LUMBAR PLEXUS BLOCKAGE ON PSOAS COMPARTMENT FOR POSTOPERATIVE ANALGESIA AFTER ORTHOPAEDIC SURGERIES

LUIZ EDUARDO IMBELLONI[1]

SUMMARY

Objectives: The lumbar plexus is located between the quadratus lumborum and the psoas major muscles. The aim of this study was to evaluate the efficacy of a single 0.25% bupivacaine injection through the psoas compartment blockage in postoperative analgesia of patients undergoing orthopedic surgery. Methods: 40 patients received lumbar plexus blockage at the psoas compartment through nerve stimulator and a 0.25% bupivacaine 40-ml injection. Analgesia and pain severity were evaluated at 4, 8, 12, 16, 20 and 24 hours after surgery, similarly to rescue opioids. Results: The ilioinguinal, genitofemoral, lateral cutaneous of the thigh, femoral and obturator were blocked in 90% of patients. Blockage has reduced the amount of postoperative opioids, and 52.5% of patients required no additional postoperative analgesia, with analgesia duration of approximately 24 hours. There were no clinical signs or symptoms of bupivacaine toxicity, as well as no sequels secondary to nerves blockage. Conclusions: This report shows that injections into psoas compartment space is easy to perform and provides an effective blockage of the five nerves. The lumbar plexus blockage at the psoas compartment can be recommended for use in postoperative analgesia after orthopedic surgeries.

Keywords: *Analgesia; Anesthetics; Bupivacaine.*

Citation: *Imbelloni LE. Lumbar plexus blockage on psoas compartment for postoperative analgesia after orthopaedic surgeries. Acta Ortop Bras. [serial on the Internet]. 2008; 16(3): 157-160. Available from URL: http://www.scielo.br/aob.*

INTRODUCTION

Winnie et al[1] are responsible for originally describing two lumbar plexus blockage techniques. The "3-in-1" blockage was described in 1973 [1] while the posterior access based on paresthesia was described one year later[2]. The clinical potential of the second approach was poorly recognized, while the "3-in-1"technique was widely employed for providing analgesia in surgical procedures on lower limbs. In 1976, a second posterior technique was described, which was based on the lost resistance on the compartmental fascia between psoas and quadratus lumborum muscles[3], as corroborated by tomography imaging[4]. The study of 4 cadavers and 22 tomography images of the lumbossacral region showed that, at L_5 level, the femoral nerve lies between lateral and obturator femoral skin nerves[5], and, although the lateral femoral skin nerve lies on the same level as the femoral one, the obturator nerve can be included or within a separate fascia[5]. In 1989, by studying the motion function of lumbar plexus nerves in 80 patients, the posterior technique was shown to be superior to the 3-in-1 blockage, resulting in a higher number of blocked nerves[6].

The lumbar plexus is formed by the anterior portions of the first four lumbar spine nerves. The plexus lies across the transverse processes of the lumbar vertebrae and is comprised inside the psoas muscle and constituted of the following nerves: iliohypogastric, ilioinguinal, genitofemoral, lateral cutaneous of the femur, obturator and femoral.

The purpose of this study is to assess the effectiveness of analgesia by applying a single bupivacaine injection on psoas compartment, using a peripheral nerves stimulator in hip and femur orthopaedic surgeries.

METHODS

After approval by the Publication & Dissemination Board of the clinic and obtaining informed consents, 40 patients submitted to hip and femur orthopaedic surgeries participated on this prospective study. Exclusion criteria included: hypovolemia, coagulation disorders, serious cardio respiratory conditions, infection, refusal to the proposed method, and discharge on the next day of surgery.

All patients received a standardized anesthesia. No pre-anesthetic medication was administered while in the bedroom. After venoclysis with 16G or 18G catheter, infusion was initiated with Ringer lactate solution. Monitoring at operating theater was provided by continuous ECG at CM5, blood pressure by non-invasive method, as well as pulse oxymetry. In no patient bladder catheterization was used. After sedation with fentanyl 1 – 1.5 $\mu g.kg^{-1}$, rachial anesthesia was provided with the patient positioned at left lateral position with 0.5% isobaric bupivacaine at paramedian access into L_2-L_3 or L_3-L_4 space, with 27G Quincke needle. To those patients with femoral fractures, midazolam (0.5-1 mg) and ketamine (5-15 mg) were administered prior to blockage. Intraoperative sedation was provided with

Study conducted at the Regional Anesthesia Institute, Hospital de Base, São José do Rio Preto – SP
Correspondences to: Av. Epitácio Pessoa, 2356/203 - Lagoa - Rio de Janeiro -RJ, Brasil - CEP 22471-000 - dr.imbelloni@terra.com.br

1. Director of the Regional Anesthesia Institute, Anesthesiologist at Santa Maria Healthcare Unit and São Bernardo Clinic, Rio de Janeiro, Brazil.

Received in: 01/14/07; approved in: 04/24/07

fractioned doses of midazolam. At the end of the procedure, dipyrone (30 mg.kg^{-1}) and tenoxican (40 mg) were administered by venous infusion.

Lumbar plexus blockage at psoas compartment (Figures 1 and 2) was made with the patient lying at lateral position with the operated limb pointing up at the end of surgery, with 10 mm needle (B.Braun Melsungen AG, 21G 0.8x100 mm needle) connected to a peripheral nerve stimulator (Stimuplex®, B.Braun Melsungen AG) adjusted to release 1 mA, 1 Hz squared pulsed current, perpendicularly inserted approximately 7-10 cm deep, aiming to achieve femoral quadriceps muscle contraction. When contraction was achieved, the current was reduced to 0.5 mA, and, if the contractile response remained, 40 ml 0.25% bupivacaine was injected after negative aspiration for blood.

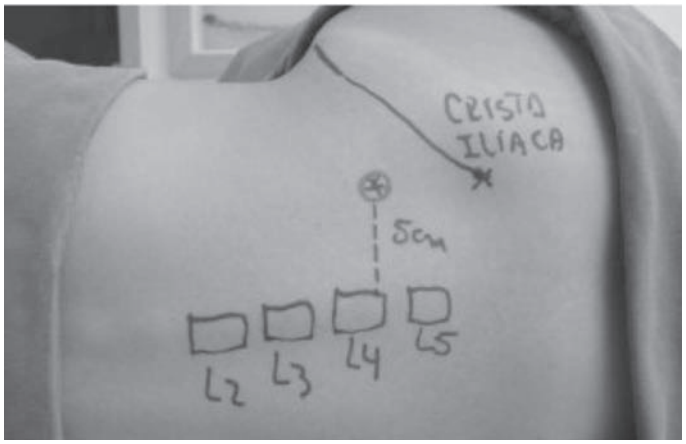

Figure 1 *– Position and marking for psoas compartment blockage*

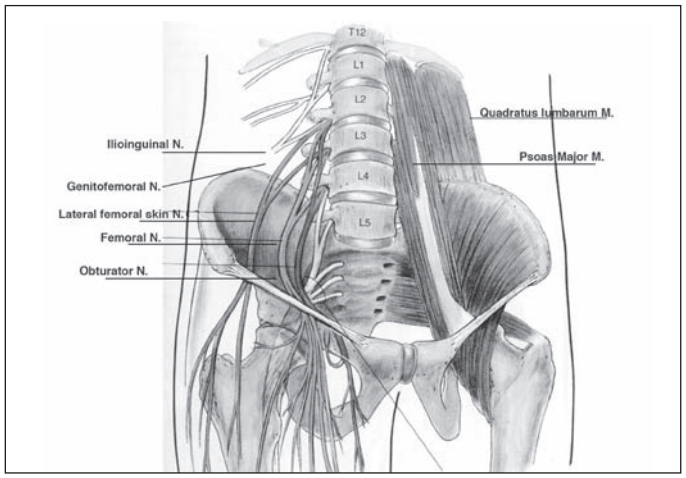

Figure 2 *– Schematic illustration of the nerves and their correlation with quadratus lumborum and psoas major muscles*

Analgesia was assessed by a pre-trained nurse by means of needle-puncture and cold test in order to determine the extension of sensitive blockage on ilioinguinal, genitofemoral, lateral cutaneous of the femur, obturator and femoral 4, 8, 12, 16, 20 and 24 hours after anesthetic injection (Figure 3), and, after the 24-hour period, the moment of the first pain complaint was recorded for patients not receiving additional analgesics. Pain was assessed by a scale ranging from 0 (no pain) to 3 (severe pain).

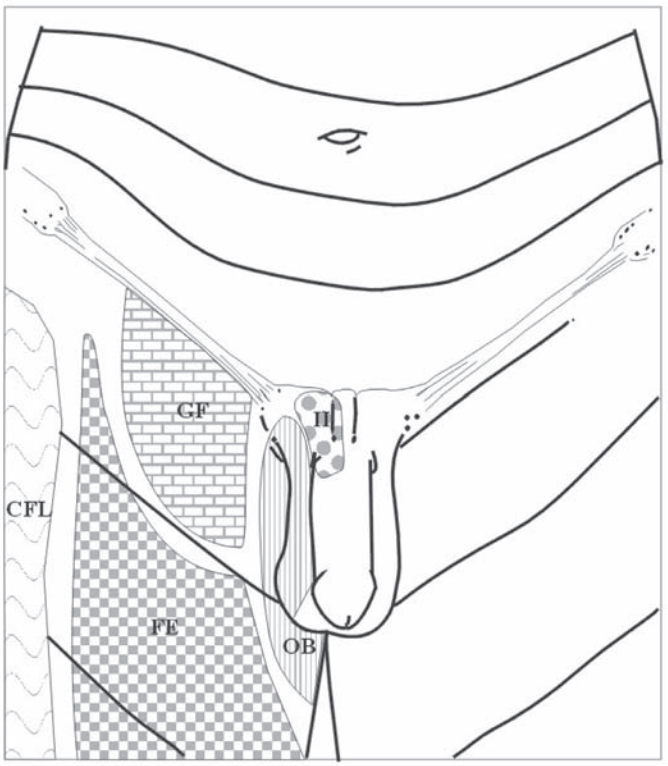

Figure 3 *– Schematic illustration showing the precise location of the nerves to be assessed after blockage*

Patients were sent to a regular hospital bedroom, and, should they complained of severe pain at the operated site, a intravenous solution containing 30 mg meperidine and 300 mg dipyrone was administered. The total number of analgesic solution doses was recorded for the first 24 hours, as well as any cardio circulatory changes. The patients were followed-up for 48 hours for checking the presence of complications at the blockage site, as well as for identifying blood hypotension as a potential single- or bilateral peridural blockage.

In five patients, 20 ml of iohexol dye with 300 mg.ml^{-1} were injected in order to study local anesthetic agent dispersion.

The results were assessed by the descriptive analysis of the studied variables and, whenever applicable, by mean and standard deviation values.

RESULTS

All surgical procedures are described on Table 1. Demographic data of patients are reported on Table 2. This method was employed to provide postoperative analgesia on 40 orthopaedic patients, showing satisfactory results.

The result of the pain severity research in the first 24 postoperative hours is described on Table 3, and, at no time maximum pain was reported (grade 3). All five nerves were blocked (full sensitive blockage of the ilioinguinal, genitofemoral, lateral cutaneous of the femur, obturator, and femoral nerves) in 36 (90%) patients. In the first 12 follow-up hours, 36 patients presented analgesia on the five nerves, with none of them requiring supplementary analgesia. The number of patients presenting blockage of the different nerves during the first 24 hours are described on Table 4.

Partial hip prosthesis	14
Total hip prosthesis	09
Femoral osteosynthesis	14
Femoral osteosynthesis + graft removal from iliac crest	03

Table 1 *– Surgeries performed (n = 40)*

Age (years)	79,32±8,18
(Range)	(63 – 101)
Weight (kg)	66,30±9,85
(Range)	(49 – 82)
Height (cm)	159,90±6,84
(Range)	145 – 175
Gender: Female	35
Male	05

Table 2 *– Demographic data of patients*

	Pain scale			
Time	0	1	2	3
4 h	40	0	0	0
8 h	40	0	0	0
12 h	40	0	0	0
16 h	37	3	0	0
20 h	18	15	7	0
24 h	11	20	9	0

Table 3 *– Pain scale in different time points*

Surgical time was 2.23±0.83 hours. In all patients, the first evaluation (4 hours after psoas compartment blockage) was conducted without any residual blockage of the rachial anesthesia. The mean duration of anesthesia was 23.33 hours. In 21 patients (52.5%) rescue analgesics were not required for the first 24 hours postoperatively. Eighteen patients (45%) received a single dose, and only one patient (2.5%) received two doses of the analgesic solution (Table 5). The mean analgesia time was 23.33±5.17 h, ranging from 16 to 36 hours. No bradycardia or blood hypotension events were seen in the first 24 postoperative hours.

No analgesic agent	21 (52.5%)
One dose	18 (45%)
Two doses	01 (2.5%)

Table 5 *– Analgesic doses in the first 24 hours*

No complication at puncture site was seen throughout follow-up time. Neither vascular injection nor unplanned puncture has occurred on subarachnoid space. No neurological complication was reported. No patient required vesicle catheterization. In two patients, occurred hematocryte reduction requiring replacement, but tomography studies did not evidence hematoma on the punctured region. One patient showed long-lasting sensitivity loss on the thigh for 36 hours. No patient complained of paresthesia after 48 hours of follow-up. The anesthetic agent dispersion immediately after injection (Figure 4) and 1 minute after injection (Figure 5) evidenced head and tail dispersion.

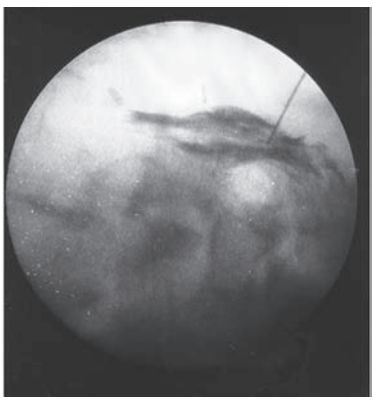

Figure 4 *– Anesthetic agent dispersion associated to dye at the moment of injection, as shown at the image enhancer*

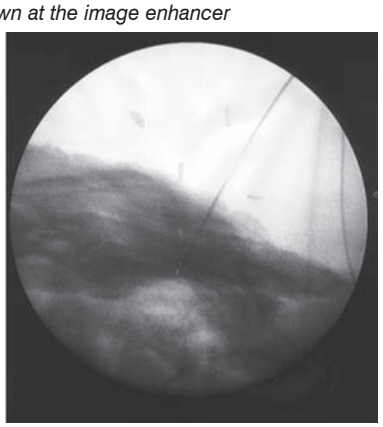

Figure 5 *– Anesthetic agent dispersion associated to dye 1 minute after injection, as shown at the image enhancer*

Time	5 nerves	II	GF	LFS	OB	FE
4 h	36 (90%)	38 (95%)	38 (95%)	40 (100%)	36 (90%)	40 (100%)
8 h	36 (90%)	38 (95%)	38 (95%)	40 (100%)	36 (90%)	40 (100%)
12 h	36 (90%)	38 (95%)	38 (95%)	40 (100%)	36 (90%)	40 (100%)
16 h	26 (65%)	32 (80%)	35 (87.5%)	29 (72.5%)	26 (65%)	37 (92.5%)
20 h	10 (25%)	20 (50%)	14 (35%)	22 (55%)	10 (25%)	31 (77.5%)
24 h	09 (22.5%)	14 (35%)	13 (32.5%)	14 (35%)	09 (22.5%)	17 (42.5%)

II=ilioinguinal, GF=genitofemoral, LFS=lateral femoral skin nerve, OB=obturator and FE=femoral

Table 4 *– Number of patients with sensitive blockage on the different nerves in the first 24 hours postoperatively*

DISCUSSION

Lumbar plexus blockage at psoas compartment with the aid of peripheral nerves stimulator is an easy and adverse effect-free technique. This technique resulted in the blockage of the five nerves on 36 patients (90%), thus blocking the three main nerves of the lumbar plexus that innervate the thigh, not requiring supplementary analgesics in 52.5% of the patients. Similar results were achieved when postoperative analgesia provided by psoas compartment blockage in children (> 90%) was compared to the "3-in-1" blockage (20%)[7].

The upper leg segment is basically innervated by lumbar and sacral plexus: lateral cutaneous of the femur (L_2-L_3) laterally; femoral nerve (L_2-L_4) anteriorly; obturator (L_2-L_4) and genito-femoral (L_1-L_2) medially, and; ischiatic nerve (L_4-S_3) posteriorly. The ilioinguinal nerve (L_1) basically innervates the iliac crest, and its blockage is important when grafts are removed, which occurred in three patients, who didn´t complain of pain for 36 hours. Chayen et al[3] developed the lumbar plexus approach in the psoas compartment. The psoas compartment, a space inside which the lumbar plexus lies, is anteriorly outlined by psoas muscle and its aponeurosis; medially, by lumbar vertebrae bodies, and; posteriorly, by quadratus lumborum muscle and transverse apophyses. At the level of the 4th lumbar vertebra, all lumbar plexus nerves are regrouped. Combined studies with cadavers and computed tomography confirmed the description of the lumbar plexus within psoas compartment[8].

Lumbar plexus blockage at psoas compartment should be performed with the patient at lateral position with the operated limb up, with a 100-150 mm needle perpendicular to skin plane, at usual depth (12 cm). In the early description, Chayen et al[3] used a gas chuck to confirm the path in the cleavage plan that constitutes psoas compartment: the use of a stimulator is preferred[9]. In our study, we used the plexus stimulator with a 100 mm needle, having achieved lumbar plexus contraction in all patients. Just like the original anesthesia[3], we also had a success rate of 90% with this postoperative analgesia technique. In this study, the lumbar plexus stimulation was used with patients still under rachial anesthesia effect. Therefore, we could not assess whether the use of a stimulator is bothersome or not. Otherwise, no nervous injury was noticed. In one patient, blood was seen on the stimulator needle, which was removed and reoriented. Both in that patient and in the others no hematoma or pain at injection site was found. For both patients in whom hematocryt levels were reduced requiring replacement, the tomography study did not evidence bleeding at injection site justifying blood supplementation.

The maximum recommended bupivacaine dose is 2 $mg.kg^{-1}$, but up to 3 $mg.kg^{-1}$ can be used at 0.5% in patients submitted to lumbar and sacral plexus blockage[10]. Adding epinephrine to 0.5% bupivacaine does not influence plasma concentrations, the time to reach peak, or the duration of analgesia [10]. In this study, 0.25% bupivacaine was employed with doses below the maximum recommended dose, and no complications were found by anesthetic agent absorption. No patient required opioids in the first 12 hours, and the mean analgesia time was 24 hours. The time of analgesia with 0.5% bupivacaine was 17 hours[10], which is shorter than the 24 hours reported in this study with a less concentrated solution. Twenty-one patients (52.5%) did not use any analgesic agent in the first 24 hours postoperatively. These results are superior to the 37%[11] and 48%[12] blocked with the same prilocaine volume associated to the sub costal nerve blockage.

Lumbar plexus blockage enables to anesthetize three of the main nerves of the lower limbs with a single injection[2]. We aimed to achieve paresthesia for Winnie´s posterior access of the lumbar plexus. According to that author this technique allows for concomitantly blocking sacral roots. Two years later, Chayen et al[3] described the lumbar plexus blockage using resistance loss, and naming this as "psoas compartment" blockage. Dalens et al[13] published a comparative study of both accesses to lumbar plexus using a neurostimulator, and concluding that the success rates are comparable between both techniques. However, the Dalens-modified technique presents an additional challenge, and is accompanied by a high rate of bilateral blockage. Using the Chayen technique and a neurostimulator, we had no cases of bilateral analgesia.

Lumbar plexus blockage at psoas compartment provides analgesia on the lower abdominal region extending to the whole thigh, respecting the ischiatic area. In this study, we achieved analgesia on the lower abdominal region (ilioinguinal and genitofemoral) in 38 patients (95%) and on the thigh in 36 patients (90%).

In conclusion, lumbar plexus blockage at psoas compartment for providing postoperative analgesia in major orthopaedic surgeries is an easy technique with the use of peripheral nerves stimulation, providing a high degree of sensitive blockage for lumbar plexus nerves, with mean analgesia duration of 24 hours, and strong reduction of the need of supplementary analgesia with opioids.

REFERENCES

1. Winnie AP, Ramamurthy S, Durrani Z. The inguinal paravascular technic of lumbar plexus anesthesia: the "3-in-1 block". Anesth Analg. 1973; 52:989-96.
2. Winnie AP, Ramamurthy S, Durrani Z, Radonjic R. Plexus blocks for lower extremity surgery. Anesth Rev. 1974;1:1-6.
3. Chayen D, Nathan H, Chayen M. The psoas compatment block. Anesthesiology. 1976; 45:95-9.
4. Dietemann JL, Sick H, Wolfram-Gabel R, Cruz da Silva R, Koritke JG, Wackenheim A. Anatomy and computed tomography of the normal lumbosacral plexus. Neuroradiology. 1987; 29:58-68.
5. Farny J, Drolet P, Girard M. Anatomy of the posterior approach to the lumbar plexus block. Can J Anaesth. 1994; 41:480-5.
6. Parkinson SK, Mueller JB, Little WL, Bailey SL. Extent of blockade with various approaches to the lumbar plexus. Anesth Analg. 1989; 68:243-8.
7. Dalens B, Vanneuville G, Tanguy A. Comparison of the fascia iliaca compartment block with the 3-in-1 block in children. Anesth Analg. 1989; 69:705-13.
8. Farny J, Drolet P, Girard M. Anatomy of the posterior approach to the lumbar plexus block. Can J Anaesth. 1994; 41:480-5.
9. Dalens B. Bloc du plexus lombaire e de ses branches proximales: In: Dalens B. Anesthésie locorrégionale de la naissance à l'âge adulte. Paris: Pradel; 1993. p. 325-52.
10. Misra U, Pridie AK, McClymont C, Bower S. Plasma concentrations of bupivacaine following combined sciatic and femoral 3-in-1 nerve blocks in open knee surgery. Br J Anaesth. 1991; 66:310-3.
11. Imbelloni LE. 3 in 1 blockade with 0.25% bupivacaine for postoperative analgesia after orthopedic surgeries. Rev Bras Anestesiol. 2000; 50:221-4.
12. Hood G, Edbrooke DL, Gerrish SP. Postoperative analgesia after triple nerve block for fractured neck of femur. Anaesthesia. 1991; 46:138-40.
13. Dalens B, Tanguy A, Vanneuville G. Lumbar plexus block in children: a comparison of two procedures in 50 patients. Anesth Analg. 1988; 67:750-8.