Adductor Canal Block Versus Femoral Nerve Block for Total Knee Arthroplasty

Study Protocol and Statistical Analysis Plan
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Adductor Canal Block Versus Femoral Nerve Block for Total Knee Arthroplasty

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1.0 Summary of Study

Peripheral nerve blocks catheters of the femoral nerve have long been used for perioperative analgesia in total knee arthroplasty (TKA). These blocks provide effective analgesia and patient satisfaction for surgical pain relief. However, one of the main drawbacks to the femoral nerve block (FNB) is a denser motor block of the quadriceps muscle that can delay aggressive physical therapy and subsequent recovery from surgery. (1) Recently, there has been increasing interest in performing adductor canal blocks (ACB) with the aim of less motor blockade while providing commensurate analgesia compared to the FNB. (1,2) Current investigative reports have provided only preliminary data, and there is potential to change the standard of care for TKA as more data mounts in favor of ACBs. The goal of this study is to verify the analgesic equivalence of the two blocks, compare patient satisfaction, surgeon satisfaction, and physical therapy grading between the two blocks. Potentially, this would change the standard of care for TKA patients at this institution.

2.0 Background and Rationale

Femoral nerve block catheters have been used to provide analgesia for lower extremity procedures for many years. The catheter is placed near the femoral nerve and a continuous infusion provides a dense nerve block in the distribution of the femoral nerve. This includes blockade of the anterior and posterior divisions supplying the middle cutaneous, medial cutaneous, and muscular (sartorius) branches in the anterior division and the saphenous, muscular (to quadriceps) and articular branches of the posterior division. In particular, the muscular branch supply to the quadriceps makes walking and participating in physical therapy difficult.

A block in the adductor canal can be expected to include the saphenous nerve, vastus medialis, medial femoral cutaneous, articular branches from the obturator and the medial retinacular nerves. This distribution provides the innervation for the medial, anterior and lateral portions of the knee. Van der Wal et al first demonstrated in 1993 the transsartorial approach to blocking the saphenous nerve.(4) In recent years, the ACB has been proposed as a potential successor to the FNB. (1,2,3,5) Kwofie et al investigated quadriceps strength and fall risk in volunteers finding that ACB significantly preserved motor strength and significantly preserved balance. ACB also demonstrated superior analgesia compared to parenteral opioids alone. Further, Kim et al performed a prospective, randomized, controlled trial comparing ACB to FNB with the end point of quadriceps strength, reported analgesia, and opioid intake showing that ACB provided similar analgesia while with less motor block.

This study has been designed to increase the knowledge concerning adductor canal block for total knee arthroplasty surgery as a potentially superior replacement for femoral nerve blocks. Previous studies have well demonstrated the preservation of quadriceps strength and balance. Analgesia also appears to be adequate. This study seeks to replicate those findings with the addition of assessment of physical therapy participation, patient satisfaction, surgeon satisfaction and time to discharge.

3.0 Significance of Study

This study has the potential to add to the growing body of evidence that the ACB will eventually be the superior regional anesthetic technique in total knee arthroplasty patients. At this institution, both blocks are currently performed, but the ACB could become the primary technique.

4.0 Objectives and Hypothesis

Following are the specific objectives of this study:

1. Determine the effectiveness of ACB for analgesia compared to FNB as determined by patient reported VAS scores
2. Determine the effectiveness of ACB for analgesia compared to FNB as determined by opioid usage
3. Determine the effectiveness of ACB in physical therapy as determined by early ambulation distance
4. Determine surgeon satisfaction via survey.
5. Determine if there is any difference in time to discharge between the two blocks.

Outline of therapy: Participants in the investigational group will receive an adductor canal nerve catheter prior to TKA surgery. Participants in the control group will receive a femoral nerve catheter prior to TKA surgery. After surgery, the patient will be seen in the recovery room to bolus the catheters and start continuous infusions of ropivacaine. Further details are below in section #

Following are primary endpoints:

1. Pain scores (VAS) at immediate post op, 24 hours, and 48 hours, including highest
2. Opioid consumption at 24 hours and 48 hours pain score at any given time post operatively.
3. Physical therapist assessment of patient participation 0-100.
4. Distance ambulated at 24 hours and 48 hours
5. Patient satisfaction
6. Surgeon satisfaction
7. Hours to discharge.

Study Hypothesis: We hypothesize that the ACB will become the standard of care for TKA analgesia on the basis of improved physical therapy participation and increased patient satisfaction without sacrificing analgesia. With better physical therapy participation, there would be quicker recovery and potentially earlier discharge, increasing patient and surgeon satisfaction.

5.0 Eligibility and Exclusion Criteria

Inclusion criteria:

1. Patient undergoing total knee arthroplasty with regional anesthesia planned for postoperative analgesia.
2. Adult, 19 years of age or older
3. Patient classified as American Society of Anesthesiology (ASA) class I, II, or III

Exclusion criteria:

1. Any subject not classified as an ASA I, II, or III
2. Allergy/intolerance to local anesthetic
3. Pre-existing neurologic or anatomic deficit in lower extremity on the side of the surgical site
4. Coexisting coagulopathy such as hemophilia or von Willebrand disease.

6.0 Randomization and Recruitment Procedures

Recruitment: Participants will be recruited, identified, and interviewed by either the study Principal Investigator or one of the co-investigators. The interviewing investigator will confirm eligibility and the absence of any exclusionary criteria. Details of the study (including risks) will be explained to prospective participants to their satisfaction and consent forms will then be signed.

Randomization: Upon enrollment into the study, participants will be randomized 1:1 to either the investigational group (*adductor canal nerve catheter*) or the control group (*femoral nerve catheter*). Randomization will be performed using a random number generator.

7.0 Study Interventions and Procedures

A. Investigational group participants in the adductor canal block arm will receive an adductor canal block catheter placed under direct ultrasound guidance as follows.
   a. Patients will be placed supine with their block limb supinated about 20 degrees to facilitate access to the anteromedial thigh. Standard noninvasive monitors will be applied, and oxygen administered via nasal canula. Parenteral midazolam and fentanyl will be titrated to patient comfort.
   b. Standard skin sterilization, prepping, and draping will be applied to the area. Under ultrasound guidance the needle will be advanced into the adductor canal. After negative aspiration, a bolus of 20 ml 0.5% Ropivacaine will be injected under direct visualization in 5 mL aliquots ensuring proper placement of the needle tip. The catheter will be advanced in this position at least 2 cm and not more than 5 cm and secured to the skin with tegaderm.
   c. Patients will be evaluated immediately post-operatively in the PACU to determine VAS score from 0-10.

d. Patients will be given a standard pain regimen while in the hospital. 24 hour opioid consumption will be calculated.
e. Patients will be evaluated 24 and 48 hours post operatively for VAS score, duration of sensory and motor block, and patient satisfaction from 0-10. The catheter will be removed on post operative day 2.
f. Patient will be followed up until nerve block resolved.
g. Physical therapists in the hospital will be surveyed with a standard questionnaire regarding the patients ability to participate in physical therapy sessions on a scale of 0-10. Ambulation distance at 24 and 48 hours will be recorded per their notes.
h. The surgeons performing the procedures will be surveyed in a general sense regarding their impression of patient recovery with this block
i. Calculate the hours to discharge for each patient.

B. Control group participants in the femoral nerve block arm will receive a femoral nerve block catheter placed under direct ultrasound guidance with the stimulating needle as follows.
   a. Patients will be placed supine with their block limb exposed to facilitate access to the anterior inuinal area. Standard noninvasive monitors will be applied, and oxygen administered via nasal canula. Parenteral midazolam and fentanyl will be titrated to patient comfort.
   b. Standard skin sterilization, prepping, and draping will be applied to the area. Under ultrasound guidance the needle will be advanced to the femoral nerve. After negative aspiration, a bolus of 20 ml 0.5% Ropivacaine will be injected under direct visualization in 5 mL aliquots ensuring proper placement of the needle tip. The catheter will be advanced in this position at least 2 cm and not more than 5 cm and secured to the skin with tegaderm.
   c. Patients will be evaluated immediately post-operatively in the PACU to determine VAS score from 0-10.
   d. Patients will be given a standard pain regimen while in the hospital. 24 hour opioid consumption will be calculated.
   e. Patients will be evaluated 24 and 48 hours post operatively for VAS score, duration of sensory and motor block, and patient satisfaction from 0-10. The catheter will be removed on post operative day 2.
   f. Patient will be followed up until nerve block resolved.
   g. Physical therapists in the hospital will be surveyed with a standard questionnaire regarding the patients ability to participate in physical therapy sessions on a scale of 0-100. Ambulation distance at 24 and 48 hours will be recorded per their notes.
   h. The surgeons performing the procedures will be surveyed in a general sense regarding their impression of patient recovery with this block
   i. Calculate the hours to discharge for each patient.

Projected Overall Study Timeline

Aug 2014	Sep 2014	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015
Startup							
Enrollment							
				Data Entry and Analysis			
						Study Write Up	

8.0 Statistical Considerations

General Data Analysis: All demographic and clinical variables with continuous measures will be expressed as means and standard deviations; categorical factors will be expressed as proportions. For non-normal data, the medians and inter quartile ranges will be displayed. The distribution of the continuous factors will be examined using the Kolmogorov-Smirnov test. For data that are normally distributed, the one-way ANOVA and Student's t-test will be used to compare groups of data. For data that are not normally distributed, the Kruskal-Wallis and Mann-Whitney tests will be used for comparisons. Chi-square and Fisher's exact tests will be used to analyze categorical data. For all comparisons, a value of $p < 0.05$ will be considered statistically significant.

Primary Outcome Analysis: Statistical analyses will be performed using SAS for Windows, version 9.2. Student's t-test will be used to compare post-operative pain scores for investigational and control subjects. Linear regression will be also be used to test the relationship between pain scores and regional anesthetic technique, while controlling for relevant clinical and demographic variables. Distance of first ambulation will be analyzed using Cox proportional hazards model. Student's t-test will be used to compare patient and surgeon satisfaction.

Statistical Power and Sample Size Estimates: Sample size (100) was determined using a Cohen's d table assuming a mean pain VAS score of 8 (sd = 3) on a scale of 0-10 for control subjects. A sample of 100 participants (50 patients per treatment group) will have approximately 80% power to detect a reduction in pain score of at least 50%, and approximately 99% to detect an 80% reduction in pain score.

9.0 Patient Safety and Data Security Monitoring

Assessment of Level of Risk: Minimal risk. Participants in this study have the risk associated with peripheral nerve block including pain and discomfort from the procedure, excessive bleeding, infection, nerve damage and failed analgesia. Both blocks are currently performed in this institution for this indication. The study would simply compare the two existing procedures to each other.

Oversight of this investigation will be provided by: Oversight for this clinical study will be provided by principal investigator (PI), Promil Kukreja, M.D, Ph.D., who is an Assistant

Professor of Anesthesiology at the University of Alabama at Birmingham (UAB).The study primary co-investigator, Samuel Korbe, M.D., is an anesthesiology resident at the University of Alabama at Birmingham (UAB).

Mechanisms for HIPAA compliance: The de-identified study data will first be entered onto standardized, preprinted data collection sheets that will have no patient identifiers on them such as name, medical record number and date of surgery.

The study data will be collected and stored on a secure research server maintained by the Department of Anesthesiology. The research server is HIPAA compliant, has researcher specific restricted access, and is password protected. This research server is backed up to another secure research server at a different location. The list of patients participating in the study with their medical record numbers and dates of surgery will be kept separately and securely in a locked filing cabinet in the locked office of Dr. Kukreja and will be destroyed, after final data analysis, using the UAB contracted confidential shredding service. The original paper data collection forms will be disposed of using the UAB contracted confidential shredding service after the de-identified data have been transferred to the password-protected, computer database. From that point in time onward, all study participants will be identified only by their individual study specific number, both on the above server and the backup server.

A data and safety monitoring plan will be implemented by Dr. Korbe to ensure that there are no changes in the risk/benefit ratio during the course of the study and that confidentiality of research data is maintained. Investigators and study personnel will meet either electronically or in person, monthly (more often if needed) during active participant enrollment to discuss the study (e.g., study goals and modifications of those goals; subject recruitment and completion; progress in data coding and analysis; documentation, identification of adverse events or research subject complaints; violations of confidentiality) and address any issues or concerns at that time, including delaying surgery for the testing.

All personnel who are involved in the design or conduct of this research study will have successfully completed required IRB training which includes the importance of measures to protect patient confidentiality.

10.0 Reporting Adverse Events

For the purposes of this study, serious adverse events will be noted in the course of routine intraoperative and postoperative care and addressed at that time. They will be reported to existing departmental and institutional programs.
Specifically, any adverse events occurring in these study participant patients will be reported immediately to the UAB Department of Anesthesiology Human Subjects Research Committee and the UAB IRB. As an integral element of data and patient safety monitoring, a completed departmental-level Data Protection and Patient Safety Monitoring Form will be presented to the UAB Department of Anesthesiology Human Subjects Research Committee every three months.

11.0 References Cited

1. Jaeger P, Zaric D, Fomsgaard JS, Hilsted KL, Bjerregaard J, Gyrn J, Mathiesen O, Larsen TK, Dahl JB. Adductor Canal Block Versus Femoral Nerve Block for Analgesia After Total Knee Arthroplasty. *Reg Anesth Pain Med* 2013; 38: 526-532.
2. Davis JJ, Bond TS, Swenson JD. Adductor Canal Block, More Than Just the Saphenous Nerve? (letter). Reg Anesth Pain Med 2009; 34: 618-619
3. Kim DH, Lin Y, Goytizolo EA, Kahn RL, Maalouf DB, Manohar A, Patt ML, Goon AK, Lee Y, Ma Y, YaDeau JT. Adductor Canal Block Versus Femoral Nerve Block for Total Knee Arthroplasty. *Anesthesiology* 2014; 120:540-550.
4. Van der Wal M, Lang SA, Yp RW. Transsartorial Approach for Saphenous Nerve Block. *Can J Anaesth*. 1993; 40: 542-546
5. Kwofie MK, Shastri UD, Gadsden JC, Sinha SK, Abrams JH, Xu D, Salviz EA. The Effects of Ultrasound-Guided Adductor Canal Block Versus Femoral Nerve Block on Quadriceps Strength and Fall Risk. *Reg Anesth Pain Med.* 2013; 38: 321-325.

Appendix A (For Internal Departmental Use Only)

Study Budget and Funding Sources

Study Title: Adductor Canal Block Versus Femoral Nerve Block for Total Knee Arthroplasty

Principal Investigator: Promil Kukreja, M.D., Ph.D.

Itemized Budget:

Is extramural funding presently being sought for this study? No
If yes, from what source or agency?
If not now, is this planned at some point in the future? No
Please provide brief pertinent details:

Present this completed appendix to the Director of Research for the Applicable Division for review and approval (Anesthesia Services Division and Cardiovascular Anesthesiology Division: Keith Jones, M.D.; Critical Care Medicine: Sadis Matalon, Ph.D.; Pain Treatment: Timothy Ness, M.D., Ph.D.)

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Director of Research Comments:

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Signature of Director of Research: _____

Name: _____ Date: _____

Appendix B: Patient Survey

On a scale of 1-10 (1 being worst, 10 being best) how would you rate your overall pain control during the nerve catheter infusion?_____

On a scale of 1-10 (1 being worst, 10 being best), how would you rate your ability to participate in physical therapy during the nerve catheter infusion? _____

Would you say you were more limited by pain or weakness during the infusion?

Would you recommend this nerve block to a friend having the same surgery?

Appendix C: Physical Therapist Survey

How far was the patient able to walk in his/her first ambulation trial?

On a scale of 1 to 10 (1 being worst, 10 being best), how well was the patient able to participate in physical therapy sessions while in the hospital? _____

Do you think the patient was limited primarily by pain or weakness?

Appendix D: Surgeon Survey

On a scale of 1-10 (1 being worst, 10 being best) how well was the patient's pain controlled? _____

On a scale of 1-10 (1 being worst, 10 being best) how well was the patient able to participate in physical therapy? _____

On a scale of 1-10 (1 being worst, 10 being best) how satisfied are you with this patient's hospital course regarding pain control and physical therapy participation? _____