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A multi-institutional prospective observational study to evaluate fascia iliaca compartment block (FICB) for preventing delirium in adults with hip fracture

Kristin Salottolo,[1] Richard Meinig,[2] Landon Fine,[3] Michael Kelly,[2] Robert Madayag,[4] Francie Ekengren,[5] Allen Tanner,[6] Phillip Roman,[4] David Bar-Or [7]

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[1]Trauma Research Department, St Anthony Hospital & Medical Campus, Lakewood, Colorado, USA
[2]Orthopedic Services Department, Penrose-St Francis Health Services, Colorado Springs, Colorado, USA
[3]Orthopedics Department, Parker Adventist Hospital, Parker, Colorado, USA
[4]Trauma Services Department, St Anthony Hospital & Medical Campus, Lakewood, Colorado, USA
[5]Trauma Services Department, Wesley Medical Center, Wichita, Kansas, USA
[6]Trauma Services Department, Penrose-St Francis Health Services, Colorado Springs, Colorado, USA
[7]Trauma Research Department, Swedish Medical Center, Englewood, Colorado, USA

Correspondence to
Dr David Bar-Or; davidbme49@gmail.com

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ABSTRACT

Objectives Until recently, systemic opioids have been standard care for acute pain management of geriatric hip fracture; however, opioids increase risk for delirium. Fascia Iliaca compartment blocks (FICB) may be favored to systemic analgesia for reducing delirium, but this has not been well demonstrated. We evaluated the efficacy of adjunctive FICB versus systemic analgesia on delirium incidence, opioid consumption, and pain scores.

Methods This prospective, observational cohort study was performed in patients (55–90 years) with traumatic hip fracture admitted to five trauma centers within 12 hours of injury, enrolled between January 2019 and November 2020. The primary end point was development of delirium, defined by the Confusion Assessment Method tool, from arrival through 48 hours postoperatively, and analyzed with multivariate Firth logistic regression. Secondary end points were analyzed with analysis of covariance models and included preoperative and postoperative oral morphine equivalents and pain numeric rating scale scores.

Results There were 517 patients enrolled, 381 (74%) received FICB and 136 (26%) did not. Delirium incidence was 5.4% (n=28) and was similar for patients receiving FICB versus no FICB (FICB, 5.8% and no FICB, 4.4%; adjusted OR: 1.2 (95% CI 0.5 to 3.0), p=0.65). Opioid requirements were similar for patients receiving FICB and no FICB, preoperatively (p=0.75) and postoperatively (p=0.51). Pain scores were significantly lower with FICB than no FICB, preoperatively (4.2 vs 5.1, p=0.002) and postoperatively (2.9 vs 3.5, p=0.04).

Conclusions FICB demonstrated significant benefit on self-reported pain but without a concomitant reduction in opioid consumption. Regarding delirium incidence, these findings suggest clinical equipoise and the need for a randomized trial.

Level of evidence II—prospective, therapeutic.

Key messages

What is already known on this topic

- Regional blockade, such as the use of fascia iliac compartment blocks (FICB), have a pain-sparing benefit for patients with hip fracture.

What this study adds

- This study examined development of delirium as the primary end point to test the effect of adjunctive FICB versus systemic analgesics (no FICB).
- Delirium incidence was similar for patients receiving FICB (5.8%) versus no FICB (4.4%), adjusted OR: 1.2 (95% CI 0.5 to 3.0), p=0.65.
- There was also no effect on opioid consumption despite an improvement in self-reported pain.

How this study might affect research, practice, or policy

- Our findings taken in context with the current literature suggest clinical equipoise, and a randomized controlled trial appropriately powered to examine delirium or opioid consumption is warranted.

BACKGROUND

Over 300 000 patients are hospitalized for hip fractures in the USA annually.[1] Hip fractures are a burden on the healthcare system with prolonged hospital stay, 85% of patients requiring discharge to a postacute recovery hospital, 50% of patients losing their permanent independence, and 1-year mortality of approximately 20%.[2–4]

Traumatic hip fractures are acutely painful and nearly all require surgical management. While awaiting surgery, pain is typically controlled with systemic analgesia, including intravenous opioids. However, side effects associated with opioids include delirium, urinary retention, constipation, and nausea and vomiting.[5] The incidence of delirium in patients with hip fracture ranges from 4% to 53% and is the most common surgical complication of older patients.[6] Delirium has been shown to be a predictor of worse in-hospital outcomes including longer length of stay (LOS) and more complications, as well as worse functional status and increased long-term mortality.[7 8]

Randomized controlled trials (RCTs) and meta-analyses have demonstrated that, compared with systemic analgesia, regional blockade is effective for reducing pain in patients with hip fracture. Regional blockade targets the peripheral nerves (femoral nerve, obturator nerve, lateral cutaneous nerve (combined, '3-in-1' block), subcostal nerves, or the lumbar plexus nerves (eg, via a fascia iliaca compartment block (FICB) or psoas compartment block or the more recently described erector spinae plane block). The American Academy of Orthopaedic Surgeons (AAOS) surgical guidelines for hip fracture in the elderly strongly recommend regional analgesia to improve preoperative pain.[9]

Whether FICB has an effect on delirium is not adequately studied. A 2017 Cochrane review of 31 trials demonstrated that regional nerve blocks reduced pain and analgesia requirements compared with standard care, but there were no differences in delirium.[10] The Agency for Healthcare Research and Quality report included 83 trials of pain management interventions, demonstrating pain was reduced for all types of regional blockade, while analgesics were only reduced with the 3-in-1 nerve block and delirium was only reduced with FICB.[11] A comparative review of nerve block techniques in 21 RCTs demonstrated that FICB was the only type of block that was significantly associated with a reduction in postoperative delirium.[12] These studies did not explore delirium as the primary outcome. As such, the FICB has shown promise to reduce delirium when used for acute pain management of hip fractures but the evidence is insufficient.

The purpose of this study was to determine if acute pain management with FICB compared with systemic analgesia improves delirium for geriatric patients hospitalized with traumatic hip fracture. We hypothesized there would be a reduction in delirium with FICB compared with systemic analgesics.

METHODS

Study design, setting, population

This was a prospective, multicenter, observational cohort study conducted at five trauma centers: St. Anthony Hospital (Lakewood, Colorado, USA); Parker Adventist Hospital (Parker, Colorado, USA), Penrose Hospital and St. Francis Medical Center (Colorado Springs, Colorado, USA); Wesley Medical Center (Wichita, Kansas, USA).

Patients were prospectively screened daily by dedicated trauma clinical research coordinators at each participating trauma center for the following inclusion criteria: 55–90 years of age, a traumatic hip fracture requiring surgery, and arrival within 12 hours of injury.

Exclusion criteria were: (1) documented pre-existing cognitive impairment (eg, dementia or Alzheimer's disease); (2) coagulopathy identified in the emergency department (ED), defined by international normalized ratio >1.8 or administration of agents or blood products intended for anticoagulant reversal; (3) significant multiple trauma defined by injury severity score (ISS) >16; (4) bilateral hip fractures; (5) regional analgesia with a modality other than FICB; (6) no documented Confusion Assessment Method (CAM) assessments in the preoperative and postoperative periods.

A sample size of 517 patients was calculated using Pearson's χ^2 tests for independent proportions with a normal approximation. The power to demonstrate the main effect of FICB over systemic analgesics is 80% using a two-tailed alpha of 0.05 based on the following assumptions: enrollment ratio of approximately 3:1 in favor of FICB and a 50% reduction in delirium with FICB versus no FICB. Patients were enrolled between January 2019 and November 2020.

Outcomes and covariates

The clinical effects of analgesia (FICB vs no FICB, systemic analgesics only) in patients with hip fracture was evaluated during the acute hospitalization. The primary end point was development of delirium from arrival through 48 hours postoperatively. Delirium was assessed by the CAM and CAM-intensive care unit (ICU) assessment tools, which are both validated tools for diagnosing presence of delirium. It is standard practice at the facilities to evaluate delirium with each shift change, or if there is a change in mental status reported by nursing staff or family. Frequent re-education was necessary to ensure proper CAM documentation throughout the hospitalization.

Secondary end points included: opioid requirements in the preoperative and postoperative periods and self-reported pain numeric rating scale scores (NRS: 0, no pain to 10, worst imaginable pain) in the preoperative and postoperative periods. Pain scores were recorded at standard intervals: hospital arrival, admission, preoperatively, postoperatively, and at discharge. Opioids were reported using equianalgesic conversion to oral morphine equivalents (OMEs).[13]

Exploratory end points were incidence of analgesic-related complications (urinary retention, respiratory depression, hypotension, constipation, block failure, overdose), hospital LOS, time to ambulation as determined by physical and occupational therapy evaluation, number of doses of non-opioid analgesics, development of delirium at any time during the hospitalization, ICU admission, and mortality. Study end points were manually abstracted from the electronic medical record.

The following covariates were examined: age, sex, ISS, race, cause of injury (fall vs other), fracture type (based on International Classification of Diseases (ICD)-10 diagnosis code: head or neck, intertrochanteric, subtrochanteric), surgical procedure (based on ICD-10 procedure code: repair or replacement), comorbidities (individual comorbidities were tabulated if they occurred in at least 10% of patients), American Society of Anesthesiologists score (ASA I/II or ≥III), hours to surgery, hours in surgery, type of anesthesia (general or not), and FICB details (type, drug, dose).

Blinding and randomization

There was no blinding or randomization for this prospective observational study. FICB injections and systemic analgesia are both standard acute pain management strategies. There was no uniform FICB protocol that is used across the facilities; however, blocks were placed almost exclusively with ultrasound guidance, usually by an anesthesiologist, and typically placed in the ED or preoperatively, as either a single shot or a continuous infusion. Systemic analgesia is prescribed based on pain thresholds. For instance, pain scores 0–3 receive acetaminophen, scores 4–6 receive hydrocodone with acetaminophen, scores 6–8 receive oral morphine or oxycodone, and scores 8–10 receive intravenous opioids.

Analysis

Statistical analysis was performed with SAS (SAS Institute). Multivariate Firth logistic regression analysis was used to test the main effect of FICB versus no FICB on delirium. Firth's correction is a standard approach for small sample sizes or rare events to reduce the bias in maximum likelihood estimates. Analysis of covariance models were used to test the main effect of FICB versus no FICB on secondary end points: total preoperative and total postoperative OME, which were log-transformed for normality; self-reported pain scores preoperatively and postoperatively. Variables that were univariately associated ($p<0.10$) with either FICB status or development of delirium were adjusted for in all multivariate regression models. Interactions between treatment arm and model covariates were assessed for effect modification with delirium and significant interactions with $p<0.05$ were examined in stratified analyses. There was no imputation of missing data. A p value <0.05 was considered statistically significant.

Table 1 Details on FICB procedure

FICB details	All FICB (n=381)	Delirium (n=28)	No delirium* (n=490)	P value
FICB	100%	78.6% (22)	73.4% (359)	0.55
Hours to FICB, median (IQR)	3.7 (2.4–6.4)	4.5 (2–7)	3.6 (2–6)	
FICB before surgery	92.4% (352)	100.0%	91.9% (330)	0.40
Continuous infusion	61.2% (233)	50% (11)	61.8% (222)	0.27
Single injection	38.9% (148)	50% (11)	38.2% (138)	
Second FICB performed†	2.9% (11)	18.2% (4)	2.0% (7)	**0.002**
Placed by anesthesiologist	96.6% (368)	95.5% (21)	96.7% (347)	0.76
FICB placement in the ED	34.9% (133)	45.5% (10)	34.2% (123)	0.29
FICB drug				0.61
Bupivacaine	66.1% (251)	59.1% (13)	66.5% (238)	
Dose,‡ single	0.3 (0.2–1.0)	0.3 (0.3–1.0)	0.3 (0.2–1.0)	
Dose,‡ continuous	0.2 (0.1–0.5)	0.2 (0.2–0.2)	0.2 (0.1–0.5)	
Bupivacaine liposomal	10.8% (41)	9.1% (2)	10.9% (39)	
Dose,‡ single	1.3 (0.3–3.1)	1.3 (1.3–1.3)	1.3 (0.3–3.1)	
Ropivacaine	23.1% (88)	31.8% (7)	22.6% (81)	
Dose,‡ single	0.5 (0.2–0.5)	0.3 (0.3–0.4)	0.5 (0.2–0.5)	
Dose,‡ continuous	0.2 (0.2–0.2)	0.2 (0.2–0.2)	0.2 (0.2–0.2)	

Seven patients developed delirium >48 hours postoperatively and are in the no delirium group.
Bold values denote statistical significance p<0.05.
*Delirium, assessed from arrival through 48 hours postoperatively.
†Timing of second FICB: 5, both preoperative; 6, preoperative and postoperative.
‡Median (range) dose of agent.
FICB, fascia iliaca compartment block.

RESULTS

There were 517 patients enrolled, 381 (74%) had an FICB and 136 (26%) did not. The average age was 76 years, the average LOS was 5 days, and the average pain on arrival was 7.4. The majority (65%) were female, with ASA scores of 1 (1%), 2 (32%), 3 (58%), and 4 (9%).

Details on the FICB procedure are presented in table 1, overall and by delirium status. The majority of FICBs were placed prior to surgery (92%), by an anesthesiologist (97%), with a median time from arrival to FICB placement of 3.7 hours. One-third (35%) of FICBs were placed in the ED. Just over half (61%) of FICBs were given as a continuous infusion. Eleven patients had a second FICB; most were done per anesthesia, either preoperatively (n=2), in the OR (n=3), or postoperatively (n=4). One transferred patient had a second block in the ED and one patient had a second block due to failure of the first block. Bupivacaine was the most common agent used (66%), followed by ropivacaine (23%) and bupivacaine liposomal (11%).

Univariate associations with FICB status are shown in table 2. Patients who received FICB were similar to those who did not in most of the variables examined; age, sex, race, ISS, fall cause of injury, ASA score, fracture type, surgical procedure, time to surgery, time in surgery, and the majority of comorbidities. Patients with FICB were less likely to be on a pre-injury anticoagulant (17% vs 25%, p=0.03) and were also less likely to have general anesthesia (85% vs 92%, p=0.03).

Delirium

The overall incidence of the primary outcome, delirium from arrival through 48 hours postoperatively, was 5.4% (n=28). The mean time from arrival to delirium diagnosis was 33 hours, with a mean of eight CAM assessments throughout the hospitalization. An additional seven patients developed delirium >48 hours postoperatively. An FICB was used in 78% of patients who developed delirium and 73% of patients who did not (p=0.55). The only difference in delirium by FICB status was that patients who developed delirium were more likely to have a second block than patients without delirium (18% vs 2%, p=0.002).

Univariate associations with development of delirium are shown in table 3. There were no differences by delirium status for age, sex, ISS, race, fall injury, fracture type, surgical repair type, use of general anesthesia, and the majority of comorbidities examined. Variables that were associated with developing delirium versus no delirium included: ASA score ≥III (86% vs 66%, p=0.03), presence of any comorbidity (96% vs 80%, p=0.03), current smoker (25% vs 10%, p=0.02), and median time to surgery (20 vs 18 hours, p=0.006).

Unadjusted outcomes

Unadjusted outcomes by FICB status are shown in table 4. There was no difference in our primary outcome of delirium with FICB versus no FICB (5.8% vs 4.4%, p=0.55). Pain NRS scores were significantly lower with FICB than no FICB, as shown in figure 1. The amount of OMEs were similar with FICB and no FICB, when examined as the total preoperative OME (30 mg per group, p=0.84) and postoperatively (45 mg FICB vs 35 mg no FICB, p=0.98). The majority of patients received opioids during their hospitalization (87% FICB vs 86% no FICB, p=0.90).

Other exploratory outcomes were similar between FICB and no FICB groups including time to ambulate postoperatively, hospital LOS, mortality, ICU admission, and non-opioid analgesics (table 3). Analgesic-related complications were also similar, reported in 17% of FICB and 14% without FICB (p=0.44). The most common analgesic-related complication was constipation (8.9%). There were 17 patients (4.5%) that had block failure; the incidence of delirium was trending towards being significantly higher when the block failed than when it was successful (18.0% vs 5.2%, p=0.06).

Table 2 Univariate associations with FICB status

Covariate, % (n) or median (IQR)	FICB (n=381)	No FICB (n=136)	P value
Age, mean (SE)	75.7 (0.5)	76.3 (0.8)	0.48
Female sex	66.9% (255)	60.7% (82)	0.19
White race	93.7% (357)	91.2% (125)	0.48
ISS >9 (other minor injury)	28.4% (108)	31.9% (43)	0.44
Fall cause of injury	96.1% (366)	93.4% (127)	0.20
ASA score ≥III	65.9% (251)	71.3% (97)	0.25
Any comorbidity*	80.1% (305)	83.8% (114)	0.34
Hypertension	56.7% (216)	58.1% (79)	0.78
Diabetes	16.5% (63)	19.1% (26)	0.49
Dependent	17.3% (66)	19.1% (26)	0.64
COPD	13.7% (52)	13.9% (19)	0.92
Smoker	10.5% (40)	11.0% (15)	0.86
Anticoagulant	16.5% (63)	25.0% (34)	**0.03**
Advanced directive	11.6% (44)	13.2% (18)	0.60
Fracture type†			0.08
Head or neck	52.8% (200)	62.7% (84)	
Intertrochanteric	44.3% (168)	36.6% (49)	
Subtrochanteric	2.9% (11)	0.7% (1)	
Surgical information			
Hip replacement (vs repair)	39.1% (149)	39.7% (54)	0.90
General anesthesia	84.5% (322)	91.9% (125)	**0.03**
Delayed surgery >24 hours	22.3% (85)	19.9% (27)	0.55
Hours to surgery, median (IQR)	19.0 (11–23)	16.8 (9–23)	0.07

bold values denote statistical significance p<0.05.
*Individual comorbidities tabulated if they occurred in at least 10% of patients.
†Four patients with 'other' or 'unspecified'; these are later coded as not head/neck.
ASA, American Society of Anesthesiologist; COPD, chronic obstructive pulmonary disease; FICB, fascia iliaca compartment block; ISS, injury severity score.

Table 3 Univariate associations with delirium

Covariate, % (n)	Delirium (n=28)	No delirium* (n=489)	P value
Age, mean (SE)	77.7 (1.5)	75.7 (0.4)	0.19
Female sex	67.9% (19)	65.2% (318)	0.77
White race	85.7% (24)	93.7% (458)	0.11
ISS >9 (other minor injury)	32.1% (9)	29.1% (142)	0.73
Fall cause of injury	100% (28)	95.1% (466)	0.63
ASA score ≥III	85.7% (24)	66.3% (324)	**0.03**
Any comorbidity†	96.4% (27)	80.2% (392)	**0.03**
Hypertension	67.9% (19)	56.4% (276)	0.24
Diabetes	25.0% (7)	16.8% (82)	0.30
Dependent	28.6% (8)	17.2% (84)	0.13
COPD	21.4% (6)	13.3% (65)	0.25
Smoker	25.0% (7)	9.8% (48)	**0.02**
Anticoagulant	17.9% (5)	18.8% (92)	0.90
Advanced directive	21.4% (6)	11.4% (56)	0.13
Fracture type‡			0.70
Head or neck	57.1% (16)	55.3% (268)	
Intertrochanteric	42.9% (12)	42.3% (205)	
Subtrochanteric	0%	2.5% (12)	
Surgical information			
Hip replacement (vs repair)	50.0% (14)	38.7% (189)	0.23
General anesthesia	82.1% (23)	86.7% (424)	0.57
Delayed surgery >24 hours	35.7% (10)	20.9% (102)	0.06
Hours to surgery, median (IQR)	20.4 (18–27)	18.1 (10–23)	**0.006**
Outcomes: median (IQR) OME and mean (SE) pain NRS score			
Preoperative OME	40.5 (19–78)	30.0 (12–59)	0.16
Postoperative OME	40.9 (12–89)	40.0 (15–92)	0.96
Preoperative pain	3.6 (0.54)	4.1 (0.12)	0.35
Postoperative pain	2.6 (0.55)	3.1 (0.11)	0.38

bold values denote statistical significance p<0.05.
*Delirium from arrival through 48 hours postoperatively. No delirium group included seven patients with delirium >48 hours postoperatively.
†Individual comorbidities tabulated if they occurred in at least 10% of patients.
‡Four patients with 'other' or 'unspecified'; these are later coded as not head/neck.
ASA, American Society of Anesthesiologist; COPD, chronic obstructive pulmonary disease; ISS, injury severity score; NRS, numeric rating scale; OME, oral morphine equivalents.

Multivariate analysis

Variables in the multivariate Firth regression model included: FICB (yes or no), ASA score (I/II or ≥III), current smoker (yes or no), pre-injury anticoagulant use (yes or no), anesthesia (general or regional), fracture type (dichotomized to avoid quasi-complete separation as head/neck fracture or other fracture), and time to surgery (within 24 hours or delayed >24 hours). The presence of any comorbidity (yes/no) was not adjusted due to collinearity with included covariates of anticoagulant use, smoking status, and ASA score.

After adjustment, FICB was not associated with delirium (OR 1.2, 95% CI 0.5 to 3.0, p=0.65) (table 5). The only covariate that was a significant predictor of delirium was an ASA score ≥III, increasing odds of delirium more than threefold compared with patients with ASA scores of I/II (OR 3.6, 95% CI 1.2 to 11.1, p=0.02).

After adjustment, FICB was not associated with reduced opioid consumption in the preoperative period (p=0.75) or in the postoperative period (p=0.51) (online supplemental table 1). Significant predictors of greater opioid consumption were smoking status (both preoperative and postoperative OMEs), delayed surgery >24 hours (preoperative OMEs), and intertrochanteric or subtrochanteric fracture (postoperative OMEs).

After adjustment, FICB was significantly associated with less preoperative and postoperative pain (online supplemental table 2). Least squares means (LSM) preoperative pain scores were 4.2 for FICB versus 5.1 for no FICB (p=0.002), while LSM postoperative pain scores were 2.9 for FICB versus 3.5 for no FICB (p=0.04). Smoking status was significantly associated with more preoperative pain: 5.2 for smokers versus 4.2 for non-smokers (p=0.01). An intertrochanteric or subtrochanteric fracture was significantly associated with more postoperative pain (3.5) than head or neck fractures (2.9, p=0.02).

DISCUSSION

This multi-institutional study was designed to determine if pain management for traumatic hip fractures using FICB reduces development of delirium and opioid consumption and improves pain. Our study demonstrated that FICB resulted in significantly lower pain scores than systemic analgesics only. However, there was no effect of FICB on delirium or opioid consumption. Both methods of acute pain management were equally effective when assessed with the primary outcome of delirium.

Despite being considered a 'negative' study, our findings contribute substantially to the literature because this study was

Table 4 Unadjusted outcomes by FICB status

Outcome, % (n)	FICB (n=381)	No FICB (n=136)	P value
Delirium through 48 hours postoperative	5.8% (22)	4.4% (6)	0.55
Pain NRS score, mean (SE)			
Preoperative pain	3.9 (0.13)	4.7 (0.23)	**0.002**
Postoperative pain	2.9 (0.12)	3.5 (0.24)	**0.03**
OME, median (IQR)			
Preoperative OMEs	30.0 (12–59)	30.0 (12–62)	0.84
Postoperative OMEs	45.0 (15–93)	35.0 (15–90)	0.98
Exploratory end points			
Analgesic-related complication	16.8% (64)	14.0% (19)	0.44
Urinary retention	4.5% (17)	1.5% (2)	0.18
Respiratory depression	3.4% (13)	3.7% (5)	1.00
Hypotension	7.1% (27)	4.4% (6)	0.27
Constipation	8.9% (34)	8.8% (12)	0.97
Block failure	4.5% (17)	–	n/a
Ambulation time (hours postoperative)	19.7 (15–25)	18.5 (15–23)	0.40
Hospital LOS, days	5 (4–6)	5 (4–6)	0.90
Mortality	0.8% (3)	0.7% (1)	1.00
ICU admission	7.6% (29)	9.6% (13)	0.48
Any delirium	7.6% (29)	4.4% (6)	0.20
Non-opioid analgesics during hospitalization, # doses*			
Acetaminophen 500 mg	9.1 (2–18)	7.8 (2–17)	0.74
Lidocaine patch	4.5 (3–7)	2.0 (2–4)	0.21
Propofol	185 (100–338)	145 (115–286)	0.89
Ketamine	30 (30–30)	20 (20–30)	0.11
Lidocaine intravenous	60 (40–100)	80 (60–100)	0.32

bold values denote statistical significance p<0.05.
*Summarized if at least five patients received the non-opioid.
FICB, fascia iliaca compartment blocks; ICU, intensive care unit; LOS, length of stay; NRS, numeric rating scale; OME, oral morphine equivalent.

designed to examine delirium, rather than pain, as the primary outcome and was powered a priori to test this hypothesis. These results, along the growing body of literature, demonstrate no clear benefit of regional blockade on delirium incidence. Prior studies that evaluated delirium report disparate findings: in patients receiving FICB, delirium was similar to control in one study (n=161, 16% continuous FICB vs 17% control, p=0.83),[14] non-significantly lower than control in one study (n=65, cognitive dysfunction: 6% FICB vs 41% control),[15] and significantly

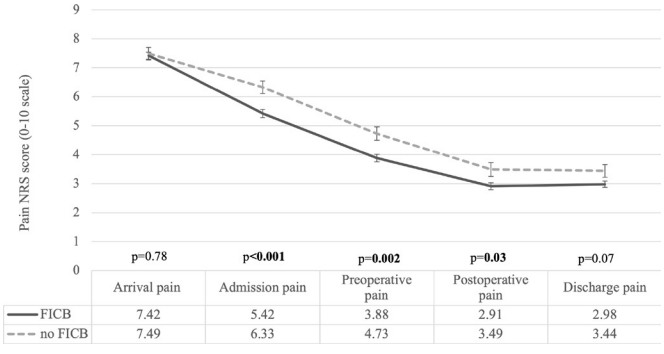

Figure 1 Mean (SE) pain numeric rating scale (NRS) scores at specified intervals. FICB, fascia iliaca compartment block.

Table 5 Development of delirium from arrival through 48 hours postoperative

Covariate	OR (95% CI)	P value
FICB versus no FICB	1.23 (0.50 to 3.02)	0.65
General versus regional anesthesia	0.71 (0.26 to 1.92)	0.50
Pre-injury anticoagulant versus not	0.82 (0.31 to 2.17)	0.69
Smoker versus non-smoker	2.22 (0.88 to 5.62)	0.09
ASA score ≥III versus I/II	3.64 (1.19 to 11.09)	**0.02**
Head/Neck fracture versus other	1.12 (0.52 to 2.41)	0.78
Surgery >24 hours versus ≤24 hours	2.03 (0.92 to 4.51)	0.08

Adjusted for variables with p<0.10 in univariate analysis. C-statistic: 0.69. Bold values denote statistical significance.
ASA, American Society of Anesthesiologist; FICB, fascia iliaca compartment block.

higher than control in one study (n=104, 20% FICB vs 6% control, p=0.03).[16]

The rate of delirium from these prior studies was greater than our reported rate of 5.4%. It is possible our lower delirium incidence was due to required documentation via the CAM assessment tool, or because physicians are no longer waiting to medically optimize patients for surgery. While there were no differences in delirium by FICB status, it was interesting to find that patients who developed delirium were more likely to receive a second block than those who did not develop delirium (18% vs 2%, p=0.002), and delirium was also higher in patients who had block failure than success (18% vs 5%, p=0.06). Our block failure rate of 4.5% was lower than the range of 6%–60% in the literature.[17–19]

Regarding opioid use, a recent meta-analysis of 11 clinical trials reported clinical inferiority of postoperative FICB to placebo for total morphine consumption.[20] Our observational study also did not identify any differences in opioid consumption with FICB. We examined opioid consumption separately in the preoperative and postoperative periods because surgery and anesthesia could equalize or negate any treatment effects of FICB. After adjustment, there were no differences by use of FICB preoperatively (p=0.74) or postoperatively (p=0.51).

Similar to the literature, we reported a significant treatment benefit with FICB on preoperative and postoperative pain. Relief of postoperative pain is a valuable achievement by itself. However, it is well established that regional blockade is effective for reducing self-reported pain, and it is our view that it would be unproductive to further study pain as the primary outcome in studies examining the efficacy of FICB in geriatric hip fracture. This study provides evidence of clinical equipoise using end points of delirium and opioid requirements, and a well-controlled trial examining one of these outcomes is encouraged.

We initially anticipated that the incidence of delirium would be lower with FICB compared with systemic analgesics, partially because improved pain with FICB may reduce analgesia requirements, subsequently reducing delirium. FICB demonstrated significant benefit on self-reported pain but without a concomitant reduction in opioid consumption or delirium. The major limitation of this study is the analgesia prescribing practices at the participating institutions. Current practice is to prescribe non-opioid medications and to increase opioids (per oral then intravenous), once the patient's pain is not adequately controlled based on self-reported pain scores. This study would have benefited from a more standardized approach to pain management that involved less subjective use of self-reported pain scores, which could partly explain our findings of no difference in

opioid requirements or delirium for FICB and no FICB groups. Moreover, this study captured what was administered, not what was prescribed. Likely, there were some instances where a patient did not receive the prescribed dose in the submitted pain order set, but rather additional or fewer opioids based on patient, nurse, or family member request. As such, one interpretation of the study is that, when opioid dosages are not appreciably modified, an FICB does not reduce the rate of delirium. Either way, there are costs and hospital resources associated with regional blockade and block failure was associated with a clinically relevant increase in delirium in this study. The benefits of reducing pain scores without subsequent reductions in narcotic use or delirium should be weighed against the costs and time of the procedure and development of analgesic-related complications. One of the unforseen findings from this study is the necessity of a well-controlled randomized trial examining narcotic use or delirium.

There are additional limitations to this study. Second, the lack of randomization and uniformity in the approach to administering FICB is a major limitation. Still, it is noteworthy that the use of FICB was similar for patients who developed delirium and those who did not, overall, and when examined as type (continuous or single) timing (preoperatively or postoperatively), whether an anesthesiologist placed the block, and whether it was placed in the ED. Third, patients with hip fracture are a complex population due to their age and the wide variability in presence and severity of comorbidities. We considered myriad confounding factors, including ASA score, individual comorbidities, and patient age. We did not directly collect any markers of frailty, nor are they routinely documented in the patient's electronic medical record. Previous studies suggest that frailty scores are prognostically superior to ASA scores in the hip fracture population, and this study could have benefited from a frailty assessment.[21 22] Fourth, regional blockade fell out of favor over the course of the study. This change in practice should not be attributed to selection bias (ie, providers did not choose to place a block in patients that were expected to have better outcomes or who had more or less pain). Rather, there were a host of factors that contributed to the decision to use FICB, and it was frequently made in consultation with the care team including the orthopedic surgeon and anesthesia. Some reasons patients did not receive a block were: provider preference, procedural costs, resources were unavailable, and patients did not consent. Future trials should randomize patients to limit temporal bias that might occur with the use of nerve blocks. Finally, we excluded patients with cognitive impairment because there is insufficient data to determine the performance of the CAM and CAM-ICU tools in the setting of delirium superimposed on dementia.[23] The exclusion of patients with pre-existing cognitive impairment might have prevented us from seeing differences in delirium because patients with chronic cognitive impairment are more likely to develop delirium.[6 24] This important group of patients are frequently excluded from regional blockade trials even though patients with cognitive impairment receive fewer pain medications and may experience inadequate pain relief.[25] In one study where these patients were not excluded, but rather given a risk score for developing delirium, FICB significantly decreased delirium in patients at intermediate risk.[26] We encourage other investigators to consider evaluating patients with dementia in studies examining FICB for geriatric hip fracture.

Randomized trials to date examining the effects of nerve blocks on delirium have suffered pitfalls that differed from the limitations we encountered in our prospective observational study. A recent systematic review of eight RCTs identified small trial sizes, all conducted outside the USA, with differing block techniques and differences in timing of block placement.[27] Future controlled trials might resolve these design limitations by: using 1:1 randomization; implementing a standard analgesia regimen, not based on self-reported pain; using one standardized nerve block approach, placed on arrival or preoperatively; including patients with pre-existing cognitive impairment, while ensuring the delirium assessment tool is appropriate for patients with dementia or using block randomization based on pre-existing cognitive impairment; and adequately powering the study for delirium incidence.

CONCLUSIONS

Our large prospective cohort demonstrates that FICB was not more effective than systemic analgesics for delirium, opioid consumption, or analgesic-related complications, while pain scores were significantly improved with FICB. Our findings taken in context with the current literature suggests clinical equipoise, and an RCT appropriately powered to examine delirium or opioid consumption is warranted.

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ORCID iD

David Bar-Or http://orcid.org/0000-0002-3685-314X

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