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Analgesic Efficacy of Ultrasound Guided Quadratus Lumborum Block and FasciaI liaca Compartment Block for Patient Schedualed for Dynamic Hip Screw Surgery

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Abstract
Postoperativepainisan important problem after total hiparthroplasty.Several modalities are usually usedforpostoperative analgesia in these patients including neuraxial analgesia, intravenous analgesia, andperipheralnerveblocks.Peripheral nerveblockshavetheadvantageofpotentanalgesia, lower motor impairment, and minimal systemic complications.The commonlyperformed peripheral nerveblocks for hip surgeriesinclude suprainguinalfasciailiacablock(FIB)and lumbar plexusblock.Quadratus lumborum (QL) block is a newlydeveloped blockwithgoodperformancein lower abdominal and hip surgery.Seventy patients aged from 8-70 years old, with ASA physical status I-III and scheduled for dynamic hip screw surgery under subarachnoid block (SAB) hip had been included in the study. Patients were randomly allocated using concealed closed envelope method into one of two groups:FICB Group (n=35): this group received suprainguinal fascia iliaca block, the end point of the injection is deep to the fascia iliaca and above the iliacus muscle inthe lateral part of the iliacus muscle. After negative aspiration, 30 mL of 0.25 % of bupivacaine will be injected under the fascial plane incrementally, aspirating every 5 ml.QLB Group (n=35): this group received ultrasound-guided transmuscular quadratus lumborum block; (Anterior QLB or QLB III), the needle tip will be placed between the psoas major muscle and the quadratus lumborum muscle.Afternegativeaspiration,30 mL of0.25% ofbupivacaine will be injected into the fascial plane incrementally, aspirating every 5 ml.Both FIB and transmuscular QLB were effective at providing early postoperative analgesia after hip arthroplasty surgeries with comparable static and dynamic VAS in the first 24 hours postoperative and comparable duration of analgesia.Both singleshot blocks,namelysuprainguinalFIB andtransmuscularQLB,provided effective postoperative analgesia afterTHA.FIBshowedslightlylower24-hour morphine consumption.

Keywords
hiparthroplasty ;fasciailiacablock; Quadratus lumborum block ; effectivepostoperative analgesia.

.Introduction

The quadratuslumborum (QL)blockis a regional anesthesia technique originally described in 2007 to provide analgesia for abdominal surgery. Several years later it was found, that this block could also provide analgesia to the hip, and various reports have demonstrated efficacy in the setting of femoral neck fracture and hip arthroplasty The anatomic target of the QL block, as originally described by Blanco and McDonnell, is at the anterolateral aspect of the QL muscle in the space between the QL fascia and the posterior endoabdominal fascia[2]. Local anesthetic injected in this area is believed to spread medially and as far cephalad as T6 and as caudal as L3 to block radicular roots as they exit the intervertebral foramina. An alternative hypothesis is that blockade occurs more laterally to the spine in this posterior fascial plane of injection effecting blockade of radicular nerves to the abdomen and nerves of the lumbar plexus once they have exited the psoas muscle[3] **.**In patients undergoing hip surgery peripheral nerve blockade has been shown to improve pain scores and reduce morphine consumption. The fascia iliaca Compartment block (FICB) can provide sensory blockade of the main nerves which supply pain to the hip[4].Recently, fascia iliaca compartmewntal block (FICB) has been proposed to avoid the

complications by anesthetizing the femoral nerve remotely from major neurovascular structures, and achieve adequate analgesia[5] .Dynamic hip screw (DHS) surgery for fracture femure are common surgical procedures for treatment of the degenerativedisordersand traumatic diseases.However, a majority of patients often experience moderate to severe postoperative pain after dynamic hip screw surgery[6].Postoperative pain control has a significant impact on earlier ambulation, initiationof physiotherapy, and better recovery. In additioneffective pain control would lower the length of hospital stay and the risk of thrombotic events which improves patients' satisfaction. Multiple analgesic strategies have been proposed including intravenous opioid, epidural analgesia, and peripheral nerve block. Each of them has its limitations[7].Patients undergoing fracture femur can be exposed to opioids for long periods of time and may be at high risk to experiencing opioid related harm, particularly chronic users of opioids preoperatively chronically use opioids postoperatively as well[8] .Systemic use of opioids is associated with patient dissatisfaction, such as nausea, vomiting, constipation, urinary retention, opioid use has been associated with worse clinical outcomes for multiple procedures in orthopaedic surgery, and increased early postoperative opioid use is associated with a longer duration of postoperative opioid use.[9]

2.Materials iand iMethods

Patients

The study was performed at Benha University Surgical Hospital, Egypt .The study was approved by Institutional Ethical committee of Benha University Hospitals .Written informed consent was obtained from each patient during the preoperative visit. We enrolled patients older than 8 years old with an American Society of Anesthesiologists physical status classification score of I to IV, scheduled for elective Elective dynamic hip screw surgery and body mass index less than 40 kg/m2. The exclusion criteria were patient refusal, unable to give consent, smaller than 8 years old ,infection at site of blocks ,coagulopathy and body mass index greater than 40 kg/m2. During pre-anesthetic evaluation of the patients, demographic variables were collected from each patient and participantsreceived education about the visual analogue scale VAS painscore (0–00 mm) (where 0=no pain and 00=worst comprehendible pain) and the details of the nerve block procedures.

Anesthesia

Patients were taken to the operating room and were monitored by ASA standard monitors : ECG, NIAB , pulse oximetry:

Technique of suprainguinal fascia iliaca block (FIB):

In the supine position,the high-frequencylinear transducerof General Electric; GE, "LOGIQ P5" ultrasound machinewith 6 -3 MHz was placed in the sagittal planetoidentifythe anterior superior iliac spine,andthe transducer was moved medially toidentify the fascia iliaca, iliopsoas, sartorius, and internal oblique muscles. Using an in-plane approach, a 00-mm, 2-G block needle tip was positioned deep in the fascia iliaca and above the iliacus muscle. After negative aspiration, 30 mL of 0.25% bupivacaine was injectedincrementally under the fascial plane, aspirating every 5 mL

Technique of transmuscular quadratus lumborum block (QLB3, anterior QLB):

The patient was in the lateral position. A low frequency convex probe was vertically attached above the iliac crest and a 00 mm, 2G non-stimulating block needle was inserted in plane from the posterior edge of

the convex probe through the quadratus lumborum in an anteromedial direction. The needle tip was placed between the psoas major muscle and the quadratus lumborum muscle. After negative aspiration, 30 mL of 0.25 % of bupivacaine was injected into the fascial plane incrementally, aspirating every 5 ml.

Subarachnoid block (SAB):

Patients received SAB after 5 minutes of block, using 25g spinal needle in the lateral position. Fifteen milligrams of hyperbaric bupivacaine was administered at L3-L4 or at L4-L5 interspace in addition to 25 mcg fentanyl with rapid crystalloid co-load. Spinal anesthesia was considered successful when a bilateral block to T2 was achieved; the block was assessed 0 -minutes after the intrathecal injection by loss of cold (cold ice) and pin prick (a 23-gauge needle) sensations. If spinal anesthesia failed, general anesthesia was administered and the patient was excluded from this study.

Postoperative care

Patients were transferredtopostanestheticcare unitfor2hoursafteranesthesia emergence . The patients will be discharged from the PACU after fulfilling the discharge criteria based on the modified Aldrete score > 9.Patients received analgesics according to local institutional protocol as the following: (paracetamol gmIVinfusion/8hrs, ketorolac 30 mg IM/2 hrs) as 2 components of multimodalanesthesiaregimen for postoperative pain control.\Apostoperativerescueanalgesia with intravenous morphineper atitration protocol (3 mg morphine sulfate IV as a bolus dose that could be repeated every 5 minutes with a maximum dose of 5mg per 4 hours or 45mg per 24 hours) was employed if visual analog pain scale (VAS) > 4.

Outcome Measures:

Theprimary outcome measure at the commencement of the study was total postoperative morphine consumption in the first 24 hours.Secondary outcome measures VAS scores at five different time-points (0 "on arrival", 6th hours, 2th hours, 8th hours and 24th hours)

Statistical ianalysis:

Thesamplesizecalculatedusing G*Power© softwareversion3..7(Instituteof experimental psychology,HeinrichHeineUniversity,Dus seldorf , Germany). Depending on previous research results with two sided (two tails) type I error 0.05 and power of 80%, effect size (d) factor 0.8, each group should involve ≥ 35 subject with dropout rate 0%.Results of the two groups will be compared using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version.Parametric normally distributed numerical data will be presented as (mean ± SD) and differences between groups will be compared using Student’s t-tests, non-parametric data will be presented as (median and interquartile range) and differences between groups will be compared using Mann-Whitney U-test, categorical data will be presented as number and percentage and intergroup comparison will be performed using Chi-Square test. We will statistically consider the results as significant if the p value is less than 0.05 and level of confidence interval is 95%.

3.Results

This study was conducted on 70 patients scheduled for dynamic hip screw surgery at Benha University Hospital. Patients were divided into two groups: **Group A:** Thirty-five patients received FICB plus conventional opioid analgesics.**Group B:**

Thirty-five patients received QL plus conventional opioid analgesics.There were no significant differences between both groups as regard age (P-value = 0.359), weight (P-value = 0.36), BMI (P-value = 0.745), and height (P-value = 0.529)Tabel . .

Table () General characteristic inboth group		**Group A (n = 35)**	**Group B (n = 35)**	**P-value**
Age (years)	Mean ±SD	52 ±8	50 ±7	0.359
Weight (kg)	Mean ±SD	8 ±6	83 ±6	0.36
BMI	Mean ±SD	25.7 ±.6	25.9 ±3	0.745
Height (cm)	Mean ±SD	78 ±6	79 ±5	0.529

❖ **Duration of surgery and morphine consumption(Tabel 2)**

There was no significant difference between both groups as regards duration of surgery (P-value = 0.32).Morphine
consumption was significantly higher in group B (25) compared to group A (9); P-value was <0.001.

Tabel 2: Duration of surgery and morphine consumption		**Group A (n = 35)**	**Group B (n = 35)**	**P-value**
Duration of surgery (min)	Mean ±SD	34 ±7	30 ±6	0.320
Morphine Consumption	Mean ±SD	9 ±6	25 ±6	<0.00

❖ **VASR in both groups(Tabel 3)**

At 0 time, VASR showed a significant difference between groups with a higher range in group B (0 – 4) than group A (0 – 3); P-value was 0.007. At 6 hours, median VASR was significantly higher in group B (4) than group A (3); P-value was 0.001. At 2 hours, median VASR was significantly higher in group B (3) than group A (2); P-value was <0.001. At 8 hours, median VASR was significantly higher in group B (3) than group A (2); P-value was <0.001. At 24 hours, median VASR was significantly higher in group B (4) than group A (2); P-value was <0.001

VASR in both groups(Tabel 3)		**Group A (n = 35)**	**Group B (n = 35)**	**P-value**
At 0 time	Median (range)	2 (0 - 3)	2 (0 - 4)	0.007
At 6 hours	Median (range)	3 (- 4)	4 (2 - 5)	0.00
At 2 hours	Median (range)	2 (- 5)	3 (- 5)	<0.00
At 8 hours	Median (range)	2 (- 4)	3 (2 - 5)	<0.00
At24 hours	Median (range)	2 (- 4)	4 (2 - 5)	<0.00

4.Discussion

Patients after total hip arthroplasty (THA) often suffered moderate or even severe pain,seriously affecting the early postoperative recovery. This study aimed to investigate the analgesic efficacy of ultrasound-guided transmuscular quadratus lumborum block (T-QLB) vs fascia iliaca compartment block (FICB) for elderlypatients undergoing THA.

Perioperative and early postoperative pain remains one of the most frequently cited challenges in hip arthroplasty,Adequate pain management following surgery is linked with increased patient satisfaction, earlier mobilization, decreased pain medication requirements,and overall improved outcomes[1].Regional anesthesia has beencommonly used for procedures around the hip, most frequently in hip fracture surgery and arthroplasty. In an effort to determine the most effective method of analgesia, studies have begun to investigate the effectiveness of the QL block for these procedures. A recent comparative study showed that hospital length of stay following total hip arthroplasty was found to be significantly decreased in patients receiving QL block compared with no block**.**

Hip innervation is complex, with contributions from many nerve components.

Birnbaum et al. reported that the nerves involved in THA's incision pain mainly including the subcostal nerve, iliohypogastric nerve, ilioinguinal nerve, femoral nerve, lateral femoral cutaneous nerve, obturator nerve, and sciatic nerve block[2]..In this study we foundthat both FIB and transmuscular QLB were effective at providing early postoperative analgesia after hip arthroplasty surgeries . FIB showed less opioid consumption in the first 24 hours postoperatively.Additionally, the latest study indicated that the femoral nerve, dominating the hip joint, branches at a higher position. And the location of the lateral femoral cutaneous nerve under the inguinal ligament has signicant anatomical variability [3]**.**Therefore, performing single-shot peripheral nerve blocks, such as lumbar plexus, sacral plexus, fascia iliaca block, and quadratus lumborum block, is challenging to meet the patients' requirements. On the other hand, the lumbar plexus block has a high potential of hematoma and nerve injury because the needle tip should be advanced deeply and close to nerves[4]..

Compared with the traditional peripheral nerve blocks (such as the lumbar plexus block), the fascial plane block technique has higher safety, produces block analgesic effects mainly by local anesthetic along the fascia plane spreading to the corresponding nerves (nerve roots) [5]**.**The FIB can be considered an anterior and safer approach of lumbar plexus block. It results in block of the femoral, obturator, and lateral femoral cutaneous nerves (3-in- block). The suprainguinal approach for the FIB increase the likelihood of blocking the three nerves with a single injection of local anesthetic[2] **.**QLB encompasses 4 distinct blocks according to the position of the needle tip in relation to the QL muscle: lateral, posterior, anterior or intramuscular. In case of anterior or transmuscular QLB, the needle tip is in the plane between the QL and psoas muscle; it can be performed at many levels as L2, L4, and subcostal [6].

Transmuscular QLB is a relatively new block. The precise mechanism by which the QLB provides analgesia to the hip joint is not fully understood. Several mechanisms can explain the analgesic effect of QLB in our patients. These include () medial spread of the local anesthetic to the thoracic and the lumbar paravertebral spaces; (2) lateral spread to the branches of the lumbar plexus; and (3) the potential spread to the lumbar plexus via the fascial layer between the anterior two-thirds and the posterior one-third of the psoas muscle[7]**..** The true mechanism of analgesia provided by anterior QLB has not yet been fully clarified. Most of the cadaveric studies of the transmuscular QLB showed direct dye spread to the roots and branches of the lumbar plexus[8]**.** Despite these few reports, most sources describe QL blocks as a motor-sparing method of regional analgesia, and there was no documented lower extremity weakness in any patients in our study. It is important to work toward identifying the most effective means of analgesia while minimizing what could be catastrophic complications[9]**.** Cutaneous sensation of most of hip surgery incisions provided by the lateral cutaneous nerve of the thigh (L-3) which is effectively blocked in

suprainguinal FICB. Whilst, the sensory blockade of QLB frequently included T2–L2dermatomes; L3 was included to a lesser extent; while L4 was usually spared [20]**.** This might explain the lesser postoperative morphine requirement in FIB group than in QLB group.Postoperatively, the time to first analgesic request was comparable in both groups, however patients in FIB group required less morphine than patients in QLB group. Quadriceps motor power is more preserved in QLB group than in FIB group. The number of patients who experienced pain during positioning for spinal anesthesia as well as the hemodynamic variables after 5 minutes of both blocks which were lower in QLB group compared to FIB group due to the relative earlier onset of action.Regarding postoperative motor function, most clinical reports on transmuscular QLB did not report motor weakness of the hip and knee and this might be due to usual sparing of lower lumbar roots in addition to the use of diluted local anesthetics 20**.**On the other hand, the quadriceps weakness is reported as a complication of FIB as the femoral nerve is reliably blocked. Thus, it is recommended to stop infusions hours before anticipated mobility in case of continuous FIB so that it does not impair ambulatory ability postoperatively[2]**.** In the present study, transmuscular QLB facilitated positioning patients during spinal anesthesia; provided comparable analgesic duration to the suprainguinal FIB; and better preservation of quadriceps motor function than the suprainguinal FIB.The total postoperative morphine requirement was slightly higher in transmuscular QLB than in suprainguinal FIB.The literature supports the analgesic efficacy of some selective regional techniques such as lumbar plexus block, FIB, and pericapsular injection; however, currently there is no consensus on any single technique or combination of techniques to be superior in THA[22]**.** Our results was consistent with**Nassar et al** study, that compared the quadratus lumborum block vs fascia iliaca blockiin 36 patients undergoing hip arthroplasty and revealed that 24 hours mean morphine consumption in fascia iliaca group was 6 mg which was lower than quadratus lumborum block group (8mg) [23]**.** Another study was consistent with our study done ***Hashmi et al,*** demonstrated that TQL does not provide superior analgesia or less motor block than FICB in patients undergoing elective hip replacement surgery[24]**.** However,there are some studies withconflicting results. ***Kukreja et al*** reported that QLB provides effective analgesia after hip arthroplasty[20]**.** whereas ***Aoyama et al*** could not find consistent sensory blockade in the lumbar nerves after transmuscular QLB using the same procedure. Our study design differed from those used in these two randomized controlled trials [25]**.** ***Kukreja et al*** compared QLB using a control (no block) regimen, ***Aoyama et al*** compared continuous QLB and femoral nerve block, while our study comparedQLB and FIB using a single-shot technique. Furthermore, epinephrine was used as an adjuvant to the local anesthetic mixture for both blocks.In a study done by ***Blackwell et al***, that assessed the efficacy of Quadratus Lumborum block versus Femoral Nerve and Fascia Iliaca blocks in hip

arthroscopy, they found that opioid consumption in quadratus lumborum group lower than fascia iliaca group which is inconsistent with our result[26]..Inanotherstudy compared QL block with femoral nerve block and FICB for hip arthroscopy, ***Parras and Blanco*** found that patients in the QL block had lower perioperative opioid requirements and visual analogue scale scores in the first 24 hours after hip arthroscopy, fascia iliaca blocks may not be an effective method of analgesia in hip arthroscopy for femoroacetabular impingement[27]**.**Complications associated with femoral nerve and fascia iliaca blocks are well documented. Quadriceps inhibition leading to falls and prolonged sensory deficits are complications associated with femoral nerve and fascia iliaca block. In fact, in femoral nerve blocks rates of postoperative falls can reach 22% [28]**.** ***Potter et al***. found that cutaneous numbness after fascia iliaca block persisted through the first clinical follow-up visit in 26% of patients. Despite the relatively positive outcomes, QL blocks are not without risk. [28]**.** ***Ueshima and Hiroshi*** found that in their series of all techniques of QL blocks, up to 9% of patients had some level of quadriceps weakness after a posterior QL block, although the mechanism is unclear and time course of muscle weakness was not stated. Similar weakness was seen in one patient in a case reportafter QL block for gynecologic laparoscopy leading to unplanned admission[29]**.**In the present study, postoperative morphine consumption was marginally lower in the FIB group than in the QLB group. This might be hypothetically explained by the blockade of L2–3 dermatomes, especially the lateral femoral cutaneous nerve, in the FIB, which represents a key cutaneous sensation for hip surgery incisions, whereas L3 is not consistently blocked in the QLB

Conclusion:

Both single shot blocks, namely suprainguinal FIB and transmuscular QLB, provided effective postoperative analgesia after THA. FIB showed slightly lower 24-hour morphineconsumption

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