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ORIGINAL RESEARCH

Effect of sono-guided fascia iliaca block versus spinal anesthesia on tourniquet pain during foot and ankle orthopedic surgery

Faramarz Mosaffa [1], Shideh Dabir [2]*, Nima Tavakoli [3], Behnam Hosseini [4], Amir Sabaghzadeh [5]

1. *Associate Professor of Anesthesiology, Anesthesiology Research Center, Department of Anesthesiology & Critical Care, Akhtar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
2. *Associate Professor of Anesthesiology, Department of Anesthesiology & Critical Care, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
3. *Anesthesiology Resident, Department of Anesthesiology & Critical Care, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
4. *Assistant Professor of Anesthesiology, Department of Anesthesiology & Critical Care, Akhtar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
5. *Assistant Professor of Orthopedics, Department of Orthopedics, Akhtar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*

*Corresponding Author:
Address: Department of Anesthesiology & Critical Care, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Email: sdabir@sbmu.ac.ir

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Abstract

Introduction: The pneumatic thigh tourniquets are routinely used in below knee orthopedic surgeries to provide a bloodless operative field. Moderate to severe thigh pain following tourniquet inflation is a common patient complaint that can be so severe that necessitate general anesthesia. In the present study, we assessed the effectiveness of a single dose fascia iliaca block on thigh tourniquet pain during unilateral orthopedic foot and ankle surgery performed under popliteal sciatic nerve block.
Materials and Methods: Seventy-two American Society of Anesthesiologists physical status 1 or 2 patients were randomly divided into two equal groups of spinal anesthesia and fascia iliaca block. Spinal anesthesia was provided with 15 mg of 0.5% hyperbaric bupivacaine. Fascia iliaca and popliteal blocks were performed under the guidance of ultrasound using 30 ml of 1.5% lidocaine and 20 ml of lidocaine 1.5% with epinephrine 1:200000, respectively.
Results: Intraoperative tourniquet pain and the use of analgesics were significantly higher and patient satisfaction was significantly lower in the fascia iliaca block group than in the spinal anesthesia group.
Conclusion: Fascia iliaca block alone was inadequate for relieving thigh tourniquet pain during surgery. However, for patients who are not suitable for spinal or general anesthesia, it can be used with supplementary intravenous analgesia for tolerance of thigh tourniquet in foot and ankle surgeries performing under popliteal sciatic nerve block.

Keywords: Thigh pain, Ultrasonography, Nerve block, Fascia iliaca block, Lower extremity

Introduction

The pneumatic thigh tourniquets are routinely used in below knee orthopedic surgeries to reduce bleeding and provide a bloodless surgical field. At various times after tourniquet inflation, patients may feel a poorly localized, diffuse dull pain that is not related to the surgical site (1,2). The pain intensity can gradually increases to an extent that becomes intolerable and necessitate general anesthesia (2,3). However, patient may complain of tourniquet-related thigh pain even with a sufficient regional anesthesia (1, 3, 4).

Sono-guided block of peripheral nerves of the lower extremity is increasingly becoming an attractive substitute to neuraxial or general anesthesia for orthopedic procedures (5, 6). They can be used safely in patients who are poor candidates for general or neuraxial anesthesia. The sciatic nerve block is a safe and effective anesthesia method for foot and ankle procedures. However, its major disadvantage is that it cannot attenuate tourniquet pain in procedures requiring a thigh tourniquet (7, 8).

It is likely that adding blockade of femoral or lateral femoral cutaneous nerve to sciatic nerve block reduces the pain caused by the tourniquet during surgery (1, 5, 9). The femoral nerve provides anesthesia of the anterior and medial thigh and the lateral femoral cutaneous nerve provides anesthesia of the anterolateral thigh (8).

Accordingly, fascia iliaca block (FIB) is a new attractive regional anesthesia option for simultaneous blocking of both femoral and lateral femoral cutaneous nerves through a single injection, and therefore may be effective in relieving tourniquet pain (10**)**. However, despite increasing attractiveness of FIB, there is still a significant lack of information on its potential advantages in providing anesthesia for lower limb surgery, including intraoperative tourniquet pain.

To our knowledge, FIB has not yet been studied as an anesthetic method for this purpose. Therefore, the aim of this clinical trial was to evaluate the effect of the FIB on thigh tourniquet pain and compare it with spinal anesthesia in foot and ankle surgical procedures. We hypothesized that FIB can attenuate thigh tourniquet pain during surgery.

Materials and Methods

The Ethics Committee of Shahid Beheshti University of Medical Sciences in Tehran, Iran approved this prospective, randomized, controlled trial on March 17, 2019 with protocol number of IR.Sbmu.Retech.Rec.1397.1370. Informed consent was obtained from all patients before participation. Seventy-two American Society of Anesthesiologists physical status 1 or 2 patients scheduled for unilateral orthopedic foot and ankle surgery entered the study. They were randomized into two equal groups of spinal anesthesia (SA) and fascia iliaca block (FIB) according to the random numbers table. Patients with known allergy to local anesthetics, age> 80 yrs., coagulation disorders, anticoagulation treatment, opium addiction, infection at the block site, previous femoral or popliteal bypass surgery, BMI ≥30, sickle cell anemia, tourniquet inflation time less than 60 minutes, and those who were uncooperative were excluded from the study. In the operating room, eligible patients were assigned to one of the two groups by lottery by a staff not involved in the study. Routine monitoring was established. All cases received 1 mg intravenous midazolam prior to the procedure. In the SA group, with the patient lying down on the limb to be operated, 15 mg of 0.5% hyperbaric bupivacaine was injected at the L4-5 level with a 25G Quincke spinal needle by a senior anesthesiology resident. The patients remained in this position for 10 minutes and then placed supine. In the FIB group, fascia iliaca and popliteal blocks were performed under the guidance of ultrasound (SonoSite S-Nerve, Bothell, WA, USA) using a 6-13 MHz linear transducer and a 22G-bevel 30°, 85 mm block needle (Visioplex®, Vygon, Ecouen, France). For the block of sciatic nerve in the popliteal fossa, 20 ml of lidocaine 1.5% + epinephrine 1:200000 was administered while the patient was in the lateral position. For the FIB, with the patient in supine position, the ultrasound probe was placed transversely on the inguinal crease. When fascia iliaca was identified, the needle was inserted in plane from lateral to medial, 30 ml of 1.5% lidocaine + epinephrine 1:200,000 was injected just below the fascia iliaca and the adequate spread of local anesthetic was monitored. Twenty minutes after injection of the local anesthetic, the level of sensory

anesthesia was evaluated by the pinprick sensations in both groups. In case of block failure, the patient removed from the study and replaced. A pneumatic thigh tourniquet inflated at a 300mmHg pressure was applied in all subjects. Immediately after tourniquet inflation, and then every 10 minutes, participants were asked to measure their tourniquet pain with a 5-point verbal rating scale (VRS) (0 =no pain, 1= mild pain, 2=moderate pain, 3= severe pain, 4=unbearable pain). If the patient complained of tourniquet pain or VRS>1, the level of sensory block was evaluated. If it was sufficient and the patient had no surgical pain, intermittent doses of IV fentanyl or ketamine were administered alternatively. If inadequate, general anesthesia was established. Duration of surgery and tourniquet inflation, intraoperative tourniquet pain score and usage of fentanyl and ketamine were recorded. At the end of surgery, patient satisfaction was graded as 4; very satisfied, 3; satisfied, 2; moderate satisfaction, 1; poor satisfaction. In the recovery room, the surgical pain was assessed by VRS. The same expert regional anesthesiologist performed all the peripheral nerve blocks.

Statistical Analysis

Data were analyzed using SPSS version 23 software. All quantitative variables were expressed as mean (standard deviation) and qualitative variables were expressed as numbers. If appropriate, t-test was used to compare the quantitative variables between the two groups and otherwise the Mann-Whitney nonparametric test was used. For comparing the qualitative variables between two groups, Pearson Chi-square test and Fisher's exact test were used. A p-value less than 0.01 was considered significant.

Results

Seventy-two patients (36 patients per each group) (24 women and 48 men) aged 14 to 79 years were enrolled in the study. Their mean age was 44.5 ±14.9 years, mean height was 171.5± 9.6 cm, and the mean BMI was 26.9 ± 4.2. No significant difference was found between the FIB and SA groups in terms of demographics, tourniquet inflation time and length of surgery (Table 1). The total dose of fentanyl and ketamine given during the surgery was significantly higher in the FIB group than in the SA group (Table 2). In the FIB group, after inflating the tourniquet and also during the surgery the intensity of tourniquet pain was significantly higher than the SA group (Fig.1, 2). In the recovery room, the surgical pain was significantly higher in the FIB group than those in the SA group (table 2), meanwhile, four patients in the FIB group received 25 mg of pethidine for pain treatment. Patient satisfaction was significantly lower in the FIB group (table 2). That is, patients received spinal anesthesia rated their satisfaction as "satisfied", while satisfaction was "moderate" in patients with FIB. No serious complication was noted in any of the patient throughout the surgical procedure.

Tabale 1: Characteristics of patients in the two study groups. Data are presented as mean±SD and numbers.

Variables	FIB group (n=36)	SA group (n=36)	P value
Gender (F/M)	10/26	14/22	
Age	41.4±15.4	47.6±13.8	0.07
Height	173.6 ±11.1	169.4 ±7.5	0.06
BMI	26.2 ± 4.3	27.5 ± 4	0.18
ASA class (1/2)	(28/8)	(27/9)	0.5
Surgery length (min)	72.8± 38.4	94.6±44.0	0.07
Tourniquet inflation duration (min)	64.3 ±31.9	83.2 ± 43.7	0.06

There was no significant difference between the two groups (p >0.01). FIB: fascia iliaca block. SA: spinal anesthesia. F: female. M: male. ASA: American Society of Anesthesiologists physical status classification.

Table 2: Comparison of the intraoperative total dose of fentanyl and ketamine, postoperative surgical pain intensity, and postoperative patient satisfaction score between the two groups. Data are presented as mean±SD.

Variables	FIB group (n=36)	SA group (n=36)	P value
Intraoperative fentanyl (µg)	81.9 ± 59.9	12.5 ± 25	<0.001
Intraoperative ketamine (mg)	20.41 ± 33.5	0	<0.001
Postoperative VRS of surgical pain	0.58±0.9	0.03±0.1	<0.001
Postoperative patients' satisfaction	2.86± 1.07	3.94±0.23	<0.001

There was significant difference between the two groups (P <0.01). FIB: fascia iliaca block. SA: spinal anesthesia. VRS: verbal rating scale of pain (0-4).

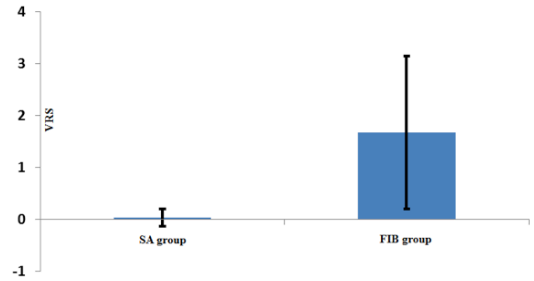

Figure 1: Comparison of tourniquet pain intensity after inflation of tourniquet between **FIB** and SA groups. There was a significant difference between the two groups (p <0.001). Data are presented as mean±SD. FIB: fascia iliaca block. SA: spinal anesthesia. VRS: verbal rating scale of pain (0-4).

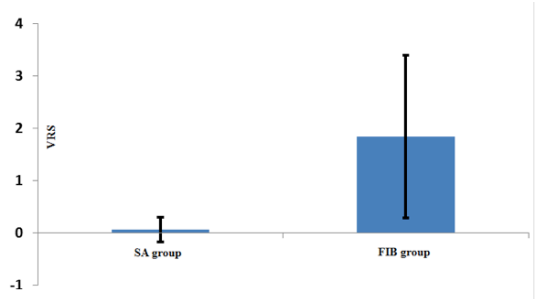

Figure 2: Comparison of tourniquet pain intensity during surgery between FIB and spinal anesthesia groups. There was a significant difference between the two groups (P <0.001). Data are presented as mean±SD. FIB: fascia iliaca block. SA: spinal anesthesia. VRS: verbal rating scale of pain (0-4).

Discussion

In the present clinical trial, we assessed the effectiveness of a single dose fascia iliaca block on thigh tourniquet pain during unilateral orthopedic foot and ankle surgery performed under popliteal sciatic nerve block. Based on the results, intraoperative tourniquet pain score and the use of analgesics was significantly higher and patient satisfaction was significantly lower in the FIB group than in the SA group. It seems that FIB alone was inadequate for relieving thigh tourniquet pain during surgery. In this research, our hypothesis was the effectiveness of the FIB in tourniquet pain tolerance during the operation; however, the results were contrary to our expectations. Block failure may not be a possible explanation because FIB is relatively easy to perform and was also done by an experienced anesthesiologist. In our opinion, the possible reason may be that the 30 ml volume of lidocaine 1.5% used for FIB block was insufficient to provide a dense anesthesia of the femoral and lateral femoral cutaneous nerve. However, for selected patients who are not suitable for spinal or general anesthesia, a FIB combined with supplementary intravenous analgesia can be used for relieving thigh tourniquet pain in foot and ankle surgeries performing under popliteal sciatic nerve block**.** The FIB was first described in children in 1989. It is widely used for analgesia in fractures and surgeries of the hip, femoral shaft or knee. Spread of local anesthetic across the fascia iliaca provides simultaneous blockade of the femoral and lateral femoral cutaneous nerve. Blockade of the lateral femoral cutaneous nerve provides anesthesia or analgesia in the anterolateral thigh. Block of the femoral nerve causes anesthesia or analgesia of the anterior and medial thigh down to and including the knee (4, 10-14). The FIB is a plane block in which a large volume of local anesthetic is needed to achieve an effective block. The success of its anesthetic or analgesic effect depends on the sufficient volume of local anesthetic as well as extent of its spread and the nerves that are blocked. Blockade of the lateral femoral cutaneous nerve provides anesthesia or analgesia in the anterolateral thigh. Block of the femoral nerve produces anesthesia or analgesia of the anterior and medial thigh down to and including the knee (10). Since a high volume of local anesthetic is required to achieve a good spread, lower concentration of the drug is used to avoid systemic complications, which results in analgesia rather than anesthesia. A volume of 30-40 ml of low concentration local anesthetic is necessary to achieve analgesic effect of the block after hip and knee procedures (10). Callear et al. administered 30-40 ml of 0.25% bupivacaine for pain relief in the hip fracture patients (11). On the other hand, the injection of a large volume of high concentration local anesthetic to induce surgical anesthesia increases the risk of systemic toxicity. We believe that for this reason, vast majority of studies have investigated the analgesic efficacy of FIB rather than its anesthetic effect. Further studies are needed to evaluate the efficacy of FIB as an anesthetic method.

Alternatively, some may argue that in the current study the dose of lidocaine used for the neural blocks was high and could increase the risk of local anesthetic toxicity. However, local anesthetic dosage in our study was no more than the doses used by the previous studies. In those studies, as in our study, no clinical manifestations of systemic adverse effects were observed. We used 750 mg of lidocaine with epinephrine containing 2o ml lidocaine 1.5% for the sciatic nerve and 30 ml for the FIB. Some authors recommend a volume of 20-30 ml for sciatic nerve block and 20-40 ml for the femoral nerve. Hadzic suggests 15-20 ml for the sciatic nerve and 30-40 ml for the fascia iliaca (9). In the study of Imbelloni et al., the combined sciatic-femoral nerve block safely performed with 800 mg of 1.6% lidocaine with epinephrine (15**)**.

Similar to our findings, it was shown that when using a peripheral nerve block, the femoral nerve block with sedation is needed to

reduce the tourniquet pain (5). Contrary to our results, Fuzzier et al., found that proximal or popliteal sciatic nerve blocks combined with simultaneous blocking of femoral and lateral femoral cutaneous nerve provided tourniquet tolerance during foot surgery (16). The study of Imbelloni et al. demonstrated the similar effectiveness of combined sciatic-femoral nerve block and that of spinal anesthesia in surgeries of the lower extremity (15). kim et al., (7) compared combined spinal epidural anesthesia with femoral/sciatic + lateral femoral cutaneous nerve block in patients undergoing total knee arthroplasty. Some of their findings were similar and others were contrary to the results of our study. Similar to our results, they showed significantly more use of analgesic and sedative drugs in the peripheral block group than in the combined spinal epidural group. Accordingly, they concluded that femoral/sciatic nerve block+ lateral femoral cutaneous nerve block cannot be the first choice for total knee arthroplasty, but it can be an alternative where neuraxial regional or general anesthesia is not indicated.

The limitation of our study was that we did not use patient-controlled analgesia after surgery and not evaluated the postoperative pain scores and the number of painkillers in the two groups. The main cause for this was the shortage of trained staff on the ward. However, it did not affect the results of this study.

Conclusion

A sono-guided fascia iliaca block combined with supplementary intravenous analgesics can be used for thigh tourniquet tolerance in foot and ankle surgeries performing under popliteal sciatic nerve block in patients who are poor candidates for spinal or general anesthesia. Our results do not advocate the routine use of FIB for attenuating thigh tourniquet pain during surgery.

Conflict of interest

Authors declare no conflict of interest.

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