CONTINUOUS SCIATIC NERVE BLOCK: COMPARTIVE STUDY BETWEEN THE PARASACRAL, LATERAL, AND ANTERIOR APPROACHES FOR LOWER LIMB SURGERY

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Abstract

Objective: The aim of the present study was to evaluate the ease and reliability of the anterior and lateral approaches to sciatic nerve block compared to the posterior parasacral approach, and their suitability for the specific factors in the patients, positions, and surgeries. Also, the insertion and usefulness of the continuous catheter technique was evaluated.

Methods: The study was carried out on 120 patients, ASA I, II and III, of both genders, age range between 20 and 70 years, scheduled for orthopedic, general and vascular lower limb surgery. Patients were enrolled in a prospective, randomized, double blind study. Patients were divided into three equal groups, 40 patients each. All the patients received femoral nerve block in addition to sciatic nerve block either parasacral (Posterior group), lateral (Lateral group) or anterior approach (Anterior group). This was followed by continuous femoral and sciatic nerve blocks in the postoperative period. Patients were assessed as regards the time, duration and intensity of the sensory and motor blocks and also the postoperative analgesia offered by the continuous block. They were also assessed for the hemodynamic changes accompanied these blocks. Radiological study was made to demonestrate the spread of different volumes of the drugs alongside the course of the sciatic nerve.

Results: The posterior parasacral approach is the easiest technique to perform and used successfully even in obese patients, but difficult to be done, if at all, in patients with limited movement such as multi-pelvic fractures. The anterior approach was found to be the best for the patients in the supine position, with best results as regards patients' satisfaction and sensory and motor blocks. Only, it is a technique that needs high experience especially in obese patients. The lateral approach was the least performed technique especially its high approach. However, it is useful in patients in supine position, and gives the best results in thin patients. The technique showed to be extremely difficult in obese patients.

Conclusion: The insertion of a catheter for continuous nerve block was easy. These blocks provided good or excellent postoperative analgesia for all patients in the different groups and facilitated early mobilization which helped in preventing the lower limb srugery – related morbidity and mortality.

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Introduction

Lower extremity peripheral nerve blocks (PNBs) have never been as widely taught or used as other forms of regional anesthesia. Over the past decade, several developments have led to an increased interest in lower extremity PNBs, including transient neurologic symptoms associated with spinal anesthesia, increased risk of epidural hematoma with the introduction of anti-thromboembolic prophylaxis regimens, and evidence of improved rehabilitation outcome with continuous lower-extremity PNBs[1].

In elderly patients and those with compromised cardiovascular conditions, the unilateral anesthesia provided by combined peripheral nerve blocks of the lower limb seems to be a logical alternative to minimize the hemodynamic effects of neuroaxial anesthesia in such patients[2].

Reviewing the different approaches of the sciatic nerve block showed that the anterior and the lateral approaches have been the least performed, and insertion of a catheter to continuously block the sciatic nerve as a tool to control the postoperative pain has not been exploited well. Moreover, these two approaches in addition to the parasacral approach are relatively new and little is known about the mechanics of the blockade, the anatomical location and extent of dispersion of the injected local anesthetic[3].

The aim of the present work is to evaluate the ease and reliability of the anterior and lateral approaches to the sciatic nerve compared to the posterior parasacral one, and their suitability for the specific factors in the patients, their positions, and the type of surgeries. Also, the insertion and usefulness of the continuous catheter technique was evaluated.

Patients and Methods

Patients

The current study was carried out on 120 patients, ASA I, II and III, of both genders, age range between 20 and 70 years, scheduled for orthopedic, general and vascular lower limb surgeries. After approval of the Local Ethics Committee, the patients were enrolled in a prospective, randomized and double blind study. Full explanation of the procedure, possible side effects and complications were discussed before informed written consents were obtained from the candidates.

Patients refusing the procedure, uncooperative, have allergy to any of the drugs used in the study, with diabetic peripheral neuropathy or have a history of stroke with lesion affecting the side to surgery were excluded form the study. Also patients with bleeding disorders or receiving an anticoagulant and those with infection at the site of injection were also excluded.

The patients were divided into three equal groups (40 patients each):

Posterior Group: 40 patients received sciatic nerve block using the para sacral approach followed by continuous sciatic block.

Lateral Group: 40 patients received sciatic nerve block using the lateral approach followed by continuous block.

Anterior Group: 40 patients received continuous sciatic nerve block using the anterior approach followed by continuous sciatic block.

Patients in all the three groups received in addition continuous femoral nerve block.

Techniques

The operating theater with all equipments and drugs for resuscitation had been made ready. Heart rate, ECG, and peripheral oxygen saturation (SPO2) were monitored continuously. Blood pressure (BP), non-invasively, was also monitored. IV cannula, 18-G was inserted and 8ml/kg of crystalloid solution was infused as a preload. Sedation was achieved with IV midazolam (0.03-0.05) and Fentanyl (50-100 mcg).

Posterior Group

The posterior superior iliac spine (PSIS) and the ischeal tuberosity were identified and the line joining these two points was drawn. The site of introduction of the needle is 6 cm distal to the PSIS. Stimuplex HNS11 machine was used in this study. After disinfection and local infiltration, a Contiplex® D Set (120 mm) with a flexible and non-wired catheter (B. Braun Melsungen AG) was advanced with a strictly sagittal orientation.

Within a distance of 6-8 cm, stimulation of the sciatic nerve was elicited in the form of contraction of the calf musculature with planter and dorsal flexion of the foot was triggered until a stimulation current of 0.2-0.3 mA was reached. 15 ml of ropivacaine 0.75% (Naropin, Astra, Sweden), were injected slowly after negative aspiration test. The catheter was advanced for 3-4 cm past the tip of the needle and then fastened with sterile strips. The catheter was then connected to a patient-controlled analgesia pump to infuse 0.2% ropivacaine at a basal infusion rate of 5 ml/hr, incremental bolus of 10 ml and lockout time of 60 min.

Lateral Group

While patient on supine position, the leg to be blocked is slightly rotated medially. The puncture site is 3 cm below and 1 cm caudal to the to the femoral trochanter major. The Contiplex needle was introduced horizontally to pass just below the lower border of the femur. The sciatic nerve was elicited and blocked in the same way as previously mentioned with the same concentration of ropivacaine. The catheter was advanced, fastened and fed in the same way as in parasacral approach.

Anterior Group

A line is drawn between the inferior border of the anterior superior iliac spine (ASIS) and superior angle of the pubic symphsis tubercle. Next, a perpendicular line bisecting the initial line was drawn and extended 8 cm cauded. The needle was inserted perpendicular to the skin, and the sciatic nerve was identified at a depth of 10-13 cm. Same volume and concentration of ropivacane and patient-controlled analgesia system (PCAS) were used.

Continuous Femoral Nerve Block

The femoral nerve was blocked just lateral to the femoral artery and immediately below the inguinal ligament. Successful location was indicated by contraction of the quadriceps femoris muscle using the nerve locator and Contiplex needle 5 mm. 10 ml of ropivacaine 0.75% were injected slowly after negative aspiration test and PCAS in the same rate and concentrations as for the sciatic nerve were started. The catheters were left for 3 days.

Assessment

I- Block Assessment

- Sensory assessment: Pinprick test was used and the results were reported by 4 points score 0 = severe pain, 1 = moderate pain, 2 = mild pain, 3 = no pain.
- Motor Assessment: Four-level Bromage[4] score method was used:

0 = able to raise the leg (L2, 3), full flexion of knee and feet

1 = unable to raise leg, able to flex ankles (L5, S1).

2 = unable to flex knee, able to flex ankles (S1, 2).

3 = unable to flex ankles.

II- Hemodynamic Assessment: Electrocardiogram (ECG), heart rate (HR), and peripheral oxygen saturation (SPO2), were monitored continuously, and mean arterial pressure (MBP)/5 min. Patients were assessed for occurrence of hypotension and/or bradycardia and treated accordingly.

III- Postoperative Pain Assessment: Postoperative pain was assessed according to 4 points score: 0 = severe pain, 1 = moderate pain, 2 = mild pain and 4 = no pain. All sensory and motor assessments were carried out by anesthetists who were blind to the type of block performed.

IV- Patients' Satisfaction: Overall level of individual's satisfaction about the technique was assessed using three -point scale: 1 = poor, 2 = good, 3 = excellent.

V- Radiological assessment: Serial X-ray films using contrast medium Omnipaque (iohexol, 180 I/ml) were taken postoperatively from 3 patients. An antero-posterior radiograph of the thigh was used to confirm proper position. The location of the catheter was considered correct when the contrast medium spreads along the course of the sciatic nerve.

Statistical Analysis

Mean and standard deviation (mean ± SD) were performed for numerical data. Continuous variables (arterial BP, heart rate, peripheral oxygen saturation and respiratory rate) were compared using ANOVA.

Nominal non-parametric data were analyzed with the Chi-square test. Frequency and percentages were used for categorized data. P values <0.05 were considered as statistically significant results. SPSS version 11.01 (SPSS Inc., Chicago, IL) was used in this analysis.

Results

Demographic Data: Demographic data of the three groups of patients showed no statistically significant differences (Table 1).

Table 1
Demographic data (Mean ± SD or %)

		Posterior Group n=40		Lateral Group n=40		Anterior Group n=40	
Age(Yr)		42.4 ± 14.7		40.3 ± 13		43± 11.4	
Weight(KG)		72.1 ± 11.2		70.8 ± 10.5		75± 11.4	
Height(Cm)		164.7 ± 4.5		164.3 ± 4.0		164.8 ± 6.8	
Duration(min)		130.5 ± 41		138.3±35.3		154.3±57.3	
		n	%	n	%	n	%
Gender	Male	27	67.5	23	57.5	22	55
	Female	13	32.5	17	45.5	18	45
ASA	I	21	52.5	22	55	20	50
	II	11	27.5	13	32.5	12	30
	III	8	20	5	12.5	8	20

Sensory Assessment

The onset time and the duration of sensory block showed no statistically significant differences (P> 0.05) (Table 2 and 3 and Fig. 1 and 2).

Table 2
Onset time (min) of sensory block (Mean ± SD).

	Posterior Group	Lateral Group	Anterior Group
	n=40	n=40	n=40
Onset time of sensory block (min)	21.3±7.6	23.9±6.6	20.9±6.0

Fig. 1
Onset time (min) of sensory block (Mean ± SD).

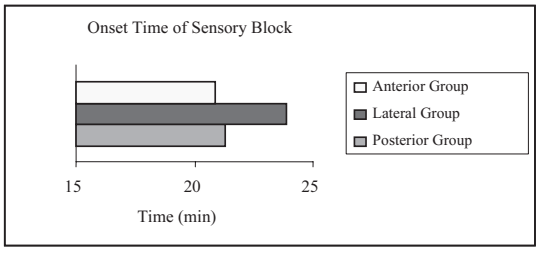
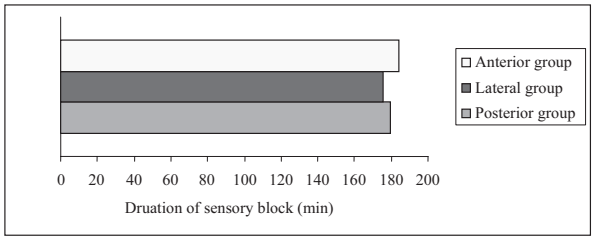


Table 3
Duration (min) of sensory block (Mean ± SD).

	Posterior group (n=40)	Lateral group (n=40)	Anterior group (n=40)
Duration of sensory block (min)	179.8 ±59.9	175.8 ±63.6	183.87 ±65.67

Figure 2
Duration of sensory block (min).



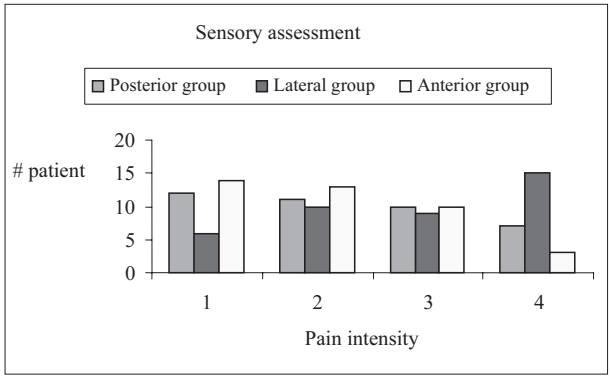
As regards the intensity of sensory block, there was statistically significant differences (P>0.05) (Tab. 4 and Fig. 3). Significant values appeared with the anterior group in severe pain (7.5%) and no pain (35%).

Table 4
Sensory intensity assessment (number, and %).

	Posterior group		Lateral group		Anterior group	
Score	(n=40)		(n=40)		(n=40)	
	n	%	n	%	n	%
3	12	30%	6	15%	14	35%*
2	11	27.50%	10	25%	13	32.50%
1	10	25%	9	22.50%	10	25%
0	7	17.50%	15	37.50%	3	7.50%*

* p value <0.05

Figure 3
Sensory intensity assessment.



Motor Assessment

The onset time and the duration of motor block in the three groups of patients (Tables 5 and 6 and Figures 4 and 5), showed no statistically significant differences between them (p >0.05).

Table 5
Onset time of motor block (min).

	Posterior group (n = 40)	Lateral group (n = 40)	Anterior group (n = 40)
Duration of motor block (min)	21.7 ±6.97	23.8 ±6.87	20.7 ±6.5

Fig. 4
Onset time of motor block (min).

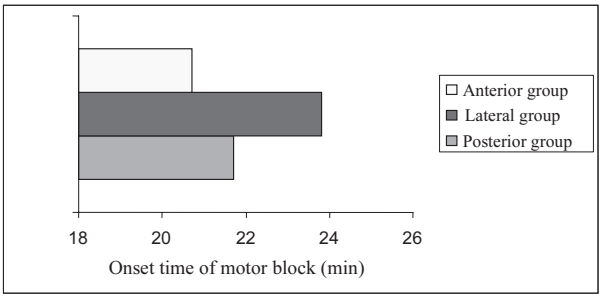
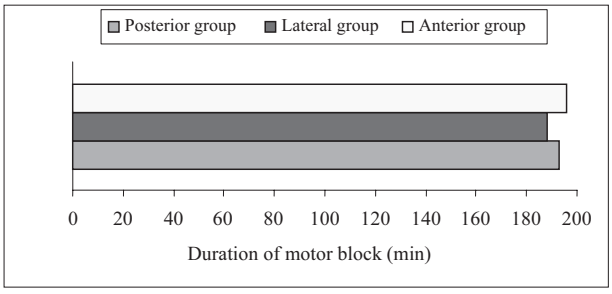


Table 6
Duration of Motor block (min).

	Posterior group (n = 40)	Lateral group (n = 40)	Anterior group (n = 40)
Duration of sensory block (min)	192.8 ±59.9	187.9 ±63.6	195.87 ±65.67

Figure 5
Duration of motor block (min).



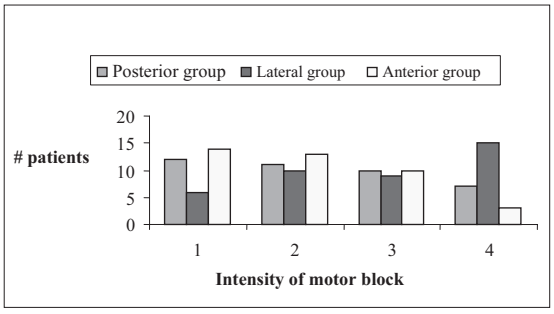
Intensity of motor block as scored according to Bromage Scale (Table 7 and Figure 6) revealed a statistically significant intense block in the anterior group compared to the other groups.

Table 7
Intensity of motor block

Score	Posterior group (n = 40)		Lateral group (n = 40)		Anterior group (n = 40)	
	n	%	n	%	n	%
3	12	30%	6	15%	14	35%*
2	11	27.50%	10	25%	13	32.50%
1	10	25%	9	22.50%	10	25%
0	7	17.50%	15	37.50%	3	7.50%*

*p value <0.05

Fig. 6
Intensity of motor block (min)



Patients Satisfaction

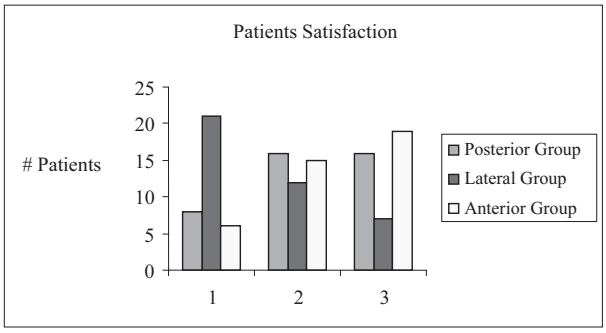
As regards patients satisfaction (Table 8 and Figure 7), there was statistically significant difference ($p < 0.05$) between the three groups. More patients in the anterior group are satisfied than in the other groups.

Table 8
Patients' satisfaction of the Procedure (number and %)

Satisfaction	Posterior group (n = 40)		Lateral group (n = 40)		Anterior group (n = 40)	
	n	%	n	%	n	%
Poor	8	20%	21	53%	6	15%*
Good	16	40.00%	12	30%	15	37.50%
Excellent	16	40%	7	17.50%	19	48%*

*p <0.05

Fig. 7
Patients' satisfaction of the Procedure (number and %)



Hemodynamic Assessment

The HR, MBP, SpO2 and RR, in the three groups of patients showed no statistically significant difference between them and from the pre block values ($p < 0.05$).

Postoperative Pain Assessment

Postoperative pain was statistically significant at 0 time ($p < 0.05$) as more patients in the posterior group

gave better pain score. At times 6, 12, 24, and 48 hrs, there was no statistical significant difference between the three groups (Table 9).

Table 9
Postoperative pain assessment.

Time	Score	Posterior Group n = 40		Lateral Group n = 40		Anterior Group n = 40	
		n	%	n	%	n	%
0	0	7	17.5	15	37.5	3*	7.5*
	1	10	25	9	22.5	10	25
	2	11	27.5	10	25	13	32.5
	3	12	30	6	15	14*	35*
6	1	13	23.5	20	50	9	22.5
	2	8	20	7	17.5	8	20
	3	9	22.5	8	20	11	27.5
	4	10	25	5	12.5	12	30
12	1	20	50	26	65	15	37.5
	2	6	15	5	12.5	6	15
	3	7	17.5	6	7.5	9	22.5
	4	7	17.5	3	7.5	10	25
24	1	26	65	31	77.5	21	52.5
	2	4	10	3	7.5	4	10
	3	5	12.5	4	10	7	17.5
	4	5	12.5	2	5	8	20
48	1	32	80	36	90	25	67.5
	2	2	5	1	2.5	2	5
	3	3	7.5	2	5	5	12.5
	4	3	7.5	1	2.5	6	15

*$p<0.05$

Radiological Assessment:

The distribution of the contrast medium 5, 10 and 15mls is shown in figures 8, 9 and 10. They demonstrated gradual spread of the contrast dye form the site of injection up and down alongside the course of the sciatic nerve as the volume increased instead of pooling around the nerve at the site of injection.

Discussion

Combined sciatic and femoral nerve blocks can be an invaluable alternative to general anesthesia and epidural or spinal block for lower limb surgery in compromised patients[5], with higher degree of patients satisfaction, surgical outcome and rehabilitation together with lower incidence of side effects.

The present study included 120 patients of ASA classes I, II, and III, divided into three equal groups and randomly allocated to receive femoral nerve block together with block of one of the aforementioned approaches to the sciatic nerve. A catheter was left in place for the postoperative analgesia.

Fig. 8
Distribution of 5 mL of contrast material alongside the course of sciatic nerve (Anterior Approach).

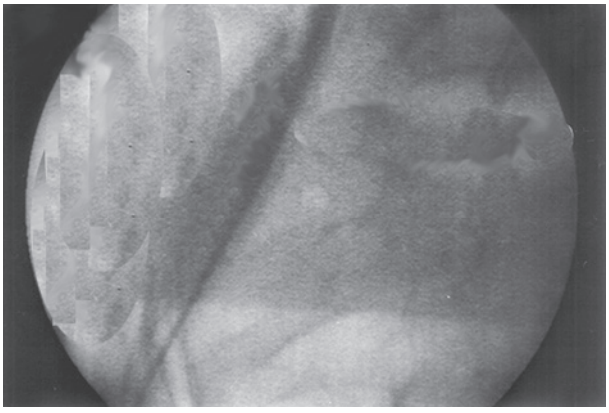


Fig. 9
Distribution of 10 mL of contrast material alongside the course of sciatic nerve (Anterior Approach).

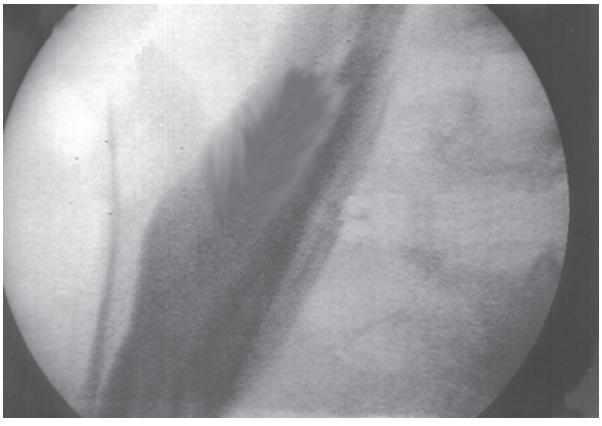
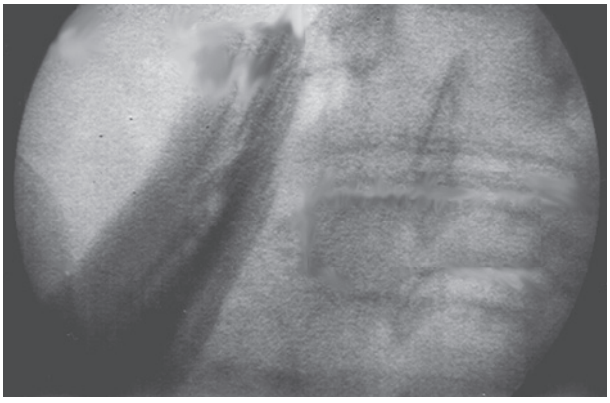


Fig. 10
Distribution of 15 mL of contrast material alongside the course of sciatic nerve (Anterior Approach)



Results of the current study showed no statistically significant differences ($p > 0.05$) between the three groups as regards demographic distribution and those related to the duration of surgery. No hemodynamic instability was reported in any of the patients. Also, No statistically significant differences ($p > 0.05$) were reported as regards the onset times of sensory and motor blocks and their duration times. Failure to insert the catheter was reported only in 5 cases: 2 in the anterior group, 2 in the lateral group and 1 in the posterior group. These patients were excluded from the study.

Assessment of sensory block using 4 point score of pain and motor assessment showed statistically significant ($p < 0.05$) better results with the anterior approach than the posterior and the lateral approaches. Also, the anterior group scored the best of the three groups as regards the patients satisfaction ($p < 0.05$).

As regards the anterior approach, we used the same landmarks as Chelly and Delunary[6], to define the inguinal ligament but our technique has made stress on the point of the femoral artery as an important landmark to determine the site of the femoral nerve and the puncture for the sciatic nerve. The results of the current study are in agreement with that reported by Chelly and Delunary[6] and Souron et al[7], as regards the onset times of sensory and motor blocks and their durations. The lower volume used in the present study compared to their studies (30 ml) can be explained by the higher concentration of the drug used (ropivacain, 0.75%) compared to bupivacain (0.5%) in their studies. The use of the catheter in anterior approach has been lacking in the literatures. In our study, the procedure continued for 48 hrs after surgery and gave good relief of pain and allowed some of the patients to undergo another procedure related to their operations during that time.

As regards the lateral approach, the current study is in agreement with that done by Pandin et al[8] in landmarks, onset times and durations of sensory and motor blocks, only differed in the volume of local anesthetic needed which was attributed to the different concentrations. They used a catheter with also good results for postoperative analgesia. In the present study, we found that it is prudent in obese patients to perform the block under fluoroscopy (C-Arm) to locate the lesser trochanter as an important landmark.

In the present study, the parasacral approach gave nearly the same results obtained by Pandin et al[8] with the exception of the initial volume used.

In conclusion, it was found that the posterior parasacral approach is the easiest technique that can be used and performed successfully even in obese patients. However, it is difficult, if at all, in patients with limited movement such as those with multi-pelvic fractures. The anterior approach was found to be the best for the patients in the supine position, with best results as regards patients' satisfaction and sensory and motor blocks. Only, it is a technique that needs high experience especially in obese patients. This difficulty was attributed to the localization of the femoral artery by palpation, a problem that can be overcome by using the Doppler ultrasound to detect the artery and its course.

It was also found that the high lateral approach was the least performed technique. However, it is useful in patients in supine position, and gives the best results in thin patients. The technique showed to be extremely difficult in obese patients due to inability to determine the landmarks, a problem that can be solved by using the fluoroscopy to demonstrate the lesser trochanter.

As regards the continuous catheter technique, the catheter was easy to insert, provided good or excellent postoperative analgesia for all patients in all approaches and facilitated early mobilization which helped in preventing the lower limb surgery-related morbidity and mortality.

The radiological study showed that increasing the volume of the local anesthetic can extend the block of the sciatic nerve down to the popliteal fossa and up towards the lumbosacral spine. Consequently, with lateral or anterior approach we can obtain the advantages of high posterior approach, but, one should be carful not to reach a volume that might cause an epidural blockade.

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