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Femoral Nerve Block in Total Knee Arthroplasty: Utilization of Technique by Certified Registered Nurse Anesthetists

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FEMORAL NERVE BLOCK IN TOTAL KNEE ARTHROPLASTY: UTILIZATION OF TECHNIQUE BY CERTIFIED REGISTERED NURSE ANESTHETISTS

by

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This thesis meets the standards for appearance, conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

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ABSTRACT

Postoperative pain control is an important component to patient rehabilitation. The multi-modal approach to pain management includes the use of peripheral nerve blocks to improve the perception of postoperative pain. The purpose of this study was to determine Certified Registered Nurse Anesthetist (CRNA) practice experience with the use of femoral nerve block (FNB) for pain control in patients receiving total knee arthroplasty.

CRNA's experienced with providing anesthesia for total knee arthroplasty were surveyed to determine their utilization of the femoral nerve block technique and their perceptions of efficacy of the technique. A quota sample of CRNA's from major hospitals in a midwestern state, were asked to participate in completing a questionnaire.

The utilization of FNB in the study was 17.2% of TKA patients. Those CRNA's that received both formal and other training in nerve block technique were more likely to use FNB for pain control than their peers who received only one type of training or no training at all. The literature review data regarding the absolute efficacy of the FNB technique was limited. The study did reveal, however, that 60% of CRNA's who do perform FNB, reported the TKA patients' pain control in the post anesthesia care unit (PACU), when using general anesthesia, as fair or poor. Barriers to the use of FNB revealed the most significant barrier to performing the procedure to be the anesthesiologist preference.

CHAPTER I

INTRODUCTION

Health care providers have a heightened awareness of the importance of assessing, treating and evaluating pain. The Joint Commission Perspectives provides standards that require organizations to recognize and address the patient's right to appropriate pain assessment and management (2001). Given that some postoperative pain is an expected "byproduct" of any surgical procedure, untreated or inadequately treated postoperative pain may be detrimental to patient rehabilitation. Thus, the role of the healthcare provider is to know and implement the appropriate interventions to minimize, or control the perception of pain to maximize positive surgical outcome.

Following total knee arthroplasty (TKA), a common orthopedic procedure, continuous passive motion exercises and extensive physical therapy are necessary. While such treatments optimize the functional prognosis for the patient, they can cause severe pain in the new joint (Rosenquist & Rosenberg, 2003). Regional techniques, including femoral nerve blocks, are part of a multimodal strategy that can be used to provide postoperative pain relief. Due to their improved safety profile with concurrent anti-coagulant therapy, (which accompanies total joint replacement), there has been an increasing interest in the use of peripheral nerve blocks for pain control.

Significance of the Study

Total knee arthroplasty is a common orthopedic surgical procedure, most often used for the treatment of osteoarthritis. This procedure is known to cause severe postoperative pain, which is exacerbated by the ongoing physical therapy that directly relates to the positive, long-term outcome of the surgery. The role of anesthesia not only involves intraoperative management, but also immediate attenuation of postoperative pain. The American Association of Nurse Anesthetists Position Statement No. 2.8 (2004) describes the CRNA's responsibility of providing safe analgesic levels for acute pain relief, which includes establishing appropriate analgesic levels for acute and/or chronic pain. These analgesic levels are established by professionals that have the competence to assess and analyze patient needs to determine the appropriateness of the planned analgesic intervention.

Anesthesia providers are placing a new emphasis on methods of multimodal pain relief. This encourages a pain management plan that includes multiple mechanisms of action, and more than one method of analgesia. Different pharmacologic interventions available to the provider include intrathecal opioids, epidural infusions with local anesthetics and/or opioids, peripheral nerve blocks, parenteral opioids, non-steroidal anti-inflammatory agents and acetaminophen. Rosenquist and Rosenberg (2003) conclude that one type of peripheral nerve block, the femoral nerve block (FNB) improves analgesia and decreases the need for morphine use after total knee arthroplasty. Ultimately, adequate pain relief after knee replacement surgery translates into improved long-term outcome with the new joint and an increase in patient satisfaction.

This study sought to determine the level of utilization of the femoral nerve block technique by CRNA's, and its perceived efficacy in controlling pain for total knee arthroplasty. After completing the survey to obtain the data for this study, a heightened awareness among the CRNA community may exist regarding the use of peripheral nerve blocks for postoperative pain control of TKA patient. This could provoke discussion and provide impetus for future studies related to this method of analgesia.

Purpose of the Study

The purpose of this study was to determine certified registered nurse anesthetist (CRNA) practice experience with femoral nerve blocks in patients receiving a total knee arthroplasty (also referred to as total knee replacement). The results of this study show the frequency of utilization of the technique and its perceived efficacy in postoperative pain control. Accordingly, if nurse anesthetists do not use femoral nerve blocks, then what were the barriers in clinical practice that prevented the CRNA from administering them?

Theoretical Framework

The Theory of Planned Behavior (Ajzen, 1991), and its application to femoral nerve block use, is the framework for this study. According to this theory, human action is guided by three considerations: behavioral beliefs, normative beliefs, and control beliefs. These beliefs determine a person's attitude toward the behavior, subjective norm and perceived behavioral control. These beliefs, then, lead to the intent to perform, and ultimately performing the behavior itself.

Research Questions

There were three major research questions in this study:

1. What was the utilization of the femoral nerve block technique (FNB) by CRNA's on total knee arthroplasty patients?
2. What was the CRNA's perceived efficacy of post operative patient pain relief when using the FNB on TKA patients?
3. What barriers existed that prevent the CRNA from utilizing the FNB for pain control in patients receiving a total knee arthroplasty?

Definitions

For the purpose of this study the following five terms were theoretically defined:

Analgesia is simply the absence of the sense of pain (Merriam-Websters, 1998).

Multimodal analgesia is the administration of multiple analgesics with different mechanisms of action (Rosaeg et al., 2001).

Efficacy is the power to produce effects, or production of the effect intended (American Heritage Dictionary, 2000).

Total knee arthroplasty (TKA) is the surgical replacement of the knee joint surfaces with metallic and plastic components (Jaffe & Samuels, 2004).

Femoral nerve block is a procedure in which a local anesthetic is injected or infused into the femoral nerve sheath to block sensory impulses from the quadriceps, sartorius and pectineus muscles, which are found in the medial and anterior thigh. This does not include sensation to the posterior knee (Morgan, Mikhail, & Murray, 2002).

Assumptions

The following assumptions were made for this study: (a) patients receiving TKA have postoperative pain; (b) movement, including physical therapy and continuous passive motion exercisers will increase the patients' pain; (c) increased amounts of pain

are undesirable and inhibit the ability to tolerate rehabilitation, which diminishes patient outcome; (d) recall of information by the CRNA for the purpose of completing the survey is accurate and unbiased; and (e) the perception of patient pain control by a CRNA is accurate.

CHAPTER II

REVIEW AND CRITIQUE OF RELATED STUDIES

Due to their relationship to total knee arthroplasty, the literature review for this subject was generated by the review of many key words: "postoperative pain", "pain management for major orthopedic procedures", "the analgesic affects on rehabilitation and patient outcome", and "the use of anticoagulant therapy." Neuroaxial techniques, including intrathecal opioids and epidural analgesia were also explored; finally, studies comparing the use of various local anesthetics for administration of peripheral nerve blocks such as femoral, sciatic and 3-in-1 blocks were examined. The role of the certified registered nurse anesthetist in the practice of anesthesia and pain management was also addressed.

Postoperative Pain

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Carr & Jacox, 1992). Pain is a form of stress that produces an elevation in circulating stress hormones and catecholamines, which have negative effects on the body when levels are elevated for prolonged periods. Effective pain management has been shown to result in shorter hospital stays, improved mortality rates, better immune function, less catabolism and endocrine dysfunction and fewer complications. Proper pain management not only

keeps patients more comfortable, but also may decrease the risk of morbidity and mortality, thus improving overall utilization of health resources.

Patients presenting for total knee arthroplasty range in all sizes and ages with different pain perception and expectations of post surgical discomfort. A review by Chung, Ritchie, and Su (1997), including over 9,900 surgical patients, described the orthopedic surgical population as having the highest incidence of postoperative pain. One such orthopedic procedure, the total knee arthroplasty (TKA) can produce severe postoperative pain that is magnified by the need for immediate flexion exercising of the newly implanted joint. Based upon the awareness of the stress response to pain, which may adversely affect post operative recovery, anesthesia providers and surgeons have a responsibility to provide the best pain control techniques available.

The current literature clearly describes the advantages of pain control and its effects on patient outcomes. Better pain control has the potential to allow for earlier hospital discharge, and may improve the patient's ability to tolerate physical therapy (Graber & Kraay, 2003); conversely, lack of pain control hinders early intensive therapy, which is an influential factor in adequate rehabilitation following joint replacement. Continuous passive motion exercise is tolerated by a larger percentage of patients treated with regional analgesia than those patients treated with narcotic based analgesia following knee surgery (Capedevila et al., 1999). This study found that the continuous femoral analgesia group (n=20) versus the patient controlled analgesia group (n=19) had improved range-of-motion, ($p < 0.05$).

Pain Management for Major Orthopedic Procedures

Since 1993, when the U.S. Agency for Health Care Policy and Research Acute Pain Management Guideline was released, the development of a conceptual basis for the treatment of postoperative pain, the refinement of regional anesthetic techniques for postoperative use (Rosenquist & Rosenberg, 2003) and the implementation of multimodal analgesic techniques have become prevalent. Regional techniques are part of a multimodal strategy that includes both pharmacological and nonpharmacological interventions. The use of the perioperative regional technique as part of this strategy may provide long-term benefits, such as improved morbidity and mortality, allowing a positive anesthesia impact beyond the traditional intraoperative period.

Multimodal analgesia involves different methods of analgesic delivery, but there are advantages and limitations of each mode. Neuroaxial techniques, including intrathecal opioids and epidural infusion of local anesthetics with or without opioids can provide pain relief from six hours post surgery to the time of removal of the epidural catheter. Limitations to this technique, however, are significant in that the incidence of spinal or epidural hematoma is increased when the patient receives anti-coagulant therapy post-operatively (Weller, Gerancher, Crews & Wade, 2003). Specifically, the use of low molecular weight heparins for deep vein thrombosis prophylaxis in this population is a drawback to the use of continuous neuroaxial analgesia. Although this potential complication of hematoma formation can be minimized through proper timing of block administration and discontinuance, formation of hematoma in the femoral sheath has fewer serious outcomes than formation of an epidural or spinal hematoma.

Parenteral (intravenous or intramuscular) use of opioids is a common therapy for pain control. Patient controlled analgesic (PCA) use has been well-studied for its efficacy (Rosenquist & Rosenberg, 2003), but is limited by systemic adverse effects such as sedation, urinary retention, nausea, vomiting, itching or respiratory depression. This IV route of opioid administration can be a helpful adjunct to neuroaxial or peripheral nerve block techniques. In fact, parenteral opioid therapy most often is used in conjunction with the other methods to cover break through pain during activity or therapy. Oral administration of nonsteroidal anti-inflammatory agents or acetaminophen is also an option within the multimodal technique.

The last pharmacologic component of the multimodal technique, the use of regional analgesia (either in the form of continuous or single injection peripheral nerve blocks), is associated with decreased postoperative pain and improved recovery following TKA (Rosenquist & Rosenberg, 2003). Several advantages of peripheral blocks are: no sympathectomy-induced decrease in blood pressure, and no narcotic-related adverse effects as seen with neuroaxial or parenteral opioids administration (Graber & Kraay, 2003; Liu & Salinas, 2003; Singelyn, Deyart, Joris, Pendeville & Gouverneur, 1998). Another study concluded, that in comparison with intrathecal morphine, a single injection femoral nerve block provides equivalent analgesia but with a significant reduction in side effects for patients having total knee arthroplasty under bupivicaine intrathecal anesthesia, $p < 0.05$, for nausea, vomiting and purities (Sites, et al. 2004). The study by Singelyn found that when continuous femoral nerve block was compared to patient controlled analgesia, patients reported significantly lower pain scores $p < 0.001$, a 50% improvement in functional recovery evidenced by better knee flexion, faster time to

ambulation $p < 0.001$ and a 20% decrease in length of stay $p < 0.001$. Chelly et al. (2003) also found that the use of continuous femoral infusion led to a 20% decreased length of hospitalization (n =92) following total knee arthroplasty, $p < 0.05$ (2001). These studies describe the positive impact, as well as the limitations, of the femoral nerve block technique.

Femoral Nerve Block

Efficacy of the femoral nerve block in postoperative pain control with TKA patients has been evaluated from many different research approaches: single injection versus continuous infusion of block, the addition of sciatic and obturator block to the femoral approach, or peripheral nerve block as compared to intravenous patient controlled analgesia and continuous epidural infusion. The general outcome of the use of femoral nerve block for post surgical analgesia favors this technique in that it provides good pain relief with minimal side effects.

The literature does present the limitations of this technique, one of which is spontaneous femoral hematoma, a serious complication in patients on anticoagulants; the risk increases with increasing therapeutic level of anticoagulation, age greater than 70, and concurrent antiplatelet therapy (Weller et al., 2003). One limitation of single-shot nerve block techniques is that they do not provide extended postoperative analgesia (Chelly, Ben-David, Williams & Kentor, 2003). Research data describing adequate coverage of analgesia with a FNB is contradictory; Ben-David, Schmalenberger, and Chelly state that "adequate analgesia after TKA cannot be achieved with continuous femoral infusion alone and that the addition of continuous sciatic infusion renders a significant improvement in analgesia" (2004). Conversely, the addition of a sciatic nerve

block to the femoral nerve block was found not to provide additional benefits to the patient (Allen, Liu, Ware, Nairn & Owens, 1998). Yet another study suggests adding an obturator nerve block to improve postoperative analgesia following total knee replacement improves pain control (McNamee, Convery & Milligan, 2001). The sample size of these three studies described ranged from twelve to sixty patients.

The timing of the administration of the femoral nerve block differed from a pre-op holding area, to the operating room immediately following induction, and the immediate post operative period in the post anesthesia care unit. Two of the studies looked at a single shot technique and a third analyzed the continuous technique to deliver the analgesic. Based upon these differences in the research, it would be difficult to reach a sound conclusion about the efficacy of femoral nerve block alone versus the addition of other blocks. The bottom line, however, is that although the perception of pain was decreased with the administration of a FNB over the use of intravenous opioids alone, the variance in analgesia obtained by a block still required supplemental intravenous opioids for complete pain control.

Other drawbacks to the use of the femoral nerve block include the potential for systemic toxicity from the administration of local anesthetic into the nerve and/or systemic vasculature, and the potential delay of surgery to complete the nerve block procedure. Although the use of femoral nerve block resulted in faster, short-term functional recovery of knee flexion during rehabilitation, it did not demonstrate a significant difference between the PCA and femoral nerve block groups 6-12 weeks into the patient's recovery (Liu & Salinas, 2003). Despite the evidence that the long-term outcome is equal between FNB and PCA groups, the short-term benefit of improved pain

control immediately postoperatively is significant for the patient's emotional well-being and their ability to tolerate the vigorous rehabilitation schedule demanded by the knee joint replacement.

The technique for a femoral nerve block is standard throughout the literature. The femoral nerve originates from nerve roots L2-L4, and enters the thigh by passing deep to the inguinal ligament, 1-2 cm lateral to the femoral artery (Arraf, 2002). The anterior branch innervates the sartorius muscle as well as sensory cutaneous fibers to the anterior and medial thigh. The posterior branch innervates the quadriceps muscle, the knee joint and its medial ligament before terminating as the saphenous nerve. The femoral nerve is not the exclusive innervation of the knee; the obturator, sciatic, and lateral femoral cutaneous nerve also provide motor and sensory innervation (Ganapathy et al., 1999).

To place the femoral nerve block, the femoral artery is palpated at the inguinal ligament and, after performing a lidocaine skin wheal, the needle is inserted 1-2 cm lateral with a cephalad angulation. The proximity of the femoral nerve is located via a nerve stimulator and the local anesthetic is injected. A catheter for continuous infusion may be placed at that time (Mulroy, 2002). The local anesthetics used for this block, according to the literature review, vary by provider and may include ropivicaine, bupivicaine, and mepivicaine. The reported efficacy and duration of block varies by research reviewed (Casati et al., 2001; Fanelli et al., 1998; McNamee, Parks & Milligan, 2002). These three studies looked at many variables: the type of block (femoral, sciatic and/or obturator), the type of analgesic used (ropivicaine, bupivicaine and mepivicaine), and the technique used (single injection versus continuous infusion). After analysis of these different studies, the conclusion of the reviewer demonstrates that no universal

technique for pain relief has been consistently identified within the anesthesia community.

The efficacy of the peripheral nerve blocks is well documented. The use of nerve blocks "is associated with decreased postoperative pain and improved recovery following total knee arthroplasty. The ability to meet range-of-motion goals earlier facilitates earlier discharge and greater functional rehabilitation" (Rosenquist & Rosenberg, 2003). Despite the well-studied efficacy of the peripheral nerve block technique, the overall incidence or utilization is not well defined or discussed in the literature reviewed.

The Role of the Certified Registered Nurse Anesthetist

One task of the anesthesia provider in managing the anesthetic involves selecting, obtaining, ordering or administering medications to provide relief from pain. CRNA's may provide this service independently or collaboratively with an anesthesiologist. Medicare or the Joint Commission on Accreditation of Health Care Organizations does not require anesthesiologist supervision or direction, individual state laws permit CRNA's to work directly with a physician, such as a surgeon, or other authorized health care professional (Professional and Legal Issues, 1989) to accomplish the pain management goals required for the patient.

Theoretical Framework

The Theory of Planned Behavior (Ajzen, 1991) and its application to femoral nerve block use is the framework for this study. According to this theory, human action is guided by three considerations: behavioral beliefs, normative beliefs and control beliefs. These beliefs determine a person's attitude toward the behavior, subjective norm

and perceived behavioral control. These, then, lead to the intent to perform and ultimately performing the behavior itself. See Figure 1.

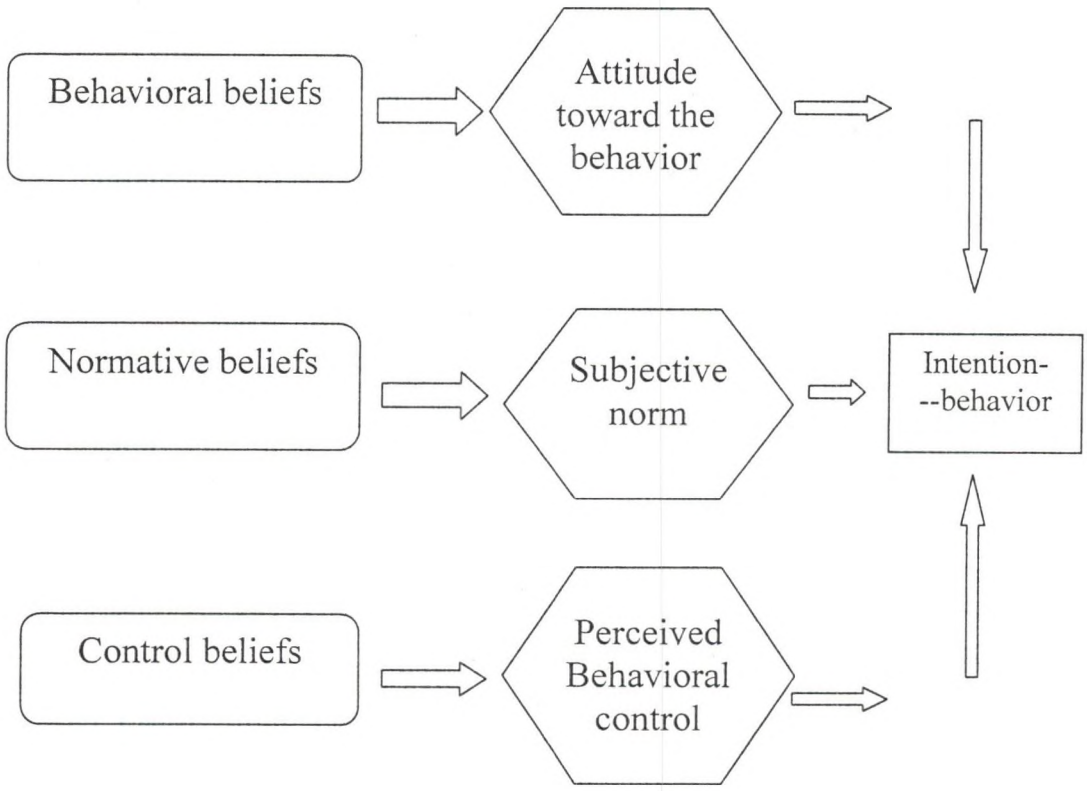

Figure1. Theory of Planned Behavior.

As it applies to this study, an important arm of this model is the concept of control beliefs. Control beliefs concern the perceived presence of factors that may facilitate or impede the performance of a behavior. For instance, the survey "Exploring the use of Femoral Nerve Block for Total Knee Arthroplasty" asks the CRNA to "evaluate" a list of reasons femoral nerve block may not by used. This identifies the presence of factors that may limit the use of the technique, which fits directly into this construct. Behavioral beliefs link the behavior to expected outcome, which can be described as the subjective

probability that the behavior will produce a given outcome. For example, if the performance of a femoral nerve block will control the postoperative pain of a total knee arthroplasty, the nurse anesthetist would be more likely to administer the block. Normative beliefs, measure the motivation to comply with behaviors that are suggested by another person, this may be a spouse, friend, coworker or other professional, and describes the social pressure to engage in certain behaviors. If other CRNA's are using femoral nerve block to control pain for the TKA patient, will the survey respondent be more likely to use this technique?

This model encourages self-report from participants, which is easily obtained in the form of a questionnaire. This allows data collection in the form of a survey, in which asking respondents to judge the predictors can directly assess all predictors in the theory of planned behavior. One method that can accomplish this task is a set of scales, such as a Likert Scale (see questions 6-8, 15 on the survey "Exploring the use of Femoral Nerve Blocks for Total Knee Arthroplasty", Appendix C). Therefore, the survey method allows the researcher to collect the necessary data to complete the study using the theory of planned behavior framework.

CHAPTER III

METHODOLOGY

The purpose of this descriptive study was to determine certified registered nurse anesthetist practice experience with femoral nerve block in patients receiving total knee arthroplasty. This surgical procedure is common, and is known to cause severe pain postoperatively, which is complicated by the immediate flexion of the joint, which is vital to positive functional outcome. The role of the anesthesia provider traditionally involves intraoperative analgesia, but can also be extended into the area of postoperative pain management to improve patient outcomes.

Study Design

A descriptive correlation survey was conducted to collect data to answer the questions regarding femoral nerve block use. Within that collection, the primary goal was to identify the CRNA utilization of this technique. The secondary goal was to identify a relationship between the barriers of this technique and its lack of utilization. A cross section of data was collected; the participants were not followed over time. The Institutional Review Board of the University of North Dakota approved the project via an exempt review process (see Appendix A).

Population & Sample

The population targeted for this study was nurse anesthetists whose practice

included total knee arthroplasty patients. Quota samples of the CRNA's at four major hospitals in a Midwestern state were asked to participate in completing the questionnaire.

Data Collection Methods

Via a tool developed by the researcher, data was collected over a predetermined time period. The Clinical Coordinators facilitating the education of student registered nurse anesthetists (SRNA) of the researcher's school were contacted at each of the clinical sites to secure their assistance in distributing and collecting the surveys. The surveys, along with individual cover letters and return envelopes, were delivered to the coordinator, and distributed to the CRNA staff. The cover letters accompanying the questionnaires described the study purpose, voluntary participation, confidentiality and process for completing the questionnaire. Consent was implied by the return of the survey. The surveys were placed in an envelope, sealed and returned to the Clinical Coordinators, who then collected, and returned the surveys to the researcher. Confidentiality was assured by receiving the data in aggregate form, excluding any participant identifying information. Surveys were then stored in the nursing research office on the campus of the University of North Dakota after completion of the analysis. Only the researcher, the advisor and the IRB auditors had access to the data.

Instrument Reliability and Validity

The survey components of CRNA practice habits, perceived efficacy and barriers to performing femoral nerve block were written specifically for this study. A modified Delphi technique was utilized to verify that the questions were easy to understand and that they included only relevant content. Two expert nurse researchers, an anesthesia

program director, a physiology expert and professor of statistics reviewed the survey for content validity.

Limitations

The following limitations were identified for this study: Femoral nerve block may not be used in the population of CRNA's that were sampled; the accuracy of the data obtained is limited by the recall of the anesthesia providers; the anesthetist, not the patient, is judging the patient's pain relief; the sample size may be small compared to the large population of practicing certified registered nurse anesthetists.

CHAPTER IV

RESULTS

The purpose of this study was to determine certified registered nurse anesthesia (CRNA) practice experience with femoral nerve blocks in patients receiving a total knee arthroplasty. The analysis of this data answered the following questions: What was the frequency of utilization of the nerve block technique among respondents; What was its perceived efficacy for postoperative pain control from the anesthetists point of view; When nurse anesthetists did not use femoral nerve blocks, what barriers are identified in clinical practice that prevent them from administering them?

Characteristics of the Sample

The survey "Exploring the use of Femoral Nerve Block for Total Knee Arthroplasty" were distributed to 115 CRNA's; 68.7 % (n = 79) surveys were completed and returned. Participants reported an average of 5.48 years in nursing prior to attendance at anesthesia school. The number of years of experience in performing anesthesia ranged from 1-30 years, with and average of 12.3 years in clinical practice.

Almost all (98.7%) of respondents affirmed their provision of anesthesia for patient's receiving total knee arthroplasty by reporting a range of 1-25 such anesthetics per month. The surveys from the 2% of respondents that denied service to this population of patients were not analyzed. The number of TKA procedures performed

annually per facility based upon the survey results showed a mean number of 420 TKA procedures per year, and a median number of 300 TKA procedures per year.

Results from Analysis of Research Questions

The research question of frequency of utilization of the femoral nerve block (FNB) technique by certified registered nurse anesthetists (CRNA's) for total knee arthroplasty (TKA) was analyzed. It was determined that 63.2% of the respondents did not perform FNB on any of their TKA patients. In contrast, 36.8% of CRNA's did provide a FNB on the average of 2.82 TKA procedures per CRNA per month. Based upon the total number of FNB performed per month (79), 17.2% of all patients included in the survey received a femoral nerve block for pain control for their total knee arthroplasty surgery.

Having determined the frequency of FNB, the CRNA's were divided into three groups for purpose of comparison, regarding training in FNB procedure: (1) those who had only received training in their anesthesia program, (2) those who had received other formal training such as an in-service or on-the-job instruction, and (3) those who had received both types of training. As the groups were compared, the frequency of performance of FNB varied between the groups; program trained anesthetists (1) used FNB for 30% of TKA anesthetics, formally trained anesthetists (2) used FNB for 68% of TKA anesthetics and those CRNA's with both types of training (3) performed FNB for 89% of TKA anesthetics. See Table 1.

Table 1. Training and Performance of Femoral Nerve Blocks.

Category	Number of Respondents With Training	Number Performing Femoral Nerve Blocks	Percent Performing Nerve Block
Program training & other formal training	9	8	89%
Other formal training	16	11	68%
Program training	20	5	17%

The 36.8% of CRNA's who reported that they did use FNB were asked to describe the method of administration of FNB and the local anesthetic agents most commonly used for the nerve block in their practice. The respondents were asked to select which method of administration of femoral nerve block that they used: continuous infusion, single shot, or a combination of these methods. Only 2% used both the combined single injection and continuous methods; all others (98%) reported using the single injection, while none of the CRNA's used the continuous method alone.

Next, the survey asked the participants to list the local anesthetic agent(s) they frequently used for femoral nerve block: (1) lidocaine, (2) ropivicaine, (3) mepivicaine, (4) bupivicaine and (5) any combination of products. Bupivicaine (Marcaine®) was the most frequently (73%) used single agent, the next agent(s) of choice were ropivicaine (Naropin®) combined with another local anesthetic agent (17%), ropivicaine (Naropin®) alone was reported as the third most popular (10%) drug(s) used for this nerve block.

All respondents were asked to identify the setting in which the femoral nerve block (FNB) was administered. Four choices were offered: a pre-op area, the operating

room (OR), the post anesthesia care unit (PACU), and the nursing unit. The setting most frequently utilized according to the survey was the PACU (54%), followed by the OR (39%) and pre-op (7%), the nursing unit was not identified as a setting for performance of a FNB. See Figure 2.

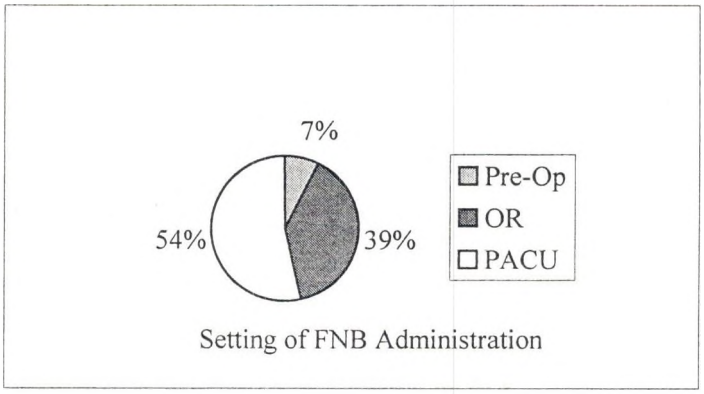

Figure 2. Setting of Performance of Femoral Nerve Block.

The analysis revealed that CRNA's performed anesthesia for a mean average of 2.82 TKA procedures per month. Only 36.8% of these CRNA's provided a FNB for postoperative pain control. To determine the other pain control methods used for TKA patients, the frequency of five alternative pain control methods were rated for frequency of use by the anesthetists: intrathecal opioids, local/opioid epidural infusion, intravenous (IV) opioids, intramuscular (IM) opioids, and non-steroidal anti-inflammatory agents (NSAID's). The CRNA data was categorized by a frequency: "never", "rarely", "sometimes" and "often" for each pain control method listed. All frequencies except "never" were included in the percent of utilization tabulation as rarely, sometimes and often indicated that the FNB method was used with some frequency. See Table 2.

Table 2. Pain Control Methods Used.

Method	Frequency				% utilization
	never	rarely	sometime	often	
IV opioids	4%	25%	40%	31%	96%
Intrathecal opioids	15%	19%	24%	42%	85%
NSAID's	15%	29%	29%	27%	85%
IM opioids	45%	28%	19%	8%	55%
Epidural infusion	47%	40%	11%	2%	53%

The method that received the most frequent rating of "often" was intrathecal opioids occurring for 42% of total knee arthroplasty pain control plans. The method that received the highest rating of utilization was the intravenous opioids at 96%.

The second research question, the CRNA's perception of the efficacy of pain control was assessed by several questions in the survey, including; method of anesthesia provided, method of pain control used, and an evaluation of the patient's pain control at two different time points post operatively. First, respondents categorized, by percentage, the frequency of the different methods of anesthesia provided for total knee arthroplasty. Three categories of anesthesia were offered; general anesthesia, spinal anesthesia and epidural anesthesia. Based upon the analysis of the data, the most frequent type of anesthetic delivered for TKA was spinal at 60.86%, followed by general at 31.86% and finally epidural at 7.27% of all TKA anesthetics delivered by the survey respondents. This data is summarized in Figure 3.

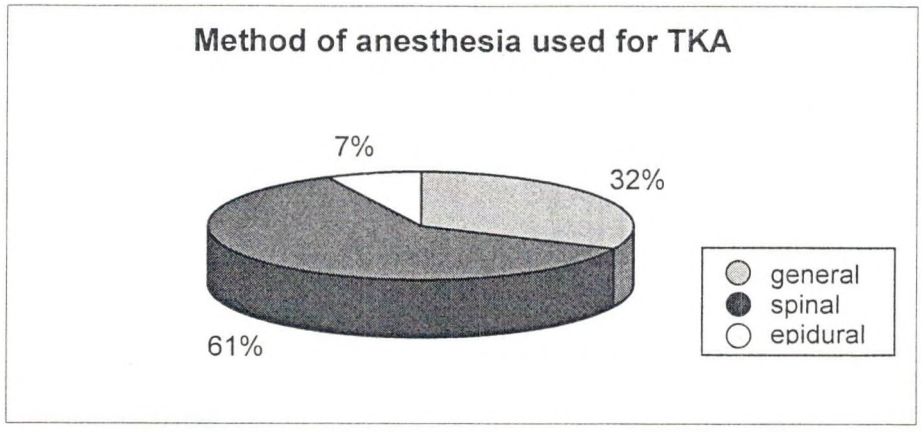

Figure 3. Method of Anesthesia Used for TKA.

The respondents were then asked to rate their perception of patient postoperative pain control at two different time points; immediately post operative (in the post anesthesia care unit) and eighteen to twenty-four hours post operative while on the nursing unit. These perceptions were rated on a scale of 1-4, which correlated to a scale of poor to excellent patient pain control. The data was evaluated to determine if there was a difference in the pain control based upon the different methods of anesthesia used.

Of all the CRNA's, 39% felt the immediate PACU pain control was "good" (rating of 3) when a general anesthetic was used for TKA. This number dropped to 10% "good" when evaluated 18-24 hours later. The pain control for spinal anesthetic revealed a larger gap in data; 86% excellent pain control in PACU to 2% excellent pain control on the nursing unit the next day. Epidural anesthesia provided the best 24-hour post operative rating of "good" at 20 %, which had dropped from 32% "good" pain control in the PACU. The epidural anesthesia group had the least amount of data to be evaluated, with 54% of respondents providing no opinion of epidural anesthesia pain control. See Table 3.

Table 3. Pain Control Rating by Type of Anesthesia.

Type of anesthesia	Time of Pain Evaluation	
	Post Anesthesia Care Unit	18-24 hours post-operative
General	39% good	10% good
Spinal	86% excellent	2% excellent
Epidural Anesthetic	32% good	20% good

After initial analysis, this data for pain control was further divided into two groups: the respondents who denied use of FNB compared to the CRNA population that did perform femoral nerve blocks. The ratings provided were quite similar between the two groups of CRNA's except for the opinions of the pain control achieved in the post anesthesia care unit for those patients receiving a general anesthesia. A t-test was run to determine if a difference existed between the groups ($n = 28$, df 46, $p < .05$). The results of the analysis showed a $p = 0.009$ which fell below the chosen alpha level of 0.05 which gives significance to the data. The CRNA's that did use the FNB reported a lower rating of patient pain control upon arrival to the PACU when a general anesthetic was used, with more of these respondents giving a poor to fair rating than the majority of all CRNA's in the sample giving a fair to good rating when categorizing their perception of patient pain control at this time point. See Figure 4.

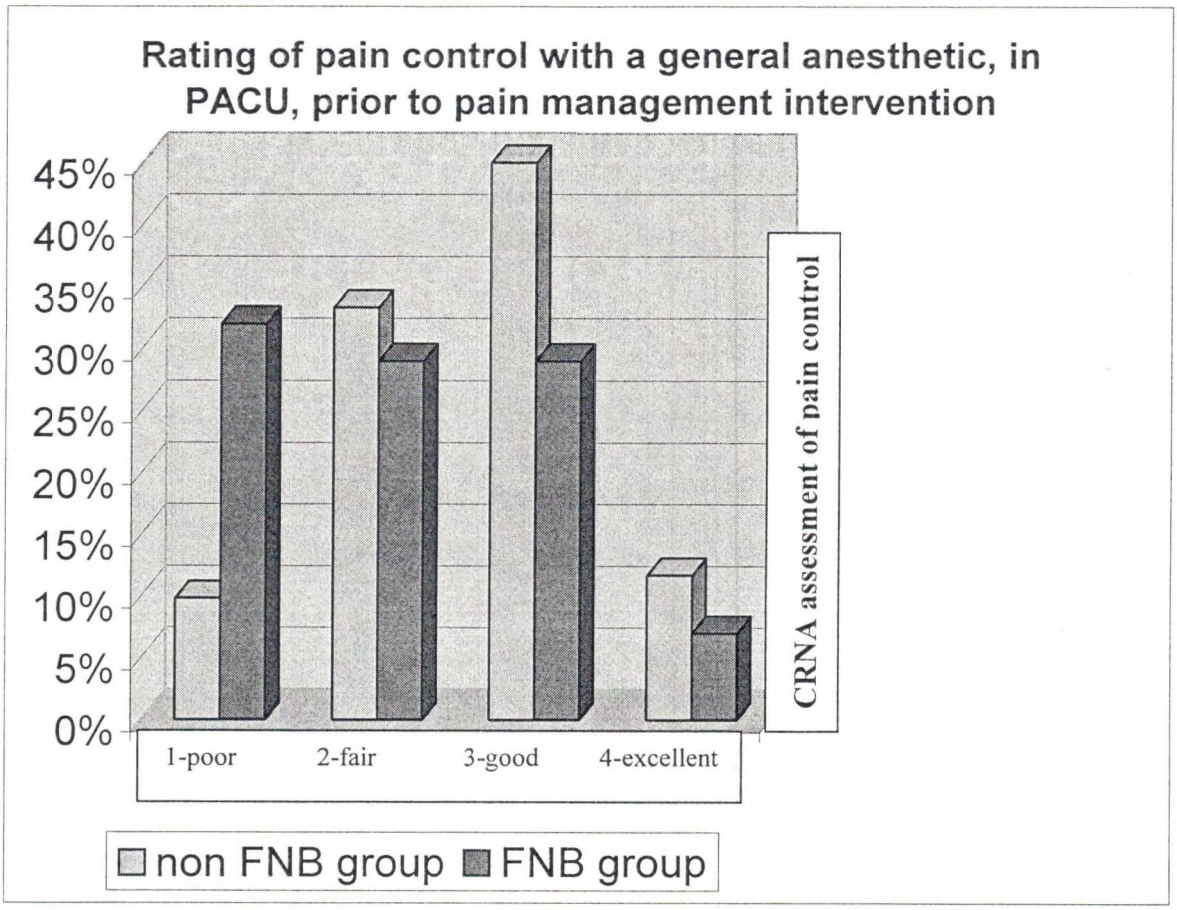

Figure 4. Rating of Pain Control with a General Anesthetic in PACU.

To complete the research questions, the CRNA's provided data regarding the perceived barriers to performing a femoral nerve block. The respondents were asked to agree or disagree to a list of reasons FNB may not be used. The following barriers were offered for rating: lack of time between cases, lack of equipment or supplies, lack of training or experience, anti-coagulation therapy, risk of quadriceps muscle weakness, and surgeon preference. Figure 5 lists these barriers in order of strongly agree (SA=4.0), that these barriers would prevent the use of a FNB, to strongly disagree (SD=1.0), that the barriers would not prevent FNB use for the TKA patient.

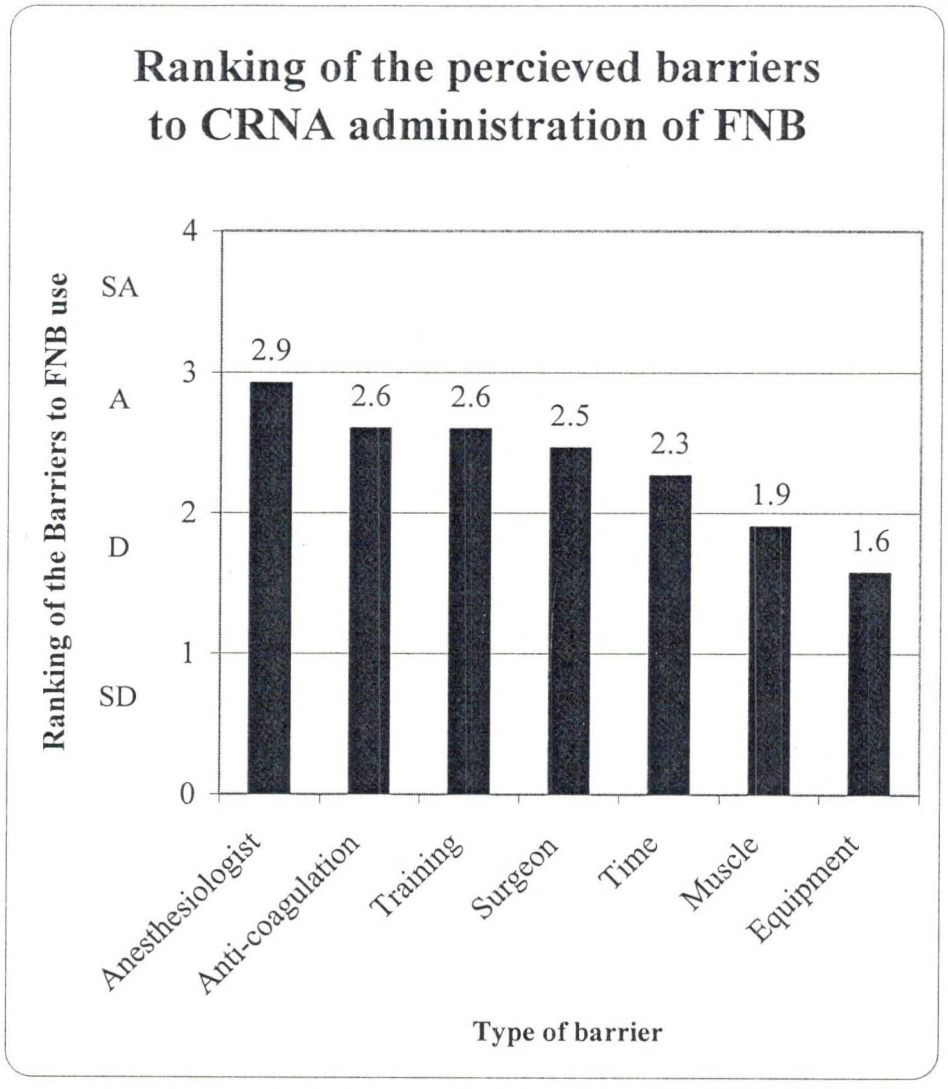

Figure 5. Perceived Barriers to Administration of FNB.

Summary

A total of 79 surveys were analyzed for data regarding the use of femoral nerve block by CRNA's, including training received, setting in which the nerve block was performed, and the type of local anesthetic agents used for the technique. Pain control via multimodal therapy and types of anesthesia provided for total knee arthroplasty were also explored. These survey questions provided adequate data to draw conclusions for each of the research questions posed by this project.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Summary of Purpose and Methods

CRNA's have the competence and professional responsibility to assess and implement analgesic intervention for a patient undergoing a total knee arthroplasty (TKA). Multimodal pain therapy includes the use of peripheral nerve blocks for operative and post operative pain control. This study explored the use of femoral nerve block by CRNA's for the TKA patient.

The data was collected via surveys to CRNA's providing total knee arthroplasty anesthetics and then analyzed to determine the utilization of femoral nerve block, the perceived efficacy of pain control for the TKA population, which they served, and to explore barriers to the use of femoral nerve block.

Discussion

The utilization of femoral nerve block (FNB) according to the study results was 17.2% of all TKA patients included in the survey. Currently, no other data on utilization of FNB could be found in the literature with which to compare the 17.2% utilization found in the Midwest with other areas of the United States. The survey data did show a complete range of utilization, within a relatively small geographic area. Providers reported 0-7 FNB per month, showing that FNB is a technique that is used as frequently as 100% of all TKA's in a certain setting, or it can be completely ignored by CRNA's as

a method of pain control for TKA. This difference in utilization cannot be explained by the variability in training received, years of anesthesia experience or the volume of TKA procedures by a particular institution. The survey did not allow identification of the site of practice; it was therefore not possible to evaluate the utilization based upon the particular institution in which it was performed.

Those CRNA's who received both formal and other training in nerve block technique were more likely to use FNB for pain control than their peers. The Theory of Planned Behavior normative beliefs (those beliefs that are performed and supported by so-workers), may account for the incidence of performance of the FNB. An interesting discovery among the surveys revealed three respondents who indicated no program training or other formal training did perform FNB routinely, between 2-5 blocks per month.

The method of FNB that was almost unanimously reported as used by the CRNA's was the single injection method, with bupivicaine emerging as the most popular agent (73%) for providing anesthesia to the femoral nerve. It is unclear in the survey data why the single injection method is preferred. Follow up monitoring and treatment may be a detriment to higher utilization of the continuous method, as well as anti-coagulation concerns for continuous catheter removal as described by Weller et al., 2003.

The setting of FNB was most often the PACU (54%). This finding raises several questions; does the level of pain control in the PACU determine whether FNB is performed and does the use of general anesthetic lead to a higher use of FNB? The data revealed that, of the CRNA's who do perform FNB, 60% reported the pain control of general anesthesia upon arrival of the patient to the PACU as either fair or poor. Also,

the nerve stimulator technique for placing a FNB cannot be utilized with spinal or epidural anesthesia, unless performed pre-op, before motor block, or hours after the surgery when the motor block has subsided in order to effectively evaluate the response to nerve stimulation during placement of the needle. Therefore, is the FNB performed more often with general anesthesia than spinal/epidural anesthesia?

The data for assessing pain control in the PACU was 90% complete by the respondents for all three categories of general, spinal and epidural anesthesia. In contrast, the data for evaluation of the pain control 18-24 hours postoperatively was provided in only 43% of the surveys returned. The reason that this delayed assessment of patient pain control was not complete is not available from the data obtained, however, if a delayed assessment of patient pain control is not available, the practitioner may not appreciate the relatively long-term analgesic effect of a FNB. The behavior beliefs from the Theory of Planned Behavior, describe the probability that the behavior will produce a given outcome. If the provider does not know the pain control of FNB beyond the PACU, the provider may choose not to use the block.

The perceived barriers to administration of FNB were ranked by mean preference. The lack of equipment or supplies and risk of quadriceps muscle weakness were the two items the CRNA's did not feel were barriers to performing the procedure. Anesthetists chose these barriers: lack of time between cases, surgeon preference, lack of training, risks of anti-coagulation therapy, and anesthesiologist preference as reasons FNB may not be used. The anesthetists closely ranked these five items with the mean scores ranging from 2.9-2.3 (a score between 2-3 indicated the respondents agreed the barrier prevented the performance of FNB). According to the survey respondents, they agree

these five barriers are encountered by CRNA's when a FNB for pain control is considered for the TKA patient.

Addressing these barriers so that FNB may be utilized more often for TKA patients requires flexibility from health care providers. The perceived or actual lack of time between surgical cases is an issue that crosses over many departments within a facility. A major effort would be required to increase the amount of time available to facilitate the placement of these blocks for the patient. In contrast, the issue of surgeon preference is highly individualized and may require review of current literature and an educational process to address the safety and efficacy concerns of the orthopedic surgeon.

Lack of training has a stronger impact on the non-use of FNB. According to the data, 54 of 79 of respondents had received some type(s) of training in the administration of FNB. Of this group that had received some type of training, 55.5% of them reported performance of the FNB technique. This rate of utilization suggests that CRNA's would use the nerve block technique at least one-half of the time in their practice with TKA patients if they had received some instruction or training in the administration of the block. This could change the 17.2% utilization of FNB by CRNA's for the TKA patient revealed by the analysis of this study.

The risk of anti-coagulation therapy is a concern among the respondents with a mean response of 2.6, which indicates they agree anti-coagulation presents a barrier to FNB administration. However, the review of literature shows the risk of hematoma is lower for nerve blocks than the hematoma risks for neuroaxial analgesia (spinal or epidural infusion). Risk can also be decreased by using the single injection method for femoral nerve block, prior to the initiation of anti-coagulation versus using a continuous

infusion into the femoral sheath, which requires ongoing assessment and discontinuation of the catheter after anti-coagulation therapy has been initiated.

Finally, the preference of the anesthesiologist (MDA) was ranked as the most frequent barrier to performing FNB. In an environment where MDA's and CRNA's work together to provide anesthesia to many patients within a single surgical day, teamwork between providers is an asset. Perhaps the MDA is actually performing the FNB procedure more frequently than the CRNA due to their flexibility to see patients in the pre-op and PACU area, while the CRNA provides the majority of their anesthesia care during the surgical procedure within the operating room. This may translate into more FNB being used for patients than what is reported in this study because utilization data for only CRNA's, not MDA's was included.

Contribution to Nursing

A role of the nurse anesthetist is to implement appropriate interventions to minimize or control the perception of pain to provide positive outcomes for patients. As advanced practice nurses in the specialty of anesthesia, CRNA's have the ability to make a significant impact upon the perception of pain experienced by the surgical patient. CRNA's are experts at multi-modal pharmacologic therapy for anesthesia, which easily crosses over to the arena of multi-modal pain control, including the technique of nerve blocks for prolonged postoperative analgesia.

Implications for Education

As the results indicate, the incidence of femoral nerve block use increases as the amount to training increases. All nurse anesthesia programs should provide didactic instruction in peripheral nerve block techniques as well as clinical opportunities to

perform the block with guidance from anesthesia providers. The need for follow-up assessment of the patient should also be stressed as part of an anesthesia program to make post-operative visits and evaluation of anesthetic care a routine part of every patient's anesthetic experience.

Additional Research Opportunities

The Theory of Planned Behavior provided an appropriate framework for this study and could be utilized again to obtain more data. More specifically, this study could be expanded to clearly define under which anesthetic conditions (general, spinal or epidural) the FNB technique was used. It may be interesting to determine if another provider, such as a surgeon or anesthesiologist is performing the FNB for pain control thus increasing the actual utilization of the technique. Finally, the direction of the pain efficacy portion of the study could be pivoted to evaluate pain control from the perspective of the patient, instead of the CRNA.

APPENDICES

APPENDIX A
IRB APPROVAL

REPORT OF ACTION: EXEMPT/EXPEDITED REVIEW

University of North Dakota Institutional Review Board

Date: 6/22/2004 **Project Number:** IRB-200406-399

Principal Investigator: Wuest, Michele

Department: Nursing

Project Title: Femoral Nerve Block in Total Knee Arthroplasty

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on June 22, 2004 and the following action was taken:

☐ Project approved. **Expedited Review** Category No. _____
Next scheduled review must be before: _____

☐ **Copies of the attached consent form with the IRB approval stamp dated _____ must be used in obtaining consent for this study.**

☒ Project approved. **Exempt Review** Category No. 2
This approval is valid until June 22, 2005 as long as approved procedures are followed. No periodic review scheduled unless so stated in the Remarks Section.

☐ **Copies of the attached consent form with the IRB approval stamp dated _____ must be used in obtaining consent for this study.**

☐ Minor modifications required. The required corrections/additions must be submitted to ORPD for review and approval. **This study may NOT be started UNTIL final IRB approval has been received.**
(See Remarks Section for further information.)

☐ Project approval **deferred. This study may not be started until final IRB approval has been received.**
(See Remarks Section for further information.)

REMARKS: Any adverse occurrences in the course of the research project must be reported immediately to the IRB Chairperson or ORPD.

Any changes in protocol or Consent Forms must receive IRB approval prior to being implemented. You must submit a memo with a copy of the Consent Form and a revised Human Subjects Review Form, with the appropriate signatures, to the Office of Research and Program Development for review and approval.

PLEASE NOTE: Requested revisions for student proposals MUST include adviser's signature. All revisions MUST be highlighted.

☒ Education Requirements Completed. (Project cannot be started until IRB education requirements are met.)

Waiver of signed consent per 45 CFR 46.117 c2

cc: Helen Melland; Graduate School

Signature of Designated IRB Member — Date: 6-22-04
UND's Institutional Review Board

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 310 Form may be required. Contact ORPD to obtain the required documents.

(Revised 10/2002)

APPENDIX B
CONSENT

Dear CRNA:

You have been chosen to participate in a study being conducted regarding the use of femoral nerve blocks with total knee arthroplasty patients. As a graduate nursing student at the University of North Dakota, Grand Forks, I am requesting your assistance in completing the enclosed questionnaire, which will provide data for my master's thesis. The purpose of this study is to determine practice experience with femoral nerve blocks in patients receiving a total knee arthroplasty.

Your reply will be kept confidential and the results will be reported in aggregate format in a thesis, as a partial requirement for completion of a Masters Degree in Nursing. Your participation is voluntary and return of the completed questionnaire will comprise consent to participate in the research study. This should require no more than 10 minutes of your time. For your convenience, an envelope has been enclosed to assure confidentiality and anonymity of all responses. Only the researcher, the advisor and IRB auditors will have access to the data. The data will be stored in the research room, in the Nursing building on the UND campus and destroyed after three years.

Please return the completed questionnaire, sealed in the envelope, to the UND Clinical Coordinator as soon as possible so I can include your data in my analysis.

If you have any questions or desire a copy of the results upon completion, please feel free to contact me, my research advisor or the Office of Research and Development at the following phone numbers:

Michele Wuest	Home	701-775-1075
Dr. Helen Melland	Office	701-777-4525
Office of Research & Development		701-777-4278

Thank you for your time and participation.

Sincerely

Michele Wuest, RN, BSN
Researcher
Graduate Nurse Anesthesia Student
University of North Dakota

APPENDIX C
SURVEY

Exploring the use of Femoral Nerve Blocks for Total Knee Arthroplasty

Demographics

1. How many years were you in nursing practice before attending an anesthesia program?____
2. How many years have you been in anesthesia practice since graduation?_____
3. Please estimate the annual number of total knee arthroplasties(TKA) in your hospital._____
4. Estimate the number of TKA anesthetics administered by you, per month._____

Anesthesia

5. Of all the TKA anesthesia you have provided to TKA patients in the last year, check your estimate % of type of anesthesia used on these patients.

	0-<25%	25-<50%	50-<75%	75-100%
general anesthetic	_____	_____	_____	_____
spinal anesthetic	_____	_____	_____	_____
epidural anesthetic	_____	_____	_____	_____

6. Of the following methods used for post-op pain control with TKA patient, circle how frequently you use the techniques listed.

	never	rarely	sometimes	often
intrathecal opioids	1	2	3	4
local/opioid epidural infusion	1	2	3	4
IV opioids only	1	2	3	4
IM opioids	1	2	3	4
NSAIDs	1	2	3	4

7. In your opinion, what do you think a TKA patient's general level of pain control is **upon arrival to PACU**, when you use:

	poor			excellent
general anesthetic	1	2	3	4
spinal anesthetic	1	2	3	4
epidural anesthetic	1	2	3	4

8. In your opinion, what do you think a TKA patient's general level of pain control is **18-24 hours** post-operatively?

	poor			excellent
general anesthetic	1	2	3	4
☐ no opinion				
spinal anesthetic	1	2	3	4
☐ no opinion				
epidural anesthetic	1	2	3	4
☐ no opinion				

Femoral Nerve Blocks

9. Did you receive training in your anesthesia program to perform femoral nerve blocks?
Yes_____ No_____

10. If you **did not** receive academic training, did you receive other formal training, i.e. inservice, on-the job for placement of femoral nerve block? Yes_____ No_____

11. Please estimate the number of femoral nerve blocks performed by you per month: (if you do not perform femoral nerve block, enter 0 and skip to # 14)
number of femoral nerve blocks per month_____

12. Which method of femoral nerve block did you use? Select one.

continuous infusion____ single shot____ both methods____

13. Of the local anesthetic agents listed, which one do you use **most** often for femoral nerve block? If you use a combination of products do not check, please write in space below.

Lidocaine____ (Xylocaine®) Ropivicaine____ (Naropin®) mepivicaine____ (Carbocaine®) bupivicaine____ (Marcaine®)
combination of which products_____

14. In which setting is femoral nerve block most commonly performed in the agency where you work? Select one.

pre-op_____ OR_____ PACU_____ nursing unit_____

15. Below is a list of reasons femoral nerve block may not be used. Circle the number which corresponds with your opinion for each reason listed.

	Strongly disagree	Disagree	Agree	Strongly agree
Lack of time between cases	1	2	3	4
Lack of equipment or supplies	1	2	3	4
Lack of training or experience	1	2	3	4
Anti-coagulation therapy	1	2	3	4
Risk of quadriceps muscle weakness	1	2	3	4
Surgeon preference	1	2	3	4
MDA preference	1	2	3	4

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