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Research Article

Postoperative Analgesia in Lower Limbs Orthopedic Surgeries: A Comparative Study between Sciatic Nerve Block and Spinal Morphine

Luiz Eduardo Imbelloni[1]*, Marcelo de Araujo Pistarino[1], Thaís Bezerra Ventura[2], Eduardo Piccinini Viana[1], Álvaro da Silva Oliveira Júnior[3], Luana Miranda Souza[3] and Geraldo Borges de Morais Filho[4]

[1]*Anesthesiologist of Hospital Clínicas Municipal São Bernardo do Campo, SP, Brazil*

[2]*Anesthesiologist of Hospital Regional Wenceslau Lopes, Piancó, PB, Brazil*

[3]*Anesthesiologist Resident of Hospital Clínicas Municipal São Bernardo Campo, SP, Brazil*

[4]*Master in Labour Economics, UFPB, João Pessoa and Government Employee of the State of Paraíba, PB, Brazil*

***Corresponding Author:** Luiz Eduardo Imbelloni, Anesthesiologist of Hospital Clínicas Municipal São Bernardo do Campo, SP, Brazil.

Received: August 31, 2020; **Published:** September 28, 2020

Abstract

Introduction: In our department, most anesthesiologists associate morphine with local anesthetic for analgesia in orthopedic surgeries. Sciatic nerve block with different approaches provides postoperative pain relief after below knee surgery. The purpose of this study is to compare the efficacy of single-shot sciatic nerve block for postoperative pain management in below knee orthopedic surgery compared to two doses of morphine.

Methods: Eighty adult patients, ASA I - II, scheduled for below the knee orthopedic surgery were included in the study. Patients were randomized into two equal groups. Both groups received spinal anesthesia as preferred by the anesthetist. Group I received sciatic block with neurostimulator and 40 ml of 0.25% bupivacaine for postoperative analgesia at the end of surgery and Group 2 received bupivacaine associated with 80 µg or 100 µg of morphine for spinal anesthesia. Data relating to surgical time, recovery time of motor block, need for catheterization, pain and treatments administered were recorded by an observer. Pain will be assessed in both groups using the visual analog scale (VAS) after complete recovery from spinal anesthesia. VAS will be assessed at 4h, 10h, 16h and 24h postoperatively. Patient satisfaction was assessed.

Results: There was no significant difference between both groups in demographic data. The visual analog scores of patients at each time point in the two groups showed significant difference. The incidence of urinary retention, itching, nausea and vomiting was not observed in patients with analgesia through sciatic nerve block. While with the use of morphine the incidence of urinary retention was 37.5%, itching 55% and nausea and vomiting 25%. The incidence of urinary retention was significantly higher with 100 µg compared to 80 µg of morphine. The duration of analgesia was significantly longer in group 1 and side effects more present in group 2. All patients in group 1 were satisfied with the postoperative analgesia technique, significantly higher than the 75% of patients with the use of morphine, reported by the inconveniences of side effects.

Conclusion: Sciatic nerve block with the neurostimulation technique provides longer duration of analgesic, lower incidence of side effects, higher incidence of satisfaction compared to the use of intrathecal morphine. There was no complication with the use of sciatic nerve block.

Keywords: *Spinal Anesthesia; Sciatic Nerve Block; Bupivacaine; Neurostimulator; Morphine; Visual Analogue Scale*

Introduction

Postoperative pain is one of the most feared surgical complications reported by patients, particularly for orthopedic surgeries, which are frequently followed by a painful recovery and experience postoperative pain that persists for several days after surgery [1]. Optimal postoperative analgesia after orthopedic surgeries is the key for earlier recovery and functional outcomes. Inadequate or poorly treated postoperative pain after these surgeries not only significantly prolongs the rehabilitation process, increased risk of other complications, sometime progress as persistent postoperative pain into chronic pain and it also prolonged the overall length of hospitalization and cost [1].

Intrathecal opioids are used routinely in the various countries for intra- and postoperative analgesia. Survey using questionnaire survey to 270 anesthetic departments in United Kingdom, 199 replies was received, corresponding to 73.7% [2]. This research showed that intrathecal opioids were used in 175 (88.4%) departments. Of these departments, 61.1% had local guidelines or protocols in place. Opioids such as diamorphine used in 78.2% of departments and fentanyl 74.1% with a shorter duration of action are now more commonly used than morphine 21.3% for intrathecal analgesia. In recent meta-analysis, about opioids added to local anesthetics (LA) for single-shot intrathecal anesthesia in patients undergoing minor surgery, morphine (50 - 200 μg) added to bupivacaine was the most frequently tested [3]. Duration of postoperative analgesia was prolonged either with morphine (315 to 641 min).

Perhaps more than any other specialty, orthopedic surgery lends itself to the practice of regional anesthesia. Peripheral nerve blocks may be used as a primary anesthetic or as part of a combined technique to provide postoperative analgesia. For single-injection techniques, benefits generally last around 20 hours, depending on the type of local anesthetic used [4]. To further prolong postoperative analgesia, a continuous infusion of local anesthesia can be delivered through a perineural catheter. Postoperative analgesia was provided with a 40-hour infusion of 0.1% bupivacaine (400 mL) at a rate of 10 mL $hour^{-1}$ with an elastomeric pump [5].

Despite the introduction of newer techniques, drugs and better understanding of postoperative pain mechanism, postoperative pain is recognized internationally as being under-managed, and the majority of patients still suffer from extreme pain immediately after surgery. The goals of perioperative pain management are to relieve suffering, achieve early mobilization after surgery, reduce length of hospital stay and achieve patient satisfaction.

Purpose of the Study

The purpose of this study was to compare the effectiveness of single-shot sciatic nerve block techniques in four approaches with the use of spinal morphine (usual method of the Anesthesiology Department) in below knee orthopedic surgery. Opioid consumption and side effects including urinary retention, nausea, pruritus, + and patient satisfaction will also be compared.

Methods

After obtaining approval from institutional research ethical committee, an informed consent was obtained from all participants in this study. The protocol was registered in the Brazil Platform (CAAE: 0075.0.351.000-11). This study was carried on 80 patients with physical status ASA I-II admitted for lower limbs orthopedic surgery in Brazilian Public Health System (Sistema Único de Saúde [SUS]) Hospital in the Orthopedic Department.

Utilizing the significant level of 5% and an error limit 0.10 the sample size was 62 patients. Eighteen more patients were added to totalize a sample of 80 patients, in two groups of 40 patients. Exclusion criteria were hypovolemia, coagulation disorders, infection and refusal of the proposed method. Patients were randomized and allocated into two equal groups using sealed envelope: 40 patients received sciatic nerve block with 40 mL of 0.25% bupivacaine (Group 1) or intrathecal 80 or 100 **μ**g morphine (Group 2).

Patients did not receive pre-anesthetic medication. Monitoring consisted to EKG, of noninvasive blood pressure, heart rate, and pulse oximetry. Ringer's lactate was administered after venoclysis with a 20G catheter for hydration, volume expansion, and administration of drugs. Patients were randomly divided using coded envelopes prepared especially for the study.

After sedation with intravenous fentanyl (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. In both groups after observing CSF confirming the correct position of the needle, 10 to 18 mg of 0.5% isobaric or hyperbaric bupivacaine were administered at a rate of 1 mL/15s. Patients were immediately placed in supine position for surgery. The sensorial blockade and motor blockade were evaluated at 15 minutes after injection and placed in position and released for surgery. Transoperative sedation will be achieved with fractionated doses of midazolam. Cardiorespiratory parameters were measured every 10 minutes. Hypotension (a reduction in SBP > 30% when compared to the pressure in the regular ward) was treated with ethilephryne (2 mg IV), while bradycardia (HR < 45 bpm) was treated with atropine (0.50 mg IV). At the end of the procedure, ketoprofen = 100 mg and dipyrone 40 mg/kg will be administered in 50 mL of Ringer Lactate.

In Group 1, the sciatic nerve block in several approaches (anterior, subtrochanteric, middle femoral, lateral popliteal) will be performed at the end of the operation, connected to the neurostimulator HNS 12. The sciatic nerve will be stimulated using a A100-mm needle connected to a peripheral nerve stimulator set to discharge 0.6 mA, a frequency of 2 Hz and a pulse of 0.30 ms. After the start of foot contraction and aspiration of the negative needle for blood, 40 mL of 0.25% bupivacaine will be injected into the nerve in one of four approaches. In Group 2, the routine established at the Anesthesiology Department will be performed, which consists of administration of morphine 80 (Subgroup A) or 100 µg (Subgroup B) together with the local anesthetic, during the performance of spinal anesthesia. Pain will be assessed in both groups using the visual analog scale (VAS) after complete recovery from spinal anesthesia. VAS will be assessed at 4h, 10h, 16h and 24h postoperatively.

In PACU after termination of motor block, patients received 200 mL of 12.5% CHO. The patient was transferred to the regular ward and, if he/she complained of pain, a solution containing 100 mg tramadol (8/8 hours) and 1g dipyrone (6/6 hours) was administered intravenously. Data relating to surgical time, recovery time of motor block, need for catheterization, pain and treatments administered were recorded by an observer. Patients were followed until the second day after surgery to assess the conditions of discharge and patient satisfaction with the postoperative analgesia technique. The patient was followed for one week to check for complications at the block site and hyperalgesia after the peripheral nerve block or intrathecal morphine.

Statistical analysis

To investigate the association between categorical data, we used the Chi-square test and Fisher's exact test. One way to visualize this association is to use mosaic plot. To investigate the difference between quantitative variables from two independent samples, we used the Wilcoxon-Mann-Whitney test. When there is more than one factor we use the Kruskal-Wallis test. The level of significance was adopted at P value less than 0.05.

Results

The groups did not differ in terms of demographic variables (Table 1). Patient recruitment and flow are summarized in figure 1. Applying the Wilcoxon-Mann-Whitney test the visual analog scores of patients at each time point in the two groups showed significant difference (Figure 2).

In group 1, 31 patients were anesthetized with isobaric solution and nine with 0.5% hyperbaric bupivacaine solution. In group 2, two patients were anesthetized with isobaric solution and 38 with 0.5% hyperbaric bupivacaine solution. There is a significant difference between the uses of the two solutions between the two groups (Exact Test Fisher, p = 0.0000).

Variables	Group 1 (Sciatic)	Group 2 (Morphine)	P-Value
Age (years)	38.40 ± 12.05	36.12 ± 11.73	0.4613*
Weight (kg).	74.65 ± 13.15	75.32 ± 13.28	0.6507*
Height (cm)	171.57 ± 7.06	171.20 ± 7.94	0.575*
Gender (M/F)	34/6	33/7	1.000**

Table 1: *Patients data.*

**: Wilcoxon-Mann-Whitney test.*

***: Fisher's exact test.*

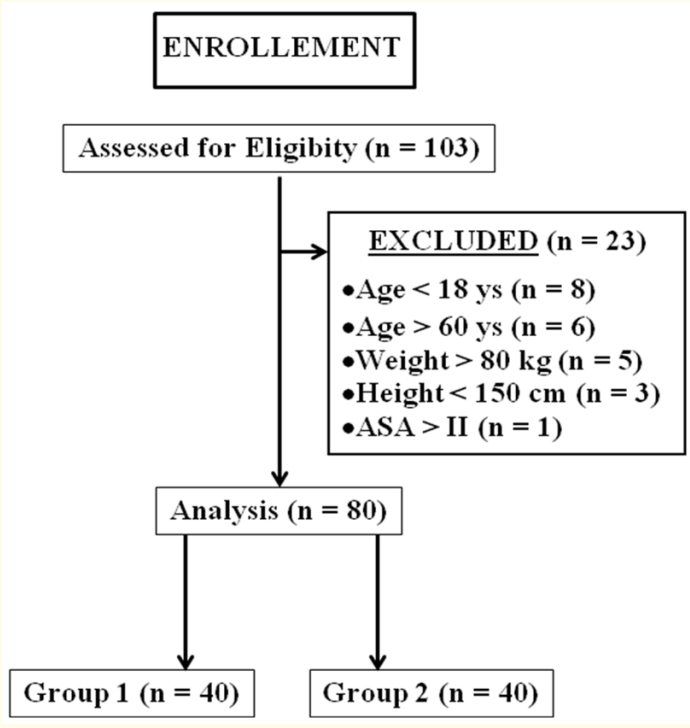

Figure 1: *Consolidated standards of reporting trials (CONSORT) flow diagram.*

In group 1, the different sciatic approaches were: anterior 8 patients, subtrochanteric 9 patients, middle femoral 11 patients, and lateral popliteal 12 patients, with no significant difference between the approaches. In group 2, 20 patients received 80 µg and 20 patients received 100 µg of morphine together with the local anesthetic solution, with no significant difference between the two doses.

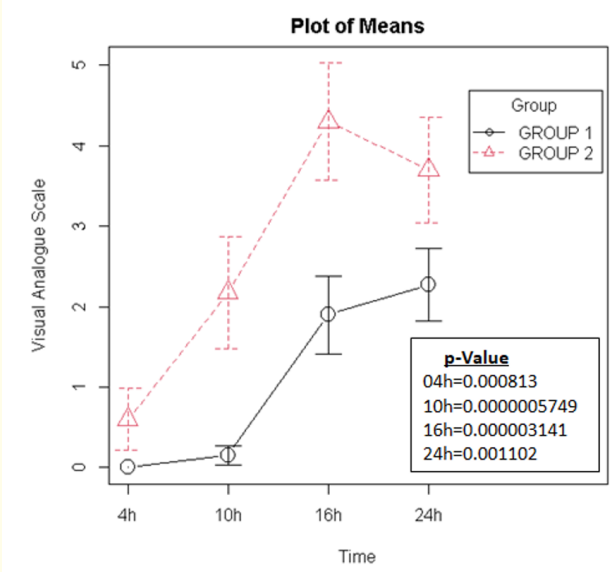

Figure 2: *Visual analog scale in time.*

In group 1 there was a predominance of spinal anesthesia with isobaric bupivacaine (77.5%), while in group 2 the predominance was the hyperbaric bupivacaine solution (95%), resulting in a significantly higher dispersion in group 2, with the 3 segments above (Mode, T9 vs T6) (Figure 3). This difference in the use of the two bupivacaine solutions resulted in a significantly higher incidence in the appearance of hypotension in group 2. There was no significant difference in the appearance of bradycardia (Table 2). All patients in both groups had complete motor limb block.

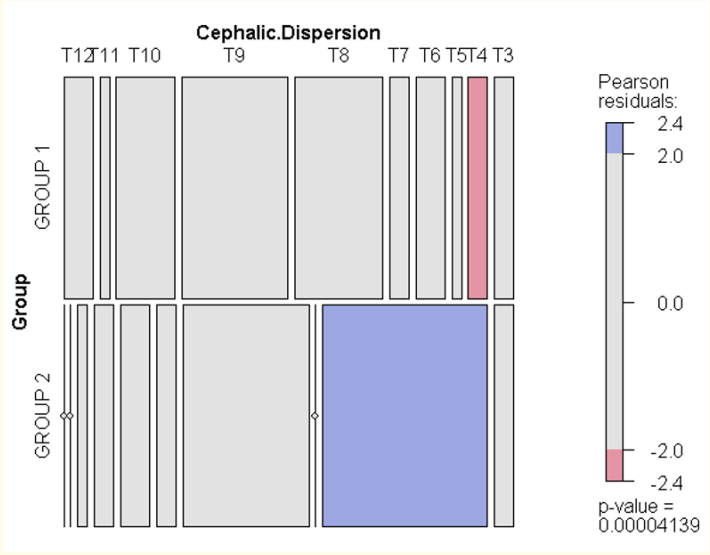

Figure 3: *Cephalic dispersion of analgesia in both groups.*

The duration of sensory block and motor block was not significantly different in the two groups. In group 1 with a predominance of spinal anesthesia with the isobaric solution, the motor block was greater than the sensitive block, whereas in group 2 with predominance of the hyperbaric solution, the sensitive block was greater than the motor block (Table 2 and figure 4). There was no significant difference regarding the duration of the surgery (Table 2).

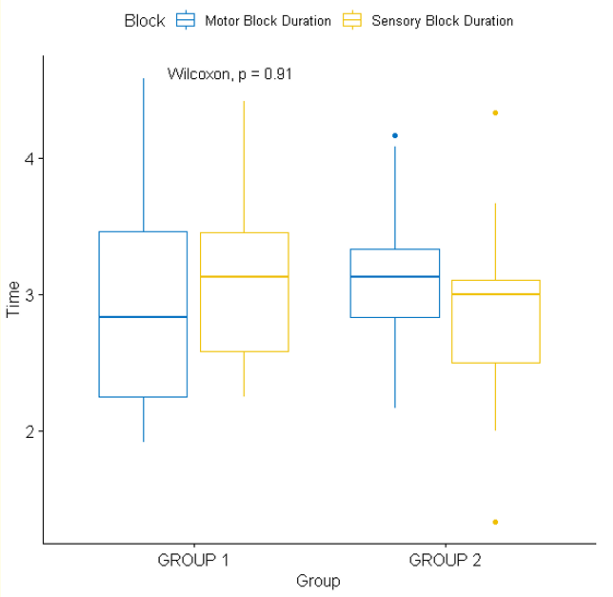

Figure 3: *Duration of sensory and motor blocks in both groups.*

Variables	Group 1 (Sciatic)	Group 2 (Morphine)	P-Value
Surgery duration (min)	1:56 ± 0:47	1:43 ± 0:41	0.2301*
Block sensitive duration (h)	3:06 ± 0:35	2:51 ± 0:31	0.07288*
Block motor duration (h)	2:58 ± 0:46	3:09 ± 0:29	0.1757*
Bupivacaine ISO/HYPER	31/9	2/38	0.0000**
Bradycardia	5%	25%	0.06609**
Hypotension	2.5%	30%	0.001495**

Table 2: *Parameters evaluated.*

**: Wilcoxon-Mann-Whitney test. **: Fisher's exact test.*

Complications associated with the nerve blocks with neurostimulator, including hematoma, intravascular injection and/or toxicities, and intraneural injection did not occur in all 40 patients. The incidence of urinary retention, itching, nausea and vomiting was not observed in patients with analgesia through sciatic nerve block. While with the use of morphine the incidence of urinary retention was 37.5%, itching 55% and nausea and vomiting 25%. The incidence of urinary retention was significantly higher with 100 µg compared to 80 µg of morphine (Chi-Square test, with p = 0.022243) (Figure 5). The other side effects had no significant difference in relation to the doses of morphine.

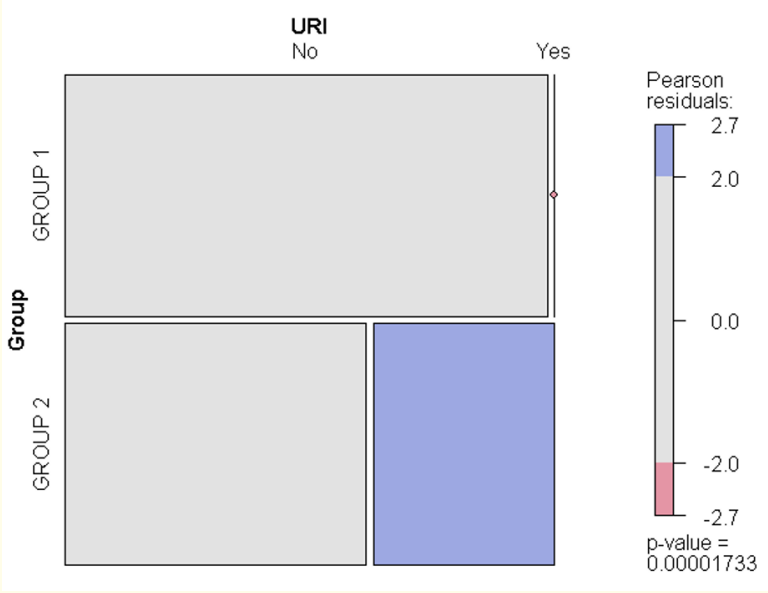

Figure 5: *Urinary retention with both morphine doses.*

The duration of analgesia was significantly longer with the use of sciatic nerve block was 23 ± 3 hours compared to the use of spinal morphine was 15 ± 5 hours (Wilcoxon-Mann-Whitney test, p = 0.0000). Comparing the analgesic mean of the two doses of morphine, with 80 µg 13:75 ± 4:73 hours and 100 µg 17:40 ± 5:65 hours, with significant difference (Wilcoxon-Mann-Whitney test, p = 0.0000).

No patient complained of dura mater post-puncture headache in both groups. In the postoperative interview, there was no complaint of paresthesia or dysesthesia in the sciatic nerve path. There was no motor deficit in the postoperative period in all patients in the study. All patients in group 1 were satisfied with the postoperative analgesia technique, significantly higher than the 75% of patients with the use of morphine, reported by the inconveniences of side effects (Chi-Square test, with p = 0.00072323). No case of hyperalgesia was noted in all patients undergoing sciatic block in the same way as in the group that received morphine.

Discussion

Regional block techniques using the neurostimulator, ultrasound or the combination of the two are gaining increasing popularity for surgical anesthesia and analgesia in lower limb orthopedic surgery. This technique allows the patient to return to the pre-procedure status more quickly and minimize or eliminate the need for opioid analgesics and their side effects. Regional techniques desensitize a specific part of the body to a painful stimulus using a local anesthetic that can be combined with other medications to increase the duration of the block or provide analgesia. In this study, the use of regional block (sciatic in a four approaches) with local anesthetic was compared with the use of two different doses of morphine, showing that the duration of analgesia with regional block was significantly of better quality than morphine, with fewer side effects and a higher incidence of satisfaction.

Postoperative pain after orthopedic surgery of the lower limb is very severe and is one of the main components of postoperative morbidity. Lower limb blocks performed with a neurostimulator are safe and have several advantages, such as relief of postoperative pain and not providing sympathetic block [6]. The sciatic nerve is formed by the lumbosacral trunk (L_4 - L_5) and previous divisions of the sacral

plexus (S_1 - S_3) merge to form the tibial nerve, whereas the posterior divisions merge to form the common perineal nerve. Sciatic nerve block alone provides relief from postoperative pain after surgery below the knee. Many studies with different approaches to sciatic nerve block with neurostimulator use [7] and different local anesthetic drugs have been conducted to demonstrate its effectiveness [8]. In this study, four approaches to the sciatic nerve were performed: anterior, subtrochanteric, middle femoral and lateral popliteal, with no difference in the quality of the block with these approaches using the neurostimulator, and 0.25% bupivacaine resulting in longer-lasting analgesia (23 hours) when compared to morphine (15 hours).

Investigating the use of 20 ml of 0.5% bupivacaine or 0.75% ropivacaine regarding the speed of onset, quality and length of duration of sciatic nerve block performed with a lateral popliteal approach with neurostimulator for hallux valgus surgery, surgical anesthesia required less than 30 minutes in both groups to be ready, with longer duration analgesia with ropivacaine (16 hours) compared with to bupivacaine (13 hours) [9]. Using the posterior access located by US and neurostimulator and injection of 20 ml of 0.5% bupivacaine, it provided an average analgesia of 19 hours with 26.7% patients did not require any rescue analgesia [10]. Our study was performed only for postoperative analgesia, obtaining an average of 23 hours of analgesia with the various accesses of the sciatic nerve. Unfortunately, the dose of both anesthetics provided prolonged postoperative analgesia but with complete motor bloc, impeding ambulation and hospital discharge [9]. Fact not observed with the lowest concentration of bupivacaine in our study.

The optimal dose of intrathecal morphine in orthopedic surgery is not clear. In one study [11], it was found that both 100 μg and 200 μg morphine resulted in similar postoperative pain relief following hip arthroplasty. However, 100 μg of morphine provided, in older patients, the best balance between efficacy and side effects. In this study, comparing 80 μg with 100 μg of morphine resulted in an increase in side effects with the highest dose, mainly urinary retention.

The analgesic effects of intrathecal morphine can persist for several hours. Moreover, nausea, vomiting, pruritus and urine retention can occur. In order to reduce the risk of respiratory depression in elderly patients, the intrathecal dose of morphine has to be reduced (< 0.2 mg) [11]. In this study, reducing the dose from 100 μg to 80 μg resulted in less time for analgesia and fewer side effects.

Opioids in the treatment of postoperative pain in some types of surgery are considered "gold standard", being the most commonly used morphine and usually added to LA in spinal anesthesia. Bladder catheterization is common in major surgery. With increase fast-track surgical procedures, catheterization should be restricted to a few procedures, depending on the time of surgery. Postoperative urinary retention (POUR) has been shown to increase with age, has been reported in men (4.7%) compared to women (2.9%) [12]. Morphine may be the most suitable opioid for intrathecal administration in the treatment of postoperative pain because it provides good quality of analgesia, with long elimination, which can cause adverse effects, and is not recommended for outpatients [13]. Clinical guidelines recommend the use of a mixture of local anesthetic with potent opioid, improving the quality of analgesia, decreasing adverse effects and improving patient satisfaction [14]. The use of morphine can provide analgesia for 24 hours [14]. Postoperative urinary retention is a common complication after total hip or total knee replacement, especially amongst men and patients receiving intrathecal morphine [15]. In this study with a dose of 80 μg, urinary retention occurred in 10%. When increasing the dose to 100 μg the incidence of urinary retention increased to 27.5%.

The 40 ml dose of 0.25% bupivacaine with access to the single shot sciatic nerve block with neurostimulator provide effective pain relief to majority of the patients up to 20 hours in below knee orthopedic surgery and did not cause any systemic intoxication or rapid absorption after injection. Rebound pain is a condition characterized by hyperalgesia after the peripheral nerve block wears off. In a recent narrative review addressing rebound pain after peripheral nerve blocks for orthopedic surgeries may reduce the overall benefits of

regional anesthesia [16]. Following the patients for a week, no case of hyperalgesia was noted in patients undergoing sciatic block in the same way as in the group that received morphine.

Conclusion

The majority of peripheral regional anesthetic techniques have been shown to produce benefits for patients such as better quality of analgesia, lower incidence of side effects and hospital efficiency, in orthopedic surgery patients below the knee. Sciatic nerve block with the neurostimulation technique provides longer duration of analgesic, lower incidence of side effects, higher incidence of satisfaction compared to the use of intrathecal morphine. The highest dose of morphine produced a higher incidence of urinary retention. There were no complications related to the single shot sciatic nerve block with neurostimulator.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Volume 4 Issue 10 October 2020