The impact or quadratum lumborum (QL) block versus pericapsular nerve group (PENG) with lateral femoral cutaneous (LFC) nerve blocks for analgesia after hip arthroplasty: a prospective, randomized clinical trial.

NCT05710107

February 2023

PROTOCOL TITLE:

The impact of quadratum lumborum (QL) block versus pericapsular nerve group (PENG) with lateral femoral cutaneous (LFC) nerve blocks for analgesia after hip arthroplasty: a prospective, randomized clinical trial.

PRINCIPAL INVESTIGATOR: Ellen Hay, M.D.

1.0 Objectives / Specific Aims

- Purpose: Evaluate difference in postoperative opiate consumption in patients receiving a lateral quadratum lumborum (QL) block versus pericapsular nerve group (PENG) with lateral femoral cutaneous (LFC) nerve block for analgesia after hip arthroplasty.
- Hypothesis: The combination of PENG and LFC blocks will provide superior analgesia to the lateral QL block.

2.0 Background

The quadratus lumborum block is a fascial plane block. Originally described for abdominal surgery, numerous publications have highlighted the effectiveness of quadratus lumborum blocks as an analgesic technique for hip fracture and hip arthroplasty [1-4]. The pericapsular nerve group (PENG) block has been more recently described [5,6] and has demonstrated improved analgesia versus no block [7], and similar analgesia with improved motor function versus fascia iliaca block [8] or femoral nerve block [9]. The PENG block is commonly combined with a lateral femoral cutaneous (LFC) nerve block for coverage of the lateral thigh incision.

3.0 Intervention to be studied

- The lateral QL, PENG, and LFC blocks are already performed daily at MUSC as part of our standard perioperative care for patients undergoing hip arthroplasty. Currently, selection of the block type is dependent on the team caring for the patient that day, and studies have not compared QL and PENG+LFC blocks for postoperative analgesia after hip arthroplasty.
- **QL blocks**: The lateral QL block is performed by injecting local anesthetic deep to the transversus abdominus aponeurosis and superficial to the fascia transversalis with direct ultrasound guidance. After completing consent, placing monitors and providing mild sedation, the patient is positioned laterally and the muscular anatomy (external oblique, internal oblique, transverse abdominis, quadratus lumborum and latissimus dorsi muscles) identified. After placing a subcutaneous skin wheel with lidocaine, a blunt regional anesthesia needle is inserted using in-plane ultrasound guidance. Local anesthetic is deposited incrementally with frequent aspiration in the anterolateral border of the quadratus lumborum muscle at the junction of the transversalis fascia, outside the anterior layer of the thoracolumbar fascia and superficial to the fascia transversalis.
- **PENG block:** The pericapsular nerve group (PENG) block is an ultrasound-guided approach, first described by Giron-Arango et al. for the blockade of the articular branches of the femoral, obturator and accessory obturator nerves that provide sensory innervation to the anterior hip capsule [5,6]. In the PENG block, a low-frequency, curvilinear probe is used to visualize the anterior inferior iliac spine, iliopsoas tendon, and iliopubic eminence. After placing a subcutaneous skin wheel with lidocaine, a blunt regional anesthesia needle is inserted using in-plane ultrasound guidance. The needle is advanced until the tip lies on the lateral and inferior margin of the iliopsoas tendon between the anterior inferior iliac spine (lateral) and iliopubic eminence (deep).
- **Risks:** Risks of both blocks are similar. In general, all blocks have the risks of infection, bleeding, or local anesthetic toxicity (LAST). Infection risk is minimized

by utilizing appropriate antiseptic and sterile technique as is standard for any regional procedure. The risk of LAST is a risk with any regional procedure and is minimized by frequent aspiration, incremental local anesthetic injection and vital signs monitoring throughout. As for any truncal block, the QL block also has the risk of bowel perforation as it is higher in the abdominal wall. This risk is minimized with real time US visualization. The PENG block is located closer to the femoral nerve, and local anesthetic could spread to the femoral nerve with medial or superficial injection.

- **Current practice:** Both QL and PENG blocks are utilized at MUSC daily for postoperative pain following hip arthroscopy, arthroplasty, and hip fracture. Our current practice in patients receiving a PENG block includes also blocking the lateral femoral cutaneous (LFC) nerve for coverage of the lateral thigh incision.
- We hypothesize that PENG+LFC blocks will reduce opioid consumption following hip arthroplasty compared with lateral QL blocks.

4.0 Study Endpoints

- The primary outcome will be postoperative cumulative opioid consumption (in IV morphine mg equivalents: IV MME) over time, up to 72 hours postoperatively. Cumulative opioid consumption will be evaluated at in PACU, and through 72 hours post-op.
- Secondary outcomes: Postoperative pain score measures on the visual analog scale (VAS) captured in the preoperative area, PACU, and through 72-hours post-op.
- Additional outcomes of interest include time to first ambulation, functional and mobility outcomes, PACU duration, patient satisfaction, and opioid related side effects.

5.0 Inclusion and Exclusion Criteria/ Study Population

Inclusion Criteria

- Age greater than or equal to 18 years old
- Ambulatory patients undergoing elective hip arthroplasty (planned same day discharge or observation 23 hours or less)

Exclusion Criteria

- Local anesthetic allergy
- Subjects with a weight less than 40kg
- Subjects that are unable or choose not to give informed consent
- Known preoperative substance abuse

6.0 Number of Subjects

A total of 106 subjects will be included.

7.0 Setting

- MUSC perioperative areas.

8.0 Recruitment Methods

- For patients presenting to a preoperative clinic visit, information regarding the study will be presented to subject during their surgical consultation in the form of a flyer and informed consent document. Subjects will be educated on the role of regional anesthesia in postoperative analgesia. Subjects will be given ample time to consider participating in the surgery and asking questions. On the day of surgery, subjects may then choose to provide written consent or decline to participate. For patients without a surgical consult, the study will be presented on the day of surgery and will be given enough time to read the consent and consider participation.
- Subjects will be enrolled on the day of surgery in the preoperative holding area.

9.0 Consent Process

After discussion in a private area in the preoperative holding area regarding risks and benefits of the study and both block techniques, patients will be given adequate time to read the consent, think about participating, and ask questions. If agreeable to participating, consent will be obtained from patient by an IRB approved CITI certified study team member who is a physician or other medical clinician and has been trained on the protocol. Written consent will be completed once all questions are answered and inclusion and exclusion criteria verified. Copies of all documents will be provided to the patient. Once patients are consented, they will be assigned a study ID. Randomization group (quadratus lumborum block versus pericapsular nerve group with lateral femoral cutaneous nerve blocks) will be determined by a randomization list created by a statistician and assigned based on the subject's study ID.

10.0 Study Design / Methods

- **Objective and outcomes**: Determine if PENG+LFC blocks reduce opioid consumption compared to a QL block after THA.
- **Design**: This prospective, blinded clinical trial will randomize subject to receive a PENG+LFC or QL block prior to THA. The randomization will be created by a statistician prior to subject enrollment.
- **Groups:** Subjects will be randomized to receive a preoperative PENG+LFC (n=53) or QL (n = 53) block prior to THA.
- Potential participants that are on the operating room schedule for THA will be screened for eligibility via chart review.

Baseline

- Once subjects have signed an informed consent, they will be assigned an enrollment number. Randomization will be created prior to the study starting with half of the research subject numbers being assigned to receive a PENG+LFC block, and the other half assigned to receive a QL block. Both blocks are considered our current standard of care. A study team member will open the envelope labeled with the subject's assigned study ID to reveal the randomization assignment.

- The participant's medical record will be reviewed for demographic data collection and durations (operative, PACU, hospital stay).
- Before placing the block, participants will be asked what their current pain score is by using a Visual Analog Scale (VAS) from 0-100, and complete the HOOS Jr, and PROMIS-10 Global Health questionnaires.

Randomization

- All subjects will be positioned, prepped, and sedated for the randomized regional anesthesia procedure in the preoperative holding area. The subject will be positioned in the supine position and pulse oximetry and blood pressure cuff placed for monitoring. As part of routine care, the subject will receive sedation for their comfort. All subjects would receive *3*0 ml of 0.25% ropivacaine in their nerve block regardless of randomization. The relevant anatomy will then be identified using ultrasound guidance and real time imaging. For both groups, ropivacaine will be injected slowly with frequent aspiration to rule out inadvertent intravascular needle placement. Local anesthetic injection will also be observed with real time ultrasound guidance. All participants, regardless of group assignment, will have subcutaneous numbing medication placed just below the skin at both block sites (skin wheal). This will be done so that participants and the research team collecting results will be blinded. Subjects, surgeons, and data collectors will all be blinded to the allocated group. Unblinded personnel will be the Anesthesia Attending placing the block and clinical staff assisting.
- In subjects randomized to the QL group, ultrasonography will be used to identify external oblique, internal oblique, transverse abdominus, and quadratus lumborum muscles. A needle will then be advanced under ultrasound guidance below the internal oblique aponeurosis and lateral to the quadratus lumborum muscle. Ropivacaine will be injected slowly with frequent aspiration to rule out inadvertent intravascular needle placement. Local anesthetic injection will also be observed with real time ultrasound guidance.
- In subjects randomized to the PENG+LFC group, ultrasonography will be used to identify the anterior inferior iliac spine, iliopsoas tendon, and iliopubic eminence. After placing a subcutaneous skin wheel with lidocaine, a needle will be advanced until the tip lies on the lateral and inferior margin of the iliopsoas tendon between the anterior inferior iliac spine (lateral) and iliopubic eminence (deep).

Post-Op and Follow-Up

The participant will be asked to provide their average pain score while at rest, and average pain score with movement in the specified time period using a visual analog scale from 0-100 with 100 being the worst. The first pain score will be recorded before they leave the PACU on the day of the procedure. Beginning the following morning, the participant will receive a text message link sent by Twilio's secure server that opens a survey housed in RedCap. The first text message will arrive at 9:00 AM and will follow the schedule in **Table 1.**

The follow-up text messages will also ask the patient the name, dose, and frequency of any pain medication taken in that time period. On Day 7, the text message survey will assess functional outcomes by using two different questionnaires. The patient will schedule at least two post-operative in-person follow up visits as standard of care. One visit at approximately 2-3 weeks post-op, and the other at approximately 6 weeks.

During these two visits the patient will complete the same functional questionnaires as they did at Baseline and on Day 7. This may be done in person at their standard of care post-op visits or may be contacted by study personnel to complete via telephone. Adverse events will also be collected throughout the study.

The text messages are sent from a secure server, Twilio, and are housed in REDCap. The set of questions will state what time window (example: 12:00 AM midnight the night prior to 12:00 PM noon the same day) to consider when answering the questions.

If the participant has been discharged from the hospital, they will answer these questions in the text message each day. If they are admitted to the hospital at these points in time, the information will be gathered from their chart for medications and asked verbally for pain scores and additional questions. Additional data will be recorded by physical therapy and surgical staff and pulled from the patient's medical record for data collection.

If the participant is unable or unwilling to receive text messages, they will be provided a paper document to record their data for the pre-determined intervals so when a study member contacts them, they are able to relay their answers back accurately.

Care in the perioperative period will otherwise be standardized. In the post-anesthesia care unit (PACU), hydromorphone or morphine will be titrated by the PACU nurse for the subject's comfort. Additionally, as standard of care, Physical Therapy will evaluate patients in the PACU before discharge.

An outline of study time points and assessments is shown in **Table 2.**

Table 1. Post-Op Follow Up Assessment Schedule

Post-Op Day	Time of Text Message	Data Collection Time Period
POD 0	Right before discharge	Waking up from surgery to discharge
POD 1-AM	9:00 AM	Discharge to 11:59 midnight prior
POD 1-PM	3:00 PM	12:00 AM midnight night prior to 12:00 PM noon same day
POD 2-AM	9:00 AM	12:01 PM noon day prior to 11:59 PM midnight night prior
POD 2-PM	3:00 PM	12:00 AM midnight prior to 12:00 PM noon same day
POD 3-AM	9:00 AM	12:01 PM noon day prior to 11:59 PM midnight night prior
POD 3-PM	3:00 PM	12:00 AM midnight prior to 12:00 PM noon same day

Table 2. Summary of Study Procedures and Follow-Ups	
Study Activities	**Details/Assessments**
Informed consent	• Obtain informed consent
Baseline	• Pre-Operative VAS Pain Score • Quad Strength Pre-Op • HOOS Jr • PROMIS-10 Global Health
Randomization (day 0)	• Confirm eligibility criteria • Randomization
Randomization procedure (day 0)	• Complete PENG or QL Block according to randomization allocation
Post-Op First Opportunity in PACU	• Opioid Consumption
Ambulation (Assessed by Physical Therapy in PACU)	• Time that first ambulation occurred in PACU • Distance ambulated in PACU • Quad Strength in PACU
Post-Op Day 1 9:00 AM (*text message)*	• Opioid and pain medication consumption • VAS Pain Score
Post-Op Day 1 3:00 PM (*text message)*	• Opioid and pain medication consumption • VAS Pain Score
Post-Op Day 2 9:00 AM(*text message)*	• Opioid and pain medication consumption • VAS Pain Score
Post-Op Day 2 3:00 PM (*text message)*	• Opioid and pain medication consumption • VAS Pain Score
Post-Op Day 3 9:00 AM (*text message)*	• Opioid and pain medication consumption • VAS Pain Score
Post-Op Day 3 3:00 PM (*text message)*	• Opioid and pain medication consumption • VAS Pain Score • Satisfaction with analgesia • Side Effects of nausea/vomiting, itching, over sedation, respiratory concerns related to opioids • Adverse Events
Day 7 Post-Op 9:00 AM (*text message)*	• HOOS JR • PROMIS-10 Global • Adverse Events
Week 2-3 Post-Op *(scheduled SOC clinic visit or telephone)*	• HOOS JR • PROMIS-10 Global • Adverse Events
Week 6 Post-Op *(scheduled SOSC clinic visit or telephone)*	• HOOS JR • PROMIS-10 Global • Averse Events
After completion of 6-week post-op follow-up	• All study activities complete

11.0 Data Management

- **Sample size and power**: The primary outcome for assessing differences between PENG+LFC vs. QL blocks will be postoperative cumulative opioid consumption (in IV morphine mg equivalents; IV MME) over time, up to 72 hours postoperatively. Cumulative opioid consumption will be evaluated in PACU, and at 12-hour intervals during the first 72 hours of the postoperative window. Differences in cumulative opioid consumption over time between block groups will be assessed using a linear mixed model approach. The model will include fixed effects for treatment group, postoperative time, and the interaction between block group and postoperative time and a random subject effect to account for correlation between measures collected on the same patient over time. Differences between block types at each postoperative time will be evaluated using linear contrasts from the model. A previous study[9] conducted at MUSC found mean IV MME at 12 hours postop in subjects undergoing THA with a QL block was 16 ± 12 MME. A sample size of 48 subjects per group with 9 repeated measures of opioid consumption provides 80% power to detect a difference in cumulative MMEs consumed postoperatively of 4 MMEs at significance level $\alpha = 0.006$ (Bonferroni adjusted for 9 pairwise comparisons between group) assuming a standard deviation of ± 12 MMEs, a first-order autoregressive correlation structure and correlation between observations on the same subject of $\rho = 0.33$. We will plan to enroll 53 subjects/group (106 total) to allow for 10% attrition.
- Postoperative VAS pain score captured in the preoperative area, PACU and 12-hour intervals during the first 72 hours of the postoperative window will be collected as a secondary outcome and will be evaluated using a LMM similar to the primary outcome. Additional outcomes of interest include time to first ambulation, functional and mobility outcomes, PACU duration, patient satisfaction, and opioid related side effects.

12.0 Provisions to Monitor the Data to Ensure the Safety of Subjects

- All new complaints and symptoms (i.e., those not existing prior to signing of informed consent) will be recorded on the AE CRF. All AEs will be characterized in terms of their start and stop dates, intensity, action taken, relationship to intervention, subject outcome, and whether or not the AE led to an SAE.
- Any adverse events related to placement of nerve blocks will be treated according to MUSC Hospital policy and procedures and the practice of the Department of Anesthesia.
- The Department of Anesthesia's DSMB will review the study on an annual basis. Any adverse events will be reported and reviewed by the DSMB. Adverse events will be reported to MUSC's IRB per policy.
- All data will be kept in a locked office, in a locked cabinet, and electronic data will be stored on a password protected MUSC server. Only CITI certified, IRB approved study team members will have access to data.

13.0 Withdrawal of Subjects

- The participant has the right to voluntarily withdraw consent from the study at any time for any reason without prejudice to his/her future medical care by the physician or at the institution. For the occasional participant who withdraws consent, the date and reason for consent withdraw should be documented. Participant data will be included in the analysis up to the date of the consent withdraw.

- Investigators may stop a subject's participation in the study at any time if they decide it is in the subject's best interest. They may also do this if the subject does not follow the investigator's instructions.

14.0 Risks to Subjects

- PENG+LFC Block: risks include infection, bleeding, local anesthetic systemic toxicity (LAST), nerve damage, block failure, and quadricep weakness. Infection risk is minimized by utilizing appropriate antiseptic and sterile technique as is standard for any regional procedure. The risk of LAST is a risk with any regional procedure and is minimized by frequent aspiration, incremental local anesthetic injection, and vital sign monitoring throughout.
- QL Block: risks include infection, bleeding, local anesthetic systemic toxicity (LAST), nerve damage, block failure, and quadricep weakness. Infection risk is minimized by utilizing appropriate antiseptic and sterile technique as is standard for any regional procedure. The risk of LAST is a risk with any regional procedure and is minimized by frequent aspiration, incremental local anesthetic injection, and vital sign monitoring throughout. There is also a risk of quadricep weakness.
- Subjects will be randomly assigned to receive either 1) PENG + LFC or 2) QL block. One group may prove to be less beneficial than the other.
- There is also a risk of loss of confidentiality.

15.0 Potential Benefits to Subjects or Others

- The PENG+LFC target analgesia for directly to the hip capsule compared with the QL blocks and may improve targeted analgesia without compromising motor function of the operative extremity and promoting earlier postoperative physical therapy.

16.0 Sharing of Results with Subjects

Prior to starting the investigation, the trial will be registered at clinicaltrials.gov. Results will be posted after the study is completed.

17.0 Drugs or Devices

- All medications are FDA approved. All nerve block procedures are already performed daily at MUSC. The block medication will be managed and dispensed by the OR pharmacy.

References

1. Kelly T, Wolla CD, Wolf BJ, et al. Comparison of lateral quadratus lumborum and lumbar plexus blocks for postoperative analgesia following total hip arthroplasty: a randomized clinical trial. Regional Anesthesia & Pain Medicine 2022;47:541-546.

2. Ueshima H, Yoshiyama S, Otake H. The ultrasound-guided continuous transmuscular quadratus lumborum block is an effective analgesia for total hip arthroplasty. J Clin Anesth 2016;31:35.

3. Johnston DF, Sondekoppam RV. Continuous quadratus lumborum block analgesia for total hip arthroplasty revision. J Clin Anesth 2016;35:235–7.

4. McCrum CL, Ben-David B, Shin JJ, et al. Quadratus lumborum block provides improved immediate postoperative analgesia and decreased opioid use compared with a multimodal pain regimen following hip arthroscopy. J Hip Preserv Surg 2018;5:233–9.

5. Girón-Arango L, Peng PWH, Chin KJ, Brull R, Perlas A. Pericapsular Nerve Group (PENG) block for hip fracture. Regional Anesthesia and Pain Medicine 2018; 43: 859–63.

6. Del Buono R, Padua E, Pascarella G, et al. Pericapsular Nerve Group (PENG) block: an overview. Minerva Anestesiologica 2021; 87: 458–66

7. Pascarella G, Costa F, Del Buono R, Pulitanò R, Strumia A, Piliego C, De Quattro E, Cataldo R, Agrò FE, Carassiti M; collaborators. Impact of the pericapsular nerve group (PENG) block on postoperative analgesia and functional recovery following total hip arthroplasty: a randomised, observer-masked, controlled trial. Anaesthesia 2021 Nov;76(11):1492-1498.

8. Aliste J, Layera S, Bravo D, Jara Á, Muñoz G, Barrientos C, Wulf R, Brañez J, Finlayson RJ, Tran Q. Randomized comparison between pericapsular nerve group (PENG) block and suprainguinal fascia iliaca block for total hip arthroplasty. Reg Anesth Pain Med. 2021 Oct;46(10):874-878.

9. Lin DY, Morrison C, Brown B, Saies AA, Pawar R, Vermeulen M, Anderson SR, Lee TS, Doornberg J, Kroon HM, Jaarsma RL. Pericapsular nerve group (PENG) block provides improved short-term analgesia compared with the femoral nerve block in hip fracture surgery: a single-center double-blinded randomized comparative trial. Reg Anesth Pain Med. 2021 May;46(5):398-403.