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Ultrasound Guided Quadratus Lumborum Versus Transversus Abdominis Plane Blocks For Postoperative Pain Control In Lower Abdominal Surgeries

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ABSTRACT

Background: ***Acute postoperative pain is a major problem, leads to undesirable outcome if not controlled probably. Therefore, appropriate management of acute perioperative pain using multimodal or balanced analgesia is crucial. The aim of the study was to compare between ultrasound guided quadratus lumborum block (QLB) and transversus abdominis plane (TAP) block as postoperative analgesia in lower abdominal surgeries. Patients & Methods: Thirty patients, aged from 21 to 50 years, ASA physical status I or II, scheduled for unilateral lower abdominal surgeries under general anesthesia were randomly divided into two equal groups of fifteen each. QLB group: patients received unilateral QLB block with 30 ml of 0.25% bupivacaine and TAP Group: Patients received unilateral TAP block with 30 ml of 0.25% bupivacaine. All patients in both groups were assessed for: Postoperative Visual analogue score (VAS), time to 1st rescue of analgesia, sensory block assessment (onset, level). In addition, total nalbuphine consumption in the first postoperative 24h and patient satisfaction were also recorded. Results: VAS was significantly higher in patients received TAP block. Patients received QLB showed rapid sensory loss with higher sensory block level in comparison to TAP block group. Time to 1^{st} rescue of analgesia, was delayed in patients received QLB, so, this group showed longer duration of analgesia with higher satisfaction score than TAP group. In addition, the total nalbuphine consumption was higher in the first 24 hours in TAP block group compared to QLB group. Conclusion: The recently introduced QLB, may be a good option for postoperative pain relief after lower abdominal surgery with reduction of opioid consumption, prolonged duration of analgesia, and higher patient satisfaction compared to transversus abdominis plane block. We belief that if US guided QLB is performed by experienced hands; it is safe and effective technique for postoperative analgesia.***

Keywords: Ultrasound, quadratus lamborum block, transversus abdominis plane block, lower abdominal surgeries.

INTRODUCTION

Acute postoperative pain is a major problem, leads to undesirable outcomes if not adequately controlled. Early postoperative ambulation and reduction of hospital stay necessitate efficient postoperative analgesia **[1,2]**. Lower abdominal surgeries such as open inguinal hernioplasty and open appendectomy cause mild to severe postoperative pain. If it is not treated, it will lead to chronic pain and undesirable events such as patient discomfort and prolonged immobility **[3].**

The role of regional anesthesia in abdominal surgery is well established, with epidural analgesia being the gold standard in perioperative analgesia. However, following the advent of enhanced recovery after surgery protocols**[1]**, early mobilization, minimally invasive surgical techniques, and pharmacologic venous-thromboprophylaxis are now recognized as key components of efficient surgical recovery. The search for less-invasive, motor-sparing, safer, and efficacious alternatives to epidural analgesia has been prioritized **[4]**.

Multiple novel analgesic techniques for abdominal surgery have been described in recent years, most of which make use of fascial planes, and their purported benefits would make them ideal candidates for a multimodal analgesic strategy for abdominal surgery. The ubiquity of ultrasound technology and ultrasound-guided techniques has been vital in cementing the role of fascial plane blocks in the analgesic armamentarium. However, the evidence base for many of those approaches remains limited **[5]**.

Innervation of the anterolateral abdominal wall arises from the anterior rami of spinal nerves T7 to L1. These include the intercostal nerves (T7-T11), the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1) **[6]**. Two techniques that have been the subject of the most interest are the transversus abdominis plane (TAP) block and the quadratus lumborum (QL) block approaches. The transversus abdominis plane (TAP) block was first described in 2001 by Rafi as a traditional blind landmark technique using the lumbar triangle of Petit. The TAP block targets the somatic nerves on the anterior abdominal wall, through the transversus abdominis plane, between the internal oblique and transversus abdominis muscles **[7]**.

Numerous clinical trials have examined the role of the TAP block following a variety of surgical procedures. Until recent meta-analyses, its clinical efficacy was presumed. It is now increasingly apparent, however, that the cutaneous analgesia provided by TAP blocks is modest. Although several studies have reported a significant reduction in pain scores and opioid consumption with TAP blocks compared to epidurals, local infiltration analgesia, or placebo, the clinical magnitude of those differences may be limited **[8]**. The limited extent of blockade and lack of visceral analgesia means the clinical importance of the differences is debatable **[9]**.

The QLB approaches were an evolution of the TAP block and have also been revised and adapted over the years **[10]**. The quadratus lumborum block (QLB) was described by Blanco and McDonell in 2007 **[11]**. It is used for perioperative pain control in pediatrics, adults and pregnant undergoing abdominal and hip surgeries **[12]**. The quadratus lumborum block has four approaches (transmuscular, posterior, lateral and intramuscular) **[13]**. In the posterior approach, the local anesthesia was injected posterior to the QL **[14]**. The QLB has been sought to provide the patient with more visceral block **[15]**.

This study was designed to compare the efficacy of TAP block versus QLB in providing postoperative analgesia for lower abdominal surgeries.

PATIENTS & METHODS:

After obtaining approval from the scientific committee of anesthesia and surgical intensive care department and the institutional review board (IRB) of faculty of medicine Zagazig University, written informed consent was obtained from all participants. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

This Prospective comparative randomized double blind clinical study was carried out in general surgeries operating rooms from January 2018 to Augustus 2018. Thirty patients, aged from 21 to 50 years, ASA physical status I or II, who were scheduled for unilateral QLB or TAP block (each of them 15 patients) were enrolled. Patient with; known allergic history to the studied drugs, drug addiction, on chronic use of analgesia or drug dependence, contraindication of regional anesthesia e.g., coagulopathy or septic focus at the site of injection, were excluded from the study.

Preoperative assessment:

The night before surgery, the block technique was explained to the patients. Patients were instructed how to represent their level of pain using the visual analogue scale (VAS), in which 0 = no pain and 10 = worst pain imaginable. All patients were kept nil orally before the operation (8 h for fatty meal, 6 h for light meal and 2 h for clear fluids). Intravenous lines were inserted for administration of anesthetic drugs and fluids. All patients were premedicated with (0.02-0.05 mg/kg) midazolam intravenously (IV).

Surgical technique:

General anesthesia was induced with IV fentanyl (2 μg/kg), and propofol (2 mg/kg). After ensuring adequate ventilation, injection of atracurium (0.5 mg/kg) was administered to facilitate orotracheal intubation. Immediately after intubation, the patient was connected to mechanical ventilation (TV 7 ml/kg, RR 14 /min, I: E ratio 1:2.5), ventilator parameters were adjusted to keep ETCO2 35-40 mmHg. At the end of the surgical procedure, after wound closure, patients were randomly allocated according to a computer generated tables to one of the two treatment groups; TAP group and QLB group. Patients and data collector were blind to group assignment.

TAP block group: In U.S. guided TAP block, while the patient was in the supine position. The iliac crest and the costal margin were identified and the linear US probe (6-13 MHz, sonosite) positioned in the space between them in the mid-axillary line under complete aseptic condition. The three layers of abdominal wall were detected, 22-gauge spinal needle was inserted in plane and after negative aspiration, 30 ml of 0.25 % bupivacaine were administrated in the plane between internal oblique and transversus abdominis muscles with hydrodissection of muscles plane **[16]**.

Posterior QLB group: In U.S. guided QL B, the patient was placed supine (with slightly lateral rotation) with the side to be anesthetized turned upwards with bellow under iliac crest. The convex probe(2-5 MHz) was placed in the midaxillary line immediately, moving the transducer posteriorly, QL was detected at the end of the three lateral abdominal muscle layers adherent to the apex of the transverse process of L4 vertebral body ,with psoas major anterior and erector spinae muscle posterior. Then after negative aspiration, 30ml of 0.25% bupivacaine was injected posterior to the muscle between QL and erector spinae muscles **[10]**.

At the end of surgical procedure and the block, inhalational anesthesia (isoflurane) was disconnected, residual muscle relaxant was antagonized using neostigmine (0.05 mg/kg) and atropine (0.02mg/kg). Patients were extubated after fulfilling the criteria of extubation then the patients transferred to the post anesthesia care unit (PACU). All patients received IV analgesia in the form of; IV infusion paracetamol (1 g every 8 h), 2mg I.V. nalbuphine was given when VAS equal or above 3 as rescue analgesia with maximum single dose 20mg. Dose can be repeated every 3-6 hrs when needed all over the study period (24 hrs. postoperatively) with a maximum daily dose160 mg/day.

Postoperative evaluation and outcomes:

After full recovery using 4 points scale as follow: 3 if normal sensation, 2 if decreased cold sensation,1 if absent cold/ present touch sensation and 0 if absent cold/absent touch sensation. Sensory onset was defined as time from the end of injection till loss of sensation **[17]**.

Hemodynamics (heart rate and blood pressure) and pain score (VAS) were recorded at 1,2,4,8,12 and 24hs postoperatively. Time to 1st rescue of analgesia (the time interval between end of LA injection and patient pain complaint (VAS > 3), total nalbuphine consumption in the first 24 hours were also recorded. Patient satisfaction was considered and recorded at the end of the first 24 h postoperative using patient satisfaction score (good; fair; poor) **[12]**.

Primary outcomes: Time to first rescue of analgesia and total nalbuphine consumption. **Secondary outcomes:** postoperative VAS score, sensory blockade assessment (level, onset of sensory block), patient satisfaction, side effects and complications.

Statistical analysis:

Data analysis was performed using the software SPSS (Statistical Package for the Social Sciences) version 20. Quantitative variables were described using their means and standard deviations. Categorical variables were described using their absolute frequencies and to compare the proportion of categorical data, chi square test and fisher exact tests were used when appropriate. Kolmogorov-Smirnov (distribution-type) and Levene (homogeneity of variances) tests were used to verify assumptions for use in parametric tests. ANOVA test and Friedman test were used. The level statistical significance was set at 5% (P<0.05).

RESULTS

The study included 30 patients (15 patients in each group). All data including (age, sex, and body mass index, duration of operation, ASA and type of operation) is represented in **Table (1)**.

There was non-significant (p>0.05) difference between studied groups. Regarding sensory assessment; QLB group showed rapid onset of sensory loss versus

TAP group that was statistically significant (p<0.001), with sensory block level from T7-L2 in comparison to TAP block (T10 - T12) **(Figure 1)**. Postoperative pain score (VAS) was significantly higher in TAP group compared to QLB group at all studied times (P<0.001) **(Figure 2)**.

The time to 1st rescue of analgesia was significantly delayed in patients received QLB (15.33 ± 3.52versus 8.73±2) which indicates prolonged duration of analgesia, In addition, postoperative nalbuphine consumption, and Frequency of nalluphine demand over 24h were significantly lower in QLB group in comparison to TAP group **(Table 2)**.

All patients in both groups were satisfied by the type of analgesia provided; however, degree of satisfaction was higher in QLB group (p<0.001) compared to TAP group. Both groups showed hemodynamic stability with no complications related to the block or the drugs used through the whole study time **(Table 3)**.

Table (1): demographic characteristics, and operative data

	QLB (n=15)	TAP (n=15)	t	p
Age (kg):				
▪ Mean ± SD ▪ Range	40.67 ± 10.92 22 – 58	35.93 ± 7.54 25 – 50	1.381	0.178
BMI(Kg/m²):				
▪ Mean ± SD ▪ Range	24.55 ± 5.24 22 – 32	25.34 ± 6.46 21 – 34	-0.368	0.359
Gender:	**N (%)**	**N (%)**	**X2**	**p**
▪ Male ▪ Female	8 (53.3) 7 (46.7)	9 (60) 6 (40)	0.136	0.317
Duration of operation (min)				
▪ Mean±SD ▪ Range	70±20 (50-90)	60±154 (45-75)	1.5	0.137
ASA:				
▪ I ▪ II	14 (93.3) 1 (6.7)	14 (93.3) 1 (6.7)	Fisher	1
Type of operation:				
▪ Appendectomy ▪ Prostatectomy ▪ Hernioraphy ▪ Open removal of lower ureteric stone	7(46.7) 1 (6.7) 7 (46.7) 0 (0)	9(60) 0 (0) 5 (33.3) 1 (6.7)	2.583	0.46

Data are represented as Mean ± SD, number (N) and percentage (%). X2: chi square test.
P>0.05 was considered non-significant.

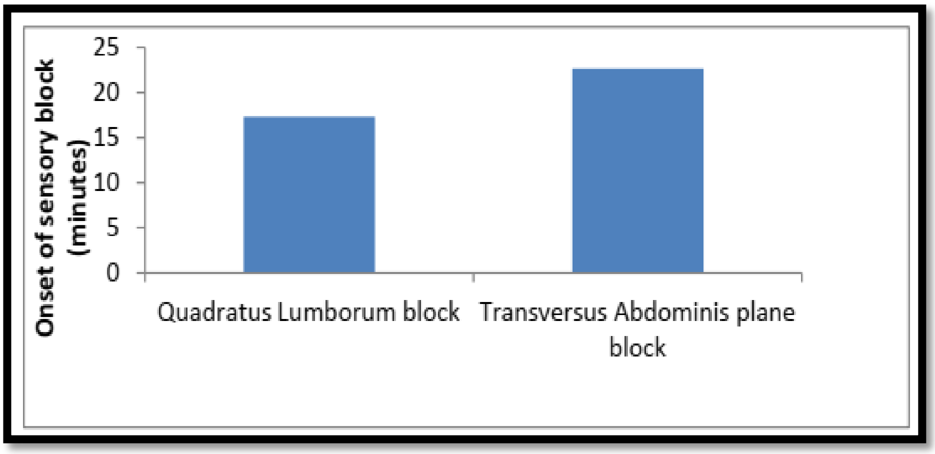

Figure (1): Simple bar chart showing comparison between the studied groups regarding onset of sensory block (minutes).

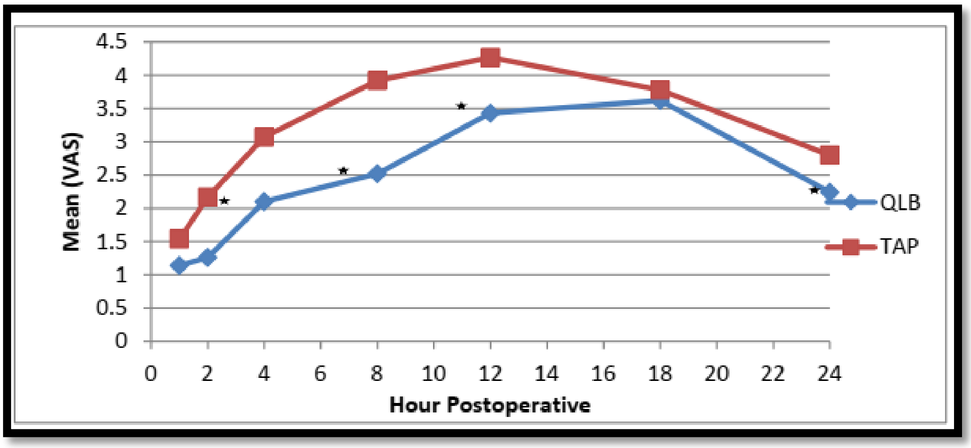

Figure (2): Visual analogue scale (VAS) scores in the studied groups

Table (2): Sensory assessment (onset, level) of blocks, postoperative nalbuphine consumption and time to 1st rescue of analgesia in the studied groups

	QLB (n=15)	TAP (n=15)	T	p
Onset of sensory block (minute):				
▪ Mean ± SD ▪ Range	17.33 ± 4.17 15 – 30	22.67 ± 3.2 20 – 30	-3.93	0.001**
Time to 1st rescue of analgesia(hour):				
▪ Mean ± SD ▪ Range	15.33 ± 3.52 8 – 18	8.73 ± 2.84 3 – 12	5.653	<0.001**
Postop. Nalbuphine consumption (mg)				
▪ Mean ± SD ▪ Range	3.2 ± 0.77 3 – 6	7.53 ± 2 4 – 12	-7.825	0.001**
Sensory Level block (dermatome):	**N (%)**	**N (%)**	**X2**	**p**
▪ T7– T 10	15 (100)	0 (0)	Fisher	<0.001**
▪ T10– T12	15 (100)	15 (100)	0	1
▪ L1 – L2	15 (100)	0 (0)	Fisher	<0.001**

Data are represented as Mean ± SD, number (N) and percentage (%). X2: chi square test.
**p≤0.001 is statistically highly significant

Table (3): Patient' satisfaction in the studied groups

	QLB (n=15)	TAP (n=15)	X^2	p
Patient satisfaction:	**N (%)**	**N (%)**		
▪ Poor	0 (0)	8 (53.3)	23.778	<0.001**
▪ Fair	2 (13.3)	7 (46.7)		
▪ Good	13 (86.7)	0 (0)		

Data are represented as number (N) and percentage (%), X2: chi square test
*p<0.05 is statistically significant

DISCUSSION

Truncal blocks have a place within multimodal analgesia techniques in abdominal surgeries. The present study was designed to compare posterior QL and TAP blocks as postoperative analgesia in lower abdominal surgeries, the obtained results indicated the efficacy of QL block as analgesic modality manifested by significant differences as regards postoperative pain score, duration of postoperative analgesia, opioid consumption and patient's satisfaction compared to TAP block **[14]**.

Although the low thoracic epidural remains the gold standard for postoperative analgesia after abdominal surgery, unfortunately, it is not always possible to provide epidural -based analgesia to some patients. The shift towards short- stay surgery, the introduction of fast-track surgery protocols, the general unavailability of monitored beds, and the incidence of sepsis or coagulopathy have resulted in patients unfit for a central neuraxial mode of analgesia. Thus, there is a need for a reliable alternative to intrathecal and epidural-based analgesia for abdominal surgeries **[18]**.

Shaker et al. reported that TAP block was associated with lower morphine consumption and decreased incidence of hypotension in the early post-operative period compared to Thoracic epidural anesthesia in patients undergoing abdominal oncologic surgeries **[19]**.

The aim of this study was to compare the analgesic efficacy and opioid consumption of the two blocks and not to evaluate the effect of adjuvants, also, to exclude the possibility that some of the analgesic benefit of the QLB derived from a systemic effect of the additives rather than from the block.

The results of current study demonstrated that patients received TAP block were higher in pain score and were the first to ask for postoperative analgesia with shorter duration of postoperative analgesia, so they had higher dose of nalbuphine consumption in the 1st 24h than QLB group. This is compatible with **Öksüz et al.[20]** w compared TAP block and QLB in pediatric patients undergoing lower abdominal surgery. They reported that TAP block group showed significantly higher postoperative VAS scores than QLB group, furthermore, the number of patients who received rescue analgesia in the first 24 h postoperatively was significantly higher in TAP block group with lower parent's satisfaction scores than in QLB.

Along with our study, in another prospective trial by **Blanco et al.[21]** recorded that QLB produces prolonged analgesia and decreases the consumption of opioids and their side effects postoperatively after lower abdominal surgeries than TAP block.

The limitation of the US guided TAP block is of covering incision above and below the umbilicus, so, two levels of block needed to cover it, while the QLB in single shot has the advantage of covering all the dermatome segments from caudally L2 to cranially T4 segments. This was demonstrated by **McDonnell et al.[11]** in the landmark technique, single bolus dose covering the incision above and below the umbilicus. In the present study, QLB covered the sensory level of T7-L1, while TAP block covered T10-T12 with duration of postoperative analgesia 15h in QLB versus 8h in TAP block

El sharkawy et al. [22] found that injection of local anesthesia at level of L3-4 posterior to quadratus lumborum and between it and transversalis fascia may spread toT10 through spreading along the thoracic paravertebral space. Therefore, the spread involves somatic nerves and thoracic sympathetic trunk and this explain why QLB gives both somatic and visceral analgesia over TAP block, which gives only somatic analgesia.

Similarly, a case report was published comparing between anterior QL block and TAP block in a patient undergoing subtotal colectomy through a midline incision extending from above the umbilicus to pubic symphysis. This patient reported a difference in level of sensory blockade where there was sensory block distribution of the corresponding dermatomes for about 48 hours in the side of QL block; however, TAP block on the contralateral side did not cover the whole length of the incision. It showed that QL block can create sensory blockade and analgesia along mid and lower thoracic dermatomes and can prolong the analgesia for appropriately selected abdominal surgeries **[23]**.

In addition, the difference in the level of sensory block may be due to volume used. There are no guidelines on the volume of drug to be injected. In an US guided contrast study by **Barrington et al. [24]** on cadavers demonstrated that multiple injections could involve more nerves and amount to be used up to 30-40 ml to obtain spread to as high as T4 and expected to last longer. But **carney's et al. [25]** study in landmark guided TAP block found that 0.6 ml/kg doses had inconsistent distribution of sensory block, toxicity is a concern to use such high volumes. The drug dosage description is beyond the scope of this study.

Takeshi et al. [26] studied 11 patients scheduled for laparoscopic ovarian surgery under general anesthesia. The patients received bilateral single-injection QLBs (20 mL of 0.375% ropivacaine per side). The results were retrospectively compared with the results of their previous study on lateral TAP block and found that the effect of a single injection QL block with 20 mL of ropivacaine could spread to T7 - T12 and could last for longer duration than TAP block when applied to laparoscopic ovarian surgery.

In the present study, the onset of sensory block was delayed in TAP block in comparison with QLB. In the fascial plane block, the onset and level of block was inconsistent and in practice, sensory block in volunteers and clinical setting may be different as sensory spread did not reflect same as in our cases but we may explain the difference in onset of sensory block by the anatomical, histological characteristic of thoracolumbar fascia (TLF).These high threshold and low threshold mechanoreceptors and pain receptors are sensitive to the local anesthetics and play a role in the development of both acute and chronic pain. The QLB analgesia could be, at least partially explained by local anesthesia blocking of these receptors **[10].**

The current study was in harmony with other studies **[27-29]** compared QLB and TAP block in patients undergoing total abdominal hysterectomy, in laparoscopic bariatric surgery and laparoscopic gynecologic surgery, they reported that patients with TAP block group were significantly higher in postoperative VAS than QLB group ($p<0.05$). Patient satisfaction scores were lower in TAP group than in QLB.

Murouchi et al.[29] investigated the relationship between the local anesthetics blood level and the efficacy of the QLB type 2 and TAP block in adults. They found that in TAP block, the local anesthetic blood levels were higher than QLB type 2, but the analgesic effect was better with QLB type 2 than with TAP block. This result was explained by the following: during QLB, some of the administered drug is thought to move from the intramuscular space into the paravertebral space which is filled with adipose tissue and the local tissue perfusion of the adipose tissue is low which results in low absorption speed of a local anesthetic into the blood **[10, 29]**.

CONCLUSION:

The QL block provides better pain management with less opioid consumption, prolonged duration of analgesia than the TAP block after lower abdominal surgery. We belief that if US guided QLB is performed by experienced hands; it is safe and effective technique for postoperative analgesia.

No Conflict of Interest.

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