Single Injection Fascia Iliaca Block for Pain Control after Arthroscopic Anterior Cruciate Ligament Reconstruction: A Randomized, Controlled Trial

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Background: *Arthroscopic anterior cruciate ligament reconstruction (AACLR) is one of the orthopedic surgeries associated with moderate to severe post-operative pain. The fascia iliaca block (FIB), a block of the femoral nerve and lateral femoral cutaneous nerve of the thigh, is relatively simple, safe, and provides effective analgesia post-operatively.*
Objective: *To investigate the effectiveness of using fascia iliaca block for post-operative pain relief after AACLR.*
Material and Method: *After approval by the Ethics Committee for Khon Kaen University (HE510817), the patients were randomly allocated into two groups using a computer-generated random number and concealed by sealed opaque envelopes. FIB was delivered via a 16-gauge Tuohy needle at the PACU. The patients received either 0.25% bupivacaine with adrenaline or 0.9% NSS 40 mL. Morphine consumption, time to first rescue analgesia, Numerical Rating Scale (NRS), side effects, and complication within 24 hours were recorded.*
Results: *Forty-seven patients were enrolled. There was a statistically significant difference in the 24 hours morphine consumption between the bupivacaine and NSS groups (22.1 ± 7.2 and 31.8 ± 9.3 mg, respectively; $p < 0.001$). Time to first rescue analgesia was significantly longer in the bupivacaine group (4.60 ± 2.2 vs. 2.83 ± 1.6 hour, p 0.003). The difference of resting and on movement pain score were also significant (2.1 (95% CI 1.3-2.8), $p < 0.001$ and 1.8 (95% CI 1.2-2.4), $p < 0.001$ respectively. Neither serious side effect nor neurological sequel was found.*
Conclusion: *The fascia iliaca block is effective for providing pain control for at least 24 hours after anterior cruciate ligament reconstruction. This technique is quite easy, safe, and inexpensive to use.*

Keywords: *Fascia iliaca block, Anterior cruciate ligament reconstruction, Post-operative pain control, Morphine consumption*

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Arthroscopic anterior cruciate ligament reconstruction (AACLR) produces moderate to severe post-surgical pain[1]. Inadequate pain control affects the quality of patient care, delays physiotherapy and may prolong the hospital stay. There are many approaches to control post-operative pain, including: (1) conventional systemic opioids; (2) oral pain medication (*e.g.,* NSAIDs, acetaminophen, opioids); (3) intra-articular injection of opioid or local anesthetic; (4) intrathecal morphine; and (5) femoral nerve block. To avoid the side-effects of opioid use, multimodal analgesia is implemented to reduce the amount of opioid used.

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Femoral nerve block provides good post-operative analgesia. Nevertheless, this technique requires a peripheral nerve stimulator and an insulated needle, which has its own costs. Fascia iliaca block is a relatively easy way to block the femoral and lateral femoral cutaneous nerves of the thigh that supply the surgical area. The pain blockage can persist up to 24 hours[2]. The aim of this present study was to investigate the effectiveness of using fascia iliaca block for post-operative pain relief after AACLR.

Material and Method

The authors obtained the ethical approval for the present study (Ethical Committee of Khon Kaen University for human research, the protocol number HE510817 then got informed, written consent from each patient. The authors conducted a prospective, randomized, double-blind study with 47 patients, having an American Society of Anesthesiologists

physical status of I to II. Each patient was scheduled for elective, unilateral arthroscopic anterior cruciate ligament reconstruction under spinal anesthesia at Srinagarind Hospital.

The exclusion criteria were: (1) under 18 and over 75 years of age; (2) having a known bupivacaine allergy; (3) having a morphine hypersensitivity; (4) chronic opioid usage; (5) chronic pain unrelated to the anterior cruciate ligament injuries; and (6) any contraindication to regional anesthesia.

The patients were randomly assigned, according to a computer-generated block randomization in sealed opaque envelopes, to one of two groups (*viz.*, Group B: 40 mL of 0.25% Bupivacaine with adrenaline 1:200,000; and, Group C: 40 mL of normal saline). The drug solutions were prepared by an anesthesiologist not involved in performing the fascia iliaca block.

The fascia iliaca block technique is based on the presence of a space between the fascia lata and fascia iliaca. To locate, a line is drawn between the anterior superior iliac spine and the pubic tubercle. This line is trisected. Two centimeters caudal to the junction of the lateral and middle thirds is marked for the injection point. Using sterile technique, fascia iliaca block is performed using a 16-gauge Tuohy needle.

In the operating room, all patients were monitored by electrocardiogram, non-invasive blood pressure, and pulse oximetry. Patients were placed in a lateral decubitus position with the surgical site down. The subarachnoid block was achieved with 15 mg of 0.5% hyperbaric bupivacaine injected in the L3-4 interspace. A 25- or 27-gauge Quincke-type needle was inserted after sterile skin preparation with providone iodine. Patients were then placed in a supine position for surgery. No sedative or narcotic was administered. After surgery, the patients were transferred to PACU for standard monitoring and performed the fascia iliaca block.

Patients whose local anesthetic regressed beyond the injection point received a 1% lidocaine skin wheal. The needle was advanced slowly perpendicular to the table until a distinct "pop" was felt across the two fascial planes, *i.e.,* fascia lata and fascia iliaca. Local anesthetic or normal saline was injected in 5 mL aliquots and alternated with aspiration.

Intravenous, patient-controlled analgesia (IVPCA) was attached to the patient. Instructions on the use of the IV PCA were explained to each patient before and after their surgery. The PCA morphine was 1 mg/mL with a lock-out time of five minutes and a one-hour limit of 12 mg with no background infusion setting. The 24-hour morphine consumption and time to first analgesic use via IV PCA were recorded.

Post-operative assessments were made by the ward nurse according to our hospital's Routine Acute Pain Service Guideline at 4, 8, 12, 16, 20, and 24 hours both at rest and with movement, including: (1) the pain score; (2) the nausea/vomiting and sedation scores; (3) pruritus; (4) infection and other adverse events such as hematoma; and (5) motor blockade. The Acute Pain Service Record Form follows the Guideline and has been in general use in our hospital for five years.

Post-operative pain was measured using the NRS score (range, 0-10; 0 = no pain and 10 = worst pain). Sedation was scored (range, 0 to 3; 0 = alert, 1 = sometimes drowsy but easy to arouse, 2 = often drowsy but easy to arouse, 3 = difficult to arouse). Nausea was scored (range, 0 to 3; 0 = nil, 1 = mild, no treatment request, 2 = vomiting, anti-emetic resolved problem, 3 = does not respond to anti-emetic). Motor weakness was assessed using the modified Bromage score (range, 0 to 3; 0 = no motor block, able to do a straight leg raise, 1 = unable to do a straight leg raise, but able to lift knee off bed, 2 = unable to lift knee off bed but able to flex ankle, 3 = unable to lift knee or flex ankle – complete motor block).

The primary outcome of the present study was 24-hour morphine consumption. To demonstrate a 30% reduction in morphine consumption with 80% power and an α of 0.05, 23 patients were required in each group. SPSS and STATA were used to do the statistical analyses. The 24-hour morphine consumption and time to first rescue analgesic medication were analyzed using the student's t-test. All the authors' analyses were done on an intention to treat basis. In order to estimate the magnitude of the difference of the pain score between the two groups at the six times of measurement, the generalized estimating equation (GEE) was used. A value of $p < 0.05$ was considered significant (Fig. 1).

Results

Forty-seven patients were enrolled and remained to the end of the present study. There were no significant differences in the demographic data between the two groups (Table 1). However, there was a statistically significant difference in the 24-hour morphine consumption between the two groups (22.1 ± 7.2 mg; bupivacaine group and 31.8 ± 9.3 mg; normal saline group $p < 0.05$). Time to first rescue dose of analgesia was significantly different between the

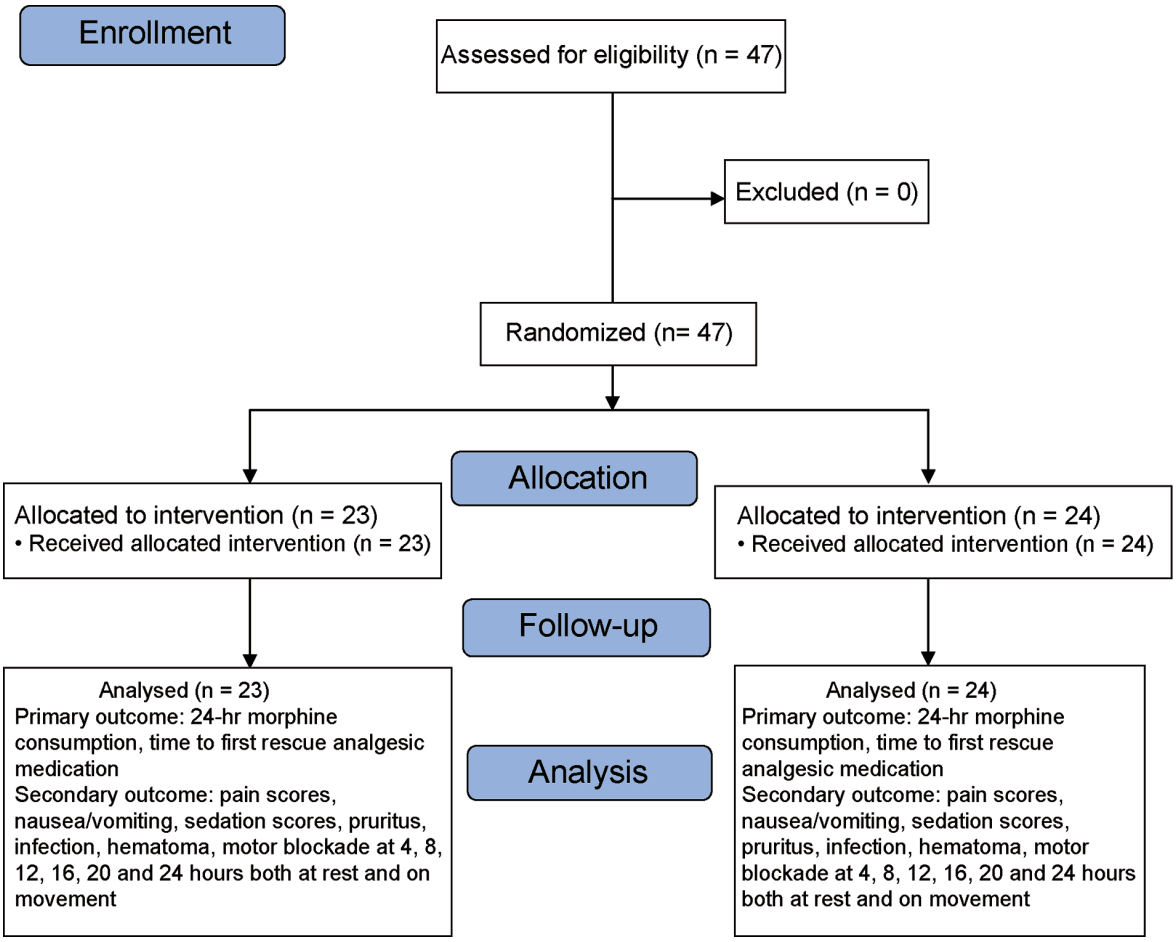

Fig. 1 Study diagram

groups (4.60 ± 2.2 hours for the bupivacaine group and 2.83 ± 1.6 hours for the normal saline group, p = 0.003).

The pain score on movement and at rest between the two groups was statistically significant (Fig. 2, 3). The effect of bupivacaine was significant overall 24 hours on both the movement pain score (pain score difference 1.8 (CI 1.2-2.4); p < 0.001) and the resting pain score (pain score difference 2.1 (CI 1.3-2.8); p < 0.001). There was no evidence of any neurologic sequelae. A few of the presented patients had nausea and vomiting over the 24 hours (Table 2).

Discussion

Anterior cruciate ligament reconstruction (ACLR) results in moderate to severe pain for the first

Table 1. Patient characteristics

	Bupivacaine (n = 23)	NSS (n = 24)
Age (yr)	30.00 ± 11.27	27.12 ± 8.23
Sex (male:female)	21:2 (91.4%:8.6%)	24:0 (100%:0%)
Weight (kg)	68.26 ± 10.05	67.50 ± 6.61
Height (cm)	168.65 ± 6.65	170.54 ± 4.93
ASA (I:II)	23:0 (100%:0%)	24:0 (100%:0%)
Duration of surgery (min)	103.65 ± 23.06	129.58 ± 30.60

Table 2. Adverse events

Adverse event	Bupivacaine (n = 23)	NSS (n = 24)
Vomiting	1 (4.3%)	2 (8.3%)
Pruritus	0 (0%)	2 (8.3%)
Sedation	0 (0%)	0 (0%)
Infection	0 (0%)	0 (0%)
Hematoma	0 (0%)	0 (0%)
Motor weakness	0 (0%)	0 (0%)

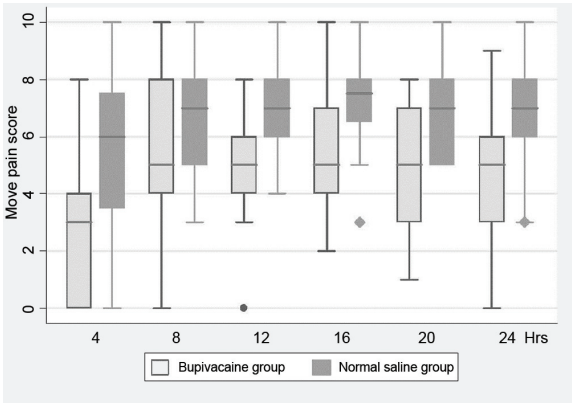

Fig. 2 NRS pain scres with movement
The box represents the 25th to 75th percentiles; the gray line in the boxes indicates the median
The extended bars represent the 10th to 90th percentiles; the circles represent the values outside this range

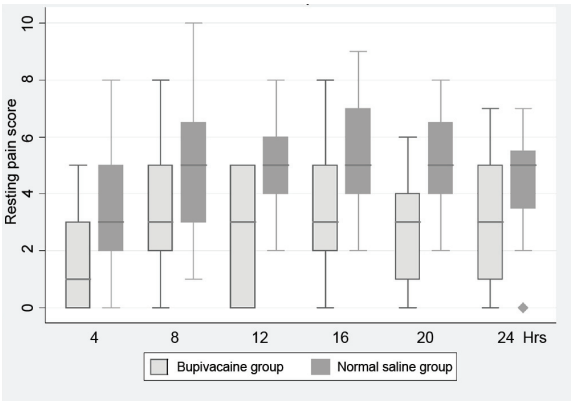

Fig. 3 NRS pain scores at rest
The box represents the 25th to 75th percentiles; the gray line in the boxes indicates the median
The extended bars represent the 10th to 90th percentiles; the circles represent the values outside this range

24 to 48 hours following arthroscopic assisted surgery. Extensive bony and soft tissue manipulation may be the cause of this pain. Since many hospitals perform this operation as an out-patient procedure, post-operative pain is one of the discharge criteria. Inadequate pain control affects the success of a patient's rehabilitation program. The better the pain control is, the more accelerated and satisfactory the rehabilitation program can be.

Importantly, effective regional analgesia avoids postoperative nausea/vomiting (PONV) and other adverse events from opioid use and unexpected hospital admission. In this regard, there are many methods that provide effective analgesia for ACL reconstruction, including: (1) spinal morphine; (2) intravenous patient control analgesia (IV PCA); (3) intra-articular injection of local anesthetic or opioid; (4) femoral nerve block (FNB) both single shot or continuous infusion via catheter; and (5) oral analgesic medication (*i.e.,* NSAIDs, acetaminophen) as multimodal analgesia.

All of the patients in the present study underwent AACLR with allografts (hamstring/semitendinosous). The authors used fascia iliaca block, which was easy technique to perform a block of the femoral nerve and lateral femoral cutaneous nerve of the thigh. These nerves supply the anterior portions of the knee and do not require use of a peripheral nerve stimulation device. The fascia iliaca block is fast, easy and safe to perform in PACU because the location of the procedure is far away from any neurovascular structure and does not need to be done prior to surgery in the operating room.

Some studies have demonstrated a limited benefit of single-injection FNB as an analgesic technique for ACL reconstruction[3,4] because of the limited duration of analgesia compared with continuous FNB[5]. One study revealed a significant effect of a single shot femoral nerve block with 0.25% bupivacaine and ropivacaine of up to ten hours post-operatively[6]. The present study, however, demonstrated a significant improvement in post-operative analgesia both at rest and with movement and a decrease in morphine consumption compared with systemic opioid therapy, *i.e.,* in the first 24 hours after ACL reconstruction, which is the period of the most intense pain. Another study revealed peak narcotic use and pain score after ACLR on the post-operative day 1 and 2[7]. However, single injection femoral nerve block, especially fascia iliaca block, is less costly than a continuous femoral catheter.

Some research shows the benefit of additional sciatic nerve block with femoral nerve block for controlling pain in the posterior portion of the knee[8]. Although intra-articular injection of local anesthetic technique has been shown to have some benefit for ACL reconstruction, the evidence is not compelling, and in most cases observed reductions in post-operative pain were small to moderate and short-lasting. There is insufficient evidence to conclude such analgesics have any impact on early recovery[9]. Many studies supported the benefit of femoral nerve block over

intra-articular injection technique[10]. Dauri et al reported that the continuous intra-articular local anesthetic plus opioid technique seemed unable to control pain compared with continuous epidural or femoral nerve block[11]. Importantly, however, spinal morphine and epidural analgesia are involved with urinary retention.

In the present study, there were a few minor adverse events such as nausea, vomiting, and pruritus, which were perhaps the result of systemic opioid use. The peripheral nerve block technique has advantages over spinal opioid in that it circumvents side-effects such as urinary retention. The incidence of urinary retention from spinal morphine ranges between 20 and 25%[12,13], while nausea/vomiting is between 19 and 21%, pruritus 27 and 70%, and the risk of respiratory depression 0.01 and 7%[14,15]. Temporary quadriceps weakness and numbness may occur depending on the concentration of local anesthetic used. In the present study, 0.25% bupivacaine was used. Even though this concentration cannot completely relieve pain, it sufficiently mitigates pain intensity to allow the start-up of the rehabilitation program within 24 hours post-operatively.

The authors did not find any hematoma at the site of injection. This fascia iliaca block technique is performed distant from the main neurovascular area. The distribution of local anesthetic volume through the fascial plane was the main reason for approaching the femoral nerve. Bupivacaine 100 mg was within the safe dosage range for adults and frequent aspiration prevents any possible systemic toxicity with local anesthetic.

Peripheral nerve block for post-operative pain management also provides a cost saving. Several studies reported on the cost-effectiveness of regional anesthesia for outpatient orthopedic surgery[16]. Greenburg's study supports the routine use of peripheral nerve block anesthesia/analgesia for invasive outpatient orthopedic procedures in 82% of patients[16]. Their patients were able to exit PACU faster with less post-operative pain. Most (96%) also avoided hospital admission, which resulted in a cost-saving for the hospital.

The limitation of the present study was that the authors could not confirm the precise placement of each block. Using ultrasound to guide and confirm the hypoechoic sign around the femoral nerve after injection might help to more rigorously evaluate the technique and to determine the successful precise placement of the block.

Conclusion

Femoral nerve block using the fascia iliaca technique is relatively simple and provides safe and effective post-operative pain control for at least 24 hours after arthroscopic anterior cruciate ligament reconstruction. Routine use of this method of analgesia should provide satisfactory analgesia and minimize the need for opioids.

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Potential conflicts of interest

None.

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การระงับปวดหลังผ่าตัดสร้างเอ็นไขว้หน้าข้อเข่าโดยใช้กล้องส่องข้อด้วยเทคนิค single injection fascia iliaca block: การศึกษาแบบสุ่มที่มีตัวควบคุม

มาลินี วงศ์สวัสดิวัฒน์, ปานัดดา ปทานนท์, วิมลรัตน์ ศรีราช, พนารัตน์ รัตนสุวรรณ ยิ้มแย้ม, สุดใจ บรรเทาทึก

ภูมิหลัง: การผ่าตัดสร้างเอ็นไขว้หน้าข้อเข่าโดยใช้กล้องส่องข้อ (arthroscopic anterior cruciate ligament reconstruction: AACLR) เป็นหนึ่งในการผ่าตัดทางออร์โธปิดิกส์ที่สัมพันธ์กับความปวดหลังผ่าตัดระดับปานกลางถึงรุนแรง การทำ fascia iliaca block (FIB) ซึ่งเป็นการสกัดการนำส่งกระแสของเส้นประสาท femoral nerve และ lateral femoral cutaneous nerve ของต้นขาเป็นวิธีที่ทำได้ง่าย ปลอดภัย และมีประสิทธิภาพในการระงับปวดหลังผ่าตัด

วัตถุประสงค์: เพื่อศึกษาประสิทธิภาพของการทำ fascia iliaca block ในการระงับปวดหลังผ่าตัด AACLR

วัสดุและวิธีการ: หลังผ่านการพิจารณาจากคณะกรรมการจริยธรรมการวิจัยในมนุษย์มหาวิทยาลัยขอนแก่น (HE 510817) ผู้ป่วยจะถูกแบ่งออกเป็นสองกลุ่มโดยการสุ่มด้วยคอมพิวเตอร์และปกปิดด้วยซองทึบปิดผนึก ทั้งสองกลุ่มจะได้รับการทำ FIB ที่ห้องพักฟื้นหลังผ่าตัด โดยการฉีด bupivacaine 0.25% ผสม adrenaline หรือ NSS 0.9% ปริมาณ 40 มล. ผ่านเข็ม Tuohy เบอร์ 16 บันทึกปริมาณ morphine ที่ใช้ ระยะเวลาในการขอยาระงับปวดครั้งแรก ระดับความปวด Numerical Rating Scale (NRS) ทั้งในขณะพักและขยับตัว ผลข้างเคียงและภาวะแทรกซ้อนใน 24 ชั่วโมงหลังผ่าตัด

ผลการศึกษา: มีผู้ป่วยเข้าร่วมในการศึกษาทั้งหมด 47 ราย พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของปริมาณการใช้ยามอร์ฟีนใน 24 ชั่วโมงแรกหลังผ่าตัดระหว่างกลุ่มที่ได้รับ bupivacaine กับกลุ่มที่ได้รับ NSS (22.1 ± 7.2 vs. 31.8 ± 9.3 มก. ตามลำดับ $p < 0.001$) ระยะเวลาในการขอยาระงับปวดครั้งแรกในกลุ่ม bupivacaine นานกว่ากลุ่ม NSS อย่างมีนัยสำคัญ (4.60 ± 2.2 vs. 2.83 ± 1.6 ชั่วโมง, p 0.003) และพบความแตกต่างของระดับความปวดทั้งในขณะพักและขณะขยับตัวอย่างมีนัยสำคัญเช่นกัน (2.1 (95% CI 1.3-2.8), $p < 0.001$ และ 1.8 (95% CI 1.2-2.4), $p < 0.001$ ตามลำดับ) ไม่พบผลข้างเคียงหรือภาวะแทรกซ้อนที่รุนแรงต่อระบบประสาท

สรุป: Fascia iliaca block มีประสิทธิภาพในการระงับปวดหลังผ่าตัด AACLR ใน 24 ชั่วโมงแรก เทคนิคที่ใช้ทำได้ค่อนข้างง่าย ปลอดภัย และมีราคาไม่แพง