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Comparative Study between Type II and Type III Ultrasound-guided Quadratus Lumborum Block for Analgesia after Cesarean Delivery

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ABSTRACT

Background: Neuraxial anaesthesia (mainly spinal anaesthesia) is the anaesthetic technique of choice for elective cesarean delivery. Sufficient postoperative analgesia is an integral component of Enhanced Recovery After Surgery (ERAS) protocols; it supposes greater importance in women undergoing cesarean delivery and is rapidly gaining popularity.

Aim of the study: This study investigates postoperative analgesic efficacy after cesarean section of two different approaches of quadratus lumborum block; posterior (QLB 2) and anterior (QLB 3) approaches compared to the conventional intravenous.

Patients and Methods: A prospective double-blinded randomised controlled clinical study in Al-Azhar university hospitals in Cairo conducted on 102 patients aged 21 to 35 were scheduled for elective cesarean delivery under spinal anaesthesia without any other surgical intervention as tubal ligation or ovarian cyst removal after approval of the institutional ethical committee.

Results: Our study demonstrated a statistically significant difference between groups according to VAS S score at T0 to T24 with p-value ($p<0.05$ S). In addition, the VAS S score was significantly lower among the QLB groups, either QLB2 or QLB3), compared to the No-QLB group, in the time from T2 to T24. The difference between QLB2 and QLB3 was statistically, at the time of T2, T4, T12, and T16, according to the VAS score.

Conclusion: The present study showed that QLB has an essential role in treating postoperative pain after cesarean section.

Keywords: *Comparative Study; Ultrasound-guided; Quadratus Lumborum; Cesarean Delivery.*

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INTRODUCTION

Neuraxial anaesthesia (mainly spinal anaesthesia) is the anaesthetic technique of choice for elective cesarean delivery, which lacks the advantage of prolonged analgesia [1]**.** Unrestricted mother mobility, minimum maternal and neonatal adverse effects, rapid return to baseline functionality, and early release home are all aims of optimal pain treatment following caesarean delivery., which are the fundamental of early rehabilitation after surgery (ERAS) protocol [2]**.**

Poor maternal bonding with the newborn, nursing difficulties and an increased risk of prolonged pain and postpartum depression are linked to suboptimal analgesia. The most commonly used analgesics in these cases are NSAIDs and opioids. Nevertheless, the use of these drugs is limited by the associated side effects [3]**.**

The quadratus lumborum muscle block can be done in various ways, each termed after the anatomical location of the needle tip in respect to the quadratus lumborum muscle [4] . It does not only provide somatic analgesia, but also it can efficiently reduce visceral pain by spreading the local anaesthetic to the paravertebral space. This block effectively provides analgesia from T7 to L1 dermatomes [5]**.**

However, many trials have approved the efficacy of QLB in abdominal surgery. Literature review reveals that few studies have compared the effectiveness of different QLB approaches. To our knowledge, this study will be the first trial to investigate the difference in efficacy between ultrasonography-guided QLB type 2 and type 3 in providing analgesia after Cesarean Delivery.

PATIENTS AND METHODS

This study a prospective randomised controlled double-blinded clinical study. The study was performed after approval of the institutional ethical committee, Al-Azhar University Hospital in Cairo. We took informed written consent from all parturient for participating in the study and for portraying the block technique.

After obtaining informed consent, 102 parturients who were scheduled for elective cesarean section under spinal anaesthesia were equally randomised into three groups; QL2, QL3, and no QL group. We include patients with physical status 1 or 2 as determined by the American Society of Anesthesiologists, as well as a normal singleton pregnancy with a gestation of at least 37 weeks. Patients suffering coagulopathy, anatomical anomalies, local infection, anticoagulant use, or inability to interpret or use the verbal rating pain score system or the patient-controlled analgesia (PCA) pump were excluded.

To estimate sample size, the MedCalc® version 12.3.0.0 programme "Ostend, Belgium" was used, as well as a statistical calculator based on a 95 percent confidence interval and study power of 80 percent with a 5 percent error. A previous study showed that the percentage of parturient required analgesia among the QL group at 12.5%, whereas the requirement was 41.6% among the second[6]. As a result, we computed the sample size based on these values. The smallest sample size required to detect a difference was 97 individuals. If a 5% drop-out rate is assumed, the sample size will be 102 cases, subdivided into three groups, Group P (n=34), Group A (n=34), and Group C (n=34).

The parturient were randomly assigned into one of the study three groups using a computer-generated table. Concealment was ensured using sealed envelopes.

For all parturients, Cesarean section was done under spinal anaesthesia with 0.5% heavy Marcaine alone with no adjuvants according to the guidelines.

QL block technique:

At the operation end, bilateral, ultrasound-guided QL block was performed in the groups (A) and (P) while the patient was in lateral decubitus positions. The probe was manipulated to scan structures under it and demonstrate the transverse process of L2 or L3 lumbar vertebrae, the erector spinae muscle, quadratus lumborum muscle, and psoas muscles. A spinal needle 9cm in length was advanced as described before, cautiously visualising the whole needle throughout the procedure. The tip of the needle was placed according to the desired site of injection.

After we had double-checked that the needle tip was in the right place, aspiration was done. We injected 0.4 ml/kg of 0.25% bupivacaine plus 2mg dexamethasone on each side, and the hydro-dissection of the injectate in the targeted place of lumbosacral fascia and adjacent structure were real-time portrayed. We calculate the drug dosage according to body weight by Omni lean body mass online calculator**.**

In the posterior approach (QLB II), the needle tip was placed in the middle layer of the thoracolumbar fascia between the posterior border of the QL muscle and erector spinae muscle.

In the anterior approach (QLP III), the needle tip was passed through the QL muscle and placed at the anterior lumbosacral fascia between the quadratus lumborum and psoas muscles.

We take care not to exceed the maximum acceptable dose of bupivacaine by adjusting the total volume of local anaesthetic injected as 2mg/kg.

Postoperative management:

The postoperative VAS score was assessed at T0, T2,4,8,12,16 and 24 hours and indicated when the patient requested analgesia. All parturients of all groups (ketorolac 30mg and paracetamol 10 mg/kg infusion over 10 minutes) started on patient request when VAS ≥4. We recorded the time for each intervention. We reassessed the patient VAS after 30 minutes of ketorolac-paracetamol administration. If the score was still ≥ 4, we gave an IV bolus of nalbuphine (4 mg) and may be repeated after 30 minutes if VAS was still ≥ 4. The patient was reevaluated 30 minutes again after the second dose of nalbuphine. If (VAS) remain ≥ 4 despite NSAIDs and two successive doses of nalbuphine, we consider a failure of that technique but the patient data inter our analysis. In the first 24 hours, we considered four doses of ketorolac-paracetamol as the Maximum doses allowed. If the patient needed additional analgesia, nalbuphine top-up doses up to (0.45mg/kg) (30mg /day) were allowed in an average weighted parturient of 70 but no more. In cases of the maximum dose of nalbuphine in addition to the maximum allowable doses of ketorolac-paracetamol had been reached, we considered the patients dropped out, and we did not analyse his data. The modified Bromage score will assess quadriceps muscle weakness [8]. The parturient with a score of more than one was recorded and hourly observed until fading of the motor effect and observer satisfaction score was included in the patient follow up sheet, and the observer was requested to report his opinion.

Statistical analysis:

Recorded data were analysed using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). We used the Kruskall Wallis

test for multiple-group comparisons in non-parametric data and F-one way analysis of variance when comparing more than two means. We used the Post Hoc test: Tukey's test for multiple comparisons between different variables. We used independent-samples: t-test of significance when comparing two means and Mann Whitney U test for two-group comparison in non-parametric data. We used the Chi-square test and Fisher's exact test to compare groups with qualitative data instead of the Chi-square test only when the expected count in any cell was less than five. We accept The 95% confidence interval and the 5% margin of error. So, the p-value was considered significant if it was ≤0.05, highly significant if it was ≤0.001, and non-significant if it was >0.05.

RESULTS

The results of the present study are demonstrated in the following tables.

We aimed by our study to investigate postoperative analgesic efficacy after cesarean section of Two different approaches of quadratus lumborum block; posterior (QLB 2) and anterior (QLB 3) approaches compared to the conventional intravenous.

Heart Rate (Beat/min)	Group P: QL2 (n=31)	Group A: QL3 (n=32)	Group C: No QL (n=29)	F-test value	p-value
Baseline					
Mean±SD	106.97±4.74	105.16±6.67	107.90±4.09	1.271	0.621
Range	95–116	85–115	98–116		
T0					
Mean±SD	105.32±3.20	107.03±4.67	104.17±5.83	2.919	0.059
Range	99–112	95–116	91–115		
T2					
Mean±SD	108.10±4.10A	97.06±6.88B	108.97±4.19A	49.703	<0.001**
Range	98–116	84–109	98–116		
T4					
Mean±SD	96.26±7.78C	101.06±7.01B	111.14±3.92A	40.592	<0.001**
Range	79–109	85–111	106–121		
T8					
Mean±SD	82.29±6.59C	86.84±6.43B	92.24±4.68A	20.678	<0.001**
Range	71–99	69–98	83–99		
T12					
Mean±SD	85.39±6.23B	81.84±6.04BC	94.72±5.74A	36.801	<0.001**
Range	73–97	71–95	85–106		
T16					
Mean±SD	77.68±6.30B	75.16±7.04B	83.48±6.45A	12.538	<0.001**
Range	65–91	63–91	71–99		
T24					
Mean±SD	76.29±4.91A	71.09±4.62B	79.48±6.38A	19.402	<0.001**
Range	65–86	61–79	68–91		

Table 1: Comparison between studied groups according to heart rate (beat/min).

Mean arterial blood pressure (mmHg)	Group P: QL2 (n=31)	Group A: QL3 (n=32)	Group C: No QL (n=29)	F-test value	p-value
Baseline					
Mean±SD	85.13±7.99	85.09±7.86	84.21±5.47	1.885	0.161
Range	67–98	67–98	73–91		
T0					
Mean±SD	78.29±3.49B	81.06±5.28B	85.34±7.29A	12.352	<0.001**
Range	72–86	73–91	69–98		
T2					
Mean±SD	80.74±5.04B	78.34±3.99B	91.10±5.81A	55.647	<0.001**
Range	73–91	71–87	78–99		
T4					
Mean±SD	88.10±5.70B	84.44±6.14B	93.28±7.08A	14.980	<0.001**
Range	78–98	73–97	79–106		
T8					
Mean±SD	76.19±7.15C	83.13±6.42B	88.14±5.47A	26.390	<0.001**
Range	62–89	71–99	78–98		
T12					
Mean±SD	78.71±6.15AB	75.28±7.45B	81.28±5.66A	6.564	0.002*
Range	61–91	63–95	71–95		
T16					
Mean±SD	74.94±7.05B	73.16±5.06B	78.07±6.45A	4.208	0.036*
Range	63–91	61–80	65–89		
T24					
Mean±SD	78.48±5.67B	75.88±4.97B	82.52±5.79A	11.296	<0.001**

Range	68–91	65–86	71–95

Table 2: Comparison between studied groups according to mean arterial blood pressure (mmHg).

VAS Score	Group P: QL2 (n=31)	Group A: QL3 (n=32)	Group C: No QL (n=29)	H-test value	p-value
T0					
Mean±SD	2.26±0.86B	3.06±0.84A	2.07±0.84B	19.896	<0.001**
Median (IQR)	2 (2–3)	3 (3–4)	2 (1–3)		
Range	1–4	1–5	1–3		
T2					
Mean±SD	3.26±0.73A	2.41±0.76B	3.59±0.82A	27.613	<0.001**
Median (IQR)	3 (3–4)	3 (2–3)	4 (3–4)		
Range	2–5	1–4	2–5		
T4					
Mean±SD	6.06±1.48B	4.56±1.44C	7.41±1.21A	38.305	<0.001**
Median (IQR)	6 (5–7)	4 (4–5)	8 (6–8)		
Range	3–9	3–8	5–9		
T8					
Mean±SD	3.06±1.21B	3.44±1.34B	4.10±1.70A	8.981	0.011*
Median (IQR)	3 (2–3)	3 (3–4)	3 (3–5)		
Range	1–6	2–7	2–8		
T12					
Mean±SD	3.90±1.22B	3.06±1.08C	5.17±1.56A	34.519	<0.001**
Median (IQR)	4 (3–4)	3 (2–3)	4 (4–7)		
Range	3–7	1–6	3–8		
T16					
Mean±SD	3.13±0.88A	2.72±0.99B	3.07±1.22A	6.178	0.045*
Median (IQR)	3 (3–3)	2 (2–3)	3 (2–4)		
Range	2–5	2–5	2–6		
T24					
Mean±SD	2.90±0.87B	2.53±1.08B	3.52±0.99A	12.607	0.002*
Median (IQR)	3 (3–3)	3 (2–3)	4 (3–4)		
Range	1–4	1–4	1–6		

Table 3: Comparison between studied groups according to VAS score.

Time to first postoperative analgesia (minutes) of nalbuphine	Group P: QL2 (n=31)	Group A: QL3 (n=32)	Group C: No QL (n=29)	F-test value	p-value
Mean±SD	256.58±38.45B	384.84±99.06A	215.34±38.48C	55.198	<0.001**
Range	135–314	241–561	139–285		

Table 4: Comparison between studied groups according to time to first postoperative analgesia (minutes) of nalbuphine. There was a highly statistically significant difference between groups according to time to first postoperative analgesia (minutes) of nalbuphine with a p-value <0.001. We found the highest value in Group A (384.84±99.06), followed by Group P (256.58±38.45), while the lowest value was found in Group C (215.34±38.48).

Time to first postoperative analgesia (minutes) of Ketorolac-Pracetamol	Group P: QL2 (n=31)	Group A: QL3 (n=32)	Group C: No QL (n=29)	F-test value	p-value
Mean±SD	211.06±34.56B	336.63±102.49A	163.66±42.15C	53.429	<0.001**
Range	109–239	207–480	98–237		

Table 5: Comparison between studied groups according to the first postoperative analgesic time (minutes) of Ketorolac-Paracetamol. There was a highly statistically significant difference between groups according to the first postoperative analgesic time (minutes) of Ketorolac-Paracetamol with a p-value <0.001. We found the highest value in Group A (336.63±102.49) followed by Group P (211.06±34.56), while the lowest value was found in Group C (163.66±42.15).

Total ketorolac & Total pracetamol consumption (dose/day)	**Group P: QL2 (n=33)**	**Group A: QL3 (n=34)**	**Group C: No QL (n=31)**	**H-test value**	**p-value**
Median (IQR)	6 (2-6)B	5 (2-6)B	11 (7-15)A	40.513	<0.001**
Range	2–6	1–3	2–4		

Table 6: Comparison between studied groups according to total ketorolac and paracetamol consumption (dose/day). There was a highly statistically significant difference between groups according to total ketorolac paracetamol consumption (dose/day) with a p-value p<0.001. We found the highest value in Group C 3 (3-4) followed by Group P and group A [2 (1-2) & 2 (1-2)] respectively.

Nalbuphine	**Group P: QL2 (n=33)**	**Group A: QL3 (n=34)**	**Group C: No QL (n=31)**	**x2**	**p-value**
Yes	23 (69.7%)	**22 (64.7%)**	31 (100.0%)	13.365	<0.001**
No	10 (30.3%)	**12 (35.3%)**	0 (0.0%)		

Table 7: Comparison between studied groups according to quantitative of nalbuphine. There was a statistically significant higher nalbuphine use in group C than in group P and A, with a p-value (p<0.001 HS).

Satisfaction score	**Group P: QL2 (n=33)**	**Group A: QL3 (n=34)**	**Group C: No QL (n=31)**	**H-test value**	**p-value**
Very dissatisfied 1	3 (9.1%)	1 (2.9%)	7 (22.6%)	17.944	0.022*
2	5 (15.2%)	4 (11.8%)	8 (25.8%)		
3	8 (24.2%)	7 (20.6%)	10 (32.3%)		
4	9 (27.3%)	10 (29.4%)	5 (16.1%)		
Very Satisfied 5	8 (24.2%)	12 (35.3%)	1 (3.2%)		

Table 8: Comparison between studied groups according to satisfaction score. There was a statistically significant higher satisfaction score in group A and group P than group C, with a p-value (p<0.05 S).

DISCUSSION

It's still difficult to produce the best post-cesarean analgesia. The most recent advancements in modalities like opioids, TAP block, wound infiltration/infusion, ketamine, gabapentin, and ilioinguinal-iliohypogastric nerve block are summarised in a systematic review (II-IH) [6]. However, QLB type 2 was found to be superior to TAP block in an RCT [7].

This study demonstrated that there was a statistically significant difference between groups according to VAS S score at T0 to T24 with p-value (p<0.05 S). In addition, the VAS S score was significantly lower among the QLB groups, either (QLB2 or QLB3), compared to the No-QLB group, in the time from T2 to T24. According to the VAS score, we found a statistically significant difference between QLB2 and QLB3 at the time of T2, T4, T12 and T16. Moreover, we found a highly statistically significant difference between groups according to time to first postoperative analgesia (minutes) of nalbuphine with a p-value <0.001. The highest value was found in Group QLB3 (384.84±99.06), followed by Group QLB2 (256.58±38.45), while the lowest value was found in Group No-QLB (215.34±38.48).

Our results indicated that ultrasound-guided QL3 block has superior analgesic effects after C-section relative to that of QL2 block. These findings differed from earlier research in that they demonstrated that QL2 block is a superior analgesic approach that can reduce morphine intake as well as the need for postoperative pain treatment following caesarean surgery.

All right, our results are in agreement with that reported by Kang et al., who studied the analgesic efficacy of different QLB approaches after C-section. They indicated that ultrasound-guided QL3 or QL2+3 blocks showed higher analgesic efficacy after C-section compared to that of QL2 block alone.

The difference between our study results and those previously described were explained as follows. The needle tip's injection position has a significant impact on the analgesic efficacy of QLB. A recent cadaver study compared three types of QLB, one of three QL1 blocks and one of three QL2 blocks were misplaced, and if supplied to patients, they would not offer postoperative analgesic effect, even if they were conducted by an expert anaesthetist with rich experience in cadaver regional anaesthesia [8].

Because it was inconvenient for parturients to lie in the lateral position after surgery, QLB was done using an anterolateral route in this study. However, we discovered that this strategy was more difficult to implement in parturients, which was thought to be due to a unique postural issue that could contribute to a higher likelihood of needle misplacement. As a result, we assumed that, while QL2 would be useful for pain relief, it was an unreliable method following a C-section due to injection accuracy failure and anatomical differences[9]. Our findings suggested that practitioners should use caution while performing this type of block and then stay prudent.

The QL3 block is far more effective than the QL2 block because it is not affected by changes in connective tissue anatomy. When the needle tip of the QL3 block goes into the quadratus lumborum, it can offer a definite and unambiguous endpoint, as well as anaesthetic diffusion both posterior and lateral to the psoas muscle **[11]**. Furthermore, in the QL3 block, anaesthesia spreads primarily posterior to the arcuate ligaments and into the thoracic paravertebral space [10]**.**

When completing the QL3 block, there are a few considerations to keep in mind. The QL3 block, which is a deeper nerve block than the QL2 block, necessitates the use of ultrasonography. In this study, areas for blood haemorrhage and organ damage were thoroughly identified. Furthermore, the lumbar nerve roots may potentially be affected by the QL3 block. A spread to the lumbar plexus, according to a case study, might cause weakness in the iliacus, quadriceps and psoas muscles. [11]**.** The negative consequences of lumbar plexus block, on the other hand, were not common in our patients.

CONCLUSION

The current study found that QLB plays a significant effect in the treatment of postoperative pain following a caesarean section. The best injection site was just anterior the quadratus lumborum muscle. QLB3 is the optimal approach and showed analgesic efficacy, superior to QLB2. Because of increased image resolution, a longer distance to the intra-abdominal viscera, and the existence of nearby muscles, the block's safety is improved, and complications may be avoided. When the procedure is used correctly, it can considerably reduce the use of opioids after caesarean sections.

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