Brazilian Journal of Anesthesiology 2023;73(6):711–717

Sociedade Brasileira de Anestesiologia

Brazilian Journal of ANESTHESIOLOGY

ORIGINAL INVESTIGATION

Supra-inguinal fascia iliaca block in older-old patients for hip fractures: a retrospective study

Cagla Bali *, **Ozlem Ozmete**

Baskent University School of Medicine, Anesthesiology and Reanimation Department, Adana, Turkey

Received 17 April 2021; accepted 28 August 2021
Available online 25 September 2021

KEYWORDS
General anesthesia;
Hip fracture;
Nerve block;
Older-old

Abstract
Background: Pain management in hip fracture patients is of great importance for reducing postoperative morbidity and mortality. Multimodal techniques, including peripheral nerve blocks, are preferred for postoperative analgesia. Older-old hip fracture patients with high ASA scores are highly sensitive to the side effects of NSAIDs and opioids. Our aim was to investigate the effectiveness of the recently popularized Supra-Inguinal Fascia Iliaca Block (SIFIB) in this population.
Methods: Forty-one ASA III–IV patients who underwent SIFIB + PCA (G-SIFIB) or PCA alone (Group Control: GC) after general anesthesia were evaluated retrospectively. In addition to 24-hour opioid consumption, Visual Analog Scale (VAS) scores, opioid-related side effects, block-related complications, and length of hospital stay were compared.
Results: Twenty-two patients in G-SIFIB and 19 patients in GC were evaluated. The postoperative 24-hour opioid consumption was lower in G-SIFIB than in GC ($p < 0.001$). There was a statistically significant reduction in VAS scores at the postoperative 1st, 3rd, and 6th hours at rest ($p < 0.001$) and during movement ($p < 0.001$ for the 1st and 3rd hours, and $p = 0.02$ for the 6th hour) in G-SIFIB compared to GC. There was no difference in pain scores at the 12th and 24th hours postoperatively. While there was no difference between the groups in terms of other side effects, respiratory depression was significantly higher in GC than in G-SIFIB ($p = 0.01$).
Conclusion: The SIFIB technique has a significant opioid-sparing effect and thus reduces opioid-related side effects in the first 24 hours after hip fracture surgery in older-old patients.

Introduction

Hip fracture is a serious problem affecting the elderly population due to osteoporosis. With the increasing life span of individuals, the frequency of this condition is increas-

* Corresponding author.
E-mail: caglaetike@hotmail.com (C. Bali).

https://doi.org/10.1016/j.bjane.2021.08.008

ing, and it is an important socioeconomic problem globally.[1] The elderly population can be chronologically categorized as ''younger-old'' (aged 65 to 80 years) and ''older-old'' (aged more than 80 years). The risk of hip fracture in the older-old group is 15 times higher than that in younger-old patients.[2] Mortality and morbidity are higher among patients with hip fractures and older-old patients have worse outcomes and more in-hospital complications than younger-old patients.[3,4]

Early surgery can reduce postoperative complications and mortality by mobilizing the patient.[5,6] In patients with hip fractures, effective pain management in addition to early surgery can positively affect the results. Effective pain management can prevent various undesired complications, such as impaired cognitive functions and delirium, and provides early mobilization, rehabilitation of the extremity and a more rapid recovery. It has been reported that the risk of developing delirium is nine times higher among hip fracture patients in whom adequate pain management cannot be achieved.[7]

Combined multimodal methods, in which opioids, paracetamol, NSAIDs, and peripheral regional anesthesia techniques are used, are preferred in postoperative pain management of hip fractures. However, pain management in geriatric patients is complicated by comorbidities, changed pharmacodynamics, and physiological changes in end-organ functions.[8] Due to renal toxicity, coagulation disorders, and gastrointestinal side effects, NSAIDs are not preferred in geriatric patients. Opioids do not reduce dynamic pain and have side effects such as respiratory depression, sedation, nausea, and vomiting. Therefore, peripheral regional methods performed by ultrasonography (USG) can be employed to reduce the required opioid dose.

Fascia Iliaca Block (FIB), which is widely used for postoperative analgesia in hip surgery, is a nerve block technique with proven efficacy. Hebbard et al. performed this block over the inguinal ligament and thus created a new technique: Supra-Inguinal Fascia Iliaca Block (SIFIB).[9] Additional studies have revealed that this block is more effective than the classical (infra-inguinal) fascia iliaca block.[10]

Although the use of SIFIB in hip surgery has recently increased, to the best of our knowledge, patients with an advanced age with high ASA (American Society of Anesthesiologists) physical status scores have not been studied. In this retrospective study, our aim was to investigate the effectiveness of SIFIB in older-old patients.

Methods

This retrospective study was approved by the Institutional Review Board of Baskent University (Project no: KA 21/29) and was funded by the Baskent University Research Fund. Patients who underwent surgery and were followed up due to femur fracture at Baskent University Adana Dr. Turgut Noyan Practice and Research Center between January 2019 and January 2021 were included in this study. Information regarding the patients was retrieved from the preoperative and intraoperative anesthesia record forms, patient files and the NUCLEUS electronic medical information system (Monad Software, Ankara, Turkey). Data collection and analysis were performed between January and February 2021.

Patients over 80 years of age with ASA physical status III and IV who refused other types of anesthesia or had a contraindication for neuroaxial anesthesia underwent general anesthesia for femoral nail surgery due to hip fractures (pertrochanteric femur fracture) were evaluated retrospectively. In our clinic, if patients receive general anesthesia, a nerve block is usually performed as part of analgesia. Patients who refused a nerve block were selected to the control group. Patients who had chronic pain for any reason and had chronic opioid use, patients who had undergone neuraxial anesthesia, had liver and kidney failure, had a BMI > 35, patients with multiple fractures, patients who were allergic to the drugs used in this study, and those who had dementia or other cognitive problems were excluded.

After the patients were taken to the operating room, standard anesthesia monitoring was performed with electrocardiography, pulse oximetry, and noninvasive blood pressure monitoring. Anesthesia was induced with propofol (0.5 to 2 $mg.kg^{-1}$) or thiopental sodium (2 to 5 $mg.kg^{-1}$), rocuronium bromide (0.5 $mg.kg^{-1}$), and fentanyl (0.5 to 1 $mcg.\ kg^{-1}$). Sevoflurane at 1% to 2% concentration in a 50% N_2O/O_2 mixture was used for maintenance. We classified the patients into groups according to the presence of SIFIB due to refusal or acceptance of the nerve block. After endotracheal intubation, among the patients who planned to undergo SIFIB, the anterior superior iliac spine was identified by a high-frequency linear probe (SonoSite SLAx [6–13 MHz]; FUJIFILM Sonosite, Inc., Bothell, WA, USA) over the inguinal ligament in the parasagittal plane, following appropriate disinfection and draping of the patient in the supine position. Then, the probe was moved medially, and the internal oblique muscle in the cranial direction, the sartorius muscle in the caudal direction, the bow-tie shape formed by these muscles, the underlying iliacus muscle, and the fascia iliaca surrounding it were visualized.[11] An 80-mm peripheral nerve block needle was inserted from the caudal side, and the iliac fascia was passed. After identification of the correct area following 2 to 3 mL of hydrodissection, 40 mL of 0.25% bupivacaine was injected. The surgery was completed, and 1 g of paracetamol was administered intravenously to all patients during the closure phase. The neuromuscular block was antagonized with 0.05 $mg.kg^{-1}$ neostigmine and 0.015 $mg.kg^{-1}$ atropine, and the patients were extubated.

Patients were observed for 1 hour in the Postanesthesia Care Unit (PACU) and evaluated using a visual analog scale (VAS, 0 = no pain, 10 = worst pain) before being transferred to the ward. Patients were instructed in the use of the VAS scale and PCA (patient-controlled analgesia) device before the surgery. Fentanyl (10 mcg) was administered to the patients with a VAS score > 4. Fentanyl PCA was administered to all patients (no background infusion, 0.2 $mcg.kg^{-1}$ bolus dose, 10-min lockout interval, 4 $mcg.\ kg^{-1}$ 4-hour limit dose). When the patients' pain could not be controlled with the PCA under ward conditions, 50 mg of intravenous tramadol was used as an additional analgesic. The total opioid consumption was calculated by adding the equivalent dose of tramadol[12] (tramadol 50 mg = fentanyl 50 mcg) that was used as an additional analgesic to the value obtained from the PCA administration of fentanyl.

In addition to the demographic data of the patients, postoperative 24-hour fentanyl consumption, which is the primary outcome of this study, and the VAS scores at rest and

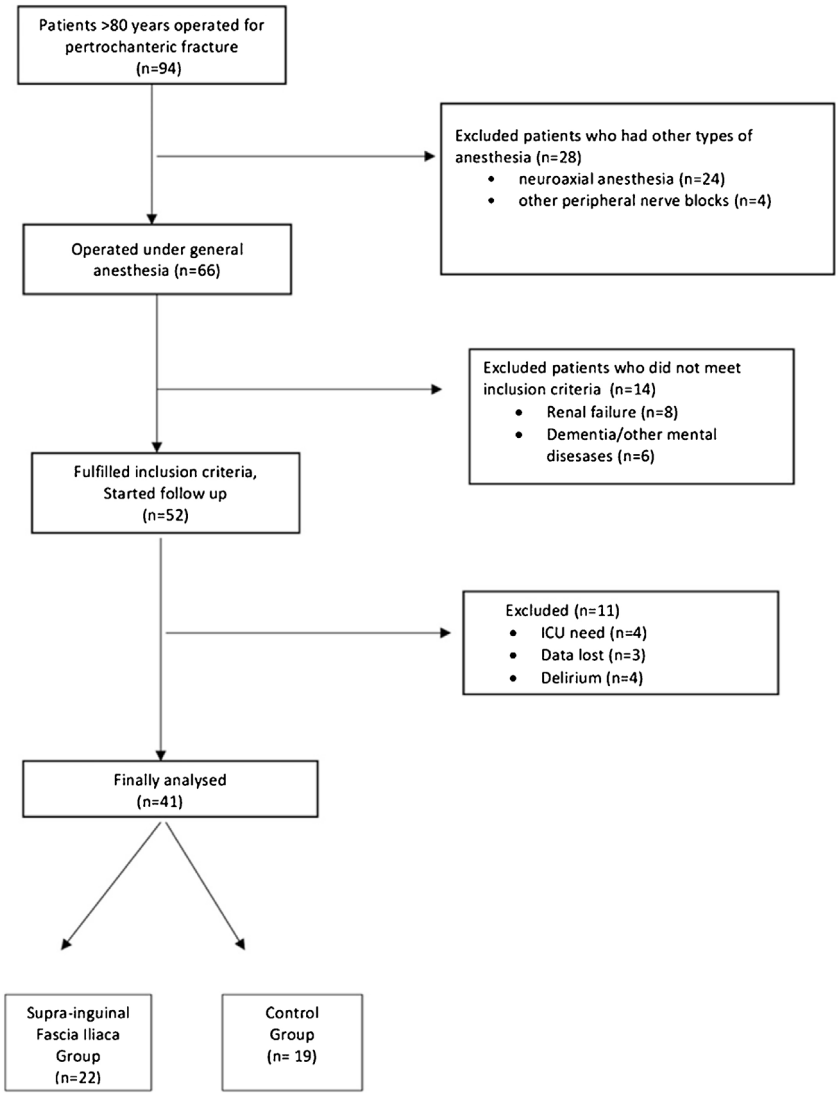

Figure 1 Study flow chart.

during movement at the 1st, 3rd, 6th, 12th and 24th hours, as secondary outcomes, were recorded. Data were collected by our anesthesia technicians out of the study team. If the patient's record was missing data essential for the study, those patients were excluded from the data analysis.

In addition, the duration of surgery, analgesic method-related nausea-vomiting (absence/presence within 24 hours following the procedure), pruritus (acute itching after opioid administration without skin lesions), respiratory depression (defined as $SpO_2 < 90$ when the patients were breathing room air), urinary retention (sudden inability to micturate during the study period), hematoma at the injection site for the nerve block, length of hospital stay, and adverse effects such as infection and systemic local anesthetic toxicity, were also investigated.

Statistical analyses

SPSS 26.0 (SPSS Inc., IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) was used for statistical analysis. Categorical variables are shown as numbers, whereas numerical variables are shown as the mean and standard deviation (as median and minimum-maximum when required). The Chi-Square test was used for a comparison of the categorical variables between groups. When comparing numerical variables between groups, normality was assessed. If the data did not have a normal distribution, the Mann-Whitney *U* test was used; otherwise, Student's *t*-test was used; *p*-values less than 0.05 were considered significant.

Results

Ninety-four patients over 80 years of age who underwent surgery due to pertrochanteric femur fracture were evaluated retrospectively. A total of four patients (one in the SIFIB group and three in the control group) had to be excluded from the study due to delirium in the PACU. Eventually, 53 patients were excluded from the study. Twenty-two patients in the SIFIB group and 19 patients in the control group were

Table 1 Demographic variables of the patients.

	Supra-inguinal fascia iliaca block Group (n = 22)	Control Group (n = 19)	*p*
Age (years)	85.31 ± 4.53	86.10 ± 3.60	0.48
ASA (III/IV), n	15/7	13/6	0.98
Weight, mean ± SD (kg)	72.54 ± 13.41	72.47 ± 9.29	0.32
Height, mean ± SD (cm)	163.77 ± 8.40	165.63 ± 7.02	0.50
Comorbidities, n			> 0.05
Diabetes mellitus	12	12	
Cardiac disease	20	17	
Lung disease	5	8	
Kidney disease	9	7	
Cerebrovascular event	5	3	
Sex (F/M), n	13/9	12/7	0.79
Duration of surgery, mean ± SD (min)	75.45 ± 19.45	81.05 ± 16.88	0.39
Length of hospital stay, median (range)(days)	5 (2–7)	5 (2–7)	0.83

finally evaluated (Fig. 1). The patients' demographic data, comorbidities, duration of surgeries, and length of hospital stay were similar (Table 1).

An additional analgesic was used once each in two patients in the control group. The total postoperative 24-hour opioid consumption was found to be significantly lower in the SIBIF group than in the control group (74.54 ± 21.09 mg vs. 155.78 ± 33.55 mg; $p < 0.001$) (Fig. 2).

In the evaluation of the VAS scores at rest, a significant reduction was observed at the 1st, 3rd, and 6th postoperative hours in the SIFIB group in comparison to the control group ($p < 0.001$) (Fig. 3). No significant reduction was observed at the 12th and 24th hours postoperatively.

In the evaluation of the VAS scores during movement, a significant reduction was detected at the 1st, 3rd, and 6th postoperative hours in the SIFIB group in comparison to the control group ($p < 0.001$ for the 1st and 3rd hours, $p = 0.02$ for the 6th hour) (Fig. 4). There was no significant reduction in the pain scores at the 12th and 24th hours postoperatively.

Regarding the side effects related to opioid use, there was no difference between the groups in terms of nausea-vomiting, pruritus, or urinary retention ($p > 0.05$) (Table 2). There was a significant difference between the groups in terms of respiratory depression. While no respiratory depression was observed in any patient in the SIFIB group, five patients required oxygen support due to respiratory depression in the control group ($p = 0.01$) (Table 2).

No complications, such as systemic local anesthetic toxicity, infection, or hematoma at the injection site related to the nerve block were observed in any of the patients.

Discussion

We found that the application of SIFIB in patients over the age of 80 years with pertrochanteric femur fracture had reduced opioid consumption in the first 24 hours by 48% compared to patients who were given PCA alone. In addition, we found that the VAS scores at rest and during movement during the first six hours postoperatively were significantly lower in the SIFIB group than in the control group.

Postoperative pain and loss of function due to pain significantly affect clinical outcomes, complications, and mortality. This is of greater importance in older-old patients. In the guidelines published by the National Institute for Health Clinical Excellence for hip fracture, paracetamol administration every six hours, opioid administration if the patient's condition is suitable, and peripheral nerve block in the presence of trained staff is recommended. However, the use of NSAIDs is not recommended.[13] Similarly, FIB is recommended as a part of multimodal analgesia within the ERAS (enhanced recovery after surgery) protocol in hip fracture patients.[14]

Peripheral nerve blocks alleviate postoperative pain by providing analgesia specific to the operation site and preventing complications and limitations created by central neuraxial blocks. Peripheral nerve blocks can be used as a part of light general anesthesia in cases of anticoagulant use where central neuraxial blocks are contraindicated and in cases where severe hypotension caused by a spinal block could create problems in very old patients with a high ASA physical status score. Nerve blocks can also reduce the need for opioids without causing hemodynamic instability.[15]

Fascia iliaca block is an effective and safe block used in pain management after hip and femur fracture surgery.[8] This easily applicable technique can be considered an anterior approach to the lumbar plexus. SIFIB has a lower risk of nerve damage than the classical infra-inguinal method due to its distance from the femoral nerve. In addition, the close course of the nerves in the fascial plane over the inguinal ligament makes the block more effective when performed supra-inguinally.[9] In our study, we applied the longitudinal supra-inguinal method used by Desmet et al.[11] and, consistent with their findings, observed a 48% reduction in opioid consumption within the first 24 hours. While Desmet et al. reported a significant reduction in VAS scores within the first 4 postoperative hours using a 40 mL dose of 0.5% ropivacaine, we achieved a significant reduction in VAS scores within the first 6 hours using a 40-mL dose of 0.25% bupivacaine in our study. This difference can be explained by the fact that the mean age of the patients in Desmet et al.'s study was 60 years, whereas the average age of the

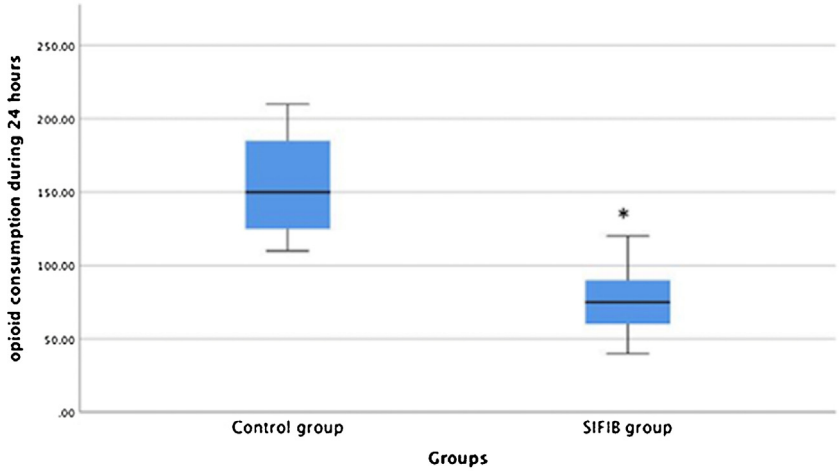

Figure 2 Opioid consumption (mgr) within 24 hours (*$p < 0.001$).

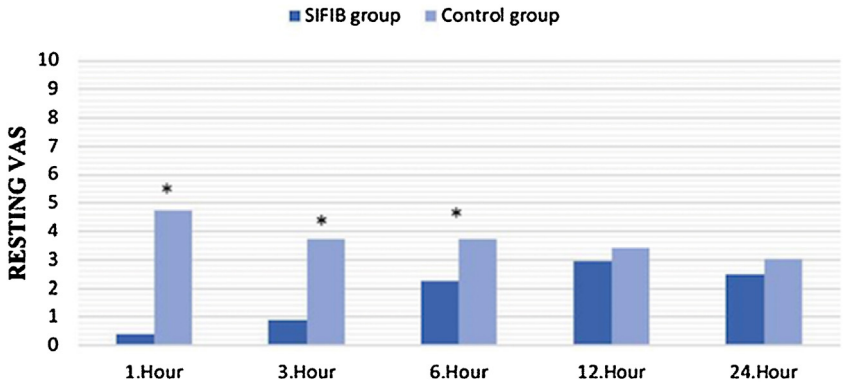

Figure 3 Postoperative pain scores at rest at various time points. Data are expressed as means. VAS, Visual Analogue Scale (*$p < 0.001$).

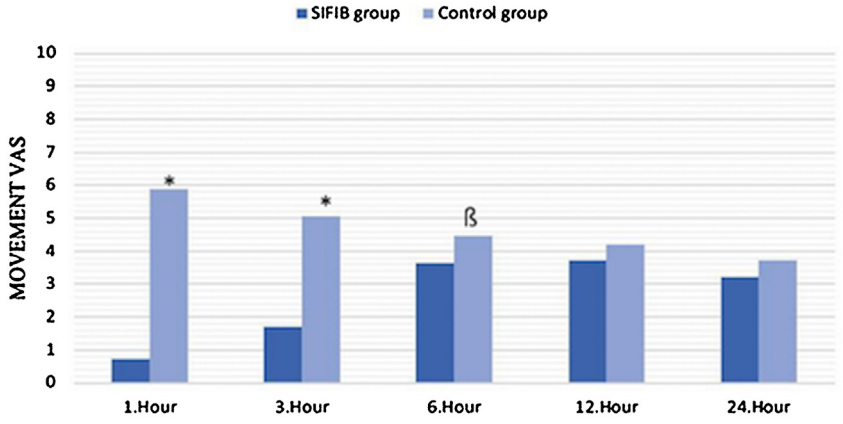

Figure 4 Postoperative pain scores with movement at various time points. Data are expressed as means.VAS, Visual Analogue Scale (*$p < 0.001$, ß $p = 0.02$).

patients in our study was 85. With increasing age, loss of myelin in neural tissues and loss of mucopolysaccharide in perineural tissues changes the response of peripheral nerves to local anesthetics, causing greater exposure of neural tissue to local anesthesia.[16] This may be the reason for the longer sensory block time and lower VAS scores in our study.

Although the VAS scores both at rest and during movement up to the 6th hour in our study were significantly lower than those of the control group, the dynamic pain scores started to increase as the nerve block started to lose its effect at the 6th hour, and VAS scores at the 12th and 24th hours were similar between the groups due to higher fentanyl consump-

Table 2 Comparison of the opioid-related side effects between the groups.

	Supra-inguinal fascia iliaca block Group (n = 22)	Control Group (n = 19)	p^a
Nausea/vomiting	3	5	0.31
Respiratory depression	0	5	**0.01**
Urinary retention	1	2	0.46
Pruritus	1	3	0.23

[a] Significant *p*-values are written in bold.

tion in the control group. Desmet et al. reported that when the block was performed longitudinally and supra-inguinally, the obturator nerve, which has an important role in hip and femur innervation, was involved more frequently, thus increasing the success of the block.[11]

There are other studies in the literature showing that SIFIB, in line with our results, reduces opioid consumption. Kumar et al. compared SIFIB to the classical infra-inguinal technique in hip fractures and found a significant decrease in VAS scores in the first 6 hours in the supra-inguinal block group.[10] The authors also reported that VAS scores were similar at the 12th and 24th hours and that total opioid consumption was much lower in the supra-inguinal fascia iliaca group. In another hip surgery study in which the control group was compared with the SIFIB group, both VAS scores and opioid consumption within the first 48 hours were found to be significantly lower in the fascia block group.[17] In addition, the authors concluded that SIFIB accelerated recovery from general anesthesia by reducing the extubation time and the time spent in the PACU. The authors also commented that SIFIB combined with general anesthesia might be more appropriate as an anesthetic method in geriatric patients with a poor basal status. In contrast, in Shariat et al.'s study, the researchers performed FIB for hip surgery, and there was no difference in the 24-hour opioid consumption and pain intensity in comparison to the sham group.[18] However, in that study, the authors used a 30 mL dose of 0.5% ropivacaine, and the infra-inguinal technique was employed in the transverse plane. Performing the block in the transverse plane may have limited the cranial spread of the local anesthetic, and 30 mL of local anesthetic solution may have been insufficient. This study showed that infra-inguinal FIB performed in the transverse plane is not a favorable method.

In another study comparing SIFIB with periarticular infiltration, VAS scores, postoperative opioid need, and discharge times were found to be similar.[19] However, in that study, a 60 mL dose of 0.5% ropivacaine was used. Although this volume was considered safe by the authors, Local Anesthetic Systemic Toxicity (LAST) is a serious complication that should be kept in mind during peripheral nerve block applications. In geriatric patients specifically, due to their decreased pharmacodynamics and organ functions, the clearance rate of local anesthetics decreases, and the risk of drug accumulation increases at higher doses. Therefore, the geriatric patient population is a very sensitive group in terms of LAST.[20] Helayel et al. reported that the average local anesthetic volume required to create a sufficient FIB was 36 mL.[21] Since FIB is a compartment block that does not directly target the nerves and since our patients were ''older-old'', we used 40 mL of local anesthetic at a concentration of 0.25%, as has been used in many studies. In addition, real-time USG guidance increased the success of the block by ensuring the proximal spread of the local anesthetic, reducing the application time of the block, and preventing undesired vascular punctures.

In another study, in which the SIFIB applied for postoperative analgesia in hip surgery was compared with lumbar plexus block, no difference was found between the two groups in terms of cumulative morphine consumption, VAS scores or side effects.[22] However, a more intense sensory block and a shorter length of hospital stay were achieved with SIFIB. In our study, there was no significant difference between the two groups regarding the length of hospital stay. This may be due to our patients' age and high ASA physical status scores. Consistent with the findings of our study, Kastanis et al. investigated the effect of the ASA physical status in hip fracture patients and reported that ASA III and IV patients received longer periods of medical care, and therefore, their length of hospital stay increased proportionally.[23]

Nausea-vomiting, sedation, urinary retention, pruritus, and respiratory depression are common side effects associated with opioid use. In our study, while there was no difference between the groups in terms of nausea-vomiting, urinary retention, or pruritus, five patients in the control group had respiratory depression that responded to oxygen using a face mask. We believe that this situation is related to the advanced age of our patients. Although low anesthetic drug doses were used in our study, it was based on intubated patients in terms of anesthesia techniques. However, hip fractures performed with deep sedation plus a fascia iliaca block without any airway intervention have also been reported in the literature.[24]

Our study had some limitations. The retrospective design of our study, the small number of patients, the fact that patient satisfaction was not evaluated, and the lack of evaluation of the motor and sensory innervation area of each nerve we thought could be affected by the fascia iliaca block are major drawbacks. Due to small sample size, multivariable regression analyses or other advanced statistical analyses could not be performed to determine the potential confounders and effect modifiers. This may also be addressed as bias since we accepted all performed SIFIBs as successful from the start, and patients in the SIFIB group may have stated more positive data about their VAS scores to please their physicians. Although we did not find a difference between the two groups regarding the length of hospital stay, prospective studies with a large number of

patients may reveal an effect of the block on the length of hospital stay and hospital costs. In addition, although we performed a single-dose block, the effect of continuous infusion techniques with catheters on early mobilization and on joint rehabilitation and limb function in the long term should be a subject of future studies.

Conclusions

In conclusion, the SIFIB technique has a significant opioid-sparing effect and thus reduces opioid-related side effects in the first 24 hours after hip fracture surgery in older-old patients. This technique may also be an important part of multimodal analgesia in patients with high ASA scores where opioid avoidance is especially important.

Funding

This study was supported by the Baskent University Research Fund.

Conflicts of interest

The authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.bjane.2021.08.008.

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