A Comparative Study between two approaches of ultrasound-guided transmuscular quadratus lumborum block on post-operative analgesia after total hip arthroplasty.

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Introduction

The demand for total hip arthroplasty (THA) continues to increase, with the obvious goals of improving physical function. However, THA is associated with significant post-operative pain, which remains a serious concern for patients (1, 2). Further, post-operative ambulation may be delayed by poorly treated post-operative pain, increasing the risk of pulmonary complications and venous thrombosis(3).

Effective postoperative pain management can improve patient comfort, increase patient satisfaction, promote earlier mobilization and ensure early participation in rehabilitation. Otherwise, patients may suffer chronic pain and disability, with a poor quality of life(4).

Multimodal analgesia including opioids, nonsteroidal anti-inflammatory drugs, patient-controlled analgesia, and regional anesthesia (5, 6) have been shown to reduce pain and opioid consumption after THA (7). Regional anesthetic techniques provides dense analgesia, decrease opioid related side effects (nausea, vomiting, sedation, itching, urinary retention, respiratory depression) by decreasing reliance on opioid medications and decrease pain scores compared with systemic analgesia alone (8, 9).

Quadratus lumborum block (QLB) is a fascial plane block where local anesthetic is injected into the fascial plane around the quadratus lumborum muscle(10). QLB was initially reported for postoperative pain control by Blanco in 2007 (11).It initially described as an analgesic modality for

abdominal surgery. Depending on the needle tip positioning in relation to quadratus lumborum muscle and local anesthetic (LA) injection location, there are several QLB variations using anterior (transmuscular), lateral (QL1), and posterior QL (QL2) approaches (12).

Transmuscular (anterior) QL block involves injection in the plane between the psoas major (PM) and the QL muscles. Cadaveric studies have reported spread of the injectate to the somatic nerves in the thoracic paravertebral space, as well as the spinal nerve which runs anterior to the QL muscle(13-15).

Previous studies have shown that QL1 and QL2 blocks may generate analgesia from T7 to L1,and the transmuscular block(QL3) may cause caudal spread to the L2–L3 dermatomes (16). Thus, the QL3 approach may be more suitable for hip surgery than the other approaches. (17, 18). Recent evidence of the anterior QL block performed at the L3–L4 level in cadavers has shown spread to branches of the lumbar plexus(19, 20), which may account for the analgesia observed after hip surgery(16, 21).

Paraspinous Sagittal Shift QL block is a modification of the anterior QL block, done at L4 transverse process level in a sagittal orientation, involving a craniocaudal approach of LA injection between the QL and PM muscles just after piercing QL fascia. This may allow LA spread behind the anterior thoracolumbar fascia (ATLF) at the level of L4. This approach may achieve better caudal spread to the nerves covered with the fascia iliaca, with a potential for medial spread to the ventral rami of L2 and L3, in addition to a possibility of blocking the nerves passing anterior to the QL muscle, including subcostal, ilioinguinal and iliohypogastric nerves (22).

Aim of work

The aim of this study is to compare between the post-operative analgesic effect of two approaches of transmuscular quadratus lumborum block (transverse versus paraspinous sagittal transmuscular QLB) in total hip replacement surgery.

The primary outcome of this study is the postoperative morphine consumption. Secondary outcome will be the postoperative pain score which will be assessed by visual analogue scale (VAS).

Patients and methods

This prospective, randomized, controlled double blind study will be carried out at Tanta University Hospital on 75 patients scheduled for total hip replacement surgery for a period of one year from September 2021 to August 2022 after approval of institutional ethical committee, and obtaining written informed consent from each patient.

All data of patients will be confidential with secret codes and private file for each patient. All given data will be used for the current medical research only. Any unexpected risks appeared during the course of the research will be cleared to the participants and ethical committee on time and managed.

*NOTE (The study Protocol was approved from Tanta ethical committee with approval number (34800/7/21) on 25/07/2021.

Every patient will receive an explanation to the purpose of the study and have secret code number to ensure privacy to participants and confidentiality of data, an informed written consent will be taken from all patients.

Inclusion criteria:

75 patients, aged between 21- 80 years old, of both sex ASA I - III scheduled for total hip replacement surgery.

Exclusion criteria:

- Patient refusal.

- Coagulopathy
- Spinal deformities
- Peripheral neuropathy; sensory disorders in the leg requiring surgery and chronic pain.
- Mental dysfunction, psychiatric illnesses and cognitive dysfunction.
- History of drug abuse &chronic analgesic use
- History of allergy to local anesthetic.
- Local skin infection at the site of block.
- Body Mass Index >40Kg/m^2.
- Patients with severe cardiac disease, liver disease or renal dysfunction.

Preoperative preparation:

Preoperative assessment will be done by:

History taking, clinical examination, routine laboratory investigations including: CBC, coagulation profile, random blood sugar, renal function test.

During the preanesthetic assessment, all patients will be educated about the visual analogue scale (VAS) for pain assessment, with scores ranging from 0 to 10 (0 represent no pain, while10 represent maximum intolerable pain).

The patients will be randomly classified into three equal groups (25 patients each). Group allocation will be done by computer generated random numbers and closed opaque sealed envelopes. The study will be designed to be double blind as all patients and postoperative assessor will be blinded to group assignment.

Patients will be randomized to one of three equal groups:

- Group I: Control group (n= 25 patients): Patients in this group will receive ipsilateral sham ultrasound-guided block via subcutaneous injection of 1 ml of normal saline after surgery.
- Group II (n= 25 patients): Patients in this group will receive an ipsilateral single shot of transverse transmuscular approach of QLB (30 ml of plain bupivacaine 0.25%) after surgery using ultrasonographic guidance.
- Group III (n= 25 patients): patients in this group will receive an ipsilateral single-shot of paraspinous sagittal approach of QLB (30 ml of plain bupivacaine 0.25%) after surgery using ultrasonographic guidance.

Intraoperative:

On arrival of the patient to operating room, an intravenous access will be established with intravenous cannula and starting routine monitoring (pulse oximetry, electrocardiogram and noninvasive blood pressure).

Spinal anesthesia will be the anesthetic choice in sitting position and under complete aseptic conditions. Local anesthetic skin infiltration with 3 ml lidocaine 1% at intervertebral space will be done then spinal anaesthesia will be performed using a 25-gauge spinal needle. Once intrathecal placement will be confirmed, a mixture of 2.5 ml of hyperbaric bupivacaine (12.5 mg) and 0.5 ml of fentanyl (25 μg) will be injected. Moreover, sensory and motor blockade will be assessed. Oxygen will be provided to the patient through a nasal canula at a flow rate of 3 L/min.

Blockdescription:

Technique of transverse transmuscular quadratous lumborum block(23):

At the end of the surgery, with the patient in a lateral decubitus position and under antiseptic precautions, the block area will be sterilized with povidone-iodine, a curvilinear ultrasound transducer (2–5 MHz) will be placed transverse to the abdominal flank in the anterior axillary line above the iliac crest to clearly visualise the three abdominal muscle layers. Then, the probe will be moved posteriorly with the external oblique and the internal oblique muscles disappearing into aponeurosis and the latissimus dorsi appearing with the QL muscle beneath. By moving the probe farther posteriorly, the transverse process of the lumbar vertebra, QL, PM and erector spinae muscles identified as a 'Shamrock sign'. After subcutaneous local infiltration with 3 ml lidocaine 1%, the needle will be inserted using the in-plane technique from the posterior end of the ultrasound probe through the back muscles and then will be advanced through the QL muscle (transmuscular approach), targeting the fascial plane between the QL and PM muscles The right needle tip position will be confirmed by injection of 1-2 ml of normal saline solution that spread between the quadratus lumborum and psoas major muscles, then the local anaesthetic (30 ml of plain bupivacaine 0.25%) will be injected in the Group II(transverse trans muscular QL group).

Technique of paraspinous sagittal approach of QLB(22):

With the patient in lateral decubitus and the block side independent, and under antiseptic precautions the block area will be sterilized with povidone-iodine, a curvilinear ultrasound transducer (2-5 MHz) will be directed caudally in a sagittal plane 3-4 cm lateral to the lumbar spinous process of L4, which is almost opposite to the iliac crest, producing a longitudinal scan of the lumbar paravertebral region; and thus identifying

the transverse processes of L3 and L4, with PM muscle in-between and erector spinae muscle posteriorly.

The probe will be shifted slowly to the lateral side until the transverse processes disappear and the QL muscle is evident in its long axis attached caudally to the iliac crest with a characteristic sonographic image of three muscle layers appearing from posterior to anterior as: erector spinae, QL, and PM muscles respectively. Here, anterior thoracolumbar fascia which is considered as continuation of fascia transversalis is seen separating QL and PM muscles.

After subcutaneous local infiltration with 3 ml lidocaine 1% at the cephalic end of the probe, the block needle will be advanced in a cephalo-caudal direction, through the erector spinae and QL muscles, until it pierces the QL. 30 ml of bupivacaine 0.25% will be injected anterior to the QL muscle, observing its spread in a caudal direction towards the iliac crest between the QL and psoas muscles.

Technique of sham block:

Subcutaneous injection of 1 ml sterile normal saline will be performed in the control group at the same area using ultrasound transducer pressure that will be intended to simulate a real block procedure (24).

Postoperative:

Postoperative pain will be assessed by the VAS (score for the severity of pain in the range 0–10, where 0 = no pain and 10 = severe pain) at 2,4,6,12,18,24 hours. If the VAS is 4 or more, 3 mg of intravenous morphine will be given as a rescue analgesia. All patients will receive paracetamol 1g intravenous infusion every 6 h and ketolac 30 mg every 12h.

Measurements:

All measurements will be recorded by an investigator who will not be aware about the study design or intervention.

- Demographic data (Age, sex and weight)
- Postoperative pain will be assessed by VAS (score for the severity of pain in the range 0–10, where 0 = no pain and 10 = severe pain) at 2,4,6,12,18,24 hours. If the VAS is 4 or more, 3 mg of intravenous morphine will be given as a rescue analgesia.
- Total Morphine consumption in the first 24 h of the post-operative period will be recorded.
- Time of first analgesic request.
- Incidence of post-operative complications during the first 24 hours will be recorded such as nausea and vomiting, bradycardia, hypotension, pruritus, manifestations of local anesthetic toxicity (cardiac dysrhythmias, convulsions, respiratory depression) will be recorded.
- Patient satisfaction using subjective 5-level scale (1: not satisfied at all, 2: only slightly satisfied, 3: partly or somewhat satisfied, 4: fairly satisfied, 5: perfectly satisfied).

After our study measurements will be complete, the study will be discontinued.

Sample size calculation:

Based upon previous study(23), sample size calculation revealed that at 25 patients will be required in each group to detect a significant change in the postoperative morphine consumption of 2.9 mg at alpha value 0.05 and 80% power of the study.

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