Anesthesia & Clinical Research

Cohen et al., J Anesth Clin Res 2014, 5:10
http://dx.doi.org/10.4172/2155-6148.1000452

Research Article Open Access

Preoperative Sciatic and Femoral Nerve Blocks for Anterior Cruciate Ligament Reconstruction: A Retrospective Analysis

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Abstract

Objective: Uncontrolled postoperative pain and nausea and vomiting are the most common causes for hospital admission following ambulatory anterior cruciate ligament (ACL) reconstruction. Therefore, finding techniques that provide excellent postoperative pain control is of critical importance. This retrospective study compared patients who received preoperative femoral nerve blockade to those who received combined femoral and sciatic nerve blockade. We hypothesized that a combined preoperative nerve block would result in lower postoperative pain, decreased postoperative opioid consumption, and shorter recovery.

Methods: The medical records of 191 patients who underwent ACL reconstruction were retrospectively analyzed. We then developed multivariable regression models for each primary outcome parameter.

Results: The postoperative pain scores were lower in patients receiving a combined nerve block compared with patients receiving a femoral nerve block (P<0.001) and higher in patients receiving an autograft vs. an allograft (P=0.009). Total morphine equivalents were lower in patients receiving combined nerve block versus patients receiving femoral nerve block (P<0.001) and higher in patients with a higher BMI (P<0.001). Recovery unit length of stay was prolonged by more than 25 minutes in patients with PONV (P=0.001) and in patients who needed a postoperative nerve block in the recovery unit (P ≤ 0.001).

Conclusions: A preoperative combined sciatic and femoral nerve block improved postoperative pain management, while postoperative nausea and vomiting or the need for a postoperative nerve block increased the recovery unit time.

Keywords: Anterior cruciate ligament reconstruction; Femoral nerve block; Sciatic nerve block; Regional anesthesia; Post-operative pain; PACU length of stay

Introduction

Pain and postoperative nausea and vomiting (PONV) are the most common causes for hospital admission following ambulatory surgery [1,2]. Therefore, finding techniques that facilitate rapid recovery and early discharge by providing excellent analgesia with minimal side effects is of critical importance. The anterior aspect of the knee is innervated by the femoral nerve, while the sciatic nerve innervates the posterior portion of the knee--both of these being potential sources of postoperative pain following reconstruction of the anterior cruciate ligament (ACL). Several studies have examined the benefit of a femoral nerve block in knee surgery. Femoral nerve blockade has been shown to improve analgesia following ACL reconstruction [3-6] in some studies, but this effect has not been consistently reproduced [7]. Various surgical factors may influence the efficacy of peripheral nerve blocks. The femoral nerve block did not reduce postoperative analgesic requirements when a hamstring graft was harvested [8] for example. Other authors have suggested that epidural anesthesia provides superior analgesia and improved patient satisfaction, but at the cost of urinary retention [9].

The contribution of the sciatic nerve block towards postoperative analgesia for total knee arthroplasty (TKA) has been debated in recent literature [10]. A single shot sciatic nerve block or continuous catheter contributed to improved analgesia and decreased postoperative opioid consumption [11,12].

A large retrospective review of 1,200 outpatient knee surgeries at a single institution evaluated the use of femoral and sciatic nerve blocks [13]. A femoral or combined femoral-sciatic block performed prior to complex knee surgery was associated with fewer unplanned hospital admissions. A combined femoral-sciatic block performed prior to complex knee surgery was associated with a reduced requirement for parenteral nursing pain interventions in the step-down recovery unit.

In our current practice, while all patients receive a femoral block, the sciatic block is based on the surgeon's preference. We administer rescue sciatic blocks in the recovery room to patients demonstrating severe pain located the sciatic nerve distribution to reduce the patient's pain to acceptable levels.

The aim of this study was to retrospectively compare patients at our center receiving preoperative femoral nerve blockade (FNB) to those undergoing combined femoral and sciatic preoperative nerve blockade (FSNB) for ambulatory arthroscopic ACL reconstruction. We hypothesized that the addition of a preoperative sciatic nerve block to a femoral nerve block would result in lower postoperative pain scores, a decreased requirement for postoperative opioids, and a shorter PACU duration. In addition, we hypothesized that the incidence of PONV and the need for a rescue block in the recovery unit would be lower in patients receiving a sciatic and a femoral nerve block.

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Received August 14, 2014; **Accepted** October 16, 2014; **Published** October 21, 2014

Citation: Cohen JM, Kolodzie K, Shah S, Aleshi P (2014) Preoperative Sciatic and Femoral Nerve Blocks for Anterior Cruciate Ligament Reconstruction: A Retrospective Analysis. J Anesth Clin Res 5: 452. doi:10.4172/2155-6148.1000452

Methods

This study was approved by The Committee on Human Research at the University of California, San Francisco. Upon receiving IRB approval, a retrospective study review of patients undergoing arthroscopic ACL reconstruction at a single ambulatory center between 10/2/2009 and 05/09/2011 was performed.

Patients

Our patient eligibility criteria for the outpatient surgery center are: (1) patients ages 14 or older and (2) American Society of Anesthesiologists (ASA) score I-III. All patients who underwent arthroscopic ACL reconstruction surgery at our outpatient orthopedic surgery center were included in the chart review. Patients were excluded from the analysis if any of the following occurred: (1) patients with a history of chronic pain, (2) use of neuropathic medications or chronic opioids at time of surgery, (3) intraoperative administration of opioids other than fentanyl or hydromorphone, (4) or administration of a preoperative obturator nerve block. Patients with chronic pain were defined as patients who were taking neuropathic pain medications or patients that were taking opioids for a reason other than their ACL injury. We wanted to track pain scores and opioid consumption and we felt that the above would significantly alter the outcomes for these patients. Patients were then divided into two groups. Patients in Group FNB had received only a preoperative femoral nerve block, whereas patients in Group FSNB had received both preoperative femoral and sciatic nerve blocks as per surgeon preference.

Anesthesia management

Patients in both groups received ultrasound-guided femoral nerve blocks in the preoperative holding area. Preoperative midazolam 1-2 mg and/or fentanyl 25-50 mcg were administered to all patients if deemed necessary by the anesthesiologist before or during the nerve block. Patients were positioned in the supine position for the femoral nerve block. The site of injection was cleaned with chlorhexidine, the transducer was covered with a sterile sheath, and 2% lidocaine 2-5 mL was injected subcutaneously near the inguinal crease. 20-30 mL ropivacaine 0.5% or bupivacaine 0.375% was injected around the femoral nerve.

Patients in Group FSNB additionally received either ultrasound-guided or nerve stimulator-guided sciatic nerve blocks. The technique depended on attending anesthesiologist preference. Patients were either placed in a semi-prone position with the knee and hip flexed (Classic Labat approach), or prone with the operative leg in a neutral position. The site of injection was located in the subgluteal region. Block administration consisted of 20-30 mL ropivacaine 0.5% or bupivacaine 0.375%.

All patients underwent general anesthesia. Propofol was used for induction. A laryngeal mask was placed in all patients. Anesthesia was maintained either using volatile anesthetics (sevoflurane or desflurane, supplemented with oxygen/air or oxygen/nitrous oxide mixture) or using a continuous propofol infusion (100-200 mcg/kg/min). Intraoperative ketorolac was used in a small percentage of patients in both groups for prophylactic treatment of PACU pain.

Nerve blocks were performed in the PACU if patients had intolerable postoperative pain and consisted of either a femoral, sciatic, or obturator block depending on the anatomical distribution of the pain. Patients were considered ready for discharge when (1) pain level was controlled with a pain score less than 5, (2) airway remained patent with oxygen saturation greater than 95% on room air, (3) heart rate, systolic and diastolic blood pressure within 20% of pre-anesthetic levels, and (4) minimal levels of nausea were present with intake of clear liquids.

Surgical technique

All patients underwent primary or revision arthroscopic ACL reconstruction surgery. However, some patients received an autograft, while others received an allograft. Some patients also underwent additional procedures such as meniscectomy and meniscal repair.

Statistical analysis

The primary outcome variables were highest PACU pain score, total morphine equivalents, and PACU length of stay. The highest PACU pain score was recorded as described by the patient on a scale of zero to ten, with ten being the highest level of pain. Total morphine equivalents were calculated using the following formula=preoperative fentanyl (mcg) x 0.1 + intraoperative fentanyl x 0.1 + preoperative fentanyl (mcg) x 0.1] + [intraoperative fentanyl x 0.1] + [postoperative fentanyl x 0.1] + [intraoperative hydormorphone(mg) x 6.67] + [postoperative hydromorphone x 6.67] + [postoperative hydrocodone 5 mg/acetaminiphen 500 mg (tabs) x 1.67] + [postoperative oxycodone 5 mg/acetaminophen 325 mg (tabs) x 2.5] + [postoperative meperidine (mg) x 0.1332]. The PACU time was defined as the time between patient PACU arrival and when discharge criteria were met. Secondary outcome variables included incidence of PONV and the need for a nerve block in the PACU. Administration of the same nerve block postoperatively as was administered preoperatively was considered a "failed block", while administration of a different nerve block postoperatively than what was given preoperatively was considered a "rescue block."

For the primary analysis, data on age, sex, height, weight, BMI, surgery duration, type of surgery (primary vs. revision) and graft type (allograft vs. autograft) were collected and compared between the FNB versus FSNB groups utilizing a chi-square test for categorical variables and t-test or Wilcoxon Mann-Whitney test for continuous variables as appropriate. An uneven distribution of these baseline characteristics amongst the two groups necessitated the utilization of multivariable analysis. Those characteristics with a $P<0.05$ in univariate analysis were included in the multivariable model in addition to the block type (FNB vs. FSNB). For our primary outcome variable PACU length of stay, we also included postoperative variables PONV and the need for a nerve block in the PACU into the model as additional possible predictors. A $P<0.05$ was considered significant. Statistical analyses were performed using STATA 10 (StataCorp, College Station, TX).

Results

228 patients were identified who underwent ACL reconstruction at University of California, San Francisco between October 2, 2009 and May 13, 2010. 37 patients met our exclusion criteria and were excluded from our analysis, resulting in inclusion of 191 patients. 98 patients received only a preoperative femoral nerve block (group FNB), while 93 patients received both preoperative femoral and sciatic nerve blocks (group FSNB) (Figure 1). There were a total of 5 attending surgeons who operated during this period. One surgeon operated on 76 patients, of whom 74 were in the FSNB group. A second surgeon operated on 68 patients, of whom 64 were in group FNB. The three remaining surgeons operated on the other 47 patients.

The patients consisted of 92 females and 99 males with a median age of 31 years (range from 14 to 54 years). Median height was 173

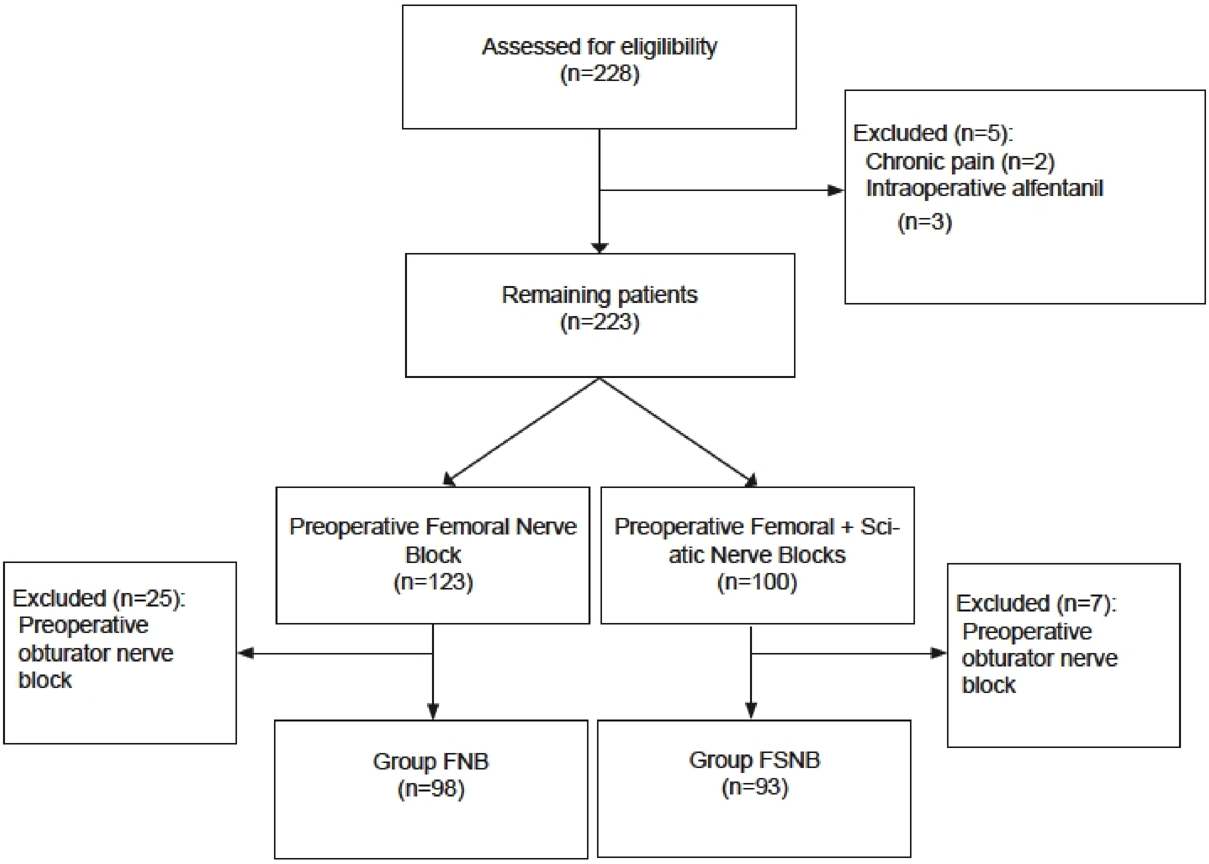

Figure 1: Division of patients into two cohorts.

Variable	Group FNB (n=98)	Group FSNB (n=93)	P
Patient Characteristics			
Age, y	33 (15-54)	29 (14-50)	0.006*
Height, cm	174 (150-193)	170 (152-193)	0.089
Weight, kg	76 (44-113)	68 (49-113)	0.007*
BMI, kg/m^2	24.9 (18-34.9)	23.6 (18.4-33)	0.008*
Female sex	42 (42.9%)	50 (53.8%)	0.149
Intraoperative data			
Type of surgery			1.000
Primary ACL	82 (83.7%)	77 (82.8%)	
Revision ACL	16 (16.3%)	16 (17.2%)	
Type of graft			0.013*
Allograft	52 (53.1%)	32 (34.4%)	
Autograft	46 (46.9%)	61 (65.6%)	
Duration of surgery, min	94 (50-272)	139 (60-282)	<0.001*

Data are expressed as median (range) or count (%) where appropriate
**P*<0.05

Table 1: Univariable analysis of baseline characteristics according to preoperative nerve block.

cm (range from 150 to 193 cm). Median weight was 72 kg (range from 44 to 113 kg). Median BMI (body mass index) was 24.1 kg/m^2 (range from 18 to 34.9 kg/m^2). Unadjusted comparison of demographic and perioperative variables between the two groups is displayed in Table 1.

Univariable analysis between the FNB and FSNB groups revealed significant differences in highest PACU pain scores, intraoperative, postoperative, and total morphine equivalents administered, as well as the number of PACU nerve blocks and rescue blocks. No differences were seen in the time to meet PACU discharge criteria or the incidence of PONV, block failure or frequency of ketorolac administration (Table 2).

To account for uneven distribution of the study groups a multivariable regression model was developed for each of the three primary outcomes (Table 3). The highest PACU pain scores were lower in patients receiving a combined FSNB compared with patients receiving only a FNB [regression coefficient (rc) -2.58; *P*<0.001] and higher in patients receiving an autograft vs. an allograft (rc 1.039; *P*=0.009). Total morphine equivalents were lower in patients receiving combined FSNB versus patients receiving FNB only (rc -10.412, *P*<0.001) and higher in patients with a higher BMI (rc 1.162, *P*<0.001). PACU length of stay was prolonged by 28.8 minutes in patients with PONV and prolonged by 27.6 minutes in patients who were in need of a postoperative nerve block in the PACU.

Discussion

Our current retrospective study shows that the addition of a sciatic nerve block decreased maximum PACU pain scores and opioid requirements. These results are consistent with findings of a recent prospective, randomized trial examining ACL reconstruction [14]. They were also able to demonstrate a shorter PACU length of stay, but this outcome did not reach statistical significance in our findings. However, the study protocol of this RCT differed significantly from our

	Group FNB (n=98)	Group FSNB (n=93)	*P*
Highest PACU pain score, VAS	6.1 ± 2.3	3.4 ± 3	<0.001*
Total morphine equivalents, mg	32.5 ± 12.9	21.3 ± 11.6	<0.001*
OR morphine equivalents, mg	17.2 ± 7.2	9.2 ± 6.9	<0.001*
PACU morphine equivalents, mg	14 ± 9.8	8.6 ± 8.9	<0.001*
PACU length of stay, min	137 ± 48.1	124.9 ± 42	0.098
PONV	15 (15.3%)	18 (19.4%)	0.566
PACU nerve block (includes rescue and failed blocks)			<0.001*
Femoral	1 (1.0%)	0	
Sciatic	34 (34.7%)	5 (5.4%)	
Obturator	0	3 (3.2%)	
Multiple	2 (2.0%)	2 (2.2%)	
Block failure	1 (1.0%)	5 (5.4%)	0.094
Rescue Block	36 (36.7%)	5 (5.4%)	<0.001*
OR ketorolac	12 (12.2%)	10 (10.8%)	0.823
PACU ketorolac	19 (19.4%)	11 (11.8%)	0.168

Data are expressed as mean ± standard deviation or count (%) where appropriate
*P<0.05

Table 2: Univariable analysis of perioperative outcome variables according to preoperative nerve block.

	Highest PACU pain score		Total morphine equivalents		PACU lengths of stay	
	P	coef	*P*	coef	*P*	coef
Block type (FNB/FSNB)	<0.001*	-2.582	<0.001*	-10.421	0.585	-4.112
Age	0.200	-0.027	0.393	0.082	0.140	0.520
BMI	0.078	0.096	<0.001*	1.162	0.124	1.386
Duration of surgery	0.188	-0.006	0.589	0.011	0.723	0.026
Type of graft (Allo/Auto)	0.009*	1.039	0.062	3.329	0.484	4.583
PONV (no/yes)	Not included		Not included		0.001*	28.804
PACU nerve block (no/yes)	Not included		Not included		<0.001*	27.626

*P<0.05

Table 3: Adjusted multivariable analysis of factors associated with highest PACU pain score, total morphine equivalents, and PACU length of stay.

own practice, utilizing large amounts of opiods that it was difficult to apply these results to our practice. Successful use of regional anesthesia reduces requirement for systemic opioids, and hopefully results in fewer opioid-related side effects. Accordingly, our patients received lower amounts of intraoperative and postoperative opioids than patients in the previous trial and our discharge home time was approximately 100 minutes shorter in both FNB and FSNB groups. No patient at our center who underwent ACL reconstruction during the study period required postoperative admission, while greater than 10% of patients in this previous study were admitted postoperatively.

In our patients the two independent predictors for an increased PACU length of stay were PONV and the need for a nerve block in recovery. A direct effect of the nerve block technique could not be shown in our data set. The reason might be a small sample size, and variable documentation of the time the patient was ready for discharge versus the actual PACU discharge time.

Patients who received a preoperative sciatic nerve block received less total opioids despite often needing supplemental opioids during performance of the sciatic nerve. Patients who received a preoperative sciatic nerve block also had lower maximum PACU pain scores. The fact that patients in FSNB group received fewer intraoperative opioids suggests improved intraoperative analgesia, while the lower PACU pain scores demonstrates improved postoperative analgesia.

Successful rescue blocks administered in all patients with unacceptable postoperative pain control resulted in a hospital admission rate of zero. This is in contrast to a previous retrospective review of 1,200 outpatient knee surgeries at a single institution reporting a hospital admission rate of about 3% [13]. Although not all unanticipated hospital admissions are due to insufficient pain control, it is known to be one of the most common causes [2]. Our practice of postoperative nerve block administration was likely a major contributor in reducing unexpected hospital admissions.

Our results support the concept that for outpatient ACL reconstruction ideally a femoral as well as a sciatic nerve block should be administered preoperatively. According to our data this simple technique will reduce the postoperative pain scores and perioperative opioid requirements. The administration of a postoperative nerve block should be reserved for block failures.

There are several limitations to this study. First, this study was retrospective in design and therefore hidden confounding variables might have been present. We would like to point out that the small difference in age (33 vs. 29) is unlikely to create a large difference in pain and opioid consumption. The FSNB group had a higher autograft reconstruction rate (65.6% vs. 46.9%) and their surgery lasted 45 minutes longer which would create an expectation of more pain and longer recovery time. Both of these would create a conservative error and only strengthen our study. A multivariable analysis was performed to adjust at least for identified confounders. Having an autograft was an independent predictor of pain and a higher BMI was associated with a higher opioid consumption. Local anesthetic type and volume were not standardized. The preoperative block was largely based on surgeon preference. Lastly, there was no patient follow-up by the study investigators and therefore no conclusions could be made about differences in outcomes after discharge. The study was also not powered to reveal differences in complication rates. A randomized-controlled trial is currently underway to address some of these weaknesses.

Clearly, performing a sciatic nerve block requires additional time and effort from the anesthesiologist preoperatively and the patient must undergo an extra procedure. It is our experience that performing these sciatic blocks preoperatively is not only easier, but also beneficial to the patient, as patients are more cooperative with the positioning and are not experiencing surgery related pain. Likewise, when required postoperatively, the surgical brace often complicates ultrasound transducer positioning. It is possible that at least some of the time gained by early discharge may be canceled by the additional time it takes to perform a sciatic block.

In summary, the addition of a preoperative sciatic nerve block to a femoral nerve block was associated with decreased opioid requirements and lower postoperative pain scores.

Acknowledgement

This study was supported entirely by internal funds of the Department of Anesthesia and Perioperative Care, University of California, San Francisco.

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