

Combined posterior lumbar plexus–sciatic nerve block versus combined femoral–obturator–sciatic nerve block for ACL reconstruction

Ayman I Tharwat

Ain Shams University, Cairo, Egypt

Background: We compared the efficacy of combined posterior lumbar plexus–sciatic nerve block with that of combined femoral–obturator–sciatic nerve block as anesthesia for anterior cruciate ligament reconstruction surgery, because both block combinations have been recommended for lower limb arthroscopic and reconstructive surgery.

Methods: Forty-eight patients undergoing elective unilateral anterior cruciate ligament reconstruction under local anesthesia were randomized to undergo either combined posterior lumbar plexus–sciatic nerve block (Group 1), or combined femoral–obturator–sciatic nerve block (Group 2). Blocks were performed using nerve stimulation and bupivacaine 0.5% mixed with lignocaine 2%. Systolic and diastolic blood pressure, heart rate, and pulse oximetry were recorded. Quality of anesthesia, motor and sensory block, time to first analgesic use, sedation, and need for general anesthesia were recorded, along with verbal postoperative pain scores, and side effects.

Results: No patient in Group 1 and two patients in Group 2 needed general anesthesia. Complete sensory blockade was higher in Group 1 than in Group 2. However, complete motor blockade was similar in both groups. In Group 1, verbal pain scores were lower than in Group 2. Time to first analgesic was similar between the two groups. Total analgesic consumption was lower in Group 1. No significant differences were found for heart rate, pulse oximetry, or systolic and diastolic blood pressure between the groups, and no signs of toxicity were encountered.

Conclusion: Combined posterior lumbar plexus–sciatic nerve block provided more comfortable intraoperative anesthesia and better postoperative analgesia than combined femoral–obturator–sciatic nerve block for anterior cruciate ligament reconstruction surgery.

Keywords: anterior cruciate ligament reconstruction, local anesthetic, nerve block

Introduction

Combined peripheral nerve block has been recommended for anterior cruciate ligament reconstruction^{1,2} due to its benefits when compared with both general anesthesia and spinal anesthesia. These benefits include better functional outcomes, such as early initiation of physiotherapy, passive knee flexion, and reduced length of hospital stay,³ and less financial cost. We compared the efficacy of combined sciatic–lumbar block with that of combined sciatic–femoral–obturator block in this setting, as well as the hemodynamic effects and toxicity of these two procedures.

Methods

Forty-eight patients undergoing elective, unilateral anterior cruciate ligament reconstruction under local anesthesia were recruited for this study, and gave their

Correspondence: Ayman I Tharwat
Ain Shams University, Cairo, Egypt
Email drayman7777@yahoo.com

informed written consent. In a randomized manner, 24 patients received combined sciatic–lumbar block (Group 1) and 24 patients received combined sciatic–femoral–obturator block (Group 2). Exclusion criteria were age <18 years, inability to communicate, revision anterior cruciate ligament reconstruction, morbid obesity (body mass index >35), contraindications to local anesthesia (eg, coagulopathy, local infection), renal failure, or hypersensitivity to bupivacaine or lignocaine.

The nerve blocks were performed in the orthopedic operating theatre at Ain Shams University by a senior anesthetist, with the assistance of a qualified anesthesia nurse, using a 22-gauge Stimuplex® insulated needle (B Braun Medical Inc, Bethlehem, PA) connected to a nerve stimulator set at an output of 2 mA at 2 Hz with a 100 μ s square-wave pulse. Intraoperative sedation with an intravenous propofol infusion was administered at the discretion of the anesthetist.

Femoral nerve blocks were performed using the classic paravascular technique described by Winnie et al,⁴ with the patient in the supine position. The femoral artery was palpated below the inguinal ligament. A 3.5 cm, short-bevel 22-gauge insulated needle was advanced lateral to the artery in the cephalad direction using contraction of the quadriceps muscle as an endpoint.

For obturator block, the needle was inserted 2 cm caudal and lateral to the pubic tubercle, “walking” inferiorly off the superior pubic ramus if contacted, until the obturator canal was entered and contraction of the thigh adductor muscles was obtained.⁵

Lumbar (psoas compartment) block was achieved using the technique described by Wedel,⁶ with the patient in the lateral position, the neck, back, and hip flexed and the operative leg uppermost, and a line drawn to connect the iliac crests (intercristal line) and identifying the L4 spine. A skin weal was raised 3 cm caudad and 5 cm lateral to the L4 spine on the side to be blocked. A six inch 22-gauge Stimuplex insulated needle was then advanced perpendicular to the skin until it contacted the fifth lumbar transverse process. The needle was slightly withdrawn and redirected cephalad to walk off the transverse process. Its depth was about 5–7 cm from the skin. To achieve contraction of the target quadriceps muscle, 10–15 mL of 0.5% bupivacaine mixed with an equal volume of lignocaine 2% was injected slowly in increments of 5 mL after negative aspiration.

For sciatic nerve block, the patient is placed in the lateral (Sim’s) position, with the operative side nondependent. The operative extremity is flexed 45° at the hip and 90° at the knee

and rests against the dependent lower extremity. The posterior superior iliac spine, greater trochanter, and sacral hiatus are identified and marked with a skin marker.⁶ Because the greater trochanter is a large landmark, marking the most superior and posterior aspect of the greater trochanter helps maintain consistency in landmarks between patients. Consistency in positioning is also critical for success of the block and can be checked by placing the posterior superior iliac spine, ie, the most superoposterior aspect of the greater trochanter and the head of the fibula along a straight line. A line is drawn with a skin marker between the greater trochanter and posterior superior iliac spine. This line is bisected. A perpendicular line is dropped 3–5 cm from the midpoint of this line to the point of needle insertion, which should lie along a third line drawn between the greater trochanter and the sacral hiatus.^{6,7}

The area of needle insertion is prepared and draped in a sterile manner. In the awake patient, a wheal of local anesthetic is placed and a six inch 22-gauge Stimuplex insulated needle is advanced perpendicular to the skin. The nerve lies about 6–8 cm deep. Stimulation intensity is initially set at 1.5–2.0 mA and adjusted downwards as the evoked motor response increases. Plantar flexion at less than 0.5 mA is the desired motor response, and indicates placement of the needle near the medial part (tibial component) of the nerve.⁶

After negative aspiration, the needle is held immobile and local anesthetic is injected incrementally, with attention paid to the presence of paresthesias, reflex movement, and resistance to injection. Although sciatic block can be performed without the use of a nerve simulator by seeking paresthesias in the awake patient, use of a nerve stimulator results in high success rates and improves the success of the block.⁷ Because the nerve trunk is large, onset time and efficacy may be improved by injecting local anesthetic into more than one location, eg, both laterally (peroneal component) and medially (tibial component).

The endpoint for nerve localization was contraction of the target musculature, with a 0.5 mA stimulating current. Upon localization, the current was reduced to the lowest level that still produced visible contractions of the target muscle. Nerve blocks were performed with a sham block behind a surgical drape blocking the patient’s view.

Sensation to light touch and cold on the anterior and medial aspects of the mid-thigh was assessed. Motor block was assessed by the ability of the patient to contract the quadriceps muscle and adduct the operative leg from a 30° abducted position to the midline. These examinations were performed on all patients by the anesthetist, and the results recorded separately to maintain blinding.

Postoperative pain management

All patients were provided postoperatively with an intravenous patient-controlled analgesia system (Graseby, Wales, UK) containing fentanyl 50 µg/mL set to deliver 25 µg every five minutes as needed. Time to first dose of fentanyl from arrival in the recovery room was noted. Cumulative doses of patient-controlled fentanyl analgesia were recorded every four hours for 24 hours after surgery. Paracetamol 1 g and intravenous infusion of liometacen were given on arrival in the recovery room, then round-the-clock every 12 and six hours, respectively. If the verbal pain score at rest was >6/10 after receiving all of the above, rescue medication of pethidine 50 mg was given every 12 hours intramuscularly.

Assessment and data collection

Knee pain was assessed at rest and with movement (30° knee flexion) using an 11-point verbal pain score (0 = no pain, 10 = worst pain imaginable). Baseline preoperative values were recorded by the anesthetist for each case. Pain scores with movement were recorded on arrival in the recovery room, and at 6 and 12 hours postoperatively by the study nurse, who was blind to group assignment. Transition from the sciatic block to parenteral opioid analgesics when the block dissipated was expected to be able to be anticipated. Assessment of motor block was done using the Bromage scoring system (0 = no motor block (full flexion of knee and foot), 1 = inability to raise extended leg and just able to move knee, 2 = inability to flex knee and able to move foot only, 3 = inability to flex ankle joint and unable to move foot or knee).⁸

Side effects to be recorded by the study nurse during the 48-hour study period comprised nausea or pruritus requiring treatment, urinary retention requiring catheterization (bladder ultrasound showing more than 500 mL volume), and any numbness or weakness in the operative leg.

Statistical analysis

Data were collected, coded, tabulated, and analyzed using SPSS® software (version 12.0; SPSS Inc., Chicago, IL). Numeric variables were presented as means (standard deviations) while categorical variables were presented as numbers of cases (percentages). Verbal pain scores were presented as Box and Whiskers plots to show their medians and quartiles. Between-group comparison of numeric variables was performed using the unpaired Student's *t*-test or Mann–Whitney *U* test as appropriate, while categorical variables were compared using Fisher's exact test. Any difference with a *P* value < 0.05 was considered to be statistically significant.

Results

Forty-eight patients participated in the study, and there were no significant differences between the two groups with regard to demographic variables and duration of surgery. Need for general anesthesia was not encountered in the Group 1, and two cases needed general anesthesia in Group 2. Anesthesia was judged to be unsatisfactory in one of 24 patients in Group 1 compared with three of 24 patients in Group 2.

There were a mild but statistically insignificant initial decrease in mean arterial blood pressure after the block in both treatment groups, but there was no need to stabilize blood pressure with medication (Table 1). There was no difference between the groups regarding mean postblock heart rates (Table 1). Also, there were no differences between the groups for average intraoperative pulse oximetry (Table 1).

Regarding postoperative pain control, there were significant differences between the groups, whereby total narcotic (fentanyl) consumption in the first 24 hours using patient-controlled analgesia was higher in Group 2 (109.4 ± 43.5 µg) than in Group 1 (74.0 ± 31.7 µg) (Figure 1). Furthermore, the need for extra intramuscular pethidine injection in the first 24 hours was significantly higher in Group 2 than in Group 1, but there was no significant difference between the two groups for average time to first analgesic dose (Table 2).

Postoperative verbal pain scores were significantly different between the groups, from time of arrival in the recovery room, and at 6 and 12 hours postoperatively, being higher in Group 2 than in Group 1 throughout the study (Figure 2).

Intact sensation in the obturator and lateral cutaneous nerves was more common in Group 2 than in Group 1, so complete sensory blockade was higher in Group 1 than in Group 2 (Table 3). However, complete motor blockade was similar between the groups according to Bromage score⁸ (Table 4).

Discussion

Peripheral nerve block can provide adequate anesthesia and decrease postoperative analgesic requirements for many types

Table 1 Hemodynamic changes with the trial nerve block techniques

	Group 1	Group 2	<i>P</i> value
Preoperative MAP	88.5 (9.9)	86.9 (10.1)	0.567
Postblock MAP	72.6 (12.0)	69.4 (9.0)	0.293
Difference in blood pressure	14.7 (7.7)	17.5 (7.4)	0.198
Intraoperative average heart rates	76.7 (5.0)	76.3 (4.7)	0.769
Intraoperative average SpO ₂	99.0 (0.8)	99.0 (0.8)	0.856

Note: *Significantly higher than the other group (No significant differences between the two groups).

Abbreviations: MAP, mean arterial pressure; SpO₂, pulse oximetry.

Table 2 Requirements for postoperative analgesia

	Group I	Group 2	P value
Time to first analgesic dose (minutes)	76.7 (9.9)	78.3 (9.6)	0.556
Total fentanyl consumption (µg) in first 24 hours	74.0 (31.7)	109.4 (43.5)*	0.002
Need for pethidine injection (%)	7 (29.2)	15 (62.5)*	0.041

Note: *Significantly higher than the other group.

of orthopedic surgery.⁹ In this study, the efficacy and toxicity profiles of two peripheral nerve block combinations were compared in anterior cruciate ligament reconstruction surgery. The results show that both combined posterior lumbar plexus–sciatic nerve block and combined femoral–obturator–sciatic nerve block provided adequate anesthesia and prolonged postoperative analgesia. This was demonstrated by reduced pain scores and a lower requirement for supplemental postoperative analgesics during the first 24 hours postoperatively. Prolonged postoperative analgesia, even longer than the expected duration of bupivacaine, was also seen, and enabled early initiation of physiotherapy and passive knee movement to prevent joint stiffness³ in both treatment groups.

For each type of block, 20–30 mL of bupivacaine 0.5% mixed with lignocaine 2% was injected in divided doses. Use of higher concentrations of local anesthetic may decrease the latency of onset of anesthesia and motor block, and a large volume of long-acting agent is chosen to obtain the maximum duration of analgesia. The mean duration of analgesia following 20 mL of 0.5% bupivacaine is 14 hours, but can range up to 24 hours. Addition of lignocaine and alkalization of bupivacaine reduces the time to onset and prolongs the duration of useful analgesia.¹⁰ Addition of lignocaine also allows us to perform multiple blocks without needing to use a high dose of bupivacaine.

Side effects, such as hypotension, were minimal, with no difference between the groups. Hypotension may occur as a

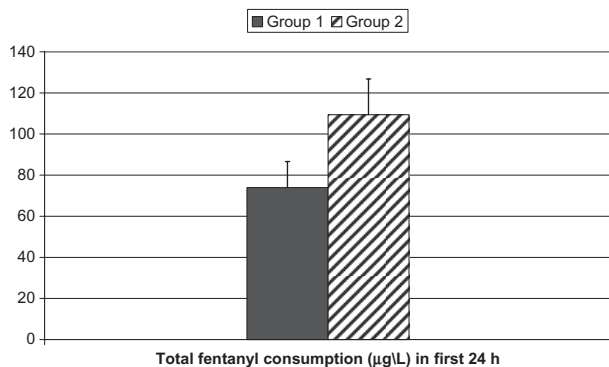


Figure 1 Total fentanyl consumption in first 24 hours.

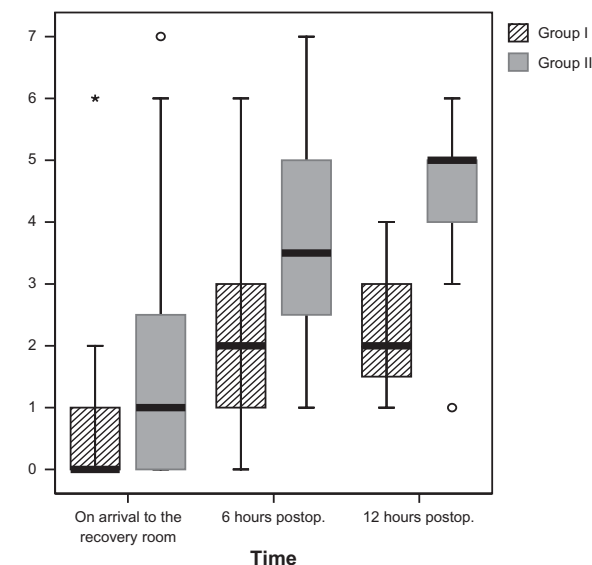


Figure 2 Verbal pain scores. **Notes:** Significant difference at all time points ($P < 0.05$); *extreme value, °outlier

result of sympathetic blockade below the level of the cardiac accelerator fibers (T1–T4) causing venodilatation and, to a lesser extent, arterial vasodilatation in the lower extremities and abdominal viscera.¹¹ The degree of hypotension will be influenced by the preoperative hydration state.

The combined lumbar plexus–sciatic nerve block technique provided more comfortable intraoperative anesthesia and better postoperative analgesia than the femoral–obturator–sciatic nerve block technique. This is probably the first study comparing both peripheral block combinations and including obturator nerve block. Most of the previous studies compared “three-in-one” block with psoas compartment block for postoperative pain control in hip or knee surgery.^{12–14} We decided to perform combined femoral–obturator block as an alternative to three-in-one block. Few previously published studies have compared three-in-one block with psoas compartment block in combination with sciatic nerve block for anesthesia in hip or knee surgery.¹⁵

Consistent with the findings of our study, Stevens et al¹⁶ demonstrated that psoas plexus block reduced pain and blood loss after hip arthroplasty. Hevia-Sanchez et al¹⁷ demonstrated effective analgesia for 10–12 hours after psoas compartment block for hip arthroplasty, with subsequent reduction in postoperative narcotic intake. Fournier et al¹⁸ reported prolongation

Table 3 Intact sensation in the obturator and lateral cutaneous nerves

	Group I	Group 2	P value
Intact sensation (%)	3 (12.5)	10 (41.7)*	0.049

Note: *Significantly higher rates than the other group.

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Table 4 Patients with Bromage score 3

		Group 1	Group 2	Total
Bromage score 3	0	Count	2	2
		% within Bromage score 3	50.0%	50.0%
		% within groups	8.3%	8.3%
	1	Count	10	8
		% within Bromage score 3	55.6%	44.4%
		% within groups	41.7%	33.3%
Total	2	Count	12	14
		% within Bromage score 3	46.2%	53.8%
		% within groups	50.0%	58.3%
		Count	24	24
		% within Bromage score 3	50.0%	50.0%
		% within groups	100.0%	100.0%
P value		0.657		

Note: *Significantly higher rates than in the other group (No significant differences between the two groups).

of postoperative analgesia for 4–6 hours following three-in-one block after prosthetic hip surgery. Although the use of psoas compartment block infusion through a catheter is recommended by many authors to prolong analgesia further,¹⁹ this practice remains debatable given the risk of local anesthetic toxicity, and the need for specialized equipment, technical expertise, and postoperative monitoring.²⁰

In contrast with previous results, Srivastava et al¹² compared psoas compartment block and three-in-one femoral–obturator block for postoperative analgesia following hip surgery. They concluded that both approaches to lumbar plexus block were effective in providing postoperative analgesia after hip surgery and also provided prolonged postoperative analgesia for more than the half-life of bupivacaine. Furthermore, Kaloul et al¹³ reported that psoas block and three-in-one femoral nerve block had similar postoperative analgesic effects when administered by a continuous catheter technique after knee replacement surgery. Biboulet et al²¹ compared the efficacy of single-dose three-in-one block and psoas compartment block with intravenous patient-controlled morphine analgesia after total hip arthroplasty under general anesthesia. They concluded that the blocks were effective only for the first 4 hours postoperatively, and reported that there was no difference between the three groups with regard to pain scores and morphine use.

Conclusion

Both combined posterior lumbar plexus–sciatic nerve block and combined femoral–obturator–sciatic nerve block provided adequate anesthesia for anterior cruciate ligament reconstruction surgery but the lumbar-sciatic technique provided more comfortable intraoperative anesthesia and better postoperative analgesia when compared with the femoral–obturator–sciatic technique.

Disclosure

The author reports no conflict of interest in this work.

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