

## A New Continuous Lateral Access to Auxiliary and Femoral Nerves Decreases Pain in Movement and Catheter Contamination

**Luiz Eduardo Imbelloni** – MD, PhD

Doutor em Anestesiologia pela Faculdade de Medicina de Botucatu-UNESP  
Professor Assistente de Anestesiologia da Faculdade de Medicina Nova Esperança-FAMENE  
Instituto de Anestesia Regional do Complexo Hospitalar Mangabeira Gov. Tarcísio  
Burity [dr.imbelloni@terra.com.br](mailto:dr.imbelloni@terra.com.br)

**Eulámpio José da Silva Neto** – MDVet, PhD

Professor Associado de Anatomia da UFPB, Consultor em Anatomia da Faculdade de  
Medicina Nova Esperança-FAMENE  
eulampioneto@globo.com

**Antonio Fernando Carneiro-TSA/SBA, PhD**

Doutor em Medicina pela Santa Casa de São Paulo  
Chefe do Departamento de Cirurgia da Universidade Federal de Goiás  
Diretor de Defesa Profissional da SBA Especialista em Medicina Intensiva [carn@terra.com.br](mailto:carn@terra.com.br)

**Renata Grigorio, MSc**

Mestre em Modelos de Decisão e Saúde - UFPB, João Pessoa, PB  
Serviço de Atendimento Móvel de Urgência (SAMU-JP)  
renatagrigorio@yahoo.com.br

**Marildo A. Gouveia - MD**

Diretor do Instituto de Anestesia Regional

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**Abstract-** Continuous axillary and inguinal blocks have demonstrated to provide effective postoperative analgesia. This study describes a new lateral approach to the axillary and inguinal plexus in cadavers and their applicability in postoperative analgesia and control of contamination. The study comprises anatomy observed in anterolateral dissection of the axillary and inguinal regions in a cadaver fixed in formalin and evaluation of the technique in patients. Twenty adult patients with fractures of the forearms or femur were selected. Position of the catheter through the injection of contrast media, quality of analgesia (VAS) and catheter contamination were checked in 48 hours. The distance from skin to axillary nerves was 85mm and 102mm for the lumbar plexus. Live, the distance was 87.2 (2.2) mm for the brachial plexus and 105 (3.6) mm for the lumbar plexus. The contrast medium produced an image in the medial aspect of the axillary region and in the superior third of the thigh, in the ileopectineo arch. No bacterial growth was found in the catheter culture. VAS score during movement and rest was <30mm, without statistical difference. The lateral access to the brachial plexus in the axilla and the lumbar plexus in the inguinal fold have shown to be easy techniques to insert a catheter, promoting an excellent postoperative analgesia at rest as in movement, improving the sleep and satisfaction of all patients. A potential advantage of this approach is the reduction of bacterial growth in the catheter site.

**Keywords:** Anesthetic techniques, regional; anesthetic techniques – Continuous peripheral nerve blocks – Nerve stimulator

### Introduction

The use of peripheral nerve blocks is recommended after orthopedic surgery<sup>1</sup>. In the past decade, there has been an increasing interest in continuous peripheral nerve blocks. Continuous peripheral nerve blocks have been shown to promote better postoperative analgesia, increase patient satisfaction, and have a positive influence on the surgical outcome and patient rehabilitation, and increase patient satisfaction compared with intravenous opioids for both upper<sup>2</sup> and lower extremities<sup>3</sup>. The combination with portable elastomeric pumps can provide prolonged analgesia in patients undergoing bilateral total hip arthroplasty<sup>4</sup>.

In the continuous peripheral nerve block the local anesthetic is then infused via the catheter providing potent, site-specific analgesia. The role of subcutaneous tunneling of the catheter has been recommended in order to prevent its movement<sup>5</sup> and prevent infection<sup>6</sup>. Therefore, it appears that subcutaneous tunneling site and catheter duration seems beneficial in reducing the development colonization<sup>7</sup>. The site of catheter insertion can be another potential risk factor for bacterial colonization. The axillary and femoral sites are associated with a rate of catheter bacterial colonization as high as 37% to 57%<sup>7,8</sup>.

The objective of this study was to find a new approach to the brachial plexus in the axillary region and access to the femoral nerve in the inguinal fold through a tunneling path to prevent dislodgement of the catheter and reduce the possibility of infection in the catheter site. The catheter tip was controlled with injection of contrast and radiographic image. Postoperative analgesia was provided through and elastomeric pump and all catheters were taken to the microbiology department for culture.

### Methods

This prospective, descriptive and exploratory study was approved by the local Ethics Committee. The research project consisted of two stages: cadaver dissections of the axillary and inguinal regions (brachial plexus in the axilla and femoral nerve in the inguinal fold) and continuous blockade of both plexuses in trauma patients using continuous technique checked with contrast medium and radiograph. The research project consisted of two stages: the cadaveric dissection of the brachial plexus in the axilla and of the femoral nerve in the groin followed by a continuous blockade of the brachial plexus in the axilla and of the femoral nerve,

both via a lateral approach, checked with contrast medium, in orthopedic surgery of the forearm and lower femur.

The anatomic study consisted of dissection of the axillary and inguinal regions in a cadaver fixed in formalin, through anterolateral approach. Entry points were marked in the deltoid region for the brachial plexus aiming the axillary artery and a point anterior to the femur aiming the femoral nerve referred to the femoral artery. The distance between the entry point on the skin and the site of both arteries was measured with a ruler in millimeters and noted. The needle of the contiplex set (Contiplex® Tuohy Continuous Nerve Block Set, B.Braun Melsungen AG) was introduced from the marked entry point as far as the arteries marked in the axillary pit and inguinal fold. The dissection was started by planes until the needle tip could be found, confirming its situation through dissection and confirming the distance with a ruler. After the dissection of the area the catheter was introduced until the tip of the needle for a photo.

After obtaining institutional approval and written informed consent, 20 adult patients of both genders aged from 20 to 60 years, scheduled for surgery of fracture of the forearm bones (continuous brachial plexus block, n =10) and distal femur fracture (continuous inguinal plexus block, n =10) were included in this study, to confirm the viability of the new approach and evaluation of postoperative analgesia. In two patients in each group it was injected radiopaque non-ionic contrast (Omnipaque ®) to evaluate the position of the catheter.

Using sterile precautions and skin infiltration with lidocaine 1%, a 18G insulated Tuohy needle with a stimulating cable guiding a 20G catheter (Contiplex®, B.Braun Melsungen AG, Germany) was used to identify the axillary nerve and femoral nerve through a peripheral nerve stimulator (Stimuplex® HNS 12). The location of the needle was considered successful after obtaining contraction of any muscle of the forearm for the upper limb for the brachial plexus and movement of the patella for the femoral stimulation, both under a current of 0.5 mA (frequency 2 Hz and pulse duration 0.3 ms). The potential perineural space was distended with 20 mL of anesthetic solutions and a 20G catheter was inserted 4-7 cm in the perineural area.

For upper limb surgery, the continuous blockade was performed for anesthesia and postoperative analgesia. With the patient recumbent and the forearm abducted, the small tubercle of the deltoid in the deltopectoral sulcus and the coracoids process were marked. In the midpoint of this distance was marked the entry point. The distance between the entry point to the axillary artery was marked with a ruler in millimeters. For the surgery 60 mL of lidocaine obtained by dilution of 30 mL of the 2% lidocaine (Cristália Produtos Químicos e Farmacêuticos Ltda) solution with 30 mL of distilled water plus epinephrine 1:400,000 were used. The catheter was then inserted.

For lower limb surgery, spinal anesthesia was performed after puncture at L3-L4 with a 27G Quincke (B. Braun Melsungen AG) and injected with 10-15 mg of isobaric bupivacaine 0.5%

(Cristália Produtos Químicos e Farmacêuticos Ltda). After the end of the surgery, with the patient still recumbent, the lumbar plexus block was placed through the lateral inguinal approach, and the same solutions was injected as in the axillary block. The superior anterior iliac spine was marked and a point 15 centimeters below the iliac spine down the thigh, lateral to the sartorius muscle.

The position of the axillary and inguinal catheter was confirmed with an injection of 10 mL of iohexol contrast medium (300 mg.mL<sup>-1</sup> Omnipaque®) followed by an anteroposterior radiograph. Prior to discharge of the patient from the post-anesthetic care unit (PACU), the perineural catheters were connected to a disposable elastomeric pump (Easy pump®, B.Braun, Germany) containing 400 mL of 0.1% bupivacaine in both sites. The pump was programmed for infusion at a rate of 8 mL.h<sup>-1</sup>. All patients received instruction to trigger the bolus device, which is part of the pump, in case of severe pain. At the end of the surgery, patients received ketoprofen 100 mg and dipyrone 3-4 g IV. The insertion site of catheter was checked twice a day by an instructed nurse for local signs of infection. The catheter remained for 48 hours in patients when it was removed and sent for culture. The culture was performed by semi-quantitative (Maki) which is held in the bearing of the catheter tip on agar plate and after incubation for 48 hours at 37° C is the counting level of colonies.

Pain scores were measured with use of a visual analog scale immediately after the end of the motor block, 6, 12, 24, 36 and 48 hours postoperatively. Pain was controlled with oral tramadol (50 mg) or IV.

The method used to assess sleep was self-report method. Sleep quality in the first and second night after surgery was investigated using the following scale: excellent (slept without waking up with pain), good (once woke with pain) and bad (woke up two or more times with pain).

The data were analyzed using the Kruskal-Wallis, Wilcoxon and Exact of Fisher was used. The exact test of Fisher was used for comparison between groups and the Kruskal-Wallis test for comparison between the means of quantitative variables and the site of injection of the anesthetic. The Wilcoxon test was used for comparison of the VAS in the various times at rest and after movement of the operated limb. It was adopted 5% as the significance level.

## Results

### a) Anatomy of the axillary and inguinal

In the axilla, the nerves are lateral, posterior and medial to the axillary artery. The four major nerves of the upper limb (musculocutaneous, radial, median and ulnar) can be blocked in the axilla. The entry site is through the deltoid muscle (deep to the cephalic vein) and posterior to the insertion of the pectoralis major muscle, deep in the axillary fosse and visualizing the nerves. The distance between the skin and the axillary artery was found 85mm (Figure 1).

In the inguinal region, the insertion of the needle in the skin was lateral to the sartorius muscle (next to its origin), advancing deep to it until the femoral trigon and reaching the femoral nerve. The distance between the skin and the femoral artery was 102mm (Figure 2).

### b) Radiographic analysis

The injection of 10 mL of iohexol contrast medium (Omnipaque®) produced a spindle-like opacification, suggesting that the catheter tip was perivascular to the artery and axillary vein (Figure 3). The same volume of iohexol contrast medium produced an opacification in the inguinal region, in the upper thigh, suggesting its placement on the bow ileopectineo within the connective tissue (Figure 4).

### c) Laboratory

Twenty catheters (axillary and inguinal) submitted to culture showed no bacterial growth after 48 hours of incubation.

### d) Patients

There were no statistically significant differences in the both groups demographic data (Tabela 1). Figure 5 and 6 depicts the pain scores on the visual analog scale at rest, at two, six, 12, 24, 36 and 48 hours and during physical movement postoperative. During 48 hours the evaluated mean VAS value at rest and movement is less than 30 mm. There is not an increase in the intensity of pain at rest and moving 24 hours after starting infusion of anesthetic ( $p = 0.6176$ ). A solution of 0.1% gave excellent analgesia (VAS <3), no motor block, no paresthesia or dysesthesias within 48 hours of use of the catheter. There was no failure and no patient experienced pain greater than five.

There was no evidence of local inflammatory signs (focal pain, redness, and induration) in all patients. There were no technical problems with catheters and devices (kinked catheter, inadvertently withdrawn catheter, displaced catheter, blocked catheter, leakage of local anesthetic around the catheter, unwanted stopping of the elastomeric pump, and other).

Sleep was excellent or good in all patients, no significant difference between 24 and 48 hours ( $p$ -value = 1.0000). None of the patients of both groups reported poor sleep evaluation within 48 hours.

### Discussion

In the cadaver, the distance from the point of entry to the dissection of axillary artery was 85mm and the point of entry into the femoral artery was dissected 102mm. The insertion of the catheter in 20 patients using the neuroestimulator was confirmed to be a practical approach and easily performed without any difficulty. In this new lateral approach, the tunneling part of the technique avoids a counter-opening by direct access in the axillar and inguinal sites. As might be expected, the axillary location of the brachial plexus and inguinal lumbar was deeper than the traditionally used

approach (perpendicular axillary and inguinal). Likewise, the result of the quality of analgesia during rest and movement is about the same as previously reported studies<sup>9, 10</sup>, and

analgesia with 0.1% bupivacaine remained below the pain score three for 48 hours. There was no bacterial growth for 48 hours in the study of the catheters. Continuous peripheral nerve block has become the technique of choice for the management of postoperative pain primarily in open shoulder<sup>2</sup>, knee procedures<sup>3</sup>, and foot surgery<sup>11</sup>. One should note that, from the standpoint of the anesthesiologists, continuous peripheral nerve block served essentially to optimize postoperative and rehabilitation. No differences in evaluation of the pain at rest and movement, showing that the continuous analgesia reduced the incidence of postoperative pain being all the time below 3mm VAS. The study did not aim to compare the benefits of the technique of continuous plexus analgesia with intravenous patient-controlled, unlike other work<sup>10</sup>.

In the multicenter prospective analysis, the catheter placement with difficulty (5,6%)<sup>7</sup> was low with respect to previous reports, even though the difficulties in perineural catheter insertion reported by various authors clearly seem to be correlated to the site of catheter placement. Difficulties inserting the catheter in a continuous interscalene block varied between 25%<sup>10</sup> and 66%<sup>13</sup>. A modified lateral approach to continuous interscalene block reduced the incidence to 6%<sup>14</sup>. In 20 patients, the lateral entrance in both the axillary and inguinal region did not pose any difficulty in its insertion, obtaining excellent analgesia in all patients. The lateral entrance in the brachial plexus allows the needle to find a nerve before reaching the axillary artery. Likewise, in the lumbar plexus the femoral nerve is situated lateral to the femoral artery. Thus, there has been no stroke in the lateral approach in both plexuses.

The subcutaneous tunneling reduces the risk of displacement, facilitating movement of the patient and allowing making personal hygiene normally. It is possible to exchange the dressing where necessary, which decreases the risk of infection. The frequency of infection associated with peripheral nerve catheters remains poorly defined<sup>7,8</sup>. Severe complications recently reported in the literature include psoas abscess

complicating continuous femoral nerve blocks<sup>3</sup>, axillary abscess<sup>15</sup> and necrotizing fasciitis<sup>16</sup> after continuous axillary block and interscalene abscess after continuous interscalene block<sup>14</sup>. Recent study shows that 29% of peripheral nerve catheters may become colonized, with 3% resulting in localized infection<sup>7</sup>. In this work, the lateral approach in both plexuses did not favor microbial growth in all (20) catheters, as at 48 hours there was no sign of inflammation at the site of puncture and all plates were negative.

The continuous peripheral nerve blocks involve the percutaneous insertion of a catheter directly adjacent to the peripheral nerves supplying an affected surgical site. The

catheter is then infused with local anesthetic resulting in potent, site-specific analgesia that lasts well beyond the time duration of a single injection nerve block<sup>17, 18</sup>. Inhibition of pain fibers is the primary goal for postoperative continuous peripheral nerve blocks, currently resulting in undesirable side effects such as muscular weakness<sup>19</sup>, particularly undesirable when the patient needs early ambulation. Patients with continuous nerve block in the upper limbs with the 0.1% bupivacaine solution did not experience loss of sensation and lack of prehensile power, the same as patients with block of the femoral nerve with the same solution. Though impossible to walk for 48 hours, because of surgeons order, they could take active physiotherapy without pain. This way no motor block was observed in both groups.

Continuous peripheral nerve blocks have shown to promote better postoperative analgesia, increase patient satisfaction and patient rehabilitation compared with patient controlled analgesia<sup>6-8, 11-14</sup>. This study demonstrates that continuous peripheral nerve blocks provided excellent analgesia during rest and movement evaluated 24 and 48 hours postoperatively.

Although continuous perineural infusions of local anesthetic dramatically decrease postoperative pain, many patients still require oral analgesics. The percentage of patients who will use supplemental oral drugs is dependent on a multitude of factors, including the type of surgery, other analgesic adjuvant, the infusion dosing regimen and local anesthetic used for infusion. The solution and the dose of bupivacaine associated to ketoprofen and dipyrone, at regular intervals, were sufficient to prevent the use of rescue drugs.

The methods used for evaluation of sleep and rest can be separated into two groups: those who use equipment and self-report. In the present study, self-report was used showing that 20 patients had good or excellent sleep on the two subsequent nights after surgery.

In conclusion, the lateral approach to the axillary and inguinal blocks proved to be easy to be carried out to placement of the catheter. The tunneling is part of the lateral approach reducing the risk of contamination of the catheter. Furthermore, a continuous lateral axillary and inguinal technique provides excellent analgesia at rest and movement reduces opioids of needs, improving sleep quality and patient satisfaction. The anatomical study on the cadaver allowed its application in humans, without any difficulty.

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### References

1. Enneking FK, Wedel DJ. The art and science of peripheral nerve blocks. *Anesth Analg*, 2000; 90:1-2.
2. Borgeat A, Schappi B, Biasca N, Gerber C. Patient-controlled analgesia after major shoulder surgery: Patient-controlled interscalene analgesia versus patient controlled analgesia. *Anesthesiology*, 1997; 87:1343-47.
3. Capdevila X, Barthelet Y, Biboulet P, Ryckwaert Y, Rubenovitch J, d'Athis F. Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery. *Anesthesiology*, 1999; 91:8-15.
4. Imbelloni LE, Vieira EM, Devito FS, Ganem EM. Continuous bilateral posterior lumbar plexus block with a disposable infusion pump. Case Report. *Rev Bras Anesthesiol*, 2011; 61:214-217.
5. Salinas FV. Location, location, location: continuous peripheral nerve blocks and stimulating catheters. *Reg Anesth Pain Med*, 2003; 28:79-82.
6. Hebl JR. The importance and implications of aseptic techniques during regional anesthesia. *Reg Anesth Pain Med*, 2006; 31:311-23.
7. Capdevila X, Pirat P, Bringuier S, Gaertner E, Singelyn F, Bernard N, Choquet O, Bouaziz H, Bonnet F. French Study Group on Continuous Peripheral Nerve Blocks. Continuous peripheral nerve blocks in hospital wards after orthopedic surgery. A multicenter prospective analysis of the quality of postoperative analgesia and complications in 1,416 patients. *Anesthesiology*, 2005; 103:1035-45.
8. Neuburger M, Buttner J, Blumenthal S, Breitbarth J, Borgeat A. Inflammation and infection complications of 2285 perineural catheters: a prospective study. *Acta Anaesthesiol Scand*, 2007;51:108-14.
9. Capdevila X, Macaire P, Dadure C, Choquet O, Biboulet P, Ryckwaert Y, D'Athis, F. Continuous psoas compartment blocks for postoperative analgesia after total hip arthroplasty: new landmarks, technical guidelines, and clinical evaluation. *Anesth Analg*, 2002; 94:1606-16013.
10. Marino J, Russo J, Kenny M, Herenstein R, Livote E, Chelly JE. Continuous lumbar plexus block for postoperative pain control after total hip arthroplasty. *J Bone Joint Surg Am*, 2009; 91:29-37.
11. White PF, Issioui T, Skrivaneck GD, Early JS, Wakefield C. The use of a continuous popliteal sciatic nerve block after surgery involving the foot and ankle: Does it improve the quality of recovery? *Anesth Analg*, 2003; 97:1303-1309.
12. Tuominen M, Haasio J, Hekali R, Rosenberg PH. Continuous interscalene brachial plexus block: Clinical efficacy, technical problems and bupivacaine plasma concentration. *Acta Anaesthesiol Scand*, 1989; 33:84-880.
13. Singelyn FJ, Seguy S, Gouverneur JM. Interscalene brachial plexus analgesia after open shoulder surgery: Continuous versus patient-controlled infusion. *Anesth Analg*, 1999; 89:1216-122.
14. Borgeat A, Dullenkopf A, Ekatothramis G, Nagy L. Evaluation of the lateral modified approach for continuous interscalene block after shoulder surgery. *Anesthesiology*, 2003; 99:436-442.
15. Bergman BD, Hebl JR, Kent J, Horlocker TT. Neurologic complications of 405 consecutive continuous axillary catheters. *Anesth Analg*, 2003; 96:247-252.
16. Nseir S, Pronnier P, Soubrier S, Onimus T, Saulnier D, Mathieu D, Durocher A. Fatal streptococcal necrotizing fasciitis as a complications of axillary brachial plexus block. *Br J Anaesth*, 2004; 92:427-429.

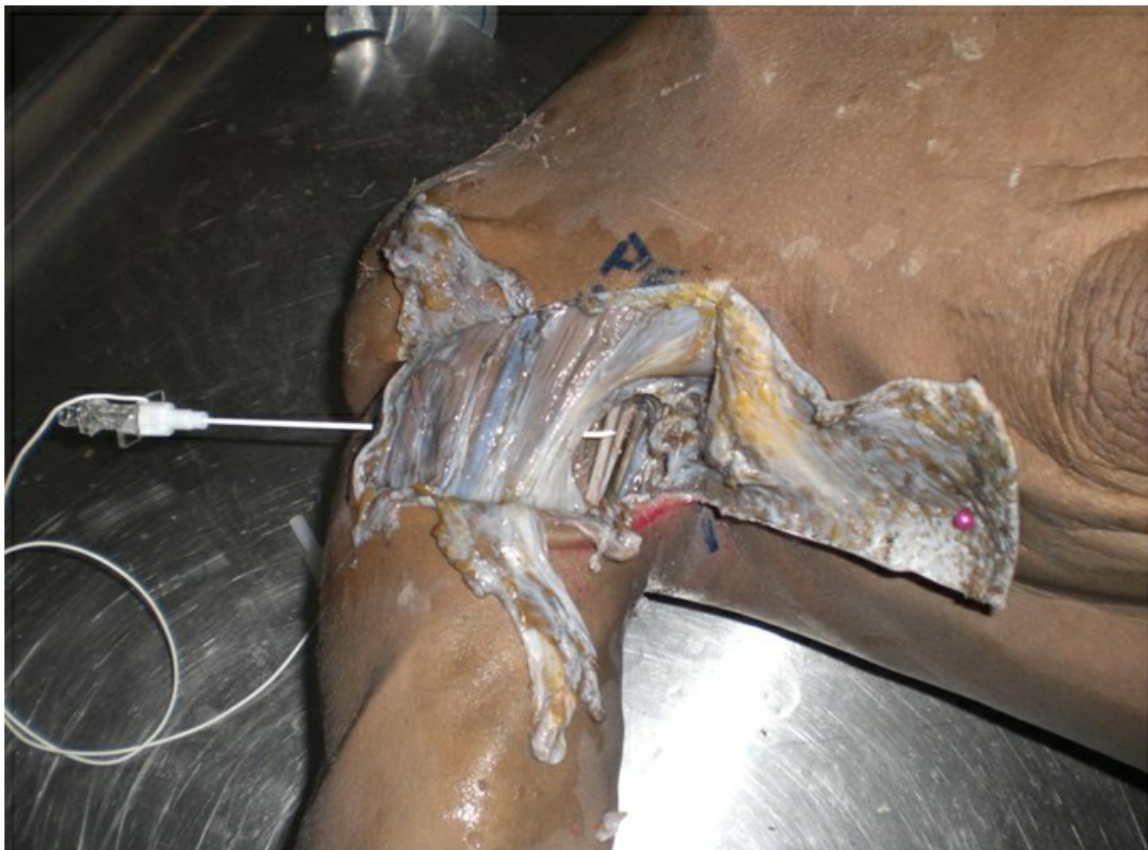
17. Singelyn FJ, Deyaert M, Joris D, Pendeville E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. *Anesth Analg*, 1998; 87:88-92.
18. Ilfeld BM, Ball ST, Gearen PF, Le LT, Mariano ER, Vandenborne K, Duncan PW, Sessler DI, Enneking FK, Shuster JJ, Theriaque DW, Meyer RS. Ambulatory continuous posterior lumbar plexus nerve blocks after hip arthroplasty: A dual-center, randomized, triple-masked, placebo-controlled trial. *Anesthesiology*, 2008; 109:491-501.
19. Borgeat A, Kalberer F, Jacob H, Ruetsch YA, Gerber C. Patient-controlled interscalene analgesia with ropivacaine 0.2% versus bupivacaine 0.15% after major open shoulder surgery: The effects on hand motor function. *Anesth Analg*, 2001; 92:218-223.

**Table I:** Demographic Characteristics

Variables	Axillary	Inguinal	P-Value
Age (years)	38.6 (13.5)	37.1 (9.8)	0.0434
Weight (kg)	67.4 (8.14)	68.5 (10.4)	0.248
Height (cm)	168.6 (10.3)	170.1 (8.7)	0.1551
Gender: F/M	2/8	3/7	1
ASA: 1/2	6/4	6/4	1
Distance P-A (mm)	87.6 (2.2)	105.1 (3.6)	0.0001

Values are expressed as mean (SD).

Distance P-A: puncture site until the artery (axillary and femoral)



**Figure 1.** Catheter placed in the axillary lateral approach in a cadaver.



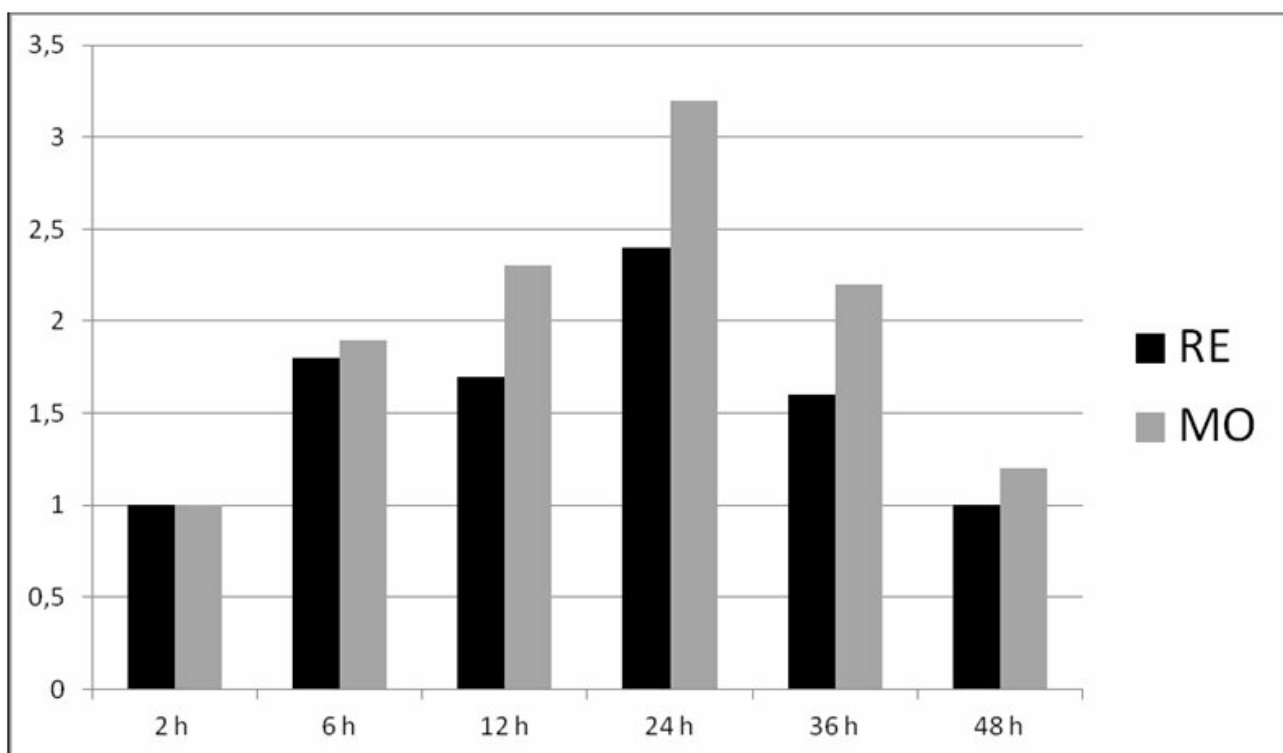
**Figure 2.** Catheter placed in the lateral inguinal region in cadaver.



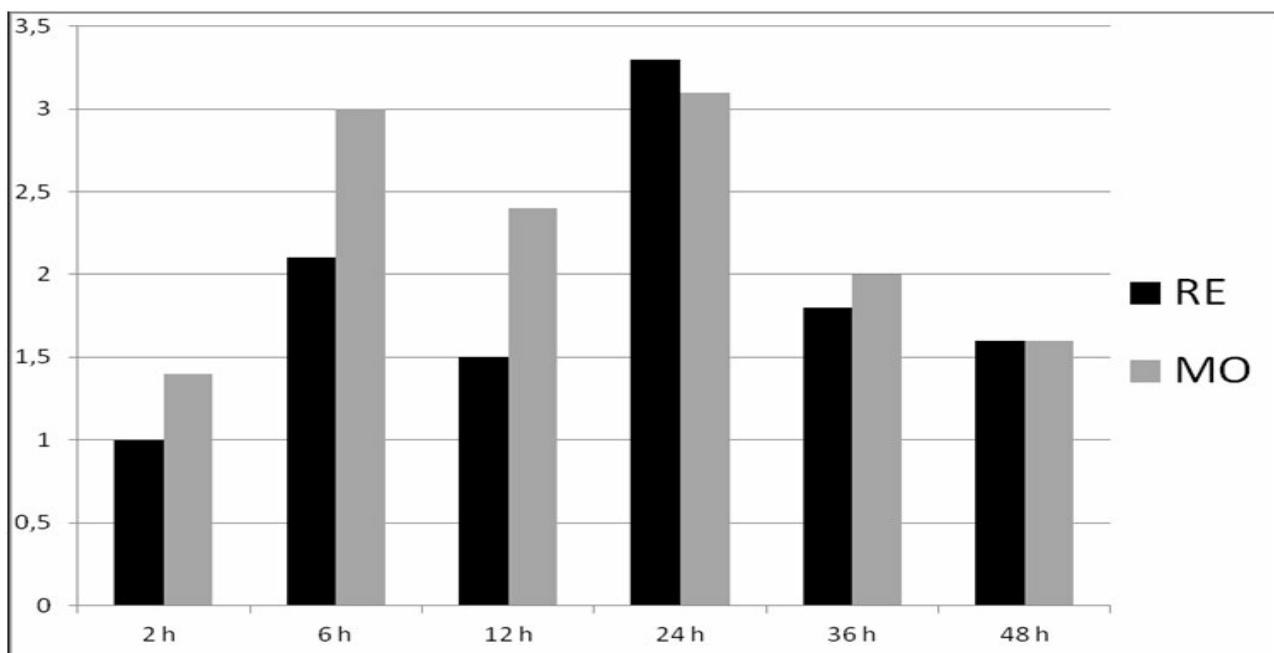
**Figure 3:** Lateral axillary plexus approach with contrast



**Figure 4:** Lateral inguinal plexus approach with contrast



**Figure 5:** Mean VAS pain at rest (RE) and movement (MO) within 48 hours after lateral axillary block



**Figure 6:** Mean VAS pain at rest (RE) and movement (MO) within 48 hours after lateral inguinal block