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CLINICAL RESEARCH

Opioid Use After Fracture Surgery Correlates With Pain Intensity and Satisfaction With Pain Relief

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Abstract

Background In 2012, Medicare began to tie reimbursements to inpatient complications, unplanned readmissions, and patient satisfaction, including satisfaction with pain management.

Questions/purposes We aimed to identify factors that correlate with (1) pain intensity during a 24-hour period after surgery; (2) less than complete satisfaction with pain control; (3) less than complete satisfaction with staff attention to pain relief while in the hospital; and we also wished (4) to compare inpatient and discharge satisfaction scores.

Methods Ninety-seven inpatients completed measures of pain intensity (numeric rating scale), satisfaction with pain relief, self-efficacy when in pain, and symptoms of depression days after operative fracture repair. The amount of opioid used in oral morphine equivalents taken during the prior 24 hours was calculated. Through initial bivariate

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
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and then multivariate analysis, we identified factors that were associated with pain intensity, less than complete satisfaction with pain control, and less than complete satisfaction with staff attention to pain relief.

Results Patients who took more opioids reported greater pain intensity (r = 0.38). No factors representative of greater nociception (fracture type, number of fractures, days from injury to surgery, days from surgery to enrollment, or type of surgery) correlated with greater pain intensity. The best multivariable model for greater pain intensity included: depression or anxiety disorder (p = 0.019), smoking (0.047), and greater opioid intake (p = 0.001). Multivariable analysis for less than ideal satisfaction with pain control included the Pain Self-Efficacy Questionnaire (PSEQ) (odds ratio [OR], 0.95; 95% CI, 0.92–0.99) alone; for less than ideal satisfaction with staff attention to pain control, the PSEQ (OR, 0.96; 95% CI, 0.92–0.99) and opioid medication use before admission (OR, 3.6; 95% CI, 1.1–12) were included.

Conclusions After operative fracture treatment, patients who take more opioids report greater pain intensity and less satisfaction with pain relief. Greater self-efficacy was the best determinant of satisfaction with pain relief. Evidence-based interventions to increase self-efficacy merit additional study for the management of postoperative pain during recovery from a fracture.

Level of Evidence Level II, prognostic study. See the Instructions for Authors for a complete description of levels of evidence.

Introduction

As of October 2012, Medicare reimbursements have been affected by patient satisfaction scores measured by the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), the development of hospital complications, and/or unplanned readmissions within a month of discharge [9]. Up to 6% of Medicare reimbursement will be at risk by 2017 based on poor outcomes from uncontrolled pain [11, 15, 27]. The HCAHPS is a standardized questionnaire developed to assess patients' opinions regarding hospital care and services [41] and is part of the Hospital Quality Reporting program.

Pain is expected after injury and surgery [3], although the extent to which patients experience pain varies [16, 18, 40]. Pain is the cognitive and emotional response to nociception [7, 13, 36]. The intensity of pain for a given noxious stimulus is strongly related to psychologic distress (depression/anxiety), heightened illness concern, and ineffective coping strategies (eg, greater catastrophic thinking and more self-doubts [lower self-efficacy] regarding the ability to control pain and function despite it) [1, 7, 13, 34, 36]. In patients with hand and upper extremity illness, disability is highly correlated with pain self-efficacy as measured with the Pain Self-Efficacy Questionnaire (PSEQ) [6, 28, 36].

Consensus is increasing that opioid medication alone is not as safe and effective as once thought, and high-dose prescription or prolonged opioid therapy does not improve outcomes [12]. Patients in the United States use far more opioid analgesics than patients in other countries but do not experience less pain or greater satisfaction with pain relief [21, 25, 31]. For acute postoperative orthopaedic pain, opioid medication was associated with less satisfaction with pain relief after ankle fracture surgery [21, 35].

Given these developments, we were curious whether greater opioid intake was associated with less pain and greater satisfaction with pain relief as evaluated using the HCAHPS measure after accounting for other important factors like effective coping strategies such as greater self-efficacy while experiencing pain in particular. We aimed to identify factors that correlate with (1) pain intensity during a 24-hour period after surgery; (2) less than complete satisfaction with pain control; (3) less than complete satisfaction with staff attention to pain relief while in the hospital; and we also wished (4) to compare inpatient and discharge satisfaction scores.

Patients and Methods

Between March 2012 and October 2012, we asked adult, English-speaking inpatients recovering from operative fracture treatment to participate in a prospective cohort study approved by our human research committee. We excluded patients who were pregnant; those with injury to the central nervous system, a facial operation, or abdominal trauma; and patients in the hospital for treatment of a nonunion, periprosthetic, or pathologic fracture. We screened the operation room schedule every day to include patients who underwent surgery and satisfied our inclusion and exclusion criteria. One hundred twenty-two patients were approached to participate on postoperative Day 1, 2, or 3. Twenty-four patients declined participation. We excluded one patient who was enrolled under the belief that he already had surgery when in fact his surgery had been postponed. This left a cohort of 97 patients.

There were 53 women and 44 men with a mean age of 57 years (range, 18–94 years). The patients used an average of 59 ± 43 oral morphine equivalents (range, 0–182) in 24 hours on the postoperative day studied, the Patient Health Questionnaire 2 (PHQ-2) score was 0.77 ± 1.5 (range, 0–6), PSEQ was 33 ± 14 (range, 6–60), and the mean pain score was 4.9 ± 2.8 (range, 0–10).

Patients were enrolled an average of 3.6 ± 2.8 days (range, 0–15 days) after injury and within 3 days of surgery (average, 1.4 ± 0.8 days after surgery). However, one patient, who was enrolled on postoperative Day 4, had been approached on postoperative Days 2 and 3 and asked to return on postoperative Day 4. Questionnaires were administered verbally in the hospital at the patient's bedside.

To address one of our secondary study questions, the HCAHPS questions and the numeric pain scale were repeated by telephone interview after surgery, thereby replicating the method typically used to collect HCAHPS data. We first attempted to call 7 days after enrollment and if unsuccessful, we called three more times up to 26 days after enrollment. Thirty-three patients could not be contacted and two declined to participate (Table 1). Most patients had fractures of the hip or femur (37%) (Table 2). There were 23 fractures of the upper extremity and these patients used 60 oral morphine equivalents, whereas the patients with a fracture of the lower extremity used 62 oral morphine equivalents ($p = 0.87$).

Sixty-two respondents were interviewed at an average of 16 ± 5 days (range, 7–26 days). The patients who participated in the phone followup were significantly younger (many older patients who were still inpatients at extended care facilities were lost to followup) and were less likely to have a history of substance abuse than those who did not. At phone contact the mean pain score was 2.8 ± 2.3 (range, 0–10) ($Z = -4.1$, $p < 0.001$).

Patients completed an 11-point ordinal scale for pain (numeric pain scale).

We used the following two questions from the HCAHPS questionnaire related to satisfaction with pain relief, both answered on Likert scales (never, sometimes, usually, or always): (1) "During this hospital stay, how often was your pain well controlled?", and (2) "During this hospital stay, how often did the hospital staff do everything they could to

Table 1. Patient demographics

Parameter	Cohort (n = 97)	Patients with phone followup (n = 62)	Patients without phone followup (n = 35)	Z	p value
Age, mean years (SD [range])	57 (21 [18–94])	54 (20 [18–94])	64 (22 [21–92])	−2.4	0.015
Days of injury to enrollment, mean (SD [range])	3.6 (2.8 [0–15])	3.9 (3.2 [1–15])	3.1 (1.8 [0–10])	−0.29	0.77
Days of followup after enrollment	16 (4.6 [7–26])	16 (4.6 [7–26])			
Days surgery to enrollment	1.4 (0.79 [0–4])	1.4 (0.76 [1–4])	1.4 (0.85 [0–3])	−0.35	0.73
Sex, number (%)					
Female	53 (55)	30 (48)	23 (66)		0.10
Male	44 (45)	32 (52)	12 (34)		
Physician, number (%)					
1	44 (45)	30 (48)	14 (40)		0.42
2	24 (25)	17 (27)	7 (20)		
3	20 (21)	10 (16)	10 (29)		
4	9 (9.3)	5 (8.1)	4 (11)		
Smoker, number (%)					
No	76 (78)	50 (81)	26 (74)		0.47
Yes	21 (22)	12 (19)	9 (26)		
History of substance abuse, number (%)					
No	84 (87)	59 (95)	25 (71)		0.002
Yes	13 (13)	3 (4.8)	10 (29)		
Depression/anxiety, number (%)					
No	74 (76)	51 (82)	23 (66)		0.066
Yes	23 (24)	11 (18)	12 (34)		
Preadmission use of opioids, number (%)					
No	81 (84)	53 (85)	28 (80)		0.49
Yes	16 (17)	9 (15)	7 (20)		
Preadmission use of steroids, number (%)					
No	90 (93)	57 (92)	33 (94)		0.99
Yes	7 (7.2)	5 (8)	2 (6)		

Table 2. Injury characteristics

Parameter, number (%)	Cohort (n = 97)	Patients with phone followup (n = 62)	Patients without phone followup (n = 35)	p value
Diagnoses				
Hip/femur	36 (37)	19 (31)	17 (49)	0.23
Tibia/fibula/patella/ankle	38 (39)	28 (45)	10 (29)	
Humerus/scapula/clavicle	6 (6.2)	3 (4.8)	3 (9)	
Ulna/radius/wrist	17 (18)	12 (19)	5 (14)	
Number of fractures				
One	75 (77)	48 (77)	27 (77)	0.28
Two	17 (18)	12 (19)	5 (14)	
Three	3 (3.1)	2 (3.2)	1 (2.9)	
Four	2 (2.1)	0 (0)	2 (5.7)	
Number of procedures				
One	86 (89)	56 (90)	30 (86)	0.57
Two	8 (8.2)	5 (8.1)	3 (8.6)	
Three	2 (2.1	1 (1.6)	1 (2.9)	
Four	0 (0)	0 (0)	0 (0)	
Five	1 (1.0)	0 (0)	1 (2.9)	
Procedure				
ORIF	50 (52)	35 (57)	15 (43)	0.41
Intramedullary nail	16 (17)	11 (18)	5 (14)	
Arthroplasty	14 (14)	6 (9.7)	8 (23)	
Trochanteric femoral nail	10 (10)	6 (9.7)	4 (11)	
Pinning	1 (1.0)	0 (0)	1 (2.9)	
Screw	5 (5.2)	3 (4.8)	2 (5.7)	
Other	1 (1.0)	1 (1.6)	0 (0)	
Mechanism of injury				
Fall	66 (68)	40 (65)	26 (74)	0.72
Traffic accident	18 (19)	12 (19)	6 (17)	
Sport	8 (8.2)	6 (9.7)	2 (5.7)	
Other	5 (5.2)	4 (6.5)	1 (2.9)	

ORIF = open reduction and internal fixation.

help you with your pain?" [2]. We duplicated the standard method by converting the four-point Likert satisfaction scales to dichotomous variables: "always" satisfied, yes, or no.

The PHQ-2 was used to assess depressive symptoms [24, 26]. The PSEQ [29] was used to measure coping strategies in response to pain. Two patients had one missing answer in the PSEQ questionnaire addressed with mean substitution. The PSEQ questionnaire was validated on a sample of patients with chronic (noncancer) pain [29], but it is used frequently in hand and upper extremity research in patients with acute pain [6, 28, 36].

We used an electronic database that tracks medication administration to record opioid use (medication type and amount) on the day of enrollment. In addition to acetaminophen and opioid use, the majority used 81 mg aspirin for cardiovascular disease, and 18 patients used other NSAIDs. We did not account for NSAIDs in the analysis, because most were taken for a cardiovascular indication. A total of 85 patients were given additional acetaminophen.

We calculated the total amount of oral morphine equivalents that each patient used between midnight and midnight on the day of enrollment with the following conversion with 30 oral morphine equivalents equivalent to 10 mg intravenous morphine sulfate; 1.5 mg intravenous hydromorphone; 7.5 mg oral hydromorphone; 20 mg oral oxycodone; 30 mg oral hydrocodone; and 150 mg oral tramadol [20, 30, 33].

In addition, we used the patients' medical records to determine whether patients regularly took corticosteroids or opioids before admission. We also assessed whether patients had a history of substance abuse and whether they had a diagnosis of depression or anxiety disorder. We did not consider recreational use of marijuana as substance abuse.

An a priori power analysis for the primary study question with alpha 0.05 revealed 84 patients provided 80% power to detect even a weak correlation of 0.3 or greater between pain intensity and the amount of opioid equivalents consumed. Anticipating missing data or attrition that is common in this type of research, we oversampled by 15% and enrolled 97 patients.

We tested whether the questionnaires were normally distributed using the Shapiro-Wilk test. Most of the questionnaires were not normally distributed, so we decided to use nonparametric tests. In bivariable analyses of pain intensity, satisfaction with pain relief, and staff attention to pain relief, we used the Spearman correlation for continuous variables, Mann-Whitney U test for dichotomous variables, and Kruskal-Wallis test for categorical variables. We entered all variables with a p less than 0.10 in bivariable analysis into multivariable analyses.

For the study question based on phone followup, we used a Mann-Whitney U test for continuous variables and chi-square test for the categorical variables to analyze differences between patients who were and who were not contacted by phone. Differences in the HCAHPS questions between the initial and final evaluations were compared with a paired McNemar test.

Results

There was a positive correlation ($r = 0.38$, $p < 0.001$) noted between pain intensity and opioid consumption. Furthermore, the best multivariable model of factors associated with greater pain intensity included greater oral morphine equivalent, depression or anxiety disorder (partial $R^2 = 0.044$), smoking (partial $R^2 = 0.031$), and preadmission use of opioid medication ($p = 0.097$), and explained 26% of the variation in pain intensity (Table 3). This multivariate model was derived from initial bivariate analysis that showed patients who reported higher levels of pain also were more likely to have a history of smoking or substance abuse or to have an established diagnosis of a depression or anxiety disorder. In addition, the PSEQ satisfied the criteria for entry in the multivariable model (Table 4). Interestingly, no factors representative of greater nociception (fracture type, number of fractures, days from injury to surgery, or type of surgery) correlated with greater pain intensity.

PSEQ (odds ratio [OR], 0.95; 95% CI, 0.92–0.99) alone was associated with less than ideal satisfaction with pain control in the multivariate model and explained 12% of the variation (Hosmer and Lemeshow test, $p = 0.49$; chi-square, 7.4). In the initial bivariate analysis, factors associated with less than always satisfied with pain control were lower self-efficacy (PSEQ [$Z = -3.0$; $p = 0.003$] and greater oral morphine equivalent intake [$Z = -2.0$; $p = 0.041$]) but not factors representative of greater nociception (Table 5).

PSEQ (OR, 0.96; 95% CI, 0.92–0.99) and opioid medication use before admission (OR, 3.6; 95% CI, 1.1–12) were associated with less than complete satisfaction with staff attention to pain relief in the multivariate model and explained 13% of the variation (Hosmer and Lemeshow test, $p = 0.67$; chi-square, 5.8). In the initial bivariate analysis, factors associated with less than complete satisfaction with staff attention to pain relief included lower

Table 3. Multivariable analysis for pain intensity

Model	Adjusted R^{2*}	p value	Partial $R^{2\dagger}$
	0.26	< 0.001	
Oral morphine equivalents		0.001	0.082
Depression/anxiety		0.019	0.044
Smoker		0.047	0.031
Preadmission use of opioids		0.097	0.022

* Adjusted R^2 = percentage of the variability in the dependent variable, which can be explained by the model; †Partial R^2 = individual contribution of every variable to the adjusted R.

Table 4. Bivariable analysis for outcomes of pain intensity

Variable	Initial pain	
	Correlation	p value
Spearman correlation		
Age	−0.14	0.18
Pain Self-Efficacy Questionnaire	−0.17	0.091
Patient Health Questionnaire 2	0.038	0.71
Days injury to enrollment	0.040	0.70
Oral morphine equivalents	0.38	< 0.001
Mann-Whitney U test (Z)		
Sex	−0.26	0.79
Smoker	−3.4	0.001
History of substance abuse	−3.2	0.001
Depression/anxiety	−3.2	0.001
Preadmission use of opioids	−2.4	0.018
Preadmission use of steroids	−1.6	0.10
Acetaminophen use	−1.5	0.15
Kruskal-Wallis test		
Diagnoses		0.51
Mechanism of injury		0.36
Physician		0.13
Procedure		0.33
Number of fractures		0.99

Table 5. Bivariable analysis of satisfaction scores

Variables	Complete satisfaction with pain control		Satisfaction with staff attention to pain relief	
	Z	p value	Z	p value
Mann-Whitney U test				
Age	−0.075	0.94	−1.8	0.067
PSEQ	−3.0	0.003	−2.1	0.036
PHQ-2	−2.0	0.051	−1.7	0.098
Days injury to enrollment	−0.57	0.57	−1.6	0.11
Oral morphine equivalents	−2.0	0.041	−0.047	0.96
Chi-square/ Fisher's exact	X		X	
Sex		0.34		0.15
Smoker		0.82		0.14
History of substance abuse		0.23		0.73
Depression/anxiety		0.90		0.90
Preadmission use of opioids		0.42	4.9	0.028
Preadmission use of steroids		0.99		0.99
Acetaminophen use		0.55	4.7	0.030
Diagnoses		0.73		0.58
Mechanism of injury		0.82		0.16
Physician		0.88		0.49
Procedure		0.73		0.70
Number of fractures		0.77		0.17

PSEQ = Pain Self-Efficacy Questionnaire; PHQ-2 = Patient Health Questionnaire 2.

self-efficacy (Z = −2.1; p = 0.036), use of opioid medication before admission (r = 4.9; p = 0.028), and acetaminophen use (p = 0.030), but not factors representative of greater nociception.

There were no differences in satisfaction scores between the inpatient rating and the postdischarge phone evaluations (complete satisfaction with pain control, 40% initially and 50% at followup, p = 0.61; complete satisfaction with staff attention to pain relief, 77% initially and 81% at followup, p = 0.77).

Discussion

Based partly on guidelines for management of pain related to terminal cancer, attempts to improve satisfaction with pain not related to cancer also have focused on increasing doses of opioid pain medication [2]. Opioid use is associated with substantial side effects. Patient satisfaction influences Medicare reimbursements. We aimed to identify factors that correlate with (1) pain intensity during a 24-hour period after surgery; (2) less than complete satisfaction with pain control; (3) less than complete satisfaction with staff attention to pain relief while in the hospital, and (4) to compare inpatient and discharge satisfaction scores. There are limitations to this study. The primary limitation is that we cannot address cause-effect relationships, and it is possible that greater pain levels reflect greater nociception leading to a request for more opioids and lower satisfaction scores. However, that lack of correlation between factors associated with greater nociception (greater number of fractures, pain measured closer to the time of surgery) argues against this. Additionally, in our sample, it was more opioids, not greater reported pain intensity levels that were associated with patient dissatisfaction. Study questions involving postdischarge phone evaluation are underpowered and hypothesis-generating at best. There were two unanswered questions in two questionnaires (a very low rate of missing data) that were addressed with mean imputation, a frequently administered way of dealing with missing values in medical research [8, 17]. We did not quantify preadmission opioid use according to oral morphine equivalent. We did not use a measure of fracture severity. There were patients who used NSAIDs, but we did not analyze this. We analyzed only the amount of opioid intake. In addition, the questionnaires were administered verbally at the bedside by a research assistant rather than by pen and paper, but we did this after validating the psychologic questionnaires for verbal/phone use in another study [5]. In addition, verbal administration of the HCAHPS questions mimics typical phone administration. There also was substantial variation between the time of injury and surgery that might have affected the opioid use pattern. Sampling bias may have occurred given that 25% of the patients we approached declined participation, which is common when enrolling subjects immediately after an operation. Some patients did not feel well enough to participate, others were not interested in general, and others were scheduled for tests and felt that participating in research would be too strenuous. Many of the patients who declined participation were older. The followup by phone is another weakness of the study. Some patients could have been tired of completion of postdischarge phone followups, which could have decreased our response rate of this secondary question. Patients also might have been transferred to a nursing home making it difficult to contact them, which might have created transfer bias.

We found that patients who used more opioids postoperatively reported greater pain intensity. In addition to greater opioid use, greater pain intensity also was predicted by depression or anxiety disorder and smoking. This suggests that increased opioid medication may not be the best strategy for decreasing pain intensity. Most of our secondary findings are consistent with prior work [13, 19, 21, 36]. Opioid intake did not correlate with injury severity or number of fractures [21]. Preadmission use of opioids was associated with dissatisfaction and greater pain intensity after TKA [19]. Depression and anxiety disorders and smoking are associated with greater pain intensity [13, 36].

We found that lower patient self efficacy was the best predictor of less satisfaction with pain control. Although there are a couple studies of patients in the emergency department that document a correlation between greater opioid use and greater satisfaction with pain relief [14, 32], the finding that administration of more opioids does not improve satisfaction with pain relief is consistent with other studies of orthopaedic patients. Helmerhorst et al. [21] found that less opioid use was associated with less pain and greater satisfaction with pain relief after operative fixation of an ankle fracture. Carragee et al. [10] compared morphine use after a fracture of the femur in American and Vietnamese patients and found that although the American patients used much more morphine than the Vietnamese patients (30 mg/kg versus 0.9 mg/kg), they were less satisfied with their pain relief. Satisfaction with pain relief may be confounded with other pain behaviors such as dependence or addiction. Effective coping strategies (greater self-efficacy) are the most effective pain reliever [37]. This suggests that increased opioid medication may not be the best strategy for decreasing pain intensity and improving satisfaction with pain control, and thus interventions to optimize self-efficacy merit additional emphasis and study.

Opioid medication use before admission and lower pain self-efficacy were the best predictors of less satisfaction with staff attention to pain relief. Our rates of satisfaction with attention to pain relief are similar to national averages and percentages reported in a previous study [4]. In a study of patients with cancer, effective coping strategies and staff attention to psychosocial issues were associated with greater satisfaction [38]. Koh and Thomas [23] showed that with the implementation of a new pain treatment modality, and thereby probably more staff attention to pain relief after surgery, patients were more satisfied with staff attention to pain relief.

There were no differences in inpatient and discharge satisfaction with pain relief and staff attention to pain relief. We intentionally used the HCAHPS questionnaire during the inpatient stay although the usual method is to administer the questionnaire by phone approximately 2 weeks after discharge. Patients without a phone followup were older (likely patients with hip fracture who were still inpatients at extended care facilities) or had a history of substance abuse, but we did not find important differences in their pain and satisfaction with pain relief suggesting that polls 2 weeks after discharge are representative. The finding that patients are satisfied when questioned while an inpatient or by phone is in agreement with the study of Ward and Gordon [39].

Based on the data to date, including the findings of this study, we may need to rethink the prescription of more and stronger opioids in attempts to reduce pain and improve satisfaction with pain relief in the acute setting. One line of study worthy of investigation is preventive analgesia using multimodal approaches to limit the time and dose of opioids that patients are exposed to. Psychologic factors also deserve more attention. Just as smoking often is associated with psychologic factors [22, 42], it may be that greater opioid intake reflects greater psychologic distress and the use of less-effective coping strategies. A request for more opioids than usual for a given nociception can be a marker for problems such as hematoma, infection, or compartment syndrome, but it also can be an indication of greater distress or less-effective coping strategies. Less-effective coping mechanisms can be improved with coaching. A visit by a trained nurse or psychologist early during the admission might help the patient improve self-efficacy. In addition, nurses, surgeons, and other team members can learn the best language, communication strategies, and even some cognitive behavioral therapy techniques.

We seem to address the biomedical factors better than the psychosocial factors. It is possible that we are missing opportunities to prepare patients for postoperative pain and assist them with unexpected pain from trauma by addressing psychologic distress and coaching and training them in more effective coping strategies.

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