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Original Contributions

Fascia Iliaca Block in Hip and Femur Fractures to Reduce Opioid Use

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□ **Abstract—Background: Fascia iliaca compartment block (FICB) has become a keystone technique for acute pain management in patients with hip and proximal femur fractures. Objectives: To demonstrate that administering FICB preoperatively to patients with hip or proximal femur fractures in the emergency department (ED) is likely to reduce opioid use and related complications, and to decrease hospital length of stay (LOS). Methods: An unblinded study of adult patients with hip and proximal femur fractures who consented to receive an FICB with 30 cc of bupivacaine with epinephrine administered in the ED. We compared this group with a contemporaneous group of controls who only received systemic opioids. Over the course of approximately 6 months, main outcome measured between the two groups was amount of morphine equivalents given from block administration until 8 h after. We also compared complications such as delirium, constipation, and bleeding rates (oozing from injection site or hematoma formation). Results: A total of 166 patients with hip and proximal femur fractures from August 12, 2018 to April 25, 2021; 81 received FICB plus systemic opioids, and 85 received only systemic opioids. Among the FICB group, morphine equivalents were reduced by 0.6 mg/h with no significant difference in LOS. A statistically significant difference in opioid-related adverse outcomes was found between the anticoagulated group vs. the no anticoagulation group. Conclusions: FICB is a safe and effective preoperative technique for initial pain management in patients with hip and proximal femur fractures, as it can also be used with additional systemic opioids. FICB administration may reduce systemic opioid use preoperatively, thus reducing opioid-related adverse effects with no significant impact on hospital LOS. © 2022 Published by Elsevier Inc.**

□ **Keywords—acute pain management; fascia iliaca compartment block; FICB; preoperative opioid use**

Introduction

Hip fractures have a high incidence rate in the elderly, which represents a major clinical challenge, as it is associated with significant morbidity and mortality (1). The pain associated with a hip fracture is of particular significance, with potentially serious consequences that delay recovery. Nonsteroidal anti-inflammatory drugs and opioid medications have traditionally been used to treat and manage pain in patients with this type of fracture. Although these medications may be effective in pain management, they are also associated with multiple adverse side effects that can compromise successful outcomes in these patients (2). Fascia iliaca compartment block (FICB), first described in 1989 and performed by anesthesiologists, has become a successful pain management alternative for these patients (3). Ultrasound-guided FICB is considered a reproducible, safe, and effective technique for pain

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management that can be easily performed by nonanesthesiologists, with a low complication risk (4).

At our institution, FICB has become a keystone technique for pain management in patients with acute hip and proximal femur fractures. In practice, we have experienced that patients receiving FICB report relatively quick pain relief and significant improvement in subjective pain. FICB has become the recommended standard-of-care procedure for adult patients who present with a hip or femur fracture at our institution's Emergency Department (ED) since November 2017.

The safety of a procedure is always a concern when patients are on anticoagulation or antiplatelet therapies, as interruption of anticoagulation can increase the risk of thromboembolic events. When possible, anticoagulation would preferably not be interrupted in low-risk procedures. There are no studies reported in the current literature that assess the bleeding risk of the FICB nerve block; however, the safety of similar procedures has been reported for patients on anticoagulants (5). However, the likelihood that a patient will be continued on their anticoagulation for 24–48 h prior to major orthopedic surgery, such as a surgical hip reduction and fixation, is low. Therefore, holding the patient's anticoagulation prior to and after the FICB is not of significant concern, as these patients will most often undergo orthopedic surgery. Most patients in this study had surgery within 6–12 h, but all within 48 h.

The safety of performing an FICB is also very important as it is deemed a low-risk and potentially high benefit procedure. This correlates to higher patient satisfaction. A major low-risk objective included low risk of developing local anesthetic systemic toxicity (LAST), as the amount of anesthetic is well within below-maximum dose to achieve an adequate nerve block; whereas some of the benefits of performing the FICB include better pain control and potential for decreased opioid use and their associated complications.

The purpose of this study was to objectively measure the difference in the average amount of opioid needs within the first 8 h of arrival among patients receiving FICB in the ED vs. patients receiving conventional systemic opioid-only pain management. For bupivacaine with epinephrine, 8 h is the expected duration of block effectiveness. Additionally, we compared the length of stay (LOS) in the hospital and opioid-related adverse outcomes between the two groups. We also wanted to determine if being on anticoagulation posed an additional bleeding risk among those patients receiving FICB.

Methods

This was a historical retrospective comparison study of current standard-of-care treatment vs. previous treatment approaches (systemic opioid analgesia in adult patients [≥18 years of age]) who presented to the ED with a hip or proximal femur fracture. We used electronic identification and manual verification to identify 165 patients who presented to the ED with a hip fracture or proximal femur fracture and subsequently received FICB. We used stratified random sampling to select 132 patients who also presented to the ED with a hip fracture or proximal femur fracture, but received systemic opioids alone for pain control. Stratums were defined by age (< 75 years, 75–84 years, ≥ 85 years), type of fracture (hip, femur), and sex. After chart review, 81 patients receiving FICB and 85 patients receiving only conventional systemic opioids were determined to meet inclusion criteria. The institutional review board approved the study with waiver of informed consent.

Inclusion and Exclusion Criteria

Inclusion criteria included adult patients (≥ 18 years-of-age) with a Pain Visual Analog Score ≥ 4 or a Pain Assessment in Advanced Dementia Scale score ≥ 1. Those with a Pain Visual Analog Score < 4 or Pain Assessment in Advanced Dementia Scale of 0 were excluded. Patients who presented with any/all types of hip and femur fractures within 48 h and upon whom orthopedic surgery was performed were included, which included all of the patients in this study. Patients with multiple injuries were excluded. Patients with international normalized ratio ≤ 3.0 were enrolled; those with international normalized ratio > 3.0 were excluded unless treated with a reversible agent, per ED protocol prior to FICB administration. Use of antiplatelet agents as mono or dual therapy were eligible for enrollment. Because risks associated with peripheral nerve blocks administration in anticoagulated patients remain undefined (according to the 3rd edition of the American Society of Regional Anesthesia and Pain Medicine guidelines), those with triple anticoagulation therapy were excluded. Inclusion criteria also included those who received anticoagulation with a novel oral anticoagulant (e.g., apixaban, dabigatran, rivaroxaban, edoxaban), as these are not normally monitored and studies have shown that unmonitored novel oral anticoagulant is as effective and safe as monitored dose-adjusted warfarin. The American Society of Regional Anesthesia and Pain Medicine 2018 updated recommendations for low-risk procedures; a shared assessment, risk stratification, and management decision in conjunction with the treating physician(s), should guide whether these new anticoagulants should be stopped. However, anticoagulation was not held solely for the FICB; it was held, however, for the upcoming orthopedic surgery, so by default, anticoagulation was also held prior to the FICB. Patients were further excluded for any of the following: irreversible

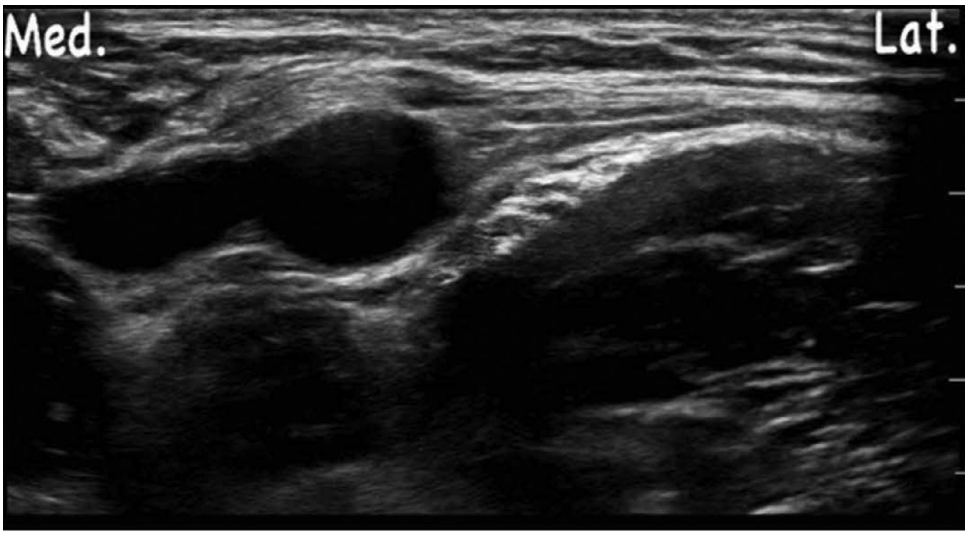

Figure 1. Femoral nerve under ultrasound.

coagulopathy (suspected or known from prior testing), pre-existing infection or large hematoma at site designated for block, known platelet count $< 75 \times 10^3/\mu L$, thrombolytic therapy given within 24 h, chronic opioid use, allergy to local anesthetics, and femoral graft or stent at the site.

Data Collection

After patients had consented to participate in the study, their medical record numbers were recorded and used to objectively record data from their respective charts. After patients left the ED for orthopedic care, data collected included medications given, vital signs, procedures performed, nursing notes, physician notes, and discharge summaries.

Procedure

For all patients who received an FICB, the emergency physicians administering the block followed a standardized outlined procedure for FICB. A sterile ultrasound-guided infra-inguinal approach was used to inject 30 cc of local anesthetic (30 cc of 0.25% bupivacaine or 0.5% ropivicaine that was mixed with 0.3 cc of 1:1000 epinephrine prior to administration) in the fascia iliaca space around the nerve under direct ultrasound visualization (Figures 1 and 2).

The ultrasound transducer is positioned close to the femoral crease and lateral to the femoral artery. Next, an 80–100-mm 22-gauge needle connected to a syringe is directed into the fascia iliaca space around the nerve under direct ultrasound visualization. Once the correct placement is achieved, anesthetic is injected slowly so as to visualize a medial-lateral spread around the femoral nerve within the fascia iliaca space. The entire procedure took approximately 2 min, not including setup time.

Statistical Analysis

Patient characteristics were described using means and standard deviation for continuous variables, counts, and percentages for categorical variables. Characteristics of patients who had FICB and those who received conventional systemic opioids alone were compared using a *t*-test, chi-squared test, or Fisher's exact test, as appropriate. Frequency of anesthetics, epinephrine use, and bleeding for FICB patients were reported. The primary outcome was the patient's average morphine equivalent per hour, and this was described using medians and interquartile range. Differences by pain control method were compared using a Wilcoxon rank–sum test. Median differences in average morphine equivalent per hour by fracture type were also reported.

Secondary outcomes—opioid-related adverse events, anticoagulant use, and antiplatelet use—were described using counts and percentages, and differences were compared using chi-squared tests or Fisher's exact test, as appropriate. Median LOS and median percent change from baseline pain score by pain control method were reported, and the Wilcoxon rank–sum test was used to test for differences. There were 23 patients excluded from the comparison of percent change in baseline pain score due to incomplete scores.

Finally, to address whether anticoagulant use conferred additional risks, the frequency and percentage of patients

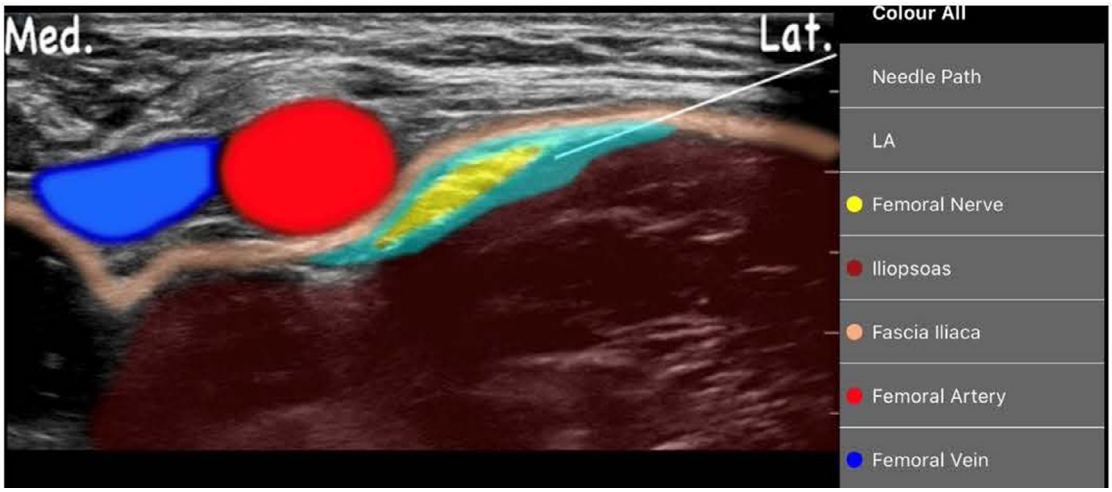

Figure 2. Femoral nerve under ultrasound (with colored anatomy).

experiencing opioid-related adverse events by anticoagulant use was reported and compared using a chi-squared test.

Results

A total of 166 patients with either a hip or proximal femur fracture from August 12, 2018 to April 25, 2021 were included. Of these, 81 received FICB in addition to systemic opioids, and 85 received conventional systemic opioids alone for pain control. The average age of patients was 79.2 years. There were 112 women (67.5%) and 54 men (32.5%). Fracture type included 39 proximal femur (23.5%) and 127 hip (76.5%) fractures. A good balance was achieved between matched and unmatched characteristics (i.e., sex and fracture type) (Table 1). Patient groups did not significantly differ in age, sex, fracture type, place of residence, or type of surgery subsequently performed.

The predominant anesthetic used for the FICB procedure was bupivacaine in 73 (90.1%), followed by ropivacaine in 7 (8.6%). Epinephrine was used in 62 (76.5%) procedures. Minor nonserious bleeding or hematoma at the FICB site was reported in 3 patients (3.7%) who did not receive epinephrine. These patients were all anticoagulated with warfarin and all spontaneously resolved. Among the FICB group, median morphine equivalents per hour was 0.7 mg/h, compared with 1.3 mg/h among the systemic opioid-only group (p-value = 0.054), with no significant difference in median pain percentage change from baseline pain among the groups within the first 8 h of arrival to the ED. Figure 3 shows the average morphine equivalent by hours since ED arrival for FICB and opioid use. When looking at morphine equivalents by fracture type, the number per hour (mg/h) for femur fractures was 1.3, and for hip fractures it was 0.7 (p-value = 0.0.54).

The secondary outcomes included hospital LOS, anticoagulant and antiplatelet use, pain scores, and opioid-related adverse events. No significant difference in hospital LOS was found between FICB group (4.1 days) and opioid-only group (3.9 days) (p-value = 0.905). A statistically significant difference in opioid-related adverse outcomes was found between the anticoagulated group (n = 64, 43.5%) and the no anticoagulation group (n = 22, 25.5%) (p-value = 0.013). The most significant of these differences was the need for noninvasive ventilation in the patients on anticoagulation. It is unclear why anticoagulation use leads to increased adverse events with opioid use, such as need for noninvasive ventilation. Adverse events experienced by patients with and without concomitant anticoagulation use are displayed in Table 2. One theory posed is that patients who are anticoagulated are generally more elderly and have more comorbid conditions and therefore, are at increased risk for poor outcomes with or without anticoagulation. We collected additional data for secondary outcomes such as discharge disposition, antiplatelet use, and median percent change in pain score from baseline. These additional comparisons between FICB and opioid patients are displayed in Table 3. Whereas the need for morphine was similar in the first 4 h, those treated with FICB required significantly less morphine later on. Figure 4 demonstrates the average percent change in pain scores by hours since arrival to the ED.

Discussion

Each year over 300,000 people in the United States sustain hip and proximal femur fractures (6). Decreasing pain while limiting side effects in patients with either hip or proximal femur fractures is a frequent need in the ED and in the hospital generally. Historically, pain control was

Table 1. Patient characteristics between FICB and traditional opioid pain control (total =166).

Characteristic	FICB patientsN = 81	Opioid patientsN = 85	p-value
Age	79.0 (13.2)	79.5 (15.5)	0.824
Sex			0.960
Female	54 (66.7)	58 (68.2)	
Male	27 (33.3)	27 (31.8)	
Fracture Type			0.863
Femur	20 (24.7)	19 (22.4)	
Hip	61 (75.3)	66 (77.6)	
Surgery Type			0.543
Intramedullary Nail	32 (39.5)	24 (28.2)	
Hemiarthroplasty	16 (19.8)	20 (23.5)	
Dynamic Hip Screw	11 (13.6)	10 (11.8)	
Total Hip Replacement	3 (3.7)	4 (4.7)	
Other	19 (23.5)	27 (31.8)	
Residence			0.627
Home	62 (78.5)	60 (72.3)	
Assisted living	8 (10.1)	12 (14.5)	
Nursing home	9 (11.4)	11 (13.3)	

FICB= fascia iliaca compartment block
Age is described using mean and SD. A two-sample t-test was used to compare means between FICB and opioid patients. All other variables are described using counts and percentages. Fisher's exact test was used to compare the distribution of surgery type by pain control method. Chi-squared tests were used for all other categorical variables. Four patients were excluded from comparison of residence because of unknown residence.

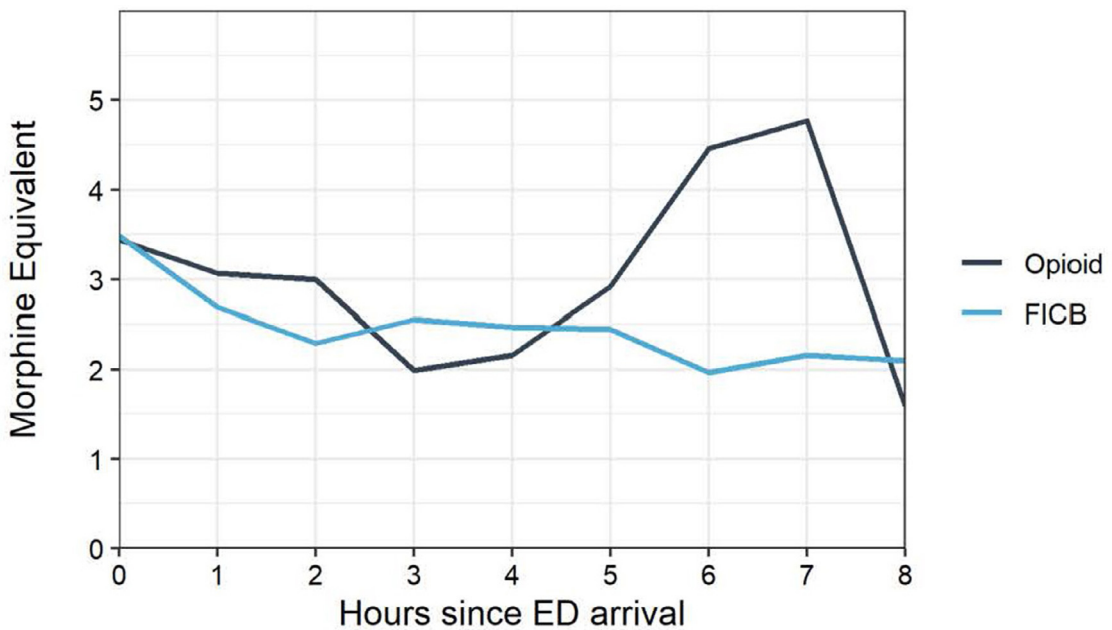

Figure 3. Average morphine equivalent by hours since emergency department (ED) arrival. FICB = fascia iliaca compartment block.

Table 2. Adverse events experienced with no anticoagulation vs anticoagulation use.

Characteristic	No anticoagulation useN = 102	Anticoagulation useN = 64	p-value
Any opioid-related adverse event during hospitalization	26 (25.5)	29 (45.3)	0.013
Total events	33	40	
Non-invasive ventilation	8	19	
Invasive ventilation	1	1	
Antipsychotic	11	5	
Delirium	5	2	
Pneumonia	1	1	
Constipation	7	12	

Table 3. Comparisons between FICB and opioid patients.

Characteristic	FICB patientsN = 81	Opioid patientsN = 85	p-value
Median length of stay (days)	4.1 (2.7)	3.9 (2.1)	0.905
Discharge disposition			0.839
Home	21 (25.9)	16 (18.8)	
Assisted living	2 (2.5)	2 (2.4)	
Nursing home	48 (59.3)	57 (67.1)	
Other	8 (9.9)	8 (9.4)	
Death	2 (2.5)	2 (2.4)	
Any anticoagulant use	38 (46.9)	26 (30.6)	0.045
Enoxaparin	19	12	
Warfarin	18	11	
Apixaban	0	1	
Dabigatran	1	0	
Rivaroxaban	0	2	
Any antiplatelet use	31 (38.3)	38 (44.7)	0.494
Aspirin	29	37	
Clopidogrel	2	1	
Any opioid-related adverse event during hospitalization	27 (33.3)	28 (32.9)	1.000
Total events	33	40	
Non-invasive ventilation	11	16	
Invasive ventilation	0	2	
Antipsychotic	10	6	
Delirium	3	4	
Pneumonia	0	2	
Constipation	9	10	
Median percent change in pain scores from baseline[a]	-29 (32)	-22 (42)	0.336

Length of stay and percent change in pain scores is described using medians and interquartile ranges. A Wilcoxon rank-sum test was used to compare medians between FICB and opioid patients. All other variables are described using counts and percentages. Fisher's exact test was used to compare the distribution of discharge disposition. Chi-squared tests were used for anticoagulant use, antiplatelet use, and opioid-related adverse events. FICB = fascia iliaca compartment block.

[a] Change in pain scores during first eight hours after ED arrival. Twenty-three patients were excluded for incomplete pain scores.

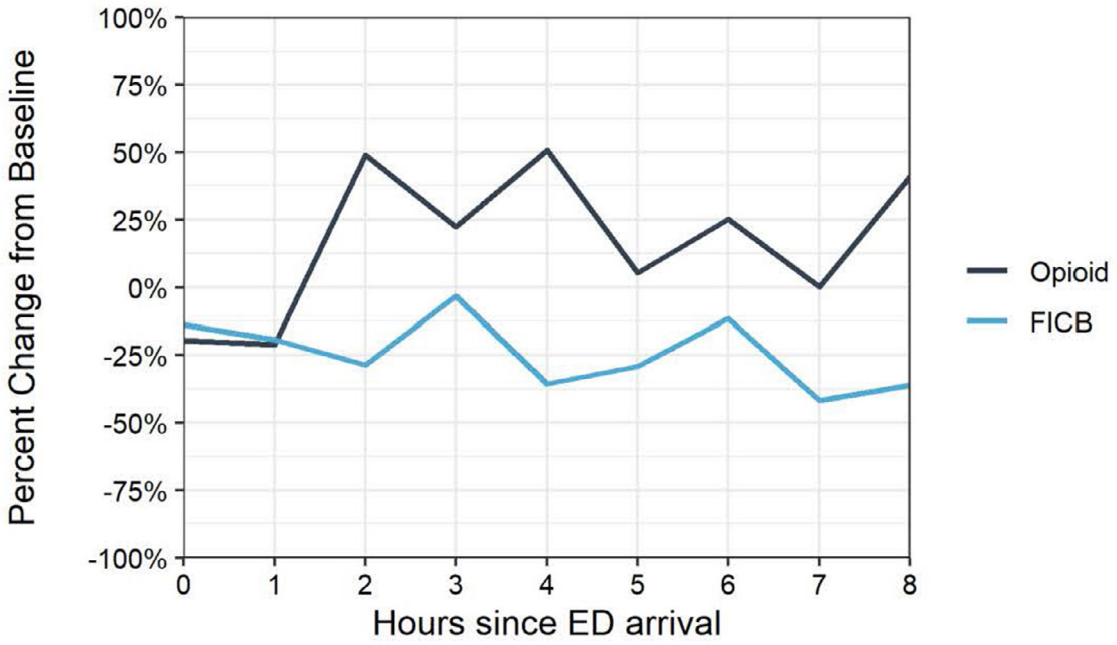

Figure 4. Average percent change in pain scores by hours since emergency department (ED) arrival. FICB = fascia iliaca compartment block.

through oral or intravenous opioid medications. This often leads to delirium, constipation, nausea, and sometimes, increased LOS in the hospital (7). Long-acting anesthetics like bupivacaine and ropivacaine, when supplemented with epinephrine, can provide pain relief for up to 8 h (8).

Studies looking at FICB without ultrasound guidance failed to show a benefit of pain relief compared with a placebo (3). This is likely due to the inaccuracy of administering the local anesthetic around the femoral nerve. Subsequent studies with ultrasound have shown a benefit to pain relief (9).

Some studies have looked at the continuous infusion of local anesthetic through a catheter near the femoral nerve as a persistent way to provide pain relief (10). This is time, material, and skill intensive, and not appropriate in the ED setting. However, a single injection of long-acting local anesthetic at the femoral nerve site under ultrasound guidance has shown benefit, and this procedure has been able to be performed safely and effectively by emergency physicians (11).

We undertook a study to see if FICB in our institution would be effective for pain control and limiting narcotic use without significant side effects. We specifically included patients on therapeutic anticoagulation. Those patients represent up to 30% of the hip and proximal femur fracture population and often have many comorbidities in which limiting narcotic use is thought to be valuable (12).

This study showed that FICB is an effective method of pain control in patients with hip fracture and femur fractures of various types in the ED. Although we were slightly short of the 95% confidence interval due to limitation of sample size (p-value = 0.054), we were able to observe a small difference in opioid requirements to optimally control pain between the two groups. We suspect the difference in opioid consumption among this high-risk population may reflect clinically significant opioid-related adverse outcomes, which may shorten the hospital LOS and potentially improve long-term morbidity/mortality outcomes.

Strengths and Limitations

Each medical procedure has strengths and limitations, and FICB is no different. However, with FICB, we believe the benefits and strengths greatly outweigh the risks and limitations. This is because it is a safe procedure when using ultrasound guidance, as there is a greatly decreased risk of misplacement and injection of the needle and anesthetic; however, this is assuming that one knows how to interpret the anatomy under ultrasound. FICB also requires relatively little time and resources to perform, which means it is cost effective. Probably one of the biggest advantages is that it improves pain while reducing opioid use.

The most significant limitation is the risk of LAST, which is a relatively rare complication of excessive local anesthetic use. However, this can be reduced if one does not exceed the maximum dose. For 0.25% bupivacaine, the typical maximum dose is 2 mg/kg/dose or 175

mg/dose, whereas for 0.5% ropivacaine, it is 200–250 mg. If a patient does develop LAST, which is a similar presentation to cardiac arrest, then the treatment is lipid emulsion therapy and management of the ABCs (airway, breathing, and circulation). It should be noted than none of the patients who received FICB in our ED developed LAST.

Conclusion

FICB is an effective technique for initial pain management of hip and proximal femur fractures and can be used with opioids for better pain control or without additional systemic opioids. However, most patients in our study received opioids prior to the FICB procedure. FICB administration within a few hours of arrival to the ED may reduce systemic opioid use preoperatively, potentially helping to avoid opioid-related adverse outcomes during hospitalization without statistically significant impact on hospital LOS.

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ARTICLE SUMMARY

1. Why is this topic important?

Patients with hip and proximal femur fractures present frequently to the emergency department (ED). Fascia iliaca compartment block (FICB) is an easy and safe procedure to perform to improve pain and may possibly reduce the amount of systemic opioids given preoperatively.

2. What does this review attempt to show?

FICB is a safe procedure and may reduce morphine equivalent use in the acute phase, with the goal of reducing length of stay.

3. What are the key findings?

FICB may reduce the amount of morphine equivalents given. There is no difference in length of stay.

4. How is patient care impacted?

FICB, if given in the ED, may improve overall patient satisfaction by improving pain and decreasing adverse events from excessive opioid use.