Role of Fracture and Repair Type on Pain and Opioid Use After Hip Fracture in the Elderly

Geriatric Orthopaedic Surgery
& Rehabilitation
2013, Vol. 4(4) 103-108
© The Author(s) 2014
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/2151458513518343
gos.sagepub.com

Sophia A. Strike, MD¹, Frederick E. Sieber, MD²,
Allan Gottschalk, MD, PhD³, and Simon C. Mears, MD, PhD¹

Abstract

Background and Purpose: Pain after hip fracture repair is related to worse functional outcomes and higher fracture care costs than that for patients with no or less pain. However, to our knowledge, few studies have examined the roles of hip fracture type or surgical procedure as factors influencing postoperative pain or opioid analgesic requirements. Our goal was to determine whether the type of hip fracture or hip fracture repair affects postoperative pain or opioid analgesic requirements in the elderly patient. **Methods:** We conducted a retrospective review of 231 patients ≥ 65 years old admitted to a hip fracture center for surgical repair. Fracture patterns were classified into femoral neck (FN) versus intertrochanteric (IT), stable versus unstable, and type of surgical repair. Demographic and intraoperative variables, postoperative pain scores, and opioid analgesic use data were collected and analyzed according to the type of hip fracture and type of surgical repair. **Results:** There were no differences in postoperative pain when comparing FN versus IT fractures, stable versus unstable fractures, or type of surgical repair. Patients with FN fractures had higher analgesic requirements on postoperative days 1, 2, and 3. There was no difference in postoperative analgesic requirements among patients with stable versus unstable fractures or type of surgical repair. Otherwise, there were no differences in postoperative pain or opioid analgesic use based on the surgical repair or fracture type. Overall, patients with hip fracture experienced low levels of pain.

Keywords

hip fracture, pain, postoperative management, femoral neck fracture, intertrochanteric fracture

Introduction

Hip fractures are a major cause of disability in the elderly, with enormous societal costs. Up to 10% of patients cannot return to their previous residence, few patients return to baseline function, many have reduced quality of life, and the mortality within 1 year reaches almost one-third.¹⁻⁴ Despite a decrease in the incidence of hip fractures since 1995, the mortality remains unchanged, necessitating improved management of these patients.¹ Additionally, significant medical costs are incurred by both the individual patient and the rest of the society.⁴

Pain after hip fracture repair can lead to delays in ambulation, long hospital stays, and poor functional outcomes and quality of life.⁵⁻⁸ Postoperative pain is often inadequately controlled and is thought to be related to postoperative delirium.^{2,8-12}

On the other hand, excessive use of opioids has also been thought to play a role in postoperative delirium.¹³ Better pain management may improve these outcomes and thus decrease the costs of fracture care.

To our knowledge, only a few studies have examined the role of hip fracture type or type of surgical repair as factors influencing postoperative pain, postoperative analgesic requirements, and delirium.^{6,7,14} Although studies commonly compare surgical procedures, pain as an outcome is not regularly included and, when measured, results are often poorly reported.^{8,12,15} Differences in the extent of tissue trauma and use of arthroplasty

versus fracture fixation suggest that postoperative pain may differ by the type of hip fracture.¹⁶ Understanding determinants of postoperative pain may provide factors on which to base pain management protocols.

The goal of our study was to determine whether the type of hip fracture or hip fracture repair affects pain score or opioid analgesic requirements in the elderly patient. We hypothesized that patients with unstable fractures would have more postoperative pain and higher analgesic requirements than patients with stable fractures. We also hypothesized that patients with femoral neck (FN) and intertrochanteric (IT) fractures would

¹ Department of Orthopaedic Surgery, The Johns Hopkins University/Johns Hopkins Bayview Medical Center, Baltimore, MD, USA

² Department of Anesthesiology, The Johns Hopkins University/Johns Hopkins Bayview Medical Center, Baltimore, MD, USA

³ Department of Anesthesiology, The Johns Hopkins University, Baltimore, MD, USA

Corresponding Author:

Simon C. Mears, c/o Elaine P. Henze, BJ, ELS, Medical Editor and Director, Editorial Services, Department of Orthopaedic Surgery, The Johns Hopkins University/Johns Hopkins Bayview Medical Center, 4940 Eastern Ave, #A665, Baltimore, MD 21224, USA.

Email: ehenze1@jhmi.edu

not have significantly different postoperative pain scores or analgesic requirements.

Materials and Methods

Hip Fracture Service

The Johns Hopkins Bayview Medical Center's Hip Fracture Service (HFS) is an interdisciplinary model of care incorporating orthopedic and geriatric teams into patient care¹⁷, that has been previously described.¹² Briefly, an orthopedic surgeon evaluates the patient immediately on arrival to the hospital and confirms a diagnosis of hip fracture, and a geriatrician oversees the patient's medical evaluation. The service goal is to proceed to surgery within 24 hours.

Management of pain after surgery begins in the postanesthesia care unit (PACU) and continues on the floor. The algorithm of Aubrun et al,¹⁸ adapted for use with intravenous hydromorphone, is used in the PACU. Nurses are responsible for pain assessment and management with multimodal (more than 1 form) therapy. Patients deemed capable of using patient-controlled analgesia (PCA) are given such control. Otherwise, resting pain is periodically assessed and appropriately controlled. With adequate oral intake, low pain scores ($\leq 3/10$, see scale subsequent description), and no PCA use in an 8-hour shift, patients are given acetaminophen and/or oxycodone orally for breakthrough pain, which is usually achieved by the day after surgery.

A numeric scale for rating pain is used by nurses in all postoperative locations (PACU, intensive care unit, and floor) to allow the staff to assess the patient's rest pain. This discrete scale ranges from 0 to 10, with 0 corresponding to no pain and 10 corresponding to the worst pain possible. Nurses assess pain every 15 minutes in the PACU and every 4 hours in other locations. Intubated, cognitively impaired, nonverbal, and noninteractive patients are not assessed for pain scores. Cumulative opioid doses administered were calculated intraoperatively, in the PACU, and on postoperative days 0 (after discharge from the PACU), 1, 2, and 3, with conversion to equivalent intravenous morphine sulfate dosing recorded as mg/kg. The following equivalencies were used: 100 μ g of intravenous fentanyl, 2 mg of intravenous hydromorphone, 30 mg of oral oxycodone, and 150 mg of oral tramadol are considered equivalent to 10 mg of intravenous morphine sulfate.^{19,20}

Both preoperatively and on postoperative day 2, a geriatrician or trained research nurse administered the Confusion Assessment Method to test for delirium.²¹ Patients unable to participate in evaluation secondary to intubation were assessed after extubation. Given the risk of residual effects from anesthesia, delirium testing was not performed on postoperative day 1.

Patient Population

After obtaining review board approval for a retrospective review of the Johns Hopkins Bayview Medical Center's database of patients with hip fracture admitted to our HFS (all of whom have consented to the collection of their medical information), we

searched for patients ≥ 65 years old who underwent hip fracture repair between April 1, 2005, and July 10, 2009. Our study population consisted of 231 patients.

From the database, we retrieved data on patient demographics, measures of pain, opioid doses, and presence of delirium and dementia. Probable dementia was based on the presence of any of the following criteria: (1) a Mini-Mental State Examination score of <24 with no evidence of delirium, (2) a history of dementia documented by the patient's primary care physician, or (3) a diagnosis of dementia during preoperative evaluation by the attending geriatrician on the HFS.

The mean age of the 165 (71%) women and 66 (29%) men was 81.5 ± 7.1 years (Table 1). The study population means for American Society of Anesthesiology physical status classification and Charlson comorbidity score were 3.0 ± 0.5 and 6.5 ± 3.9 , respectively. There were no differences in gender, time to surgery, or prefracture comorbidities (dementia, Charlson comorbidity score, or American Society of Anesthesiology status) between patients with FN and IT fractures. Similarly, there were no differences in intraoperative dose (mg/kg) of opioid medication or admission to or days in the intensive care unit (Table 1). A higher percentage of patients with prefracture dementia underwent hemiarthroplasty ($n = 20$, 23.0%) or received an intramedullary hip screw (IHS; $n = 34$, 29.6%) or percutaneous screws ($n = 11$, 61.1%) than other procedures ($n = 6$; $P = .005$). Patients with FN fractures were younger ($P = .002$), were more likely to receive spinal anesthesia ($P = .016$), were less likely to have received a red blood cell transfusion ($P = .011$), and received fewer units of packed red blood cells than patients with IT fractures ($P < .001$; Table 1).

We used preoperative radiographs, and computed tomography and magnetic resonance imaging when available, to describe each fracture according to the AO/Orthopaedic Trauma Association classification of fractures of the proximal femur.²² The IT fractures were considered stable ($n = 92$) if classified as 31-A1 (any subdivision 1, 2, or 3) or 31-A2.1. Fractures classified as 31-A2.2, 31-A2.3, or 31-A3 (subdivisions 1, 2, and 3 are reverse oblique fractures) were considered unstable ($n = 26$).²³ Femoral neck fractures were considered stable ($n = 38$) if classified as 31-B1 (any subdivision, 1, 2, or 3), which are slightly displaced fractures, and unstable ($n = 75$) if classified as 31-B2 or 31-B3 (any subdivision 1, 2, or 3), which are transcervical and subcapital, nonimpacted, and displaced fractures, respectively.

Type of surgical repair was determined from the operative notes and classified into 4 groups: monopolar/bipolar hemiarthroplasty ($n = 87$), cannulated screw fixation ($n = 18$), IHS ($n = 115$), and "other" ($n = 11$), a group containing the remainder of the procedures (total hip arthroplasty, $n = 6$; dynamic hip screw, $n = 5$).

Statistical Analysis

Frequency data were analyzed using Fischer exact test or chi-square test where frequency tables were other than 2×2 , ordinal data were analyzed with the Mann-Whitney U test or

Table 1. Demographic, Comorbidity, Intraoperative, and Postoperative Factors as a Function of Fracture Type, Fracture Stability, and Surgical Procedure.

Patient factors	Fracture type			Surgical procedure				
	FN (n = 113)	IT (n = 118)	P value	HA (n = 87)	Screw (n = 18)	IHS (n = 115)	Other (n = 11)	P value
Mean (SD) age, years	80.0 (7.1)	82.9 (6.7)	.002	80.2 (7.3)	79.6 (7.2)	82.4 (6.6)	84.1 (7.9)	.056
No. (%) men	28 (24.8)	38 (32.2)	.245	21 (24.1)	4 (22.2)	38 (33.0)	3 (27.3)	.507
No. (%) with preoperative dementia	30 (26.5)	36 (30.5)	.561	20 (23.0)	11 (61.1)	34 (29.6)	1 (9.1)	.005
Mean (median quartile range) ASA status	3 (3,3)	3 (3,3)	.068	3 (3,3)	3 (3,3)	3 (3,3)	3 (3,3)	.457
Mean (SD) Charlson comorbidity score	6.2 (3.5)	6.7 (4.2)	.348	6.3 (3.7)	6.9 (2.7)	6.6 (4.2)	6.0 (4.6)	.887
Mean (SD) time to surgery, days	1.7 (1.4)	1.7 (1.3)	.825	1.7 (1.4)	1.7 (1.3)	1.7 (1.4)	1.7 (1.0)	.994
No. (%) with spinal anesthesia	75 (66.4)	59 (50.0)	.016	59 (67.8)	11 (61.1)	57 (49.6)	7 (63.6)	.071
No. (%) PCA	32 (28.3)	25 (21.2)	.225	29 (33.3)	1 (5.6)	24 (20.7)	3 (27.3)	.046
No. (%) transfused	54 (47.8)	77 (65.3)	.011	45 (51.7)	4 (22.2)	72 (62.6)	10 (90.9)	.001
Mean (SD) pRBC transfusion, units	0.8 (0.94)	1.3 (1.4)	<.001	0.8 (0.9)	0.4 (1.0)	1.3 (1.4)	1.6 (0.8)	.002
No. (%) ICU admissions	26 (23.0)	27 (22.9)	1.000	20 (23.0)	5 (27.8)	26 (22.6)	2 (18.2)	.945
Mean (SD) ICU stay, days	0.9 (2.9)	1.0 (3.0)	.856	0.9 (2.9)	1.6 (3.3)	1.0 (2.9)	1.0 (2.2)	.852
No. (%) with postoperative delirium	32 (28.3)	28 (23.7)	.456	27 (31.0)	5 (27.8)	26 (22.6)	2 (18.2)	.529

Abbreviations: FN, femoral neck; IT, intertrochanteric; HA, hemiarthroplasty; IHS, intramedullary hip screw; ASA, American Society of Anesthesiology; pRBC, packed red blood cells; ICU, intensive care unit; PCA, patient-controlled analgesia; SD, standard deviation.

Kruskal-Wallis analysis of variance, and continuous data were analyzed using analysis of variance. Longitudinal data were analyzed using a general estimating equation approach with robust estimation of standard errors. Unless otherwise indicated, frequency data were reported as the number of events and their percentage, ordinal data were reported as median with upper and lower quartiles, and continuous data were reported as mean and standard deviation. All significance values reported are from 2-tailed tests. Differences were considered significant at $P < .05$. Statistical analysis was facilitated by Stata 10.1 (StataCorp, College Station, Texas).

Results

Postoperative Pain

There was no difference in pain throughout the postoperative period for FN versus IT fractures ($P = .692$) or stable versus unstable fractures ($P = .320$; Table 2). Similarly, there was no difference in postoperative pain by type of surgical repair ($P > .060$; Table 3). The PCA use did not affect reported pain with respect to fracture type ($P = .607$), stability ($P = .590$), or type of surgical repair ($P = .787$). Although patients with dementia reported significantly less pain ($P < .001$), inclusion of dementia in the model did not reveal differences in pain with respect to fracture type ($P = .992$), stability ($P = .441$), or type of surgical repair ($P \geq .236$).

Postoperative Opioid Analgesic Requirements

In terms of the number of patients who were prescribed a postoperative PCA, there was a significant difference by type of surgical procedure ($P = .046$) but not by fracture type (Table 1). There were no differences in intraoperative dose (mg/kg) of opioid medication by fracture type or fixation method. Patients

with FN fractures had higher postoperative analgesic requirements $P = .039$ (Figure 1). There was no difference in postoperative analgesic requirements, however, when comparing stable versus unstable fractures ($P = .335$) or type of surgical repair ($P > .092$). The PCA use did not affect opioid consumption with respect to fracture type ($P = .250$), stability ($P = .217$), or type of surgical repair ($P = .274$). Although patients with dementia consumed significantly less opioid ($P < .001$), inclusion of dementia in the model did not reveal additional differences in opioid consumptions with respect to fracture type ($P = .049$), stability ($P = .379$), or type of surgical repair ($P \geq .129$).

Discussion

Our study showed no difference in pain scores between fracture types and fixation methods. Therefore, our data did not support our hypothesis that unstable fractures would be more painful than stable fractures. It did support our hypothesis that there was no difference in pain scores among fixation methods. Multiple studies have examined differences among types of surgical repair for fractures of the proximal femur; however, pain is rarely a primary outcome. As a secondary outcome, there is some evidence regarding postoperative pain and analgesic use as a function of surgical procedure. Mak et al⁷ found that the use of an IHS or dynamic hip screw was associated with increased postoperative analgesic requirements in the immediate postoperative period compared with cannulated screws or arthroplasty. Foss et al¹⁶ obtained pain scores during the first 4 postoperative days and found significantly higher pain levels with hip flexion and/or walking for patients treated with dynamic hip screws or IHSs versus arthroplasty or parallel screws. Both of these studies suggest that postoperative pain depends on surgical procedure, whereas our study found no

Table 2. Postoperative Pain Scores by Fracture Type and Stability.

Assessment Time	Fracture type		Fracture stability	
	Femoral neck (n = 113)	Intertrochanteric (n = 118)	Stable (n = 130)	Unstable (n = 101)
PACU	0.75 (1.82)	1.05 (2.13)	0.98 (2.13)	0.81 (1.80)
POD0	2.63 (3.08)	2.63 (2.80)	2.42 (2.81)	2.91 (3.09)
POD1	2.87 (2.47)	2.28 (2.47)	2.32 (2.24)	2.87 (2.74)
POD2	2.09 (2.29)	2.21 (2.31)	2.32 (2.24)	2.87 (2.74)
POD3	2.35 (2.53)	1.86 (2.31)	2.08 (2.21)	2.25 (2.41)
P value		0.692 ^a		0.320 ^b

Abbreviations: PACU, postanesthesia care unit; POD, postoperative day.

^aComparison of femoral neck versus intertrochanteric.

^bComparison of stable versus unstable.

Table 3. Postoperative Pain Scores by Surgical Procedure.

Assessment time	Pain score by surgical procedure, mean ($\pm$)			
	HA (BP/MP) n = 87	Screw n = 18	IHS n = 115	Other n = 11
PACU	0.71 (1.75)	0.64 (1.74)	1.01 (2.08)	1.8 (3.01)
POD0	2.97 (3.16)	1.08 (2.10)	2.77 (2.86)	0.89 (1.83)
POD1	2.90 (2.54)	2.21 (1.88)	2.35 (2.47)	2.61 (2.89)
POD2	2.29 (2.32)	1.10 (1.99)	2.28 (2.32)	1.00 (1.77)
POD3	2.27 (2.45)	2.7 (2.95)	1.90 (2.34)	2.14 (2.73)
P value ^a		0.060	0.527	0.419

Abbreviations: HA, hemiarthroplasty; BP, bipolar; MP, monopolar; IHS, intramedullary hip screw; PACU, postanesthesia care unit; POD, postoperative day.

^aP values reported as noted surgical procedure compared with HA.

association. Saarenpää et al²⁴ found increased pain on weight bearing and increased use of analgesics after surgery among patients treated with an IHS versus those treated with a dynamic hip screw, although this trend was not significant. Heetveld et al²⁵ completed a meta-analysis of evidence for internal fixation versus arthroplasty as treatment for displaced FN fractures and, similar to our findings, found no difference in postoperative pain.

The patients in our study generally had low levels of pain, regardless of fracture type, fracture stability, or surgical procedure. Mendonça et al²⁶ examined differences in health-related quality of life, which incorporates pain into the score, as a function of hip fracture type and found no difference, which is consistent with our findings.

Mak and Baguley⁶ looked specifically at fracture subtypes and postoperative analgesic requirements and found that patients with unstable IT fractures required higher levels of postoperative analgesia than patients with displaced or nondisplaced FN or stable IT fractures. These results contrast with our finding that patients with FN fractures required more postoperative analgesia than patients with IT fractures. Femoral neck fractures are typically treated with parallel screws or hemiarthroplasty, principally depending on stability. Our data do not show the same trend of increased use of analgesics for these procedures versus

Figure 1. A, Postoperative pain scores as a function of fracture type: femoral neck versus intertrochanteric. B, Postoperative opioid analgesic use as a function of fracture type: femoral neck versus intertrochanteric.

those typically used to treat IT fractures; therefore, another factor must explain this discrepancy. One hypothesis is that there is an inherent bias within the clinical care team, leading to increased opioid analgesic administration to patients with FN

fractures. In our study, multiple members of the clinical care team, including nurses and physicians, all unblinded to procedure, evaluate pain levels and clinical status and adjust pain medications accordingly. A blinded study would be required to eliminate the type of procedure as a bias.

Our study had some limitations. First, participants in postoperative patient care and data collection, including surgeons, nursing staff, and research assistants, were not blinded to fracture type or surgical procedure, providing an opportunity for the introduction of bias. Second, the choice of procedure was at the surgeon's discretion. Most IT hip fractures were treated with intramedullary nail fixation and most FN fractures were treated with hemiarthroplasty. In some centers, more plate and side screw fixation may be used for stable IT hip fractures. Total hip replacement was also not commonly performed in our series. Some centers may use total hip replacement more commonly than others, particularly in the more active patient.²⁷⁻²⁹ The effects of the use of alternative procedures on pain and opioid requirements are not known. Third, pain scores were measured by nursing staff, which could lead to an under- or overestimation of pain in the dementia group. In previous studies, the 11-point Likert-type scale was the recommended scale for pain measurement in groups with cognitive dysfunction.^{30,31} Furthermore, we report results of patients treated in an optimized, early-surgery program, and this may have affected the possibility of detecting differences in pain and medication requirements. The results of this study could also be affected by the relatively high rate of intensive care unit usage and the usage of PCA. Additionally, we have a relatively small number of patients and we performed a retrospective review. All procedures were performed at 1 center, and although this lends strength to consistency of methods, it limits applying the results to other centers.

Conclusions

In summary, we found that patients with FN fractures required significantly more postoperative opioid analgesics than patients with IT fractures in the immediate postoperative period, suggesting that practitioners need to pay particular attention to pain control after FN fracture repair. Otherwise, there were no differences in postoperative pain or opioid analgesic use based on surgical repair or fracture type. Overall, our patients, regardless of fracture type or surgical procedure, experienced low levels of pain.

Future work may include exploring possible biases in the administration of opioid analgesia, including the role of the nursing staff and clinical care team in evaluating postoperative pain and administration of opioid analgesics. Additionally, a larger series that includes more patients undergoing total hip arthroplasty would allow considering this procedure as a separate variable to see whether there are differences in postoperative pain or opioid analgesic requirements.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship and/or publication of this article: This research was supported by NIH grant R01AG033615.

References

1. Brauer CA, Coca-Perrillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA*. 2009; 302(14):1573-1579.
2. Chong CPW, Savage JA, Lim WK. Medical problems in hip fracture patients. *Arch Orthop Trauma Surg*. 2010;130(11):1355-1361.
3. Gjertsen JE, Vinje T, Lie SA, et al. Patient satisfaction, pain, and quality of life 4 months after displaced femoral neck fractures: a comparison of 663 fractures treated with internal fixation and 906 with bipolar hemiarthroplasty reported to the Norwegian Hip Fracture Register. *Acta Orthop*. 2008;79(5):594-601.
4. Haleem S, Lutchman L, Mayahi R, Grice JE, Parker MJ. Mortality following hip fracture: trends and geographical variations over the last 40 years. *Injury*. 2008;39(10):1157-1163.
5. Arinzon Z, Gepstein R, Shabat S, Berner Y. Pain perception during the rehabilitation phase following traumatic hip fracture in the elderly is an important prognostic factor and treatment tool. *Disabil Rehabil*. 2007;29(8):651-658.
6. Mak J, Baguley IJ. Relationship between hip fracture subtypes and analgesia use [letter]. *J Am Geriatr Soc*. 2007;55(4):626-627.
7. Mak JCS, Lattouf I, O'Rourke F, Shen Q, Chan DKY, Cameron ID. Relationship between hip fracture subtypes, surgical procedure, and analgesia use [letter]. *J Am Geriatr Soc*. 2009;57(12):2378-2380.
8. Morrison RS, Magaziner J, McLaughlin MA, et al. The impact of post-operative pain on outcomes following hip fracture. *Pain*. 2003;103(3):303-311.
9. Adunsky A, Levy R, Mizrahi E, Arad M. Exposure to opioid analgesia in cognitively impaired and delirious elderly hip fracture patients. *Arch Gerontol Geriatr*. 2002;35(3):245-251.
10. Roberts HC, Eastwood H. Pain and its control in patients with fractures of the femoral neck while awaiting surgery. *Injury*. 1994;25(4):237-239.
11. Tait RC, Chibnall JT. Pain in older subacute care patients: associations with clinical status and treatment. *Pain Med*. 2002;3(3):231-239.
12. Wang J, Jiang B, Marshall RJ, Zhang P. Arthroplasty or internal fixation for displaced femoral neck fractures: which is the optimal alternative for elderly patients? A meta-analysis. *Int Orthop*. 2009;33(5):1179-1187.
13. Lawlor PG, Gagnon B, Mancini IL, et al. Occurrence, causes, and outcome of delirium in patients with advanced cancer: a prospective study. *Arch Intern Med*. 2000;160(6):786-794.
14. Sieber FE, Mears S, Lee H, Gottschalk A. Postoperative opioid consumption and its relationship to cognitive function in older adults with hip fracture. *J Am Geriatr Soc*. 2011; 59(12):2256-2262.
15. Parker MJ, Gurusamy K. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. *Cochrane Database Syst Rev*. 2006;4:CD001708.

16. Foss NB, Kristensen MT, Palm H, Kehlet H. Postoperative pain after hip fracture is procedure specific *Br J Anaesth*. 2009; 102(1):111-116.
17. De Jonge KE, Christmas C, Andersen R, et al. Hip Fracture Service: an interdisciplinary model of care [letter]. *J Am Geriatr Soc*. 2001;49(12):1737-1738.
18. Aubrun F, Monsel S, Langeron O, Coriat P, Riou B. Postoperative titration of intravenous morphine in the elderly patient. *Anesthesiology*. 2002;96(1):17-23.
19. Patanwala AE, Duby J, Waters D, Erstad BL. Opioid conversions in acute care. *Ann Pharmacother*. 2007;41(2):255-266.
20. Pereira J, Lawlor P, Viganò A, Dorgan M, Bruera E. Equianalgesic dose ratios for opioids. a critical review and proposals for long-term dosing. *J Pain Symptom Manage*. 2001;22(2):672-687.
21. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegel AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113(12):941-948.
22. Marsh JL, Slongo TF, Agel J, et al. Fracture and dislocation classification compendium—2007: Orthopaedic Trauma Association classification, database and outcomes committee. *J Orthop Trauma*. 2007;21(suppl 10):S1-S133.
23. Lindskog DM, Baumgaertner MR. Unstable intertrochanteric hip fractures in the elderly. *J Am Acad Orthop Surg*. 2004; 12(3):179-190.
24. Saarenpää I, Heikkinen T, Ristiniemi J, Hyvonen P, Leppilähti J, Jalovaara P. Functional comparison of the dynamic hip screw and the Gamma locking nail in trochanteric hip fractures: a matched-pair study of 268 patients. *Int Orthop*. 2009;33(1):255-260.
25. Heetveld MJ, Rogmark C, Frihagen F, Keating J. Internal fixation versus arthroplasty for displaced femoral neck fractures: what is the evidence? *J Orthop Trauma*. 2009;23(6):395-402.
26. Mendonça TM, Silva CH, Canto RS, Morales Nde M, Pinto Rde M, Morales Rde R. Evaluation of the health-related quality of life in elderly patients according to the type of hip fracture: femoral neck or trochanteric. *Clinics (Sao Paulo)*. 2008;63(5): 607-612.
27. Avery PP, Baker RP, Walton MJ, et al. Total hip replacement and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck: a seven- to ten-year follow-up report of a prospective randomised controlled trial. *J Bone Joint Surg Br*. 2011;93(8):1045-1048.
28. Chammout GK, Mukka SS, Carlsson T, Neander GF, Stark AW, Skoldenberg OG. Total hip replacement versus open reduction and internal fixation of displaced femoral neck fractures: a randomized long-term follow-up study. *J Bone Joint Surg Am*. 2012; 94(21):1921-1928.
29. Hedbeck CJ, Enocson A, Lapidus G, et al. Comparison of bipolar hemiarthroplasty with total hip arthroplasty for displaced femoral neck fractures: a concise four-year follow-up of a randomized trial. *J Bone Joint Surg Am*. 2011;93(5):445-450.
30. Hadjistavropoulos T, Herr K, Turk DC, et al. An interdisciplinary expert consensus statement on assessment of pain in older persons. *Clin J Pain*. 2007;23(suppl 1):S1-S43.
31. Pesonen A, Kauppila T, Tarkkila P, Sutela A, Niinisto L, Rosenberg PH. Evaluation of easily applicable pain measurement tools for the assessment of pain in demented patients. *Acta Anaesthesiol Scand*. 2009;53(5):657-664.