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Research Article

Post-operative analgesia following hip surgery: A single injection of 0.25% bupivacaine through posterior lumbar plexus block using a neurostimulator

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Abstract

Objectives: The lumbar plexus is located between the quadrates lumborum and the psoas major muscles. The aim of this study was to evaluate the efficacy of a single 0.25% of enantiomeric excess levobupivacaine (S75:R25) injection through the psoas compartment blockage in postoperative analgesia of patients undergoing hip orthopedic surgery. As the second objective was evaluated the presence of analgesia of the feet was also evaluated to determine whether there was dissemination to the sciatic nerve, and length of pre-operative fasting, presence of thirst and hunger in the operating room entrance, and the ability to receive net carbohydrate (CHO) after recovery from spinal block in the PACU.

Methods: One hundred patients received lumbar plexus blockage at the psoas compartment through nerve stimulator and a 0.25% enantiomeric excess levobupivacaine 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 92% of patients in the first 8 hours. Sciatic nerve block assessed by foot analgesia was observed in 15 patients at 4 hours and 12 patients at 8 hours. Sciatic nerve block disappeared in all patients after 12 hours. Blockage has reduced the amount of postoperative opioids, and 40% of patients required no additional postoperative analgesia, with analgesia duration of approximately 19 hours. There were no clinical signs or symptoms of bupivacaine toxicity, as well as no sequels secondary to nerves blockage. The mean fasting time was less than 3 hours. This reflected that no patient complied of thirst or hunger to reach the operating room.

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 hip orthopedic surgeries.

Keywords: Analgesia Postoperative; Anesthetics Local; Enantiomeric Excess Levobupivacaine; Anesthetic Techniques Regional; Psoas Compartment Block

Introduction

In 2005 it was written that lower extremity nerve blocks have been less widely used than their brachial plexus counterparts [1]. Reasons may include the fact that anesthesia of the lower limb requires blockade of several different nerves, whereas neuraxial blocks can provide intraoperative anesthesia and postoperative analgesia with a single puncture site. The depth of many nerves supplying the lower limb also constitutes a physical deterrent. In 2006, we compared anterior and posterior lumbar plexus blocks with peripheral nerve stimulation (PNS) and it was concluded that the posterior approach was effective in blocking the five nerves of the lower limb derived from the lumbar plexus (ilioinguinal, genitofemoral, lateral femoral cutaneous, obturator, and femoral), but it did not block the nerves from the sacral plexus (common fibular and tibial nerves) [2]. The previous approach was less effective in blocking the five nerves and it did block the sacral plexus.

The lumbar plexus is formed by the anterior divisions of the first four spinal lumbar nerves, being located in front of the transverse processes of the lumbar vertebrae [3]. It is within the psoas muscle, being formed by the following nerves: iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, obturator, and femoral. Lumbar plexus blocks are usually performed in the setting of hip arthroplasty and hip fracture repair. The lumbar plexus can be anesthetized with a posterior approach by depositing local anesthetic (LA) agents within the substance of the psoas muscle [4]. Based on an analysis of the clinical evidence available, the posterior approach constitutes the only reliable method to anesthetize the lumbar plexus. While early descriptions of lumbar plexus blocks have advocated a loss-of-resistance (LOR) technique [5], all subsequent studies have employed PNS [2,6].

There is evidence that the recovery from surgery can be reduced and accelerated convalescence. This approach became known as "fast-track surgery," and incorporates not only surgeons but also anesthesiologists, nurses, nutritionists, psychologists, physiotherapists, and social worker as active participants in the care of the patient [7]. We have reported a reduced length of stay, number of suspension, the duration of fasting, the release the feedback, the length of stay in the postanesthetic care unit (PACU), and incidence of hypotension in elderly patients undergoing hip surgery and who received fast-track perioperative care [8,9].

Hip fracture commonly occurs in an at-risk (elderly) patient population that is often afflicted with multiple comorbidities. Peripheral nerve blocks have been traditionally employed to optimize postoperative analgesia and curtail the consumption of breakthrough opioids. In the most recent Cochrane Database systematic review concluded that regional anesthesia decreases pain on movement within 30 min after block placement [10]. The outcomes after project implementation accelerated full recovery after surgery in orthopedics in a hospital with service to public patients over the age of 60 and hip fracture have been recently published [8,9].

The objective of this study was to evaluate the quality of analgesia by a single injection of 0.25% enantiomeric excess levobupivacaine (S75:R25) through posterior lumbar plexus block (psoas compartment) using a neurostimulator in the five nerves: iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, obturator, and femoral in patients undergoing accelerated recovery after hip surgery. As the second objective was evaluated the presence of analgesia of the feet was also evaluated to determine whether there was dissemination to the sciatic nerve, and length of pre-operative fasting, presence of thirst and hunger in the operating room entrance, and the ability to receive net carbohydrate (CHO) after recovery from spinal block in the PACU.

Methods

Between January 2012 to December 2018, were enrolled in the longitudinal prospective study at a hospital covered by the Brazilian Public Health System (SUS) in a patients undergoing corrective femur fracture over the age of 100 years. None of the patients were excluded. The protocol was registered in Brazil Platform (CAAE: 09061312.1.0000.5179), and the Ethics Research Committee (171.924) approved the study protocol and all patients were informed and agreed to participate in the study.

Inclusion criteria were: normal blood volume, no pre-existing neurological disease, no coagulation disorders, without infection at the puncture site, which did not present agitation, mental confusion and or delirium, which did not make use of bladder indwelling catheters, with hemoglobin level >10g% and that was not in the ICU. All patients were part of the implementation of Project Acerto for accelerated postoperative recovery.

Information on the pre-operative condition of these patients, mode of anesthesia, drugs used, intra-operatively measured variables (e.g. hemodynamic, blood loss) and immediate postoperative variables measured in the post-anesthesia care unit (PACU), and first day of postoperative was obtained from the study protocol. The patient is given orally 200 mL carbohydrate (CHO)-rich beverage between 2 - 4 hours prior to surgery to fasting abbreviation. It was noted the time of administration of the drink and whether the patient on arrival in the operating room was thirsty or hungry.

Premedication was not used. Monitoring consisted to EKG, of noninvasive blood pressure, heart rate, and pulse oximetry. After venous cannulation with 18G catheter in the hand or forearm, infusion of Ringer's lactate in parallel with 6% hydroxyethyl starch 130/0.4 in 0.9% sodium chloride injection was started. At the beginning of surgery cefazolin 2 g and dexamethasone 10 mg were administered intravenously.

After sedation with intravenous ketamine (0.1 µg/kg) and midazolam (0.5 - 1 mg), skin cleansing with chlorhexidine, spinal puncture was performed with the patient in sitting position, through the median interspaces L_3 - L_4 or L_4 - L_5, using a 26G or 27G Quincke needle. After observing CSF confirming the correct position of the needle, 7.5 - 15 mg of 0.5% isobaric bupivacaine were administered at a rate of 1 mL/15. Patients were immediately placed in supine position for surgery. The sensorial blockade and motor blockade were evaluated at 10 minutes after injection and placed in lateral position and released for surgery.

Cardiorespiratory parameters were measured every 5 minutes. Hypotension (a reduction in SBP > 30% when compared to the pressure in the regular ward) was treated with methylpurine (2 mg IV), while bradycardia (HR < 45 bpm) was treated with atropine (0.50 mg IV). At the end of surgery, patients received dypirone 40 mg/kg in 50 mL of Ringer's lactate.

In PACU after termination of motor block, patients received 200 mL of 12.5% CHO. If in 30 minutes nausea and vomiting did not occur, they would be sent to the infirmary. Data relating to surgical time, recovery time of motor block, time to administration CHO, length of stay in the PACU, need for catheterization, pain and treatments administered were recorded by an observer. Delirium was used to refer to drowsiness, disorientation, and hallucination.

The postoperative analgesia was performed through the posterior lumbar plexus block (psoas compartment) with a HNS12 neurostimulator, after end of surgery. Anatomical references were the iliac crest and a point 5 cm away on a line passing through the spinal processes of L_4 - L_5. It was done with A100 -mm needle connected to a peripheral nerve stimulator set to discharge a 0.60 mA square pulsatile current with 2 Hz. The needle was inserted perpendicularly, 7 to 10 cm deep, aiming at obtaining a contraction of the femoral quadriceps. Obtained the desired contraction, 40 mL 0.25% enantiomeric excess levobupivacaine (S75:R25) were injected after making sure there was no blood return. One patient received X-ray contrast with 1 mL of iohexol with 300 mg/mL, to determine needle placement, added to 40 mL of LA, to study the dispersion of the local anesthetic.

Analgesia was evaluated by a nurse and anesthetic resident, trained previously for this task, with the pin pick and sensitivity to cold tests to determine the extension of the sensitive blockade in the areas supplied by the ilioinguinal, genitofemoral, lateral femoral cutaneous, obturator, and femoral nerves 4, 8, 12, 16, 20, and 24 hours after the administration of the anesthetic. Pain was assessed according to the following scale: 0 = absence of pain, 1 = mild pain, 2 = moderate pain and 3 = severe pain. The patient was transferred to the regular ward and, if he/she complained of pain, a solution containing 100 mg tramadol and 1 g dipyrone was administered intravenously. The total number of doses of the analgesic solution during the first 24 hours was recorded, as well as any cardiovascular changes. The presence of analgesia of the feet was also evaluated to determine whether there was dissemination to the sciatic nerve. Patients were followed until the second day after surgery to assess the conditions of discharge. Patients were followed in relation to mortality after hospital discharge until the end of the first month in relation to mortality

Statistical Analysis

Descriptive measures such as mean and standard deviation were used to analyze the empirical data distribution.

Results

(Table 1) shows the demographics data, with a large predominance of women in this surgery. All patients were submitted to spinal anesthesia and there was no need of general anesthesia. In this study, 15 patients received 15 mg, 61 patients received 10 mg and 24 patients 7.5 mg of the 0.5% isobaric bupivacaine.

Parameters	Psoas Group
Age (years)	75.23 ± 11.25
Weight (kg)	67.56 ± 10.14
Height (cm)	161.32 ± 7.21
Gender: F / M	80 / 20
ASA: I / II / III	3 / 82 / 15

Table 1: Demographics data*Values expressed in mean ± SD.

The mean fasting time was less than 3 hours (Table II). This reflected that no patient complied of thirst or hunger to reach the operating room. The time to reintroduce CHO in PACU, and duration of stay in the PACU are in Table 2.

Parameters	Psoas Group
Fasting duration (h)	2:49 ± 0:26
Thirst (n)	0
Hunger (n)	0
Time feeding CHO in PACU (h)	1:18 ± 0:21
Time stay in PACU (h)	1:43 ± 0:25

Table 2: Fasting duration, incidence of thirst and hunger, time to feeding CHO in PACU, and duration of stay in the PACU.

In every patient the first evaluation (4 hours) was done without residual blockade from the spinal block. Table 3 shows the level of pain in the first 24 hours. Severe pain (grade 3) was not observed during the study.

Time/Pain	0	1	2	3
4 h	100	0	0	0
8 h	100	0	0	0
12 h	96	4	2	0
16 h	82	14	4	0
20 h	36	32	32	0
24 h	22	40	38	0

Table 3: Pain scale at the different moments.

Forty patients did not need analgesics in the first 24 hours. table 4 shows the number of patients who received 1, 2, or 3 doses of analgesics. The duration of the analgesia varied from 13 to 26 hours, with a mean of duration of 19 hours. The mean duration of the surgeries was 1.94 ± 0.45 hours.

Parameters	Psoas Group
No analgesics	40
One dose	46
Two doses	10
Three doses	4
Mean duration of analgesia (h)	19.0 ± 2.8
Mean duration of the surgery (h)	1.94 ± 0.45

Table 4: Doses of analgesics in the first 24 hours, duration of analgesia and duration of surgery

The successful blockade of the five nerves (complete sensitive block of the ilioinguinal, genitofemoral, lateral femoral cutaneous, obturator, and femoral nerves) in the first 24 hours is in Table 5. The successful blockade of the five nerves was achieved in 92% of the patients in the first 8 hours. At 12 hours 84 patients, at 16 hours 60 patients and 20 hours 20 patients had 5 nerves block. At the end of the evaluation (24 hours), 18 patients had a blockade of the five nerves. Sciatic nerve block assessed by foot analgesia was observed in 15 patients at 4 hours and 12 patients at 8 hours. Sciatic nerve block disappeared in all patients after 12 hours.

There were no cases of bradycardia or hypotension in the first 24 hours. There were no complications at the puncture site during the evaluation period. There were no cases of intravascular injection or accidental puncture of the subarachnoid space. We did not observe any cases of hypotension or unilateral or bilateral epidural block. There were no neurological complications. Vesical catheterization was not necessary. There were no complaints of paresthesia after 48 hours.

There was cephalad and caudal dispersion of the anesthetic immediately after the injection in the psoas compartment (Figure 1).

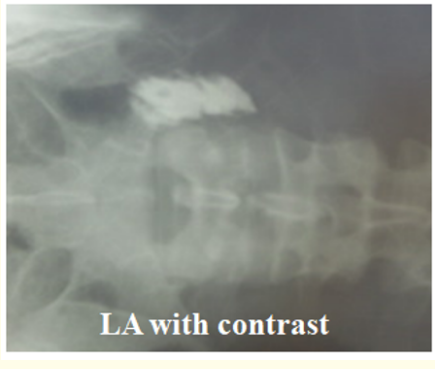

Figure 1: Distribution of the anesthetic with contrast in the psoas compartment.

Time	ILIO	GF	LFC	OB	FE	SCI
4 h	96	96	100	92	100	15
8 h	96	96	100	92	100	12
12 h	96	92	96	84	100	0
16 h	80	82	74	60	82	0
20 h	42	30	44	20	62	0
24 h	28	26	28	18	34	0

Table 5: Number of patients with sensitive blockade of the different nerves in the first 24 hours of the postoperative period.

ILIO=Ilioinguinal; GF=Genitofemoral; LFC=Lateral femoral cutaneous; OB=Obturador; FE=Femoral; SCI=Sciatic.

No patient in the study group went to the ICU. In the first pain observation evaluation, four patient presented mental confusion. No nausea or vomiting occurred in the study group. All 100 patients were ready for discharge in the first postoperative day. All patients survived the surgery and no patient died at home in the first postoperative month.

Discussion

Lumbar plexus block in the psoas compartment with the aid of a peripheral nerve stimulator is easy to perform and has few side effects. The successful blockade of the five nerves was achieved in 92% of the patients in the first 8 hours. Sciatic nerve block assessed by foot analgesia was observed in 15 patients at 4 hours and 12 patients at 8 hours. Sciatic nerve block disappeared in all patients after 12 hours. The duration of the analgesia varied from 13 to 26 hours, with a mean of duration of 19 hours. Commercially available bupivacaine is a racemic mixture of S (-) and R (+) enantiomers and was firstly used for spinal anesthesia in 1966 in concentrations of 0.5%, 0.75% and 1%, with or without epinephrine [11]. There are evidences that bupivacaine isomers have different Na+ channel blockade properties, being R (+) bupivacaine three times more potent than S (-) bupivacaine [12]. A comparison of racemic and bupivacaine with levogyre enantiomeric excess of 50% (S75:R25) for brachial plexus block, has not shown differences in observed parameters [13]. The injection of 20 mL of 0.25% bupivacaine with levogyre enantiomeric excess of 50% (S75:R25) in each pudendal nerve has promoted mean 23.77 hours analgesia and showing that blockade may be used as single technique for the proposed procedure [14]. In this study the duration of the analgesia varied from 13 to 26 hours, with a mean of duration of 19 hours, and 40 patients did not need analgesics in the first 24 hours. The number of patients with 40 mL of 0.25% enantiomeric excess levobupivacaine (S75:R25) that needed analgesics in the first 12 hours was very low, since the mean duration of the analgesia was 19 hours, similar to the analgesia obtained with 0.5% bupivacaine, 17 hours [15].

When available, ultrasound (US) guidance may be advantageous, in terms of decreasing onset time of block effect [16] and increasing success rate [17]. Recent randomized controlled trials (RCT) compared combined US-PNS and US alone for lumbar plexus blocks. In the combined group, quadriceps-evoked motor response was sought at a current between 0.2 and 0.8 mA prior to LA injection. In the US alone group, LA was simply deposited inside the posteromedial quadrant of the psoas muscle. The authors found no intergroup differences in terms of performance time, block success, and postoperative opioid consumption. However, the combined US-PNS resulted in a 34% decrease in onset time compared to US alone, and the authors conclude that neurostimulation provides small benefit for ultrasound-guided lumbar plexus block [18]. In this study using only PNS, the time for its performance was not evaluated. Studying the contrast anesthetic dispersion showed that cephalad and caudal dispersion occurred immediately after the injection in the psoas compartment.

Although the lumbosacral plexus may occasionally be blocked through the posterior approach, sciatic nerve block is necessary for complete analgesia of the lower limb. In this study, the posterior approach promotes analgesia of the region innervated by the sciatic nerve (determined by evaluating the foot) in 15 patients at 4 hours and 12 patients at 8 hours.

The block performed in L3 or L4 could result in a bilateral blockade, may it be epidural, subarachnoid, or by dispersion of the local anesthetic that is close to the paravertebral space. This happens frequently, depending on the technique used. Using the technique described by Chayen [5], reported an incidence of 88% of bilateral blockade [19], while with the Winnie technique [20] there were no reports of bilateral blockade. In this study, using the peripheral nerve stimulator there were no cases of bilateral blockade using the posterior approach.

The incidence of local anesthetics systemic toxicity was reported to be 0.04/1,000 to 1.8/1,000 in a recent summary [21]. For patients infected with hepatitis B or female patients receiving lumbar plexus blocks and sciatic nerve blocks, the authors recommended that combined ultrasound and nerve stimulator guidance should be used to improve the safety, and the use of ultrasound did not improve the quality of deep nerve block [22]. In this study because the hospital does not have US, the study was performed with PNS only, succeeding in analgesia in all patients without reporting complications.

Postoperative delirium and postoperative cognitive dysfunction share risk factors and may co-occur, but their relationship is not well established. Older adults represent a large and increasing proportion of surgical orthopedic patients in the Brazil [8,9], this article reports a study on 35 patients over 100 years. Advances in surgical and anesthesia techniques, coupled with better preoperative risk assessment, have achieved in safer operations and lower rates of some serious complications. In study observational after major noncardiac surgery 24% developed delirium during hospitalization [23]. In the present study with centenary patients, the incidence of delirium in the immediate postoperative period was 11.4%.

The majority of hip fractures occur in an elderly population over 60 years [8,9], and in this study the average was 75 years. Opioid-related respiratory depression may result in severe brain damage or death [24]. By reducing the amount of opioids used before, during, and after the surgery, [25] regional blockade may improve the mobility of persons suffering from hip fracture [26] and hence potentially facilitate a person's participation to rehabilitation. Despite their claim advantages, peripheral nerve blocks are still not widely used for people with hip fracture [27].

Conclusion

In conclusion, the outcome of anesthesia and surgery for hip fracture in centenarian's patients was relatively good with analgesia through posterior lumbosacral plexus block provides duration of 19 h, practically time for hospital discharge. This study demonstrated that in order to achieve a blockade of the five components of the lumbar plexus, the posterior approach is the best approach, providing a sciatic nerve block within the first 8 postoperative hours. Our treatment goal was to recover pre-injury walking ability for elderly patients with hip fractures on discharge. Since 2012, the use of the fast-track project in our hospital has successfully shortened the hospital stay after surgery by about 3 days. Living to age 100 years is no longer a rarity. More than 24,000 centenarians live in the Brazil today. Surgical procedures on older adults, who typically have comorbid illnesses, are clearly on the increase. Anesthesiologists and surgeons are increasingly willing to electively and emergence operate on elderly patients: the complication rate is acceptable and function may be improved to prior levels. This study showed that centenarian's patients can participate in fast-track surgery projects, accelerating their return to their home, and the analgesia provided by peripheral blocks is essential and avoid the use of opioids. This study reflects the finding of other authors, that age alone should not be a bar to surgery.

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None.

Conflicts of Interest

None.

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