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Analgesic Effects of Ultrasound-Guided Transmuscular Quadratus Lumborum Block (QLBTM) Using Different Volumes and Concentrations of Local Analgesics after Unilateral Inguinal Hernia Repair

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Abstract

Background: After abdominal surgery, the low thoracic epidural continues to be the "gold standard" for postoperative analgesia. Unfortunately, not all patient populations can or should receive analgesia based on an epidural.

Patients who cannot get a central neuro-axial method of analgesia are a result of the trend toward short-stay surgery, the adoption of fast track surgical procedures, the general lack of monitored beds, the occurrence of infection or a bleeding tendency, and other factors. Thus, effective substitutes for intrathecal and epidural-based analgesia during abdominal surgery are required.

Aim of Study: To determine if the USG-QLBTM, an ultrasound-guided transmuscular quadratus lumborum block, reduces postoperative discomfort in patients who have had unilateral inguinal hernia surgery, two different concentrations/volumes of local bupivacaine as an anaesthetic were compared.

Patients and Methods: Patients who have had unilateral inguinal hernia repair were recruited in this randomised research. Two groups of patients were assigned at random and given different doses of anaesthesia: Group A got 30 ml LA (75mg of bupivacaine plus 15ml of saline), whereas Group B were given 40ml LA (50mg of bupivacaine plus 30ml of saline). A visual analogue score was used to quantify postoperative pain at intervals of 10 minutes, as well as 30 minutes, also 60 minutes, further 12 hours, 24 hours, and 48 hours. Surgical complications were also recorded.

Results: 32 people in total participated in the study. There were no statistically significant differences in hemodynamic parameters, postoperative opioid use, or demographic information between the two groups. Patients in group B, who received bigger volume but lower concentration of local anaesthetic solution compared to group A, reported higher patient satisfaction scores and postoperative analgesia durations.

Conclusion: Following unilateral inguinal hernia surgery, ultrasound-guided QLBTM can be a component of a well-balanced postoperative analgesia. Using high volume and low concentration of local anesthetic (bupivacaine) can prolong postoperative analgesia duration. To sustain postoperative pain reduction, the ideal local anaesthetic concentration and volume must be determined through more study.

Key Words: *Transmuscular quadratus lumborum block guided by ultrasound – Postoperative analgesia.*

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Introduction

ONE of the surgical operations that is carried out the most commonly worldwide is the correction of inguinal hernias. Around the world, more than 20 million inguinal hernia operations are carried out annually [1]. Postop. problems are more likely to occur when postoperative pain is not under control. Regional blocks can help with postoperative pain management and can lessen problems that could occur when utilizing a single modality of analgesia. When opioid analgesia is overused, for example, the likelihood of side effects due to opioid overuse such pruritus, respiratory depression as well as nausea, and vomiting increases [2].

Quadratus Lumborum (QL) ultrasound-guided block as a variant of the conventional landmark-based (TAP) transversus abdominis plane block. The primary benefit of the QL block is the extension of local anaesthesia beyond the TAP plane, into the thoracic paravertebral region, and anaesthesia of both the visceral and sensorimotor abdominal walls [3]. In the most recent research, the QL block is the subject of four separate methodologies, with writers using different nomenclatures to characterise each block. The Blanco-described QL1 block is deep to the aponeurosis of transversus abdominis. QL muscle is posterior to the injection plane for a QL2 block [4]. The transmuscular QL block, which involves injecting local anaesthetic anteriorlyin the middle of the psoas major (PM) and the QL muscle, is similar to the QL3 block that Borglum described. According to Borglum's results,

the injection into this fascial plane behind the transversalis fascia reliably insured the local anesthetic's diffusion into the thoracic paravertebral region [5]. MRI analyses also showed that, unlike with the initial QL block, there was no redundant dissemination of the local anaesthetic. Finally, Direct local anaesthesia is injected into the quadratus lumborum muscle for the intramuscular QL4 block. The anterior technique, which was described for the original QL block, has been recommended as a simple and perhaps safer substitute for this transmuscular quadratus lumborum block [5,6].

Extending the time of local anaesthetic effect is typically recommended as it prolongs surgical anaesthesia and pain reduction. Dexamethasone, clonidine, opioids like morphine and fentanyl, soda bicarbonate, and vasoconstrictors are only a few examples of often used adjuvants to local anaesthetics. Dexamethasone inhibits the release of inflammatory mediators, ectopic neuronal activity, and nociceptive C-fiber release via potassium channels [7]. Adults who receive local anaesthetics along with steroids enjoy much quicker reaction times and longer-lasting analgesia [8,9].

Aim of Study: To determine if the USG-QLBTM, an ultrasound-guided transmuscular quadratus lumborum block, reduces postoperative discomfort in patients who have had unilateral inguinal hernia surgery, two different concentrations / volumes of local bupivacaine as an anaesthetic were compared.

Patients and Methods

This study was done at General Surgery Operating Theatre, Kasr Al-Aini Hospital, Cairo University during 2018.

32 patients from the ages of 18 and 65 who were scheduled for unilateral inguinal hernia surgery and had ASA I or II were included in the study after receiving approval from the departmental research ethical committee. Patients were divided randomly into one of two groups using the disguised closed envelope method:

- Group A (n=16): Received QLB with a 30ml (75mg bupivacaine + 15ml saline solution).
- Group B (n=16): Received QLB with a 40ml (50mg bupivacaine + 30ml saline solution).

Inclusion criteria:

- Patients having elective unilateral inguinal hernia surgery who are in physical status I or II according to the American Society of Anesthesiologists (ASA).
- Age group: 18-65 years.
- Both sexes.
- Body mass index below 35.
- Operation time less than 2 hours.
- Capacity to rate pain on a numeric rating scale (NRS) of 0 to 10.

Exclusion criteria:

- Patient refusal.
- ASA III and IV.
- Ages <18 and >65.
- Body mass index ›_35.
- Patients with known difficulty in assessing their level of pain.
- Local anaesthetic contraindicated cases of coagulopathy (platelet count less than 100,000 per microliter), prothrombin time greater than 13.5 seconds, patients using therapeutic anticoagulants, and the presence of a hematoma or skin infection close to the puncture site.
- Known Allergy to used drugs.
- Complicated hernia (as obstructed or recurrent).

Patients were shown how to express their level of discomfort using a VAS of 10, or Visual Analogue Score. The patient's informed written consent was obtained after a discussion with him about the advantages of the block and any potential drawbacks that might arise and how they will be handled. The essential laboratory examinations were a complete blood count (CBC), prothrombin time and concentration (PT&PC), partial thromboplastin time (PTT), bleeding time (BT), and clotting time (CT).

Operating room preparation & equipment:

To produce general anaesthesia, fentanyl (2mcg/kg), propofol (1.5-2.5mg/kg), and atracurium besylate (0.5mg/kg) were utilized. In order to maintain normocapnia, regulated breathing was altered after the insertion of an endotracheal tube. Pulse oximetry (SpO_2) is measured with adult finger SpO_2 sensor with non-invasive blood pressure monitoring (NIBP), also a GE-Datex Ohmeda 5 lead ECG cable (GE-Datex Ohmeda NIBP cuff, adult double tube with bag) was used.

After the procedure, the research anesthesiologist used a low frequency (2-6 MHz) curvilinear probe and a 100-150mm short-bevel echogenic needle to conduct QLBTM under the supervision of an ACUSON Freestyle digital ultrasonic diagnostic imaging system (Siemens Medical Solutions, Inc., USA).

The anesthesiologist was facing the patient's back, and the patients were positioned in the lateral position with the side to be anaesthetized slanted upward. The abdominal flank, which is cranial to the iliac crest, was chosen as the location for the ultrasonography probe.

The ultrasonography probe was placed in the abdominal flank, which is cranial to the iliac crest.

The transducer was then moved dorsally while continuing in the transverse mode to identify the QL muscle and its connection to the lateral border of the transverse process of the L4 vertebral body. A pattern of a shamrock with three leaves was visible when the erector spinae muscle (ESM) was posterior, the psoas major muscle (PM) was anterior, and the QL muscle was adherent to the top of the transverse process. After being implanted parallel to the lateral edge of the transducer, the needle's tip was advanced into the QL muscle until it penetrated its ventral appropriate fascia.

Postoperative:

All patients received 1g of acetaminophen intravenously every 6 hours for the first 24 hours following surgery, followed by 1g of acetaminophen oral every 6 hours for two days. When the patient's pain score was more than 4, rescue analgesia in the form of intravenous nalbuphine (in 5mg increments) was administered. When the patient required more than two 5mg doses of nalbuphine in the first hour following surgery, the block was deemed to have failed.

When vomiting and/or nausea were noted, ondansetron 4mg IV was given.

Following surgery, all patients were monitored for 48 hours. Patients, anesthesiologists, and observers who recorded the postoperative data were not informed about the group assignment.

Measurements tool:

- The patient used a visual analogue scale to quantify pain during rest, coughing, and movements (VAS), length of analgesia, mg of nalbuphine consumed over the first 24 hours, hemodynamics and the degree of sensory obstruction in the immediately following surgery (heart rate and blood pressure).
- The likelihood of side effects like nauseousness or vomiting, urine retention, local anaesthetic toxicity, intestinal injury, renal injury, and hematoma formation.
- The block failure rate.

Sample size:

Sample size was calculated using G power program, taking in consideration study power (0.8), a p-value of 0.05 to be statistically significant, equal sample size in the two groups 1: 1, assessed mean ± SD of duration of analgesia in both groups (assuming mean 7.1 ±4.6 and 13.2 ±7.6). 55 A minimum number of 14 patients were required for each group. This number was increased by 10% (to 16 patients) to compensate for possible drop-outs.

Statistical analysis:

The statistical programme SPSS version 25 was used to code and enter the data. Frequencies (the number of occurrences) and relative frequencies (percentages) were used for categorical variables, while the mean, standard deviation, median, minimum, and maximum were used for quantitative variables. For quantitative variables with regularly distributed distributions, unpaired *t*-tests were used to compare groups, whereas non-parametric Mann-Whitney tests were used for those with non-normally distributed distributions (Chan, 2003a) [7]. To compare categorical data, the Chi square (χ^2) test was employed. The precise test was used in its place when the projected frequency was less than 5 (Chan, 2003b) [8]. p-values <0.05 were regarded as significant in statistics.

Results

Patients' characteristics were comparable in both groups as shown in (Table 1).

Table (1): Patients demographics.

Variable	Group A n=16	Group B n=16	p-values
Age (years)	31.81 ± 10.83	33.00±7.59	0.722
Gender (male/female)	16/0	16/0	

N=Number.
A=30 ml (75 mg bupivacaine + 15ml saline solution).
B=40ml (50mg bupivacaine + 30ml saline solution).
- Data are reported as mean SD. It was regarded significant when p 0.05.

Both groups' block duration, total opioid use during the first 24 hours, and success rate were compared (Table 1). Regarding the success rate of opioid consumption (nalbuphine), there were no appreciable variations between the two groups. However, the duration of the block was noticeably greater in group (B) (15.443.90) than in group (A) (12.882.90) with (p 0.05).

Table (2): QLBTM duration (the period of time starting after local anaesthetic delivery and ending when an IV nalbuphine rescue analgesic is first required (hrs) & success rate. Numbers and (%) & post-operative opioid consumption in first 24 hrs (mg) recorded in patients undergoing unilateral inguinal hernia repair for which the local anesthetic bupivacaine was administered via ultrasound-guided QLBTM

Variable	Group A n=16	Group B n=16	*p*-values
Duration of block (hrs)	12.88±2.90	15.44±3.90	0.044*
Block success rate N (%)	16 (100%)	16 (100%)	
Total opioid consumption (mg)	10.00±4.08	7.50±2.58	0.102

- Data as mean ± SD, N: (Number), A=30ml (75mg bupivacaine + 15ml saline solution), B=40ml (50mg bupivacaine + 30ml saline solution), *Denotes significance $p<0.05$.

Over the first 48 hours following surgery, the Visual Analogue Score (VAS) assigned to quantify pain in both groups (Fig. 1). In group (B), the VAS score was considerably lower 10 minutes postoperatively.

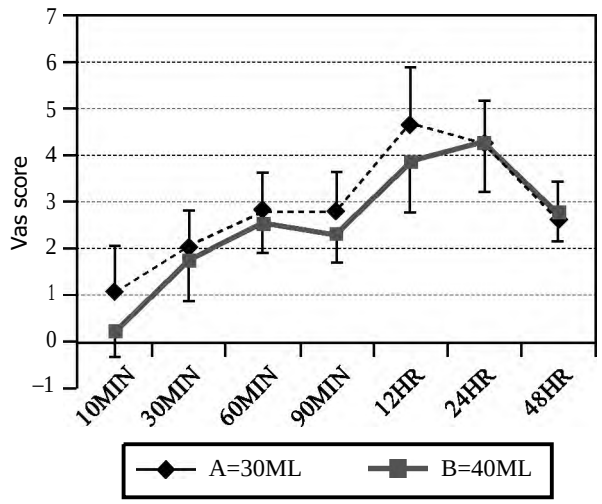

Fig. (1): Visual analogue score (VAS) measured in individuals having a unilateral inguinal hernia repaired using ultrasound-guided QLBTM, A=30ml (75mg bupivacaine + 15ml saline solution), B=40ml (50mg bupivacaine + 30ml saline solution).

The degree of sensory block (Fig. 2) and patient satisfaction level were two analgesic characteristics of both groups that were evaluated (Table 3). There were no significant variations in patient satisfaction levels between the two groups, however there was a considerably greater degree of sensory block in group (A) compared to group (B), with a p-value of 0.001. Of the 16 patients in group B, 8 (or 50%) indicated they were "pleased", whereas 8 indicated they were "not very satisfied". Out of 16 patients in the A group, four (or 25%) said they were satisfied, nine (or 56%), not very comfortable, and three (19%), upset.

Table (3): Score of patient satisfaction in patients undergoing unilateral inguinal hernia surgery with bupivacaine delivered using an ultrasound-guided QLBTM.

	Group (A)		Group (B)		*p*-values
	Count	%	Count	%	
Satisfaction:					
Very satisfied	0	0.0	0	0.0	0.149
Satisfied	4	25.0	8	50.0	
Not very satisfied	9	56.2	8	50.0	
Dissatisfied	3	18.8	0	0.0	

- A=30ml (75 mg bupivacaine + 15ml saline solution), B=40ml (50mg bupivacaine + 30ml saline solution).

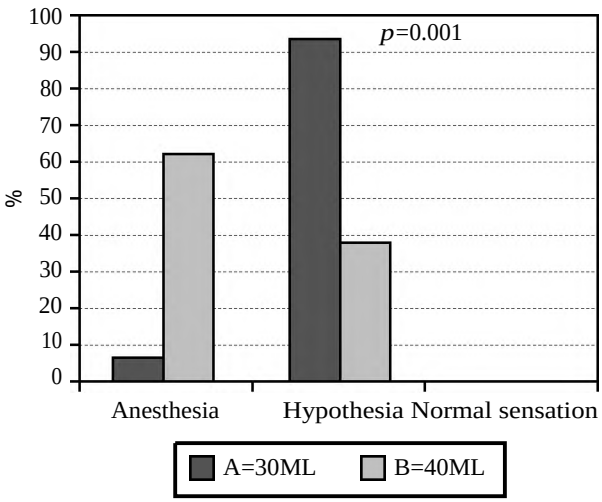

Fig. (2): Degree of sensory block (%) in patients having a unilateral inguinal hernia repaired using an ultrasound-guided QLBTM, with A=30ml (75mg bupivacaine + 15ml saline solution) and B=40ml (50mg bupivacaine + 30ml saline solution).

In the first 24 hours following surgery, two patients in each group experienced nausea and vomiting that was unrelated to any other symptoms. There were no records of further adverse events such urine retention, local anaesthetic toxicity, intestinal injury, kidney injury, hematoma development, or intravascular injection.

Discussion

In order to determine if there would be a difference in the amount of postoperative pain relief experienced by our study candidates having a unilateral inguinal hernia repaired, this study ex-

amined two different bupivacaine concentrations and two different volumes of solution utilized for ultrasound-guided QLBTM. A volume of 40ml LA (50mg bupivacaine plus 30ml saline solution) was given to group B, while group A got a dose of 30ml LA (75mg bupivacaine plus 15ml saline solution). In comparison to group A (15.443.90), the duration of postoperative analgesia was considerably longer in group B (12.882.90) (p=0.044). Patient satisfaction was also higher in group B than in group A, however this difference was not statistically significant. On the other hand, there were no appreciable variations in either group's opioid intake or hemodynamic parameters, although the VAS at 1 0min after surgery and the percentage of sensory block were substantially better in group A than in group B (p 0.05). For both abdominal and retroperitoneal surgery, there have been reports of effective post-operative pain control using the QLB.

Varying the amount and strength of local anaesthetic used for an ultrasound-guided TAP block following laparoscopic cholecystectomy, researchers found that the need for postoperative analgesics, postoperative VAS scores, and intraoperative remifentanil consumption were all significantly lower in the group receiving high volume and low concentration of local anaesthetic than in the group receiving low volume and high concentration **[9]**.

In a different research, Sauter AP et al., estimated the effective dose of ropivacaine 0.5% for a QLBTM and discovered that in 50% of patients, 20.4ml of this medication resulted in a successful block. 95% of patients would respond well to a volume of 36.0ml **[10]**.

The transmuscular QLB is easier, faster, and better at visualising the lumbar plexus block than other lumbar plexus block procedures, according to a recent clinical research. This method lessens some of the problems with the ultrasound-guided lumbar plexus block method but does not completely solve them **[11]**.

Sá M, et al., reported two cases in which they underwent right hemicolectomy and total gastrectomy under general anaesthesia and a Quadratus Lumborum type II block, but within 30 to 40 minutes, they noticed serious hypotension and tachycardia. This was explained by the block-induced sympatholysis caused by the local anesthetic's cephalad dispersion into the paravertebral and epidural space **[12]**. In this study, we documented 4 cases of postoperative nausea and vomiting in the first 24 hours after surgery in both groups. Since these individuals lacked any other symptoms or signs, we cannot conclude that these findings are related to this block's problems.

Limitations:

In our investigation, QLBTM was used to treat unilateral inguinal hernias and demonstrated its efficacy in postoperative analgesia. To demonstrate its significance in clinical practise, more cases of upper abdominal and midline incisions are required.

Conclusion:

An effective postoperative analgesic regimen may include ultrasound-guided QLBTM after unilateral inguinal hernia surgery. Increasing the concentration of local anesthesia is not as effective in providing long duration analgesia and patient postoperative satisfaction as lowering the concentration in bigger volumes.

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تأثير التخدير الموضعى للعضلة المربعة القطنية بإستخدام السونار بكميات وتركيزات مختلفة للمخدر الموضعى بعد إجراء عملية الفتق الإربى فى جانب واحد

إن جزء كبير من الألم الذى يحدث بعد إجراء عملية جراحية بالبطن ينتج عن شق جدار البطن وتوفير تسكين جيداً لهذا الألم قد يمثل تحدياً كبيراً. أحد الأساليب الموصوفة حديثاً لتوفير التسكين الجذعى بعد العمليات الجراحية بالبطن هو تخدير العضلة القطنية المربعة.

أحدث طرق تخدير العضلة القطنية المربعة الموجة بالموجات فوق الصوتية هو الحقن من خلال العضلة القطنية المربعة حيث يتم حقن المخدر الوضعى بين العضلة القطنية المربعة والعضلة القطنية الكبيرة.

الدراسة التى قمنا بها هدفت إلى مقارنة مدى تسكين الألم الناتج عن حقن كميات وتركيزات مختلفة من المخدر الموضعى من خلال العضلة المربعة القطنية باستخدام السونار بعد إجراء عملية الفتق الإربى فى جانب واحد.