Doi: 10.5152/TJAR.2020.410

Original Article
Regional Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Comparison of the Effectiveness of Suprainguinal Fascia Iliaca Compartment Block and Patient-Controlled Analgesia for Major Hip Surgeries in Elderly Patients

Mustafa Azizoğlu[1], Gülhan Orekeci Temel[2], Şebnem Rumeli Atıcı[1]

[1]Department of Anaesthesiology and Reanimation, Mersin University Faculty of Medicine, Mersin, Turkey
[2]Department of Biostatisctics and Bioinformatics, Mersin University Faculty of Medicine, Mersin, Turkey

Cite this article as: Azizoğlu M, Orekeci Temel G, Rumeli Atıcı Ş. Comparison of the Effectiveness of Suprainguinal Fascia Iliaca Compartment Block and Patient-Controlled Analgesia for Major Hip Surgeries in Elderly Patients. Turk J Anaesthesiol Reanim 2020; 48(6): 460-6.

Abstract

Objective: Fascia iliaca compartment block is an alternative analgesic technique for hip surgeries. In the new suprainguinal technique, the 'bow-tie' sign is detected with an ultrasound probe, and local anaesthetic is injected into the fascial plane with in-plane approach. In this retrospective study, we compared the postoperative analgesic efficacy of suprainguinal fascia iliaca compartment block (S-FICB) and patient-controlled analgesia (PCA) after major hip surgery in elderly patients.
Methods: We retrospectively recorded visual analogue scale (VAS) scores, morphine consumptions and opioid side effects who underwent either a S-FICB (n=67) or PCA (n=61). In the S-FICB group, 25–40 mL of 0.25% bupivacaine was administered with a single-shot S-FICB technique after induction of anaesthesia. VAS scores during resting (VAS-S) and movement (VAS-D); morphine consumption at 0, 6, 12, 24 and 48 hours; total morphine consumption; and opioid-related complications were recorded.
Results: Morphine consumptions in each measurement period and in total were significantly lower in the S-FICB group (694.03±2,007.47 µg vs. 13,368.85±4,834.68 µg; $p<0.05$). The total number of opioid-related complications were also significantly lower in the S-FICB group (17/67 vs. 48/62; $p<0.05$). More than half of the patients (38/67, 56%) did not need morphine administration in the S-FICB group. VAS-S during the first 6 hours and VAS-D up to 24 hours postoperatively were significantly lower in the S-FICB group ($p<0.05$).
Conclusion: In our study, S-FICB provided better analgesia than the PCA technique after hip surgery in elderly patients. Moreover, S-FICB reduced opioid consumption and opioid-related complications in the first 24 hours postoperatively.
Keywords: Arthroplasties, elderly, hip replacement, nerve block, opioids

Introduction

Major hip surgeries are commonly performed in elderly patients with degenerative diseases and traumatic fractures. Effective postoperative analgesia provides early ambulation and improves outcomes in elderly patients. However, nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids can cause serious adverse effects, such as upper gastrointestinal bleeding, nephrotoxicity and respiratory depression, and the elderly are especially vulnerable to these effects (1). Nerve blocks can provide effective analgesia in this population and avoid the complications of neuraxial anaesthesia and side effects of opioids (2).

Fascia iliaca compartment block (FICB) is a type of regional block of the lumbar plexus. The technique relies on local anaesthetic spread under the iliac fascia to block the femoral, lateral femoral cutaneous and obturator nerves (3-5). FICB was first described in paediatric patients by Dalens et al. (4) in 1989. Hebbard et al. (6) later described a new approach, the suprainguinal fascia iliaca compartment block (S-FICB), which provides a more effective cranial spread of the local anaesthetics. In the new technique modified by Desmet et al. (7), the 'bow-tie' sign formed by the internal oblique and sartorius muscle in the longitudinal plane is detected with the high-frequency linear ultrasound (US) probe, and a local anaesthetic is injected to spread under the abdominal wall muscle after the needle is inserted in the cephalic direction with an in-plane approach. Although many studies have shown that FICB reduces

Corresponding Author: Mustafa Azizoğlu E-mail: dryalamaoglu@hotmail.com

Received: 22.02.2020
Accepted: 22.05.2020

opioid consumption, the results are still controversial (3, 7, 8). Furthermore, recent meta-analyses have suggested that efficiency of FICB and application approaches should be studied further (9). It has been suggested that continuous FICB performed using a conventional technique provides better pain control than patient-controlled analgesia (PCA) in elderly patients (10). To the best of our knowledge, no study in the current literature has evaluated the effect of the suprainguinal technique, especially in the elderly population.

In this retrospective study, we compared the postoperative analgesic effectiveness of S-FICB and PCA after major hip surgery in elderly patients. Our primary objective was to compare the total opioid consumption between the 2 analgesic techniques with concurrent use of acetaminophen. Secondary objectives were to compare the pain scores rated on a visual analogue scale (VAS), length of hospital stay, complications and mortality rates in the study group.

Methods

After obtaining approval from the Mersin University Ethics Committee (date: 22 February, 2018; number: 2018/81), we conducted a retrospective cohort study of 128 patients who underwent hip surgery between 01 August, 2017, and 30 January, 2018, through an evaluation of their medical records. Medical records were collected from patient records and daily postoperative follow-up documents. Patients who were more than 65 years old, had unilateral hip surgery and had S-FICB or received PCA morphine were included in the study. Patients receiving spinal or epidural anaesthesia; using chronic analgesic drugs; having additional illnesses, including liver or kidney diseases, neurological deficits in the lower extremities and illnesses that interfered with communication skills such as dementia or mechanical ventilation requirement and having insufficient data were excluded from the study. A flow chart demonstrating patient selection is presented in Figure 1. There was no standard preoperative analgesia protocol in our institution; meperidine, morphine and tramadol treatments were used with acetaminophen intravenously (IV) by an orthopaedic surgeon in patients with hip fracture.

Main Points:

- Hip surgeries are usually performed in elderly patients, and this population is very sensitive to opioid side effects.
- This study revealed that ultrasound (US)-guided suprainguinal fascia iliaca compartment block (S-FICB) provides more effective analgesia and reduces opioid consumption than in the patient-controlled analgesia group.
- US-guided S-FICB can provide postoperative analgesia without any requirement for opioids in elderly patients.
- US-guided S-FICB may also reduce the incidence of opioid-related side effects.

Anaesthesia and postoperative analgesia protocols for S-FICB and PCA patients were as follows:

Anaesthesia protocol

No premedication was administered to the patients before the surgery. All the patients were monitored with electrocardiogram, invasive blood pressure, pulse oximetry and end-tidal carbon dioxide in the operation room. General anaesthesia was induced with propofol (0.5-2.0 mg kg^{-1}) or thiopental (3-5 mg kg^{-1}). Remifentanil (0.2-0.5 µg kg^{-1}) and rocuronium (0.5-0.6 mg kg^{-1}) were administered to facilitate tracheal intubation. Remifentanil was repeated in patients in whom hypertension and tachycardia were detected (20% increase compared with basal value). In the case of persistent tachycardia and hypertension, after other possible causes were ruled out, 0.5 mg of morphine was administered. Anaesthesia was maintained with 0.5%-2% sevoflurane and 3-6 L min^{-1} 50% O_2 and 50% N_2O fresh gas mixture. Neuromuscular blockade was antagonised with 0.05 mg kg^{-1} neostigmine and 0.015 mg kg^{-1} atropine before extubation.

Postoperative analgesia protocol for suprainguinal fascia iliaca compartment block and patient-controlled analgesia after hip surgeries

All the patients were administered 20 mg kg^{-1} acetaminophen IV during the operation and monitored in the post-anaesthesia care unit (PACU) for 1 hour. Targeted VAS score was ≤3 during resting. The VAS scores were evaluated and recorded at 0 hours before the patients were transferred from the PACU to the ward. The amount of opioid administered till this time, including intraoperative administration, was recorded as '0 hour' morphine consumption. Our pain management team visited the patients at 6-hour intervals. Pain scores during movement were evaluated with active leg lifting to 15 degrees. The pain management team was called by or-

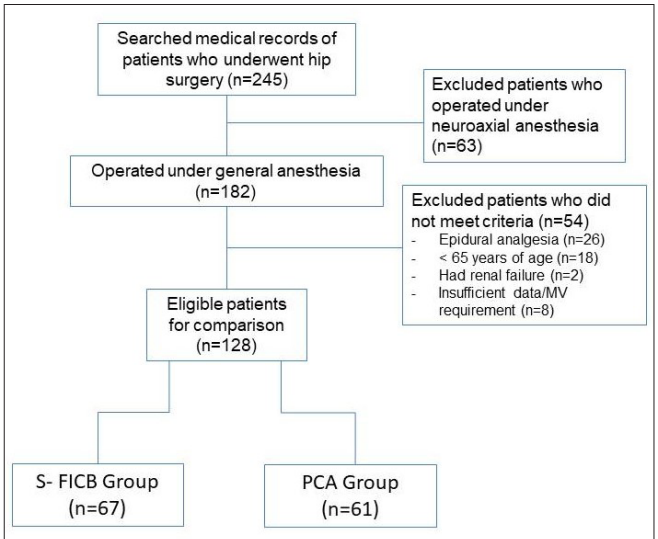

Figure 1. Study flow diagram

thopaedic service nurse when the patient was complaining of pain between scheduled visits. VAS 0–10 was used for pain measurement.

Analgesia protocol for patients with suprainguinal fascia iliaca compartment block

Intraoperative S-FICB was performed by means of the suprainguinal technique after detection of the bow-tie sign formed by the internal oblique and sartorius muscles. Because pain control was provided by IV to the patients when necessary, single-shot US-guided S-FICB was applied after induction of anaesthesia to prevent discomfort during intervention. A total of 25-40 mL (0.40–0.60 mL kg^{-1}) of 0.25% bupivacaine was injected under the abdominal muscle to maintain the spread using an in-plane technique described by Desmet et al. (7). Local anaesthetic distribution was observed under the internal oblique muscle in the facial plane during the injection. Meanwhile, care was taken to ensure that the circumflex artery was pushed upwards. Because cephalic distribution is important for the success of the method, an additional 5 mL of local anaesthetic was administered to patients where these conditions were not confirmed. If the patient did not complain of pain at rest, no additional treatment was given in the PACU. If the patient had pain, PCA morphine was set with a dose of 0.5 mg morphine on demand with a 15-minute lockout interval. If the VAS score was >3, it was considered a failed block after extubation. Acetaminophen was the first choice and a dose of 20 mg kg^{-1} was administered if the pain occurred during follow-up in the ward. In addition, PCA was set at a dose of 0.5 mg morphine on demand with a 15-minute lockout interval or equal dose of meperidine in patients who did not reach the target VAS-S with the acetaminophen treatment. If VAS-S was >3 at any time during their follow-up, morphine at 0.5 mg IV was administered. Morphine consumption was recorded as rescue analgesic treatment in this group.

Analgesia protocol for PCA patients

Patients in the PCA group were given 0.5 mg of morphine on demand with a 15-minute lockout interval. If VAS-S was >3, morphine at 0.5 mg was IV administered in the PACU or at any time during their follow-up. If a VAS of >3 persisted, additional 1 mg kg^{-1} h^{-1} infusion was adjusted. Acetaminophen 20 mg kg^{-1} was also added to the treatment in patients who did not reach the target VAS-S. Acetaminophen and bolus morphine treatment were recorded as rescue analgesia in this group.

Collected data

Demographic data, analgesic techniques; VAS scores during resting and movement; morphine consumption at 0 (recovery), 6, 12, 24 and 48 hours total morphine consumption; rescue analgesia need; opioid-related complications; length of hospital stay and mortality rates were recorded for all eligible patients.

Statistical analysis

Baseline characteristics were compared with the chi-squared test for categorical data and the Student's t-test for continuous data. Pain scores and morphine consumption were analysed using the Mann-Whitney U test to detect a statistical difference between the groups. Opioid-related complications and mortality rates were compared using the Fisher's exact test. In addition, p values of less than 0.05 were considered statistically significant.

Results

We retrospectively analysed data from 128 patients over 65 years (mean age: 73.28±8.40 years). For comparison, the patients were divided into the S-FICB group (n=67) and PCA group (n=61) according to the postoperative analgesia they received. The patients' demographic and surgical characteristics are summarised in Table 1. There were no statistically significant differences between the 2 groups with respect to age, sex, the American Society of Anesthesiologists classification, type of surgery, time from fracture to surgery, or operative time (p>0.05 for all) (Table 1). An additional 5 mL

Table 1. Patient demographic and surgical characteristics

	S-FICB	PCA	p
Age (years, mean±SD)	73.17±8.48	73.39±8.38	0.886
Sex, n (male/female)	29/38	27/34	0.912
ASA classification	0/26/34/7	5/21/27/8	0.597
Surgery, n (%)			
Total hip arthroplasty	13 (19.4)	17 (27.9)	0.55
Acetabular fracture	5 (7.5)	6 (9.8)	
Revision arthroplasty	7 (10.4)	4 (6.6)	
Proximal femur fracture	5 (7.5)	8 (13.1)	
Intertrochanteric femur fracture	13 (19.4)	14 (23)	
Femur neck fracture	24 (35.8)	12 (19.7)	
Surgery duration (minutes)	122.01±28.51	122.21±20.74	0.965
Mean morphine consumption in first 48 hours (mg) 0.000*	0.694±2.00	13.40±4.83	
Time to discharge (days)	3.78±1.57	4.11±1.71	0.246
In-hospital mortality, n (%)	4/67 (6)	6/61 (11)	0.517
1-year mortality, n (%)	7/67 (10.4)	14/61 (23)	0.349

S-FICB: suprainguinal fascia iliaca compartment block; PCA: patient-controlled analgesia; ASA: American Society of Anesthesiologists; SD: standard deviation

*p<0.05

Table 2. Distribution of opioid-related complications between the groups

	S-FICB (n=67)	PCA (n=61)	p
Total number of opioid-related complications, n (%)	17 (25.3)	48 (78.6)	0.01*
Nausea/vomiting	6 (8.9)	16 (26.2)	0.01*
Hypotension	7 (10.4)	18 (29.5)	0.01*
Hypoxemia	4 (5)	12 (19)	0.01*
Urinary retention	0 (0)	2 (3)	0.13
Delirium	1 (1)	5 (8)	0.08

S-FICB: suprainguinal fascia iliaca compartment block; PCA: patient-controlled analgesia
*p<0.05

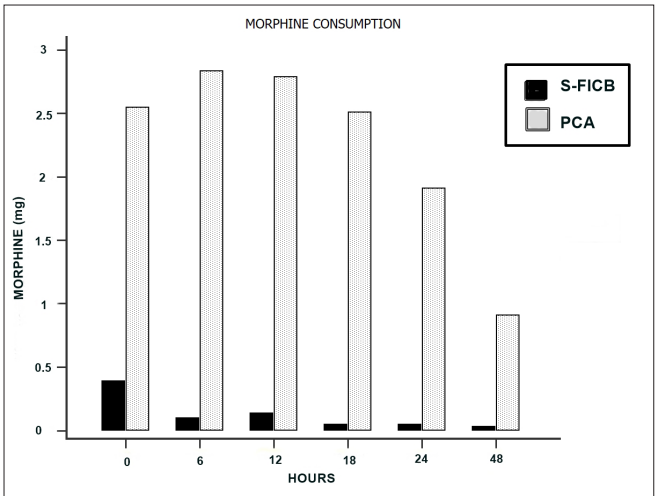

Figure 2. Comparison of morphine consumption in the early postoperative period (0–48 hours) between patients who had suprainguinal fascia iliaca compartment block and patient-controlled analgesia

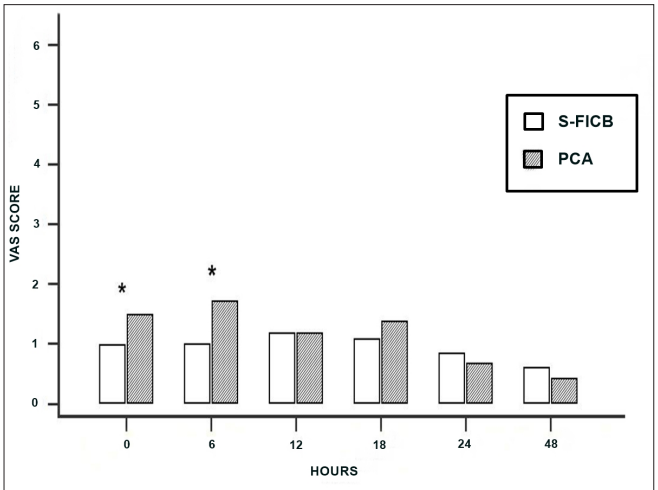

Figure 3. Comparison of static visual analogue scale scores between patients who had suprainguinal fascia iliaca compartment block and patient-controlled analgesia

of local anaesthetic was administered to 2 patients, and the mean volume of local anaesthetic was 30.22±1.61 mL in the S-FICB group. Morphine consumption was significantly lower in the S-FICB group than in the PCA group at all time points. Similarly, total morphine consumption was lower in the S-FICB group than in the PCA group (694.03±2007.47 and 13368.85±4834.68 µg, respectively) (p<0.05) (Figure 2). Overall, the rate of opioid-related complications was significantly lower in the S-FICB group than in the PCA group (17/67 and 48/61, respectively; p<0.05) (Table 2). Although the incidences of nausea/vomiting (6/67 and 16/61, respectively; p<0.05), hypotension (7/67 and 18/61, respectively; p<0.05) and hypoxemia (4/67 and 12/61, respectively; p<0.05) were found to be lower in the S-FICB group, the incidences of delirium (1/67 and 5/61, respectively; p>0.05) and urinary retention (0/67 and 2/61, respectively; p>0.05) were found to be similar in both the groups (Table 2). Muscle weakness was not detected in either group. Pain scores at rest (VAS-S) were significantly lower at recovery and at 6 hours, whereas pain scores with movement (VAS-D) were significantly lower in the S-FICB group than in the PCA group for up to 24 hours postoperatively (p<0.05 for all) (Figure 3, Figure 4). Morphine was not administered to 38 (56.7%) patients, but morphine or acetaminophen was not administered to 28 (41.7%) patients in the S-FICB group during the postoperative period. Mean dose of acetaminophen was found to be similar between the 2 groups (1.42±0.98 vial for S-FICB group and 1.23± 0.78 vial for PCA group, respectively; p>0.05). There was no significant difference between the 2 groups in terms of discharge time (3.78±1.57 and 4.11±1.71, respectively; p>0.05), in-hospital mortality (4/67 and 6/61, respectively; p>0.05) and 1-year mortality rates (7/67 and 14/61, respectively; p>0.05) (Table 1).

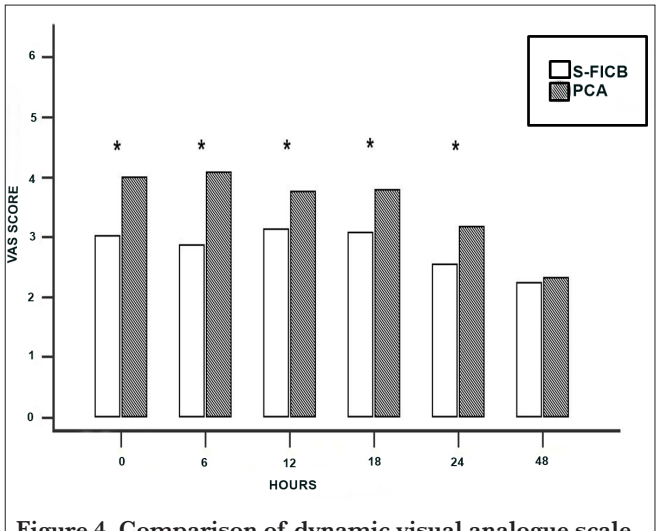

Figure 4. Comparison of dynamic visual analogue scale scores between patients who had suprainguinal fascia iliaca compartment block and patient-controlled analgesia

Discussion

In this study, we observed that S-FICB significantly reduced morphine consumption after major hip surgeries. Mean VAS-S scores were lower for up to 6 hours and VAS-D scores were lower in the first 24 hours with S-FICB than those with the PCA technique. Moreover, 56% of patients in the S-FICB group did not receive morphine in the postoperative period.

A recent meta-analysis has suggested that FICB could reduce postoperative pain scores up to 12 hours and morphine consumption in the first 24 hours after hip surgery (11). However, there is some conflicting information regarding the effectiveness of FICB in the literature. Some researchers have suggested that FICB can effectively reduce pain in patients with femur fracture with lower morphine consumption (11, 12), whereas other authors have argued that FICB did not reduce pain scores or opioid consumption rates compared with placebo or intra-articular injection (3, 11). Stevens et al. (13) have suggested that more cephalic spread of local anaesthetic solution could result in more effective blockage with S-FICB than the infra-inguinal technique. Recently, the S-FICB method was also demonstrated to have the same analgesic effect as the periarticular local anaesthetic injection (14). Obviously, there are some conflicting results related to the classical approach in the literature. Studies investigating the suprainguinal technique seem to be inadequate to determine the pain-control quality. Therefore, this study aimed to evaluate the analgesic efficacy of suprainguinal approach in elderly patients.

Vermeylen et al. (15) have shown that local anaesthetic can also spread to the ilioinguinal, genitofemoral and subcostal nerves if high volumes are used for S-FICB. Several studies have reported that the effective volume of local anaesthetic was 30–40 mL for proximal spread (16). We administered an average of 30.22±1.61 mL of local anaesthetic to perform S-FICB. These volumes were determined by the patient's body weight and adequate distribution ensured with real-time US.

Enhanced recovery after surgery protocols recommend analgesia with opioid-sparing effects, such as epidural analgesia, peripheral nerve block, periarticular injection, local infiltration of local anaesthetic solution, NSAIDs and acetaminophen, for postoperative analgesia (17). Although PCA was considered the basic method, regional anaesthetic techniques were also used to alleviate postoperative pain while avoiding complications associated with using opioids for pain relief after major surgery (18). Mean acetaminophen consumption was found to be similar in both the groups. The lack of additional postoperative acetaminophen in 28 patients in the S-FICB group, who also did not receive opioids, demonstrates the efficacy of the block. Furthermore, acetaminophen could further reduce the number of patients who needed opioid in the postoperative period.

Recent guidelines and studies have recommended early surgical treatment within 24–48 hours for patients with hip fracture to relieve pain and to reduce surgery-related morbidity and mortality rates (19, 20). Elderly patients were found to have longer hospital stays and higher risks of morbidity and mortality owing to opioid-related and other complications after total joint arthroplasty (21, 22). Patients in both the groups in our study had similar mean time to surgery. We found similar discharge times and in-hospital mortality and 1-year mortality rates between the 2 groups. It has been shown that peripheral nerve block accelerates rehabilitation, reduces the opioid side effects and shortens hospital stay (23). The mean discharge time of patients was not longer than the routine hospitalisation time at our institution. Patients without any clinical problems started to walk on the first postoperative day, followed up on the second day and discharged on the third day. We thought that most of the opioid side effects could be treated in a short time and had no effect on the length of hospital stay in our study.

Many studies have shown that hypoxemia, hypotension, nausea and vomiting are associated with opioid consumption. We found that fewer patients in the S-FICB group had complaints related to opioid usage, similar to the literature, whereas there were no differences between the groups in terms of urinary retention and delirium. The prevalence of delirium after sustaining a hip fracture has been found to be as high as 40% after surgery (24, 25). Delirium is a known side effect of opioids; however, some researchers have argued that the incidence of delirium was not related with opioid use in patients with hip fracture (25). Moreover, opioid drugs have different delirious effects; meperidine was associated with an increased risk of delirium compared with that of other drugs, such as morphine (26). The risk of delirium appears to be associated with many factors, such as environmental stimuli, metabolic disorders, drugs and injury. A recent study has shown that analgesia with a femoral catheter may not have a significant effect on the development of delirium alone in patients with hip fracture (27). We also found no difference in delirium prevalence between the 2 groups.

This study had some limitations. First, we conducted a retrospective study. Therefore, the main limitation of this study was the lack of well-described and standardised perioperative anaesthesia and analgesia protocols as that of a prospective study. Sham block was not applied to patients in the PCA group. However, data were collected from well-structured follow-up records maintained by the postoperative pain management team. Second, there was no standard instrument for evaluation of delirium in each patient. The patients who had

consulted the psychiatry department and treated for agitation and/or cognitive impairment were accepted to have developed delirium. Third, although the total numbers of complications were significantly higher in the PCA group than in the S-FICB group, the sample size of our study may not be enough to discuss opioid-related complications.

Conclusion

In our study, S-FICB provided better analgesia than the PCA in elderly patients after hip surgery. Moreover, S-FICB reduced opioid consumption and opioid-related complications than the PCA technique in the first 24 hours postoperatively. More than half of the patients did not need morphine administration after surgery.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Mersin University (22/02/2018-2018/81).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.A.; Design – M.A., G.O.T.; Supervision – Ş.R.A., G.O.T.; Resources – M.A.; Data Collection and/or Processing – M.A., Ş.R.A., G.O.T.; Analysis and/or Interpretation – Ş.R.A., G.O.T.; M.A.; Writing Manuscript – M.A., Ş.R.A.; Critical Review – M.A., Ş.R.A., G.O.T.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Di Filippo A, Magherini M, Ruggiano P, Ciardullo A, Falsini S. Postoperative analgesia in patients older than 75 years undergoing intervention for per-trochanteric hip fracture: a single centre retrospective cohort study. Aging Clin Exp Res 2015; 27: 281-5. [CrossRef]
2. Barrington JW, Halaszynski TM, Sinatra RS, For The Expert Working Group On Anesthesia And Orthopaedics Critical Issues In Hip And Knee Replacement Arthroplasty. Perioperative pain management in hip and knee replacement surgery. Am J Orthop (Belle Mead, NJ) 2014; 43: 1-16.
3. Shariat AN, Hadzic A, Xu D, Shastri U, Kwofie K, Gandhi K, et al. Fascia lliaca block for analgesia after hip arthroplasty: a randomized double-blind, placebo-controlled trial. Reg Anesth Pain Med 2013; 38: 201-5. [CrossRef]
4. 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. [CrossRef]
5. Dolan J, Williams A, Murney E, Smith M, Kenny GN. Ultrasound guided fascia iliaca block: a comparison with the loss of resistance technique. Reg Anesth Pain Med 2008; 33: 526-31. [CrossRef]
6. Hebbard P, Ivanusic J, Sha S. Ultrasound-guided supra-inguinal fascia iliaca block: a cadaveric evaluation of a novel approach. Anaesthesia 2011; 66: 300-5. [CrossRef]
7. Desmet M, Vermeylen K, Van Herreweghe I, Carlier L, Soetens F, Lambrecht S, et al. A longitudinal supra-inguinal fascia iliaca compartment block reduces morphine consumption after total hip arthroplasty. Reg Anesth Pain Med 2017; 42: 327-33. [CrossRef]
8. Gao Y, Tan H, Sun R, Zhu J. Fascia iliaca compartment block reduces pain and opioid consumption after total hip arthroplasty: A systematic review and meta-analysis. Int J Surg 2019; 65: 70-9. [CrossRef]
9. Cai L, Song Y, Wang Z, She W, Luo X, Song Y. The efficacy of fascia iliaca compartment block for pain control after hip arthroplasty: a meta-analysis. Int J Surg 2019; 66: 89-98. [CrossRef]
10. Ma Y, Wu J, Xue J, Lan F, Wang T. Ultrasound guided continuous fascia iliaca compartment block for peroperative pain control in very elderly patients with hip fracture: A randomized controlled trial. Exp Ther Med 2018; 16: 1944-52. [CrossRef]
11. Aprato A, Audisio A, Santoro A, Grosso E, Devivo S, Berardino M, et al. Fascia-iliaca compartment block vs intra-articular hip injection for preoperative pain management in intracapsular hip fractures: A blind, randomized, controlled trial. Injury 2018; 49: 2203-8. [CrossRef]
12. Groot L, Dijksman LM, Simons MP, Zwartsenburg MM, Rebel JR. Single Fascia Iliaca Compartment Block is Safe and Effective for Emergency Pain Relief in Hip-fracture Patients. West J Emerg Med 2015; 16: 1188-93. [CrossRef]
13. Stevens M, Harrison G, McGrail M. A modified fascia iliaca compartment block has significant morphine-sparing effect after total hip arthroplasty. Anaesth Intensive Care 2007; 35: 949-50. [CrossRef]
14. Gasanova I, Alexander JC, Estrera K, Wells J, Sunna M, Minhajuddin A, et al. Ultrasound-guided suprainguinal fascia iliaca compartment block versus periarticular infiltration for pain management after total hip arthroplasty: a randomized controlled trial. Reg Anesth Pain Med 2019; 44: 206-11. [CrossRef]
15. Vermeylen K, Soetens F, Leunen I, Hadzic A, Van Boxtael S, Pomés J, et al. The effect of the volume of supra-inguinal injected solution on the spread of the injectate under the fascia iliaca: a preliminary study. J Anesth 2018; 32: 908-13. [CrossRef]
16. Bang S, Chung J, Jeong J, Bak H, Kim D. Efficacy of ultrasound-guided fascia iliaca compartment block after hip hemiarthroplasty: A prospective, randomized trial. Medicine (Baltimore) 2016; 95: e5018. [CrossRef]
17. Lassen K, Soop M, Nygren J, Cox PBW, Hendry PO, Spies C, et al. Consensus review of optimal perioperative care in colorectal surgery. Enhanced Recovery After Surgery (ERAS) Group recommendations, JAMA Surg 2009; 144: 961-9. [CrossRef]
18. Soffin EM, YaDeau JT. Enhanced recovery after surgery for primary hip and knee arthroplasty: a review of the evidence. Br J Anaesth 2016; 117: 62-72. [CrossRef]

19. Ma Y, Wu J, Xue J, Lan F, Wang T. Ultrasound-guided continuous fascia iliaca compartment block for pre-operative pain control in very elderly patients with hip fracture: A randomized controlled trial. Exp Ther Med 2018; 16: 1944-52. [CrossRef]
20. Colais P, Di Martino M, Fusco D, Perucci CA, Davoli M. The effect of early surgery after hip fracture on 1-year mortality. BMC Geriatr 2015; 15: 141. [CrossRef]
21. Austin DC, Torchia MT, Moschetti WE, Jevsevar DS, Keeney BJ. Patient outcomes after total hip arthroplasty in extreme elderly patients older than 80 years. Hip Int 2019: 1120700019837943. [CrossRef]
22. Brooks E, Freter SH, Bowles SK, Amirault D. Multimodal Pain Management in Older Elective Arthroplasty Patients. Geriatr Orthop Surg Rehabil 2017; 8: 151-4. [CrossRef]
23. Joshi G, Gandhi K, Shah N, Gadsden J, Corman SL. Peripheral nerve blocks in the management of postoperative pain: challenges and opportunities. J Clin Anesth 2016; 35: 524-9. [CrossRef]
24. Amin NH, West JA, Farmer T. Nerve Blocks in the Geriatric Patient With Hip Fracture: A Review of the Current Literature and Relevant Neuroanatomy. Geriatr Orthop Surg Rehabil 2017; 8: 268-75. [CrossRef]
25. Sieber F, Mears S, Lee H, Gottschalk A. Postoperative opioid consumption and its relationship to cognitive function in older adults with hip fracture. J Am Geriatr Soc 2011; 59: 2256-62. [CrossRef]
26. Swart LM, Zanden V, Spies PE, Rooij SE, Munster BC. The Comparative Risk of Delirium with Different Opioids: A Systematic Review. Drugs Aging 2017; 34: 437-43. [CrossRef]
27. Uysal AI, Altıparmak B, Yaşar E, Turan M, Canbek U, Yılmaz N, et al. The effects of early femoral nerve block intervention on preoperative pain management and incidence of postoperative delirium geriatric patients undergoing trochanteric femur fracture surgery: A randomized controlled trial. Ulus Travma Acil Cerrahi Derg 2020; 26: 109-14. [CrossRef]