A Novel Analgesia technique for ACL Reconstruction: Adductor Canal Block with an IPACK versus Adductor Canal Block

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PROTOCOL SYNOPSIS

Protocol Title:	A Novel Analgesia technique for ACL Reconstruction: Adductor Canal Block with an IPACK versus Adductor Canal Block
Protocol Number:	2017-0934
Protocol Date:	7/25/2019
Sponsor:	Department of Anesthesiology
Principal Investigator:	Jonathan Beathe, MD
Objective:	A comparison of two pain control methods - the combination of Adductor Canal Block (ACB)/Periarticular Injection (PAI)/Infiltration of the interspace between the popliteal artery and the capsule of the posterior knee (IPACK) versus the Periarticular Injection (PAI) - in patients undergoing total knee arthroplasty. Primary outcome is NRS pain scores with ambulation on postoperative day one (24 hours post-block administration).
Study Design:	Prospective, randomized controlled, double-blinded study
Enrollment:	120
Subject Criteria:	• Patients undergoing BTB ACL reconstruction with participating surgeon • Age 13 or greater • Planned use of regional anesthesia • Ability to follow study protocol • English speaking (secondary outcomes include questionnaires validated in English only) • Patients of participating surgeons: Drs. Allen, Cordasco, McCarthy, Nawabi, Pearle, & Williams.
Data Collection:	Sources: EPIC, Patient Reported, and Anesthesiologist Variables: Name, DOB, Race, Gender, BMI, AUC of NRS Pain at rest, NRS with ambulation and with stairs, DVPRS (at rest and with movement), opioid consumption, time to meet discharge criteria, time to reach DC physical therapy, induction time, PONV, nerve block success, block duration, ORSDS, patient satisfaction, SF-*, KOOS-Jr, blinding assessment, post-op neurological symptoms, peroneal palsy (if present), power assessment, 2 opioid-related questions, sleep quality and duration assessment, bang blinding index

Statistical Analysis:	• Regression based on a generalized estimating equations approach • Alpha level: 0.05 • Beta or power level: 80%

1.0 INTRODUCTION

Patellar autograft ACL reconstruction is a painful surgery that requires optimal pain control to ensure expeditious recovery and discharge. Nerve blocks, such as the traditional femoral nerve block, are instrumental in effectively providing pain relief and improving patient satisfaction[1,2]. Pain scores are notably decreased with nerve blocks, but motor blockade impedes mobility and may pose a fall risk early in the post-operative period[3-6]. The utilization of ultrasound introduces newer block techniques offering adequate analgesia without detrimental motor blockade.

The adductor canal block serves as an alternative to femoral nerve blockade in providing anterior knee analgesia without significantly compromising quadriceps strength[7-10]. Despite this advantage, posterior knee compartment pain remains a postoperative concern. Sciatic and posterior tibial nerve blocks are also anesthetic options, but again result in motor blockade. A small percentage of patients receiving sciatic nerve blockade also exhibit foot drop due to peroneal nerve injury[11]. Alternatively, as a sensory block, the periarticular injection (PAI) proves to hasten ambulation and recovery after TKA[12]. The PAI blind injection into the posterior capsule seems to aid in pain control of the posterior compartment and reduces the total number physical therapy sessions[13].

Injection in the interspace between the Popliteal Artery and Capsule of the posterior Knee (IPACK) provides an alternative to the PAI blind technique for analgesia in the posterior compartment[14]. The IPACK block is not a nerve block, but rather infiltrates the area between the popliteal artery and the femur[15]. This area is rich with sensory nerve fibers from the posterior capsule of the knee, which originate from the sciatic and posterior tibial nerve[16]. There have been several studies validating adductor canal blocks to be noninferior in analgesia and superior in quadriceps strength for both TKR (7) and ACL (15) surgeries in comparison to the FNB. There also are retrospective studies validating the use of the sciatic nerve block with the femoral nerve block for ACL surgery (16,17,18). There are currently no studies published on the use of IPACK with ACB for ACL surgery. Currently, there is an IRB approved prospective study under enrollment at HSS investigating the use of the IPACK block for TKR.

In this prospective study, we will be the first to compare pain scores between the two groups: ACB/IPACK and ACB in patients undergoing BTB ACL surgery. We will determine whether there is a difference between groups in AUC NRS pain at rest for 24h.

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2.0 OBJECTIVE(S) OF CLINICAL STUDY

Adductor canal blocks have been shown to effectively provide adequate analgesia without compromising quadriceps strength. IPACK has been shown to optimize pain relief by providing analgesia to the posterior compartment of the knee without compromising foot strength. The IPACK is also known as the SPANK block (sensory posterior articular nerves of the knee) and is shown to involve blocking the superior medial and lateral genicular nerves, providing analgesia to the capsule of the knee joint as well as the intraarticular and extra-articular ligaments. By utilizing these new techniques, it may be possible to optimize pain relief without compromising motor strength. This may facilitate ambulation threshold

and reduce opioid consumption (with its associated adverse effects), possibly leading to an earlier discharge. The reason to do this study is to investigate whether the ACB/IPACK (anterior/posterior) in combination would be a better alternative to ACB alone. Furthermore, the study will also determine whether ACB/IPACK is superior to ACB in lowering pain scores at 24 hours post block administration. The study will assess the analgesic component of this intervention, however the DVPRS complete assessment is a 5-item instrument that includes the biopsychosocial impact of pain. We hypothesize that superior analgesia early in recovery may contribute to an improvement in DVPRS and functional outcomes (KOS) well after block resolution. In addition, questions related to opioid consumption may direct future studies in exploring strategies to reduce the risks associated with narcotic analgesics.

The aim of this study is to determine will the IPACK group will have lower pain scores.

3.0 STUDY HYPOTHESES

This is a prospective study to assess whether Patellar-autograft ACL reconstruction patients who receive ACB + IPACK will have reduced NRS pain in the first 24 hours postoperatively compared to ACB alone.

4.0 STUDY DESIGN

4.1 Endpoints

4.1.1 Primary Endpoint

1. Average NRS pain difference at rest during the first 24 hours postoperatively (starting at 3 hours post spinal placement): every 30 min for 3 hours, then 6, 12, 18, and 24 hours.

4.1.2 Secondary Endpoints

1. Time to meet discharge criteria: modified post anesthetic discharge scoring system
2. Time to ambulate
3. Induction time (time out to induction end)
4. PONV (PACU discharge)
5. ORSDS (POD1, POD14)
6. Block duration (measured as time of block placement to when patient reports block wearing off via phone call) (POD1, POD2)
7. Opioid consumption (POD0, POD1, POD2, POD3, POD7)
8. Continued opioid consumption as yes/no (POD14)
9. NRS pain score with ambulation and with stairs (PACU)
10. DVPRS pain score at rest (pre-op, PACU discharge, POD1, POD2, POD7 and 6wks)
11. SF-8 (pre-op, POD7, and 6 wks)
12. KOOS-Jr assessment (pre-op and 6 wks)
13. Patient satisfaction with pain control (PACU discharge, POD1, POD2)

14. Incidence and duration of postoperative neurologic symptoms detected including numbness, paresthesia, weakness (POD7)
15. Incidence and duration of transient peroneal palsy, if present (POD0, POD1, POD2)
16. Power assessment of extension of operative limb (quad strength) and dorsiflexion at ankle (peroneal weakness) using dynamometer (pre-op, PACU discharge)
17. Response to the following 2 questions: Are you concerned about running out of your prescription pain medication? (yes/no) Are you concerned about being addicted to prescription pain medication? (yes/no) (POD 7, POD14)
18. Sleep quality assessment *and duration of sleep* using actimeter (POD1)
19. Bang Blinding Index (POD7)

4.2 Study Sites

This study will take place at the main campus of the Hospital for Special Surgery (HSS).

5.0 STUDY POPULATION

5.1 Number of Subjects

120

5.2 Inclusion Criteria

Subjects of either gender will be included if:

- Patients undergoing BTB ACL reconstruction with participating surgeon
- Age 13 or greater
- Planned use of regional anesthesia
- Ability to follow study protocol
- English speaking (secondary outcomes include questionnaires validated in English only)
- Patients of participating surgeons: Drs. Allen, Cordasco, McCarthy, Nawabi, Pearle, Williams.

5.3 Exclusion Criteria

Subjects will be excluded from the study if:

- Hepatic or renal insufficiency
- Younger than 13 years old
- Patients undergoing general anesthesia
- Allergy or intolerance to one of the study medications
- BMI > 40
- Diabetes
- ASA IV
- Chronic gabapentin/pregabalin use (regular use for longer than 3 months)
- Chronic opioid use (taking opioids for longer than 3 months, or daily morphine equivalent of >5mg/day for one month)

6.0 PROCEDURES

6.1 Intraoperative Protocol

Both groups will receive intraoperative intravenous sedation with midazolam and propofol. Patients will not be given ketamine during the operation. Patients will be given IV 4mg dexamethasone, 4mg ondansetron, 20mg famotidine, and up to 100mcg fentanyl. Upon skin closure, patients will receive IV toradol 30mg (15mg for 65 or older).

A spinal anesthetic with 1.5% mepivacaine (3.5cc) will be performed for all groups.

Surgeons are not to administer any additional local anesthetic infiltration at the surgical site.

Group 1- IPACK *with ACB* group
Adductor canal block technique; supine position, after IV sedation. Ultrasound guided with linear transducer, GE or sonosite, Chiba needle, 22G/4 inch. Identify the femoral artery in the adductor canal deep to the Sartorius muscle, below the vasoadductor membrane. Mid-thigh injection of 15 cc of bupivacaine 0.5% with *2* mg of preservative-free dexamethasone. The local anesthetic will be delivered periarterially with spread anterior to the femoral artery, encompassing 9 o'clock to 3 o'clock position of the artery, surrounding the saphenous nerve.

IPACK technique: prone or supine, frog-leg position. Ultrasound guided with *c60 sonosite probe (5-2 Hz)*. 22G/4 inch Chiba needle. Identify the popliteal artery at popliteal crease; move cephalad, just beyond the femoral condyles, at the confluence with the femur. Identify space between the femur and popliteal artery. From medial to lateral, place needle in between the popliteal artery and femur with the tip ending 2-3 cm lateral to the artery. Inject 25 cc of 0.25% bupivacaine with *2* mg of preservative-free dexamethasone, infiltrating the area between the artery and femur.

Group 2 – ACB group

ACB (same method as above).

Postoperative:

Postoperative analgesia will consist of:

Acetaminophen (1 g IV upon arrival to PACU)
Ketorolac (30 mg IV 6 hrs following intraop dose if not yet discharged, 15 mg for 65 or older)
Tramadol (50mg q6hrs PRN mild pain 1-3)
Tramadol (100mg q6hrs PRN moderate pain 4-6)
Oxycodone (5 mg q3hrs PRN severe pain 7-10)

Dilaudid IV rescue will only be ordered for severe 7-10 pain refractory to oxycodone.

Dexamethasone (4mg IV push PRN nausea)
Ondansetron (4mg IV q 8 hr PRN nausea)

Metoclopramide (10mg IV q 6 hr PRN vomiting)
Scopolamine patch (prn refractory nausea)

Home regimen will be Naproxen 500mg q12 and Percocet 5/325mg 1-2 tabs q4hr prn pain, dispense #30

Physical Therapy
one session on DOS.

6.2 Data Collection

The following data will be collected:

Pre-operative/Baseline

- Consent
- NRS Pain (at rest)
- DVPRS Pain
- SF-8
- KOOS-Jr
- Power assessment

Post-Operative Day 0 (POD 0)

- NRS pain scores at rest
- NRS pain (with ambulation and with stairs)
- Time to meet discharge criteria
- Time to ambulation
- Induction time
- PONV
- DVPRS Pain
- Physical therapy
- Patient satisfaction
- Opioid consumption
- Post-op peroneal palsy (if present)
- Power assessment

Post-Operative Day 1 (POD 1)

- ORSDS
- Block Duration
- DVPRS Pain
- Blinding assessment
- Patient satisfaction
- Opioid consumption
- Post-op peroneal palsy (if present)
- Sleep quality and duration assessment

Post-Operative Day 2 (POD 2)

- Block duration

- DVPRS Pain
- Patient satisfaction
- Opioid consumption
- Post-op peroneal palsy (if present)

Post-Operative Day 3 (POD 3)

- Opioid consumption

Post-Operative Day 7 (POD 7)

- DVPRS Pain
- 2 Opioid-related questions
- SF-8
- Opioid consumption
- Postop neurologic symptoms
- Bang blinding index

Post-Operative Day 14 (POD 14)

- ORSDS
- 2 opioid-related questions
- Opioid consumption

6 Weeks Post-Operative

- DVPRS Pain
- SF-8
- KOOS-Jr

7.0 STATISTICAL ANALYSIS

1. Proposed analysis (e.g., student's t-test, ANOVA, chi-square, regression, etc.): Regression based on a generalized estimating equations approach
2. Alpha level: 0.05
3. Beta or power level: 80%
4. Primary outcome variable estimate (mean +/- s.d. for continuous outcome, frequency/percentage for categorical variable): Within-group standard deviation of NRS pain at rest = 4.1 points (based on Abdallah et al, 2016 [1])
5. Number of groups being compared (use 1 for paired analysis within the same subjects): 2
6. Effect size or change expected between groups: 2 points is considered a clinically significant difference in pain scores in previous literature [1,2,3])
7. Resulting number per group: 47
8. Total sample size required: 120 (original: 100, use120 total to account for 20% attrition/withdrawal)

Primary outcome:

The primary outcome, NRS pain at rest during the first 24 hours postoperatively, will be compared between the ACB and ACB + IPACK groups regression based on a generalized

estimating equations approach. The observed difference between the ACB and ACB + IPACK groups will also be compared to the previously defined clinically meaningful difference in NRS pain for the first 24 postoperative hours.

Secondary outcome:
The secondary outcomes will also be compared between the ACB and ACB + IPACK groups. Specific statistical approaches will be determined by the observed distribution of these outcomes:

- As a sensitivity analysis, AUC of NRS pain at rest during the first 24 hours postoperatively (calculated using the trapezoidal rule [similar to Abdallah et al. 2016 [1]) will be compared between groups using the Mann-Whitney-Wilcoxon U test or two-sample t-test (depending upon the distribution of the data).
- Continuous and categorical outcomes measured at multiple time points (e.g., opioid consumption, DVPRS score at rest, SF-8 and KOS assessment, patient satisfaction with pain control, etc.) will be analyzed using a generalized estimating equations (GEE) approach.
- Categorical outcomes measured at one time point (e.g., continued opioid consumption at 2 weeks, etc.) will be analyzed using chi-square and/or Fisher's exact tests.
- Continuous outcomes measured at one time point (e.g., time to meet discharge criteria, time to PT clearance, induction time, block duration, incidence and duration of transient peroneal palsy, etc.) will be analyzed using Mann-Whitney-Wilcoxon U test or two-sample t-tests.

Baseline characteristics:
Demographics and other baseline characteristics (e.g., age, sex, etc.) will be compared between the ACB and ACB + IPACK groups. Balance diagnostics may be used to determine similarity of baseline covariates between the two study groups, such as described in Austin 2009 [2].

References for Data Analysis section:

[1] Abdallah, Faraj W., et al. "Adductor canal block provides noninferior analgesia and superior quadriceps strength compared with femoral nerve block in anterior cruciate ligament reconstruction." The Journal of the American Society of Anesthesiologists 124.5 (2016): 1053-1064.
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8.0 ADVERSE EVENT ASSESSMENT

All Adverse Events (AEs) will be reported in the final study report.