containing the patients` group codes after administering spinal anesthesia and obtaining an adequate level of sensory loss. The second investigator performed all the QLB and sham procedures in both groups. Spinal anesthesia was performed by a resident of anesthesia not participating in any further steps.

The participants did not receive any premedication. In the operating theatre, pulse oximetry, noninvasive blood pressure, and electrocardiography were attached. Spinal anesthesia was done at the L4-L5 or L3-L4 intervertebral space with the participants in the sitting position with a 25-gauge spinal needle; hyperbaric bupivacaine 0.5% (12.5 mg; 2.5 mL) and fentanyl 15 μg were given.

After administering spinal anesthesia, the level of sensory loss was evaluated with pinprick, and surgery started after a level of T6 or higher was obtained. The upper level of sensory loss at 20 minutes after spinal anesthesia was recorded, and a level below T6 was regarded as failed spinal anesthesia. A similar technique for lower-segment CS was performed in all cases with Pfannenstiel incision and uterine exteriorization.

A bolus dose of IV midazolam 2 mg was allowed to manage abdominal pain or discomfort, but no opioid or anesthetic administration was allowed during surgery. If any subject required IV fentanyl and/or propofol during surgery, she would have been excluded from the study.

The study participants and the outcomes assessors did not know the specific patients` groups. An opaque screen separated the participants from the operator performing the blocks.

Technique:

In the QL group; after completing CS, while the participants in the supine position, bilateral ultrasound-guided posterior QLB was performed utilizing a 2-5 MHz curved-array probe, Figure 1:

1- After sterilizing the abdomen, the transducer was placed at the level of the anterior superior iliac spine in the anterior axillary line and slid upward (cranially) to delineate the 3 muscles of abdominal wall (external oblique, internal oblique, and transversus abdominis).
2- The transducer was slid to the mid-axillary line. At this point, the layers of abdominal muscles started to taper: the external oblique and internal oblique muscles form aponeurosis, and the transversus abdominis muscle starts to disappear. The QL muscle was observed.
3- The operator scanned the external oblique muscle posterolaterally to visualize its posterior border (hook sign). The underlying internal oblique muscle forms a roof over the QL muscle.
4- The transducer was tilted downward (caudally) to delineate a hyperechoic line corresponding to the intermediate layer of thoracolumbar fascia.
5- A spinal needle (22-gauge, 90 mm) was inserted in-plane from medial to lateral; bupivacaine 0.25% (20 mL) was injected on the posterior surface of the QL muscle with direct visualization.
6- The optimal injection point over the lumbar interfacial triangle was determined utilizing hydrodissection. The local anesthetic spread posteromedial.

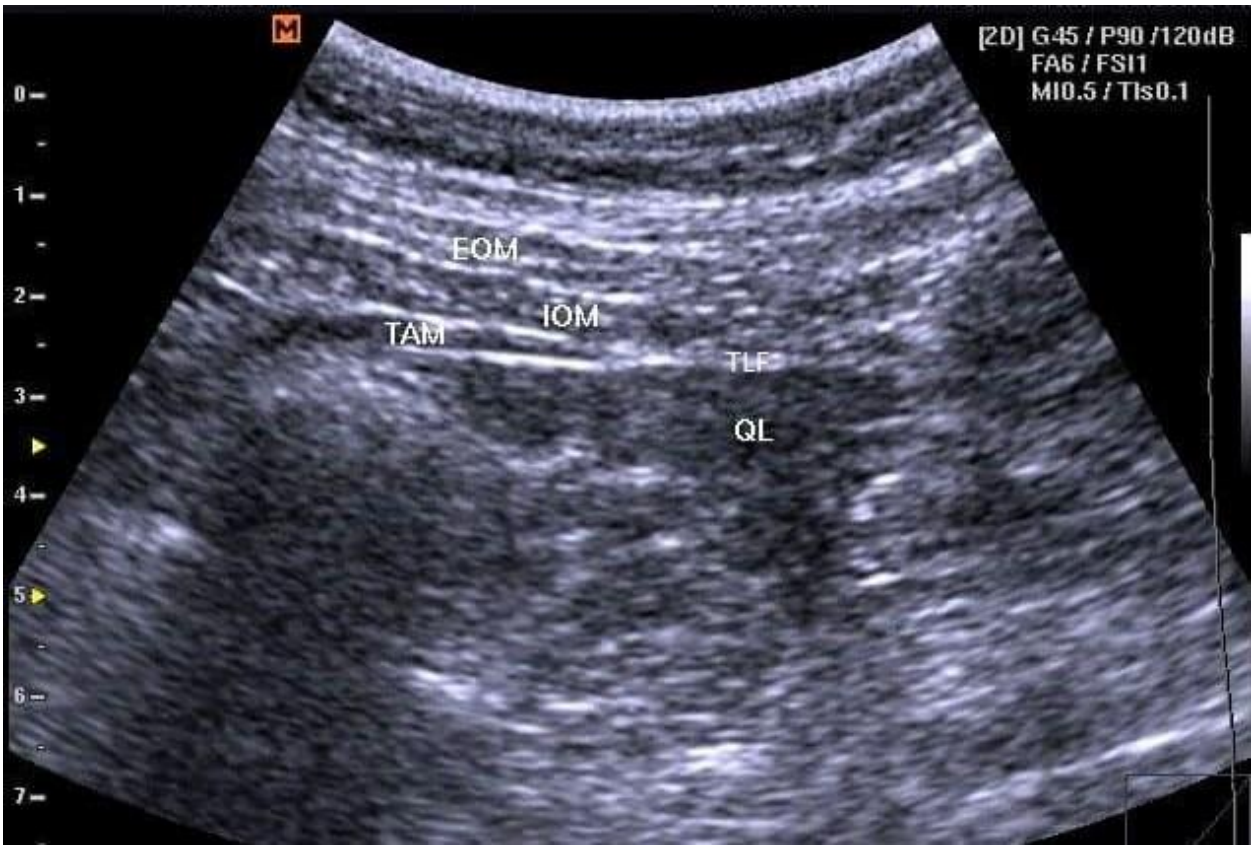

Figure 1. Ultrasound image showing the relevant landmarks for QL block (Left side): The external oblique muscle (EOM), internal oblique muscle (IOM), quadratus lumborum muscle (QL), transversus abdominis muscle (TAM), and thoracolumbar fascia (TLF).

In the Control group; a sham block was done after CS: the operator slid the transducer and pressed a covered needle on patient`s abdomen, bilaterally.

In both groups, all participants received IV paracetamol 1 gm and IV ketorolac 30 mg/8 h starting after 1 h of CS. Intravenous morphine was given by the ward nurse as a rescue analgesic only if requested by the patient; a bolus dose of 1 mg was given and repeated at patient request after at least 10 minutes (maximum hourly dose 4 mg). The time to the first request of morphine and the total morphine dose at 24 hours were recorded.

The pain scores at rest and pain scores on movement (hip flexion) were evaluated at 6, 12, and 24 h after CS, with an 11-point numerical rating scale (NRS), where 0 denotes no pain and 10 denotes the worst pain possible.

The incidence of postoperative pruritus and nausea/vomiting (managed with IV metoclopramide 10 mg) were recorded. Patient satisfaction about post-cesarean analgesia was evaluated after 24 h, with a 5-point Likert scale, where (5) denotes very satisfied, (4) denotes satisfied, (3) denotes fair, (2) denotes unsatisfied, and (1) denotes very unsatisfied.

Study Outcomes:

The primary outcome was the pain score at rest at 6 h after CS. The secondary outcomes included pain scores at rest at 12 and 24 h, pain scores on movement at 6, 12, and 24 h, time to the first request of morphine, participants requesting rescue morphine, total morphine dose, patient satisfaction, and the incidence of pruritus and nausea/vomiting.

Statistical Analysis

The R software (version 4.0.5) was used for statistical analysis and graphics. The Shapiro-Wilk test was used to evaluate the normality of continuous data. Normally distributed data, nonnormally distributed data, and categorical data were expressed as mean (SD), median (range), and number (%), respectively. The Student t test and the Mann-Whitney U test were used for the normally distributed data and the nonnormally distributed data, respectively. The chi-squared test or the Fisher`s exact test were used for categorical data. Kaplan–Meier analysis was used to analyze the time to the first morphine request, and the log-rank test was utilized to compare the data.

A *P* value <0.05 was considered statistically significant. For multiple comparisons, Bonferroni adjustment was utilized.

Sample Size Calculation:

Before enrollment of the study participants, a pilot study was done on 10 subjects utilizing sham procedure, standard analgesia, and rescue morphine analgesia

(Control). The mean (SD) of the pain score at rest at 6 h was 5 (2.5).

We assumed $\alpha = 0.0167$ (Bonferroni adjustment for multiple comparisons of the pain score at rest tested at 3 time points: 6, 12, and 24 h; 0.05/3) and power = 90% ($\beta = 0.1$). Utilizing the 2-tailed t test with unequal variances, 44 subjects were needed in each group to demonstrate a reduction in the mean pain score of 2, regarded as the minimal clinically important difference. To compensate for dropouts, 50 subjects were allocated to each group.

RESULTS

One hundred participants (50 subjects in each group) were enrolled in the study. All the subjects completed the study and their data were analyzed (Figure 2).

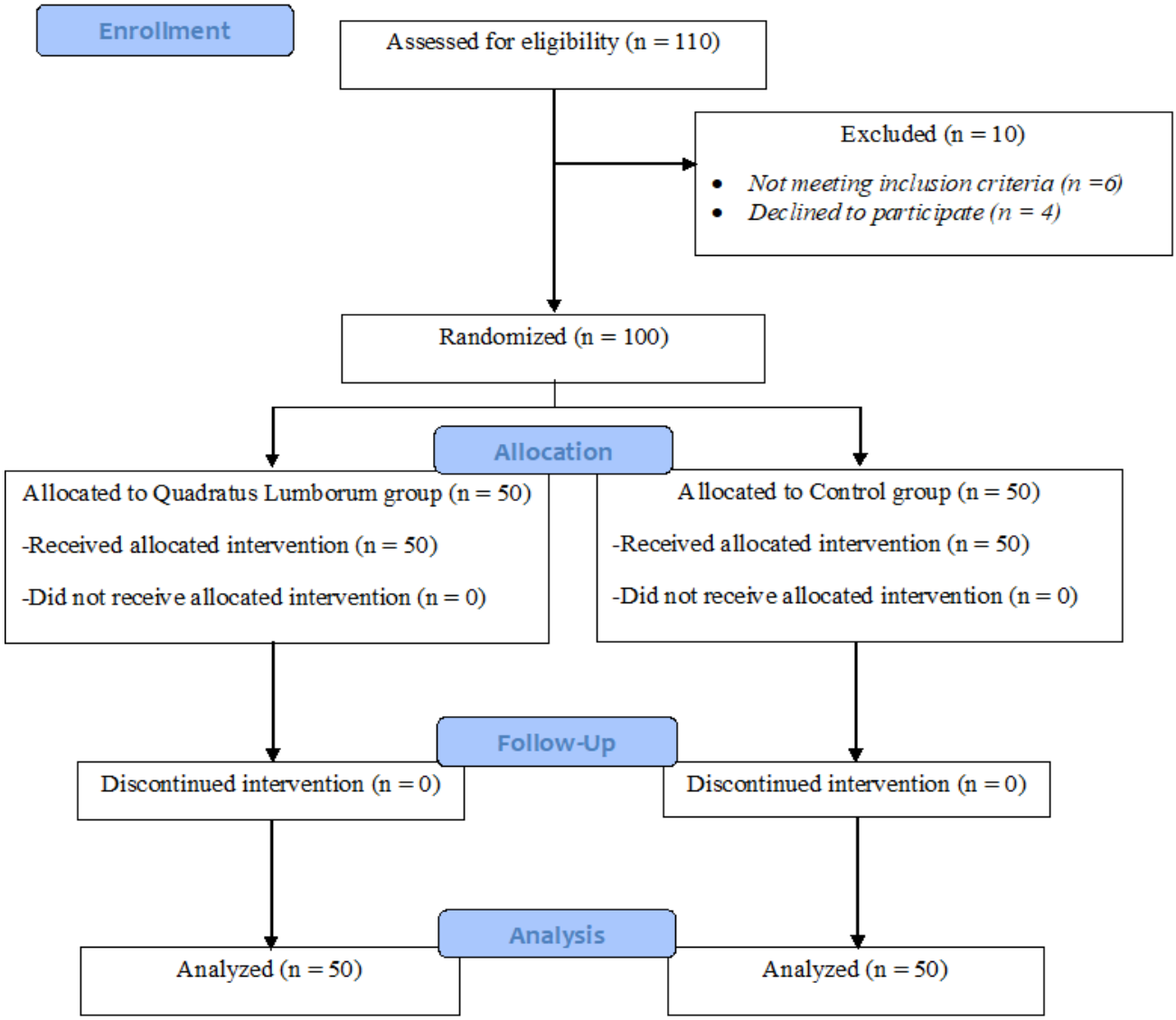

Figure 2. Consolidated Standards of Reporting Trials (CONSORT) diagram.

No significant differences in the characteristics of patients and the operative data were detected between the groups (Table 1).

Table 1. Subjects` Criteria and Operative Data

	Quadratus Lumborum Group (n = 50)	Control Group (n = 50)	Standardized Difference*
Age (years)	27 (19-42)	25 (19-39)	0.095
Weight (kg)	81 (62-110)	82 (65-110)	0.043
Height (cm)	162.7 (5.2)	162.6 (5.1)	0.019
Body mass index (kg/m^2)	31.1 (3.3)	31.3 (3)	0.067
Nulliparity	13 (26%)	12 (24%)	0.046
Gestational age (weeks)	38 (37-41)	38 (37-41)	0.041
Upper sensory level†	T4 (T2-T6)	T3 (T2-T6)	0.089
Duration of surgery‡ (min)	54.5 (40-80)	52 (40-76)	0.17

Data are median (range), mean (SD), or number (%).
* Standardized differences for continuous and dichotomous data.
† Evaluated with pinprick 20 minutes after spinal anesthesia.
‡ Duration from starting skin incision to closing the skin.

The median (range) of the pain score at rest at 6 hours was significantly lower in QL group.

The pain score at rest at 12 h and pain scores on movement at 6 and 12 h were lower in the QL group compared to Control, but no significant differences in the pain scores at rest and pain scores on movement at 24 h were detected between the groups (Table 2 and figures 3 and 4).

The number of subjects requesting rescue morphine analgesia and the total morphine dose were smaller in the QL group compared to Control, and the time to the first morphine request was longer in the QL group. Patient satisfaction was greater in the QL group compared to Control. No significant differences in the incidence of pruritis or nausea/vomiting were detected between the groups (Table 2 and figure 5).

Table 2. Outcome Data

	Quadratus Lumborum Group (n = 50)	Control Group (n = 50)	Estimated Treatment Effect	*P* Value
Pain at rest at 6 h*	2 (1-6)	5 (2-8)	-3 (-3.000007 to -2)†	<0.00001
Subjects requesting morphine	30 (60%)	41 (82%)	-22% (-41% to -2.7%)‡	0.028
Total morphine dose at 24 h (mg)	3 (0-8)	4 (0-12)	-1.99 (-2.99 to -0.000019)†	0.0047
Nausea and/or vomiting	9 (18%)	11 (22%)		0.8
Pruritus	3 (6%)	5 (10%)		0.72
Patient satisfaction§	4 (2-5)	3 (2-5)	1 (0.999 to 1.0001)	<0.00001

Data are median (range) or number (%).
* The primary outcome of the study evaluated with an 11-point NRS.
† The median difference (95% CI) between the 2 groups.
‡ The difference in proportions (95% CI) between the 2 groups.
§ Evaluated at 24 h after CS with a 5-point Likert scale.

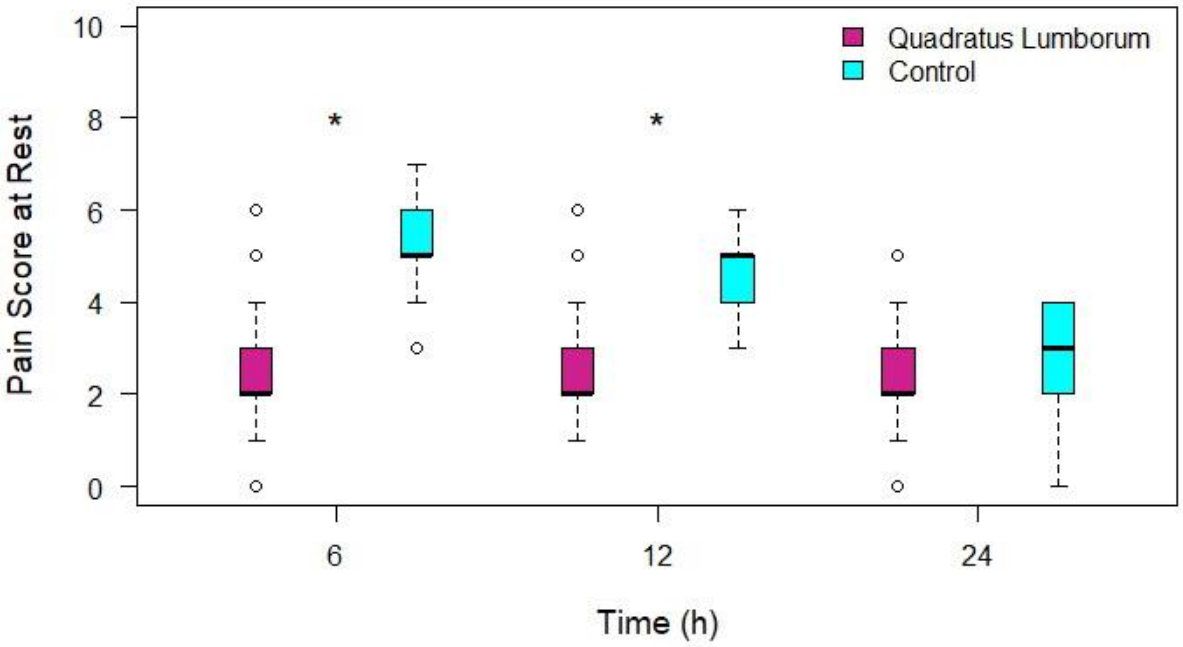

Figure 3. Box plots of pain scores at rest evaluated with an 11-point NRS at 6, 12, and 24 h after CS (*: Significant difference between the 2 groups)

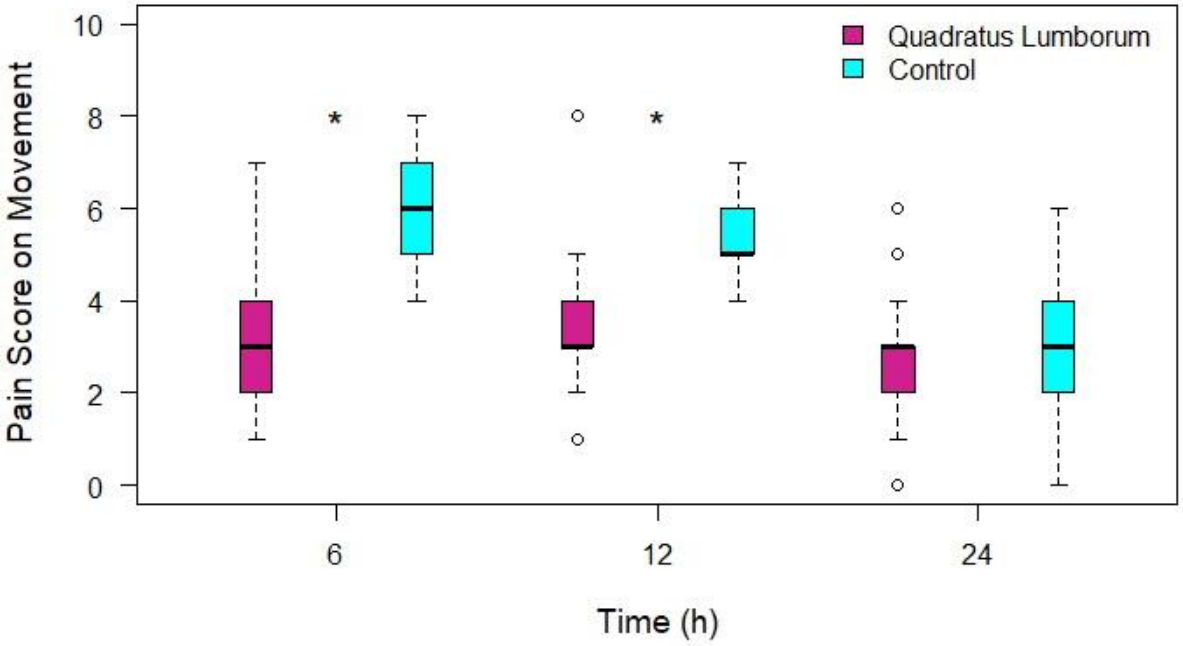

Figure 4. Box plots of pain scores on movement evaluated with an 11-point NRS at 6, 12, and 24 h after CS (*: Significant difference between the 2 groups)

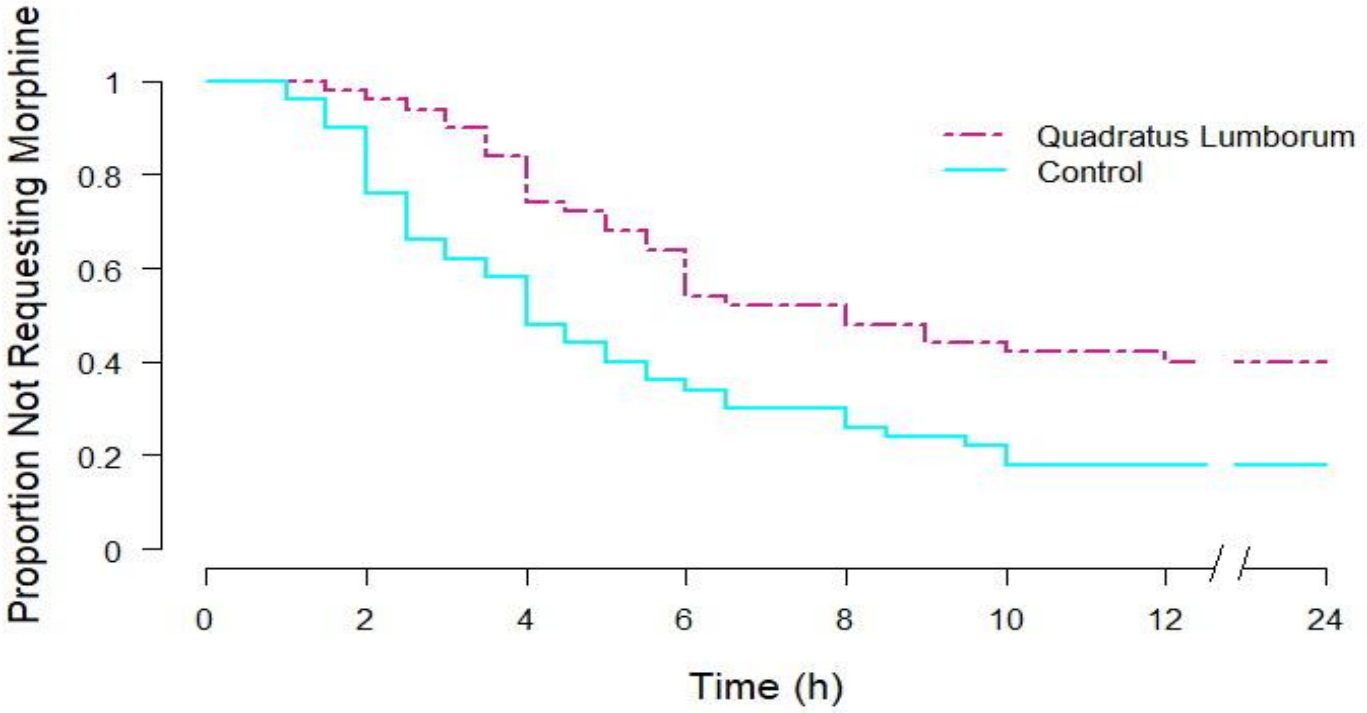

Figure 5. Kaplan-Meier graph showing the proportion of subjects not requesting rescue morphine analgesia after CS (*P* = 0.002 with the log-rank test).

DISCUSSION

This randomized controlled, double-blind study demonstrated that bilateral posterior QLB decreased pain score at rest at 6 h compared to sham procedure after CS using spinal anesthesia without intrathecal morphine. The pain score at rest at 12 h and pain scores on movement at 6 and 12 h were lower in the QL group. Additionally, QLB decreased number of subjects requesting rescue morphine analgesia and the total morphine dose, increased the time to the first morphine requirement, and improved patient satisfaction. The incidence of pruritus and nausea/vomiting was comparable between the groups.

The effectiveness of the QLB for postoperative analgesia after CS has been studied utilizing spinal anesthesia with and without intrathecal morphine. Without intrathecal morphine, many studies have demonstrated the effectiveness of the QLB to decrease the pain scores and decrease the total dose of postoperative rescue analgesic compared to sham procedure [12-15], TAP block[16-18], or wound infiltration[19].

However, a number of studies compared QLB with intrathecal morphine and demonstrated that the analgesia provided by intrathecal morphine is superior to QLB[15,20,21]. Moreover, QLB provides no benefit compared to sham procedure when intrathecal morphine is used as part of postoperative multimodal analgesia[20-22].

The most proper approach/type of the QLB for post-CS analgesia is yet to be determined. The original lateral approach (QLB-I)[23] is now not used after CS.[12] Most of the current studies have utilized the posterior approach (QLB-II)[12,13,15-17,19-22], however, other studies have successfully utilized the transmuscular approach (QLB-III)[14, 18].

A number of cadaveric studies evaluated the spread of local anesthetic injectate for different types of QLB[24-28]. They suggested that the injected local anesthetic diffuses mainly to the transversus abdominis muscle plane in QLB-I, along the middle thoracolumbar fascia in QLB-II, and into the thoracic paravertebral space in QLB-III. Therefore, the QLB-III may be the most effective technique for post-cesarean analgesia, but this approach needs a steep needle path in the sitting or lateral position, that are difficult to attain for parturients after CS.

Two studies compared different approaches of the QLB for post-CS analgesia. **Kang *et al.*** demonstrated that the analgesia provided by QLB-II and QLB-III was comparable, and that the combination of QLB II and III is superior to either of the approaches alone[29]. **Koksal *et al.*** demonstrated that QLB-III is superior to QLB-II[30].

In this study, we utilized the posterior QLB (QLB-II) because it can be done in the supine position suitable

after CS using spinal anesthesia, has a more superficial injection point and better resolution, and may be safer as the QL muscle separates the needle tip from the peritoneum, hence, decreasing danger of bowel injury or intraperitoneal injection[12].

Limitations:

This study has a number of limitations. First, morbidly obese women with BMI ≥40 kg/m^2 were not included in the study, therefore, it is unknown whether QLB is feasible and effective in this patient category. Second, the operator was not blinded to the study group because we did not perform an actual sham procedure with injection of saline into the QL plane. Instead, to blind the study participants, the operator slid the transducer on the patient`s abdomen, and the sides of the abdomen were pressed with a covered spinal needle to avoid exposing participants in the Control group to an unnecessary risk without any benefit. Third, blinding of the study participants was not evaluated (by asking the participants whether they knew to which group they were allocated).

Fourth, we did not compare the efficacy of various types of the QLB, therefore, it is unknown whether the posterior approach (QLB-II) is better or comparable to the transmuscular approach (QLB-III). Last, the rate of successful block and the sensory extent of the QLB could not be evaluated due to persistent sensory block after spinal anesthesia.

CONCLUSIONS

Bilateral posterior QLB (QLB type II) decreased pain scores at rest and pain scores on movement at 6 and 12 h postoperatively, decreased the total morphine dose, increased the time to the first morphine dose, and improved patient satisfaction after CS utilizing spinal anesthesia without intrathecal morphine.

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