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# Does time to surgery for traumatic hip fracture impact the efficacy of fascia iliaca blocks? A brief report

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## ABSTRACT

**Objectives** Outcomes after traumatic hip fracture have shown to be significantly improved with timely surgical management. This study determined whether there were differences in efficacy of fascia iliaca compartment block (FICB) on pain outcomes in patients with hip fracture, once stratified by time to surgery.

**Methods** Trauma patients (55–90 years) admitted to five Level I/II trauma centers within 12 hours of hip fracture were included. Patients with coagulopathy, significant multi-trauma (injury severity score >16), bilateral hip fractures, and postoperative FICBs were excluded. The primary exposure was analgesia modality: adjunctive FICB or systemic analgesics (no FICB). Study endpoints were incidence of delirium through 48 hours postoperatively (%), preoperative and postoperative oral morphine equivalents (OMEs), and preoperative and postoperative pain (0–10 scale). Adjusted regression models were used to examine the effect of FICB on outcomes; all models were stratified by time from arrival to surgery, ≤24 hours (earlier surgery; n=413) and >24 hours (later surgery; n=143).

**Results** FICB use was similar with earlier and later surgery (70.2% vs 76.2%), and there were no demographic differences by utilization of FICB, by time to surgery. In the earlier surgery group, preoperative pain was lower for patients with FICB versus no FICB (3.6 vs 4.5, p<0.001), with no difference by FICB for delirium (OR 1.00, p>0.99) or OMEs (p=0.75 preoperative, p=0.91 postoperative). In the later surgery group, there was a nearly twofold reduction in preoperative OMEs with FICB than no FICB (25.5 mg vs 45.2 mg, p=0.04), with no differences for delirium (OR 4.21, p=0.18), pain scores (p=0.25 preoperative, p=0.27 postoperative), and postoperative OMEs (p=0.34).

**Conclusions** Compared with systemic analgesia, FICB resulted in improved pain scores at the preoperative assessment among patients with earlier surgery, whereas FICB reduced opioid consumption over the preoperative period only when surgery was later than 24 hours from arrival.

**Level of evidence** II, prospective, therapeutic.

## BACKGROUND

Balancing the risks and benefits of narcotic medications has been a perennial problem within the healthcare community.[1] Several classes of both narcotic and non-narcotic medications have been created in an effort to “thread the needle”—provide adequate and sustainable analgesia while avoiding the serious complications and side effects of opioid use. Alternative strategies to systemic analgesia have also been created to help with this issue. One such strategy is the use of regional analgesia in the form of nerve blocks as the primary means of pain control. For patients with hip fracture, the American Academy of Orthopedic Surgeons (AAOS) recommends regional nerve blockade before surgery for improved pain control.[2]

We recently completed a prospective, multicenter, observational cohort study of patients with a traumatic hip fracture requiring surgery to examine the efficacy of fascia iliaca compartment blocks (FICBs).[3] Compared with patients receiving systemic analgesia, patients with an FICB had lower self-reported pain, but there were no differences in opioid use or complications including development of delirium. We also observed an association between time to surgery and outcomes including opioid consumption and delirium. Because of the clinical relevance of the latter observation, we sought to further examine whether the effects of FICB differed once stratified by time to surgery. Earlier surgical management of hip fractures has been shown to improve outcomes, although the optimal timing is still debated.[4–6]

In this brief report, we studied the effects of preoperative FICBs by time to surgery—either “earlier” surgery (within 24 hours) or “later” surgery (greater than 24 hours from arrival)—to see if such differences in timing had any impact on pain management and delirium. We hypothesized that differences exist in the efficacy of an FICB once stratified by time to surgery.

## METHODS

### Design, setting, and population

This study included patients with traumatic hip fracture aged 55–90 years admitted to five regional Level I/II trauma centers who required surgical intervention and whose hospital arrival was within 12 hours of injury. Patients were excluded if they had documented coagulopathy (identified in the emergency department as an INR >1.8 or administration of agents intended for anticoagulant reversal), significant multi-trauma (injury severity score (ISS) >16), or bilateral hip fractures. For this analysis only, we excluded patients who received FICB after surgery (n=40) and included patients with pre-existing cognitive impairment (n=68), for a final analysis population of 556 patients.

## Assessment and analysis

We assessed the relationship between the primary exposure (FICB or no FICB) and the study outcomes in a stratified analysis by timing of surgery within 24 hours. This time point was selected based on prior published studies demonstrating a benefit to earlier surgical management[5 7]; the median time to surgery of 19 hours in our population was similar to the preselected cut-off.

Study outcomes included delirium, opioid consumption, and pain. Delirium was assessed from arrival through 48 hours postoperative via confusion assessment method (CAM) and CAM-ICU assessment tools, which are both validated tools for diagnosing presence of delirium.[8–10] Opioids were reported using equianalgesic conversion to oral morphine equivalents (OMEs),[11] as total opioid consumption in the preoperative period and the postoperative period. Pain was self-assessed with the 0–10 numeric rating scale (NRS) using the last score recorded preoperatively and the first score recorded postoperatively.

Covariates included age, sex, race, any comorbidity present (yes vs no), pre-existing cognitive impairment (yes vs no), American Society of Anesthesiology (ASA) score (≥3 vs <3), ISS, cause of injury (fall vs other), location of hip fracture (head/neck fracture vs subtrochanteric or intertrochanteric fracture), type of surgery (repair vs replacement), length of surgery (minutes), and general anesthesia (yes vs no). Covariates that were significantly associated with FICB use or delirium in univariate analyses were adjusted for in multivariate regression models.

Statistical analysis was performed with SAS version 9.4 (SAS Institute). All regression models were stratified by timing of surgery: ≤24 hours versus >24 hours from arrival. Logistic regression tested the main effect of FICB versus no FICB on delirium, presented as adjusted ORs (AORs). Analysis of covariance (ANCOVA) models tested the main effect of FICB versus no FICB on continuous outcomes, presented as least square means (LSM): preoperative pain scores, postoperative pain scores, preoperative OMEs, and postoperative OMEs. For OMEs, the data were highly skewed and were log-transformed for normality in the ANCOVA models. The OME point estimates from the adjusted model were converted (ie, exponentiated) and presented as geometric means; a geometric mean is a more precise reporting of skewed data and eases interpretation and clinical utility. The ASA score and presence of comorbidity were collinear and only ASA score was included in the regression models. There was no imputation of missing data; in addition, there were no missing data for the covariates that were adjusted for in the regression models. A p value <0.05 was considered statistically significant.

## RESULTS

There were 413 patients in the earlier surgery group (≤24 hours from arrival) and 143 patients in the later surgery group (>24 hours from arrival). There were no differences for earlier versus later surgery by whether FICB was performed (70.2% vs 76.2%, p=0.17), whether a second FICB was performed (2.4% vs 5.5%, p=0.20), and whether the block was placed by an anesthesiologist (96.6% vs 96.3%, p≥0.99). As shown in table 1, patients with later surgical management were more likely to present with comorbidities and have a hip fracture of the head/neck, have a longer time in surgery, and were less likely to have general anesthesia, have surgical repair, and be white than the earlier surgery group. These differences by timing of surgery suggest two distinct populations, which supports the stratified

**Table 1** Univariate associations by time from arrival to hip fracture surgery

| Covariate, n (%) | Surgery ≤24 hours (n=413) | Surgery >24 hours (n=143) | P value |
|---|---|---|---|
| Demographics | | | |
| Age ≥75 years | 266 (64.4) | 84 (58.7) | 0.23 |
| ISS >9 (other minor injury) | 122 (29.6) | 36 (25.2) | 0.31 |
| White race | 367 (88.9) | 110 (76.9) | **<0.001** |
| Fall cause of injury | 393 (95.2) | 137 (95.8) | 0.75 |
| Comorbidity present | 336 (81.4) | 128 (90.1) | **0.01** |
| Pre-existing cognitive impairment | 35 (8.5) | 33 (23.1) | <0.001 |
| ASA score ≥3 | 286 (69.3) | 105 (73.4) | 0.35 |
| Surgical information | | | |
| Hip fracture of the head or neck | 213 (52.0) | 96 (68.6) | **0.001** |
| Surgical replacement | 148 (35.8) | 78 (54.9) | **<0.001** |
| General anesthesia | 352 (85.2) | 100 (69.9) | **<0.001** |
| Hours to surgery, median (IQR) | 16 (9–20) | 29 (26–46) | **<0.001** |
| Hours in surgery, median (IQR) | 0.8 (0.6–1.2) | 1.0 (0.7–1.4) | **<0.001** |
| FICB information | | | |
| FICB performed | 290 (70.2) | 109 (76.2) | 0.17 |
| Hours to FICB, median (IQR) | 3.4 (2.3–5.2) | 4.4 (2.5–17.6) | **0.001** |
| 2nd FICB performed | 7 (2.4) | 6 (5.5) | 0.20 |
| Placed by anesthesiologist | 280 (96.6) | 105 (96.3) | >0.99 |
| Hospital outcomes | | | |
| Delirium within 48 hours postop | 25 (6.1) | 13 (9.1) | 0.21 |
| Preoperative pain score, mean (SD) | 3.6 (2.7) | 4.1 (2.5) | 0.06 |
| Postoperative pain score, mean (SD) | 2.9 (2.6) | 3.0 (2.4) | 0.59 |
| Preoperative OME, median (IQR) | 25 (8–53) | 42 (15–80) | **<0.001** |
| Postoperative OME, median (IQR) | 35 (11–80) | 33 (10–113) | 0.40 |

ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block; ISS, injury severity score; OME, oral morphine equivalent.

**Table 2** Univariate associations with FICB by time from arrival to hip fracture surgery

| | Surgery ≤24 hours | | | Surgery >24 hours | | |
|---|---|---|---|---|---|---|
| **Covariate, %** | **FICB (n=290)** | **No FICB (n=123)** | **P value** | **FICB (n=109)** | **No FICB (n=34)** | **P value** |
| Demographics | | | | | | |
| Age ≥75 years | 62.4% | 69.1% | 0.19 | 59.6% | 55.9% | 0.70 |
| ISS >9 | 28.6% | 32.0% | 0.50 | 24.8% | 26.5% | 0.84 |
| White race | 89.3% | 87.8% | 0.66 | 78.9% | 70.6% | 0.32 |
| Fall cause of injury | 95.9% | 93.5% | 0.31 | 96.3% | 94.1% | 0.63 |
| Comorbidity present | 80.0% | 84.6% | 0.28 | 89.8% | 91.2% | 1.00 |
| Pre-existing cognitive impairment | 7.2% | 11.4% | 0.17 | 23.9% | 20.6% | 0.69 |
| ASA score ≥3 | 67.6% | 73.2% | 0.26 | 72.5% | 76.5% | 0.65 |
| Surgical information | | | | | | |
| Hip fracture of the head or neck | 48.8% | 59.5% | 0.07 | 65.4% | 78.8% | 0.18 |
| Surgical replacement | 35.9% | 35.8% | 0.98 | 52.8% | 61.8% | 0.37 |
| General anesthesia | 82.1% | 92.7% | **0.005** | 70.6% | 67.7% | 0.74 |
| Hours to surgery, median | 16.3 | 14.4 | **0.03** | 29.2 | 28.4 | 0.30 |
| Hours in surgery, median | 0.9 | 0.7 | 0.27 | 1.0 | 1.1 | 0.33 |
| Unadjusted outcomes | | | | | | |
| Delirium within 48 hours | 6.2% | 5.7% | 0.84 | 11.0% | 2.9% | 0.30 |
| Preoperative pain, mean | 3.8 | 4.8 | **<0.001** | 3.5 | 4.1 | 0.25 |
| Postoperative pain, mean | 3.3 | 2.9 | 0.13 | 2.5 | 3.3 | 0.33 |
| Preoperative OME, median | 25.0 | 27.0 | 0.69 | 39.5 | 51.3 | 0.06 |
| Postoperative OME, median | 37.5 | 30.0 | 0.84 | 35 | 31.8 | 0.80 |

ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block; ISS, injury severity score; OME, oral morphine equivalent.

analysis by time to surgery. After stratifying by time to surgery, there were no demographic or clinical differences by FICB, except less general anesthesia use and longer time to surgery with FICB in the early surgery group (table 2).

**Table 3** Univariate associations with development of delirium within 48 hours postoperative

| **Covariate, n (%)** | **No delirium (n=518)** | **Delirium (n=38)** | **P value** |
|---|---|---|---|
| Demographics | | | |
| Age ≥75 years | 323 (62.4) | 27 (71.1) | 0.28 |
| ISS >9 (other minor injury) | 146 (28.2) | 12 (31.6) | 0.66 |
| White race | 446 (86.1) | 31 (81.6) | 0.44 |
| Fall cause of injury | 492 (95.0) | 38 (100) | 0.25 |
| Comorbidity present | 427 (82.6) | 37 (97.4) | **0.02** |
| Pre-existing cognitive impairment | 60 (11.6) | 8 (21.1) | 0.12 |
| ASA score ≥3 | 357 (68.9) | 34 (89.5) | **0.007** |
| Surgical information | | | |
| Hip fracture of the head or neck | 288 (55.6) | 21 (55.3) | 0.97 |
| Surgical type replacement | 207 (40.0) | 19 (50.0) | 0.44 |
| General anesthesia | 426 (82.2) | 26 (68.4) | **0.04** |
| Hours in surgery, median (IQR) | 0.9 (0.6–1.2) | 1.0 (0.6–1.5) | 0.23 |
| Exposure variables | | | |
| FICB performed | 369 (71.2) | 30 (79.0) | 0.31 |
| 2nd FICB performed | 6 (1.6) | 7 (23.3) | **<0.001** |
| Hours to FICB, median (IQR) | 3.5 (2.4–5.9) | 3.2 (2.2–6.2) | 0.44 |
| Later surgery | 130 (25.1) | 13 (34.2) | 0.21 |
| Hours to surgery, median (IQR) | 19.0 (11–24) | 20.3 (17–28) | **0.03** |
| Unadjusted outcomes | | | |
| Preoperative pain, mean (SE) | 4.0 (0.11) | 3.4 (0.45) | 0.17 |
| Postoperative pain, mean (SE) | 3.0 (0.11) | 2.7 (0.50) | 0.53 |
| Preoperative OME, median (IQR) | 27.8 (10–58) | 35.0 (15–74) | 0.13 |
| Postoperative OME, median (IQR) | 35.0 (11–86) | 32.3 (11–68) | 0.50 |

ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block; ISS, injury severity score; OME, oral morphine equivalent.

Overall, 7% developed delirium. When comparing patients who did not develop delirium (n=518) versus patients who developed delirium (n=38), there were several statistically significant differences: presence of comorbidities (82.6% vs 97.4%, p=0.02), ASA ≥3 (68.9% vs 89.5%, p=0.007), use of general anesthesia (82.2% vs 68.4%, p=0.04), and performance of a second FICB (1.6% vs 23.3%, p<0.001) (table 3).

Unadjusted outcomes in the earlier surgery group demonstrate FICB resulted in lower average preoperative pain scores (3.8 vs 4.8), but no differences in other outcomes (table 2). Among patients with later surgery, there were no statistical differences in outcomes before adjustment, but there was a trend toward lower preoperative OMEs with FICB (39.5 mg) versus no FICB (51.3 mg), p=0.06.

## Adjusted results

When comparing the use of FICB with the onset of delirium, there was no statistical difference between the FICB and no FICB groups, regardless of whether surgery was earlier (AOR 1.0, p>0.99) or later (AOR 4.2, p=0.18) (table 4). In patients

**Table 4** Multivariate logistic regression: delirium within 48 hours postoperative

| **Covariate** | **OR** | **95% CI** | **P value** |
|---|---|---|---|
| Earlier surgery ≤24 hours from arrival (n=413) | | | |
| FICB vs no FICB | 1.00 | 0.4 to 2.5 | >0.99 |
| General vs regional anesthesia | 0.42 | 0.2 to 1.1 | 0.09 |
| ASA score ≥3 vs <3 | 11.75 | 1.6 to 88.5 | **0.02** |
| Later surgery >24 hours from arrival (n=143) | | | |
| FICB vs no FICB | 4.21 | 0.5 to 33.8 | 0.18 |
| General vs regional anesthesia | 0.62 | 0.2 to 2.1 | 0.44 |
| ASA score ≥3 vs <3 | 2.25 | 0.5 to 10.8 | 0.31 |

ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block.

Table 5 Multivariate linear regression* oral morphine equivalents (OMEs)

| Covariate | Preoperative OME, mg | P value | Postoperative OME, mg | P value |
|---|---|---|---|---|
| Earlier surgery ≤24 hours from arrival (n=413) | | | | |
| FICB vs no FICB | 17.5 vs 16.6 | 0.75 | 25.8 vs 26.3 | 0.91 |
| General vs regional anesthesia | 15.2 vs 19.3 | 0.29 | 25.0 vs 26.8 | 0.76 |
| ASA score ≥3 vs <3 | 17.3 vs 16.8 | 0.89 | 24.0 vs 27.9 | 0.40 |
| Later surgery >24 hours from arrival (n=143) | | | | |
| FICB vs no FICB | 25.5 vs 45.2 | **0.04** | 26.8 vs 38.1 | 0.34 |
| General vs regional anesthesia | 35.5 vs 32.5 | 0.71 | 31.9 vs 32.1 | 0.96 |
| ASA score ≥3 vs <3 | 33.5 vs 34.5 | 0.89 | 26.3 vs 38.9 | 0.27 |

*Analysis using log-transformed OMEs; least squares mean OMEs presented as geometric means for ease of interpretation.
ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block.

who had earlier surgery, an ASA score ≥3 was predictive of delirium (AOR 11.8, p=0.02).

When comparing the use of FICB with OMEs, there was no statistical difference between FICB versus no FICB for patients who had earlier surgery, after adjustment (table 5). In the later surgery group, there was a statistically significant reduction in preoperative opioid consumption with FICB versus no FICB (25.5 mg vs 45.2 mg, respectively; p=0.04), which is a nearly twofold reduction in preoperative OMEs. There was no difference in postoperative OMEs, however.

There were also differences by FICB in pain scores, based on time to surgery. In patients who had earlier surgery within 24 hours, FICB resulted in significantly lower preoperative pain than patients not receiving FICB (LSM: 3.6 vs 4.5, p<0.001). In patients who had later surgery, pain scores were equal for FICB and no FICB groups (table 6).

## DISCUSSION

Current recommendations support timely surgery of hip fractures because several studies have shown a survival benefit, although the optimal timing of surgery is not consistently demonstrated.[4–6] While awaiting surgery, the AAOS recommends regional blockade for pain management. In an effort to better stratify and understand the effects of FICB on pain management, we analyzed FICB use based on earlier versus later surgical management. This study of 556 patients with hip fracture demonstrated there were significant differences based on time to surgery for preoperative opioid use and preoperative pain, but not for delirium or postoperative outcomes. Compared with systemic analgesia, adjunctive FICB was associated with improved scores at the preoperative assessment in patients who had earlier surgery only, whereas adjunctive FICB reduced opioid use during the preoperative period if surgical management was later than 24 hours from arrival. A likely explanation for these disparate findings might be related to the timing of the pain and opioid outcome assessments. Opioid consumption was calculated for the entire preoperative or postoperative period, whereas the pain score was assessed immediately preoperatively or immediately postoperatively. Patients with later surgical management had a longer interval between the FICB placement and the pain assessment, allowing time for the efficacy of the FICB to wane.

There has long been an effort to minimize systemic opioid use within our healthcare system, to mitigate the addictive properties of opioids as well as avoid the inherent side effects of such medications. FICB is seen as a promising alternative for pain management. By demonstrating that FICB is most beneficial for reducing OMEs when surgery is performed later (>24 hours after arrival), regional blockade can be targeted for patients expected to have a delay in surgical intervention. Patients with surgery more than 24 hours from arrival had more comorbidities and were more likely to have replacement of hip fractures to the head or neck.

The FICB itself had no direct association with delirium, but it does appear that the poorer a patient's overall health (existence of comorbidities and a greater ASA), and the need for a second FICB, the more likely to develop delirium. The majority of second FICBs were done in the OR by an anesthesiologist; only one patient had a second block placed due to failure. A recent pooled analysis of eight RCTs examined the effect of regional blockade on delirium, finding no treatment effect overall (OR 0.66, p=0.18), but a reduction in delirium with regional blockade in patients without cognitive impairment (OR 0.44, p=0.03).[12] Baseline dementia is highly prevalent with hip fracture (30%).[13] Our study had a low proportion (12%) of patients with cognitive impairment because this population was initially excluded from enrollment, as there are insufficient data to determine the performance of the CAM and CAM-ICU tools in the setting of delirium superimposed on dementia.[14] Future studies should consider an interaction between regional blockade, cognitive impairment, and delirium after hip fracture.

Regarding shortcomings to our study—there are a few. This was a subset analysis of a powered study; the analysis was based on an a priori secondary aim examining efficacy of FICB by surgical timing, and the groups were of unequal sizes. Second, we did not stratify the type of anesthetic used for the FICB to see if this would make a difference in outcomes, as anesthetics have

Table 6 Multivariate linear regression: pain numeric rating scale (NRS, 0–10) scores

| Covariate | LSM* preoperative pain | P value | LSM* postoperative pain | P value |
|---|---|---|---|---|
| Earlier surgery ≤24 hours from arrival (n=413) | | | | |
| FICB vs no FICB | 3.6 vs 4.5 | **<0.001** | 2.7 vs 3.0 | 0.20 |
| General vs regional anesthesia | 4.4 vs 3.7 | 0.07 | 3.1 vs 2.5 | 0.09 |
| ASA score ≥3 vs <3 | 4.1 vs 4.0 | 0.91 | 2.9 vs 2.8 | 0.49 |
| Later surgery >24 hours from arrival (n=143) | | | | |
| FICB vs no FICB | 3.3 vs 4.0 | 0.25 | 2.5 vs 3.1 | 0.27 |
| General vs regional anesthesia | 3.5 vs 3.8 | 0.65 | 3.2 vs 2.3 | 0.06 |
| ASA score ≥3 vs <3 | 4.0 vs 3.3 | 0.16 | 2.9 vs 2.7 | 0.70 |

*Least squares mean (LSM) pain score on NRS scale (0–10).
ASA, American Society of Anesthesiology; FICB, fascia iliac compartment block.

different durations of analgesia and anesthesia. The majority of FICB anesthetic was bupivacaine (61%) or ropivacaine (27%). Still, 10% of patients received liposomal bupivacaine, which is an extended duration preparation. Third, individual types of comorbidities were not examined; this may be useful to see if specific conditions render FICB less effective (eg, neuropathy, diabetes, chronic pain disorder, etc). Fourth, the exact time of preoperative and postoperative pain assessments were not known because we abstracted these scores at predefined periods (last assessment preoperatively, first assessment postoperatively, etc). Generally, these assessments are performed within 1 hour of the procedure, but we were unable to control for this exact time interval as a confounding factor. Fifth, there is insufficient data to determine the performance of the CAM and CAM-ICU tools in the setting of delirium superimposed on dementia.[14] Sixth, multimodal pain control techniques (in addition to regional blockade) were used in this hip fracture population. 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. We did not evaluate non-opioid analgesics as part of multimodal pain management in this analysis; when they were examined in the main prospective study, we found no differences in their administration between FICB and no FICB groups.[3]

The search for the appropriate balance between adequate pain analgesia and avoiding the dire side effects of narcotic use continues to plague the medical community. In our effort to shed more light on this subject, we studied the effects of surgical timing on FICB and pain outcomes. There were no demographic differences by FICB when stratified by time to surgery. For the earlier surgery group, there was improvement in pain as assessed immediately preoperatively, but no reduction in opioid use. For the later surgery group, an FICB significantly decreased preoperative opioid consumption. FICB had no effect on delirium, based on time to surgery. These results suggest using regional blockade such as FICB as a first-line strategy against traumatic pain for hip fractures, particularly for patients expected to have a delay in surgery to help reduce systemic opioid use.

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## REFERENCES

1 Volkow ND, Blanco C. The changing opioid crisis: development, challenges and opportunities. *Mol Psychiatry* 2021;26:218–33.
2 Brox WT, Roberts KC, Taksali S, Wright DG, Wixted JJ, Tubb CC, Patt JC, Templeton KJ, Dickman E, Adler RA, *et al*. The American Academy of Orthopaedic Surgeons evidence-based guideline on management of hip fractures in the elderly. *J Bone Joint Surg Am* 2015;97:1196–9.
3 Salottolo K, Meinig R, Fine L, Kelly M, Madayag R, Ekengren F, Tanner A, Roman P, Bar-Or D. A multi-institutional prospective observational study to evaluate fascia iliaca compartment block (FICB) for preventing delirium in adults with hip fracture. *Trauma Surg Acute Care Open* 2022;7:e000904.
4 Klestil T, Röder C, Stotter C, Winkler B, Nehrer S, Lutz M, Klerings I, Wagner G, Gartlehner G, Nussbaumer-Streit B. Impact of timing of surgery in elderly hip fracture patients: a systematic review and meta-analysis. *Sci Rep* 2018;8:13933.
5 Pincus D, Ravi B, Wasserstein D, Huang A, Paterson JM, Nathens AB, Kreder HJ, Jenkinson RJ, Wodchis WP. Association between wait time and 30-day mortality in adults undergoing hip fracture surgery. *JAMA* 2017;318:1994–2003.
6 Tanner Ii A, Jarvis S, Orlando A, Nwafo N, Madayag R, Roberts Z, Corrigan C, Carrick M, Bourg P, Smith W, *et al*. A three-year retrospective multi-center study on time to surgery and mortality for isolated geriatric hip fractures. *J Clin Orthop Trauma* 2020;11:S56–61.
7 Ang D, Anglen J, Ziglar M, Armstrong J, Offner P, McKenney M, Plurad D, Flaherty S, Gonzalez E, Liu H, *et al*. A multicenter study on definitive surgery for isolated hip fracture within 24 hours. *J Trauma Acute Care Surg* 2021;90:113–21.
8 Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med* 1990;113:941–8.
9 Oh ES, Fong TG, Hshieh TT, Inouye SK. Delirium in older persons: advances in diagnosis and treatment. *JAMA* 2017;318:1161–74.
10 Wei LA, Fearing MA, Sternberg EJ, Inouye SK. The confusion assessment method: a systematic review of current usage. *J Am Geriatr Soc* 2008;56:823–30.
11 Opioid Oral Morphine Milligram Equivalent (MME). Conversion Factors. *Services Cfmam*, 2017.
12 Kim C-H, Yang JY, Min CH, Shon H-C, Kim JW, Lim EJ. The effect of regional nerve block on perioperative delirium in hip fracture surgery for the elderly: a systematic review and meta-analysis of randomized controlled trials. *Orthop Traumatol Surg Res* 2022;108:103151.
13 Harris MJ, Brovman EY, Urman RD. Clinical predictors of postoperative delirium, functional status, and mortality in geriatric patients undergoing non-elective surgery for hip fracture. *J Clin Anesth* 2019;58:61–71.
14 Morandi A, McCurley J, Vasilevskis EE, Fick DM, Bellelli G, Lee P, Jackson JC, Shenkin SD, Marcotrabucchi, Schnelle J, *et al*. Tools to detect delirium superimposed on dementia: a systematic review. *J Am Geriatr Soc* 2012;60:2005–13.