Pain Management Nursing 20 (2019) 158–163

Contents lists available at ScienceDirect

Pain Management Nursing

journal homepage: www.painmanagementnursing.org

Original Article

Change in Pain Score after Administration of Analgesics for Lower Extremity Fracture Pain during Hospitalization

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ARTICLE INFO

Article history:
Received 14 March 2018
Received in revised form
23 July 2018
Accepted 2 September 2018

ABSTRACT

Background: Effective acute pain management following injury is critical to improve short-and long-term patient outcomes. Analgesics can effectively reduce pain intensity, yet half of injury patients report moderate to severe pain during hospitalization.
Purpose: The primary aim of this study was to identify the analgesic, different analgesic combinations, or analgesic and adjuvant analgesic combination that generated the largest percent change from pre- to post-analgesic pain score.
Design: This was a descriptive retrospective cohort study of 129 adults admitted with lower extremity fractures to a trauma center.
Methods: Name, dose, and frequency of analgesics and adjuvant analgesics administered from admission to discharge were collected from medical records. Percent change was calculated from pain scores documented on the 0-10 numeric rating scale.
Results: The analgesic with largest percent change from pre- to post-administration pain score was hydromorphone 2 mg IV (53%) for the emergency department and morphine 4 mg IV (54%) for the in-patient unit. All analgesics administered in the emergency department and ~50% administered on the in-patient unit produced a minimal (15%) decrease in pain score.
Conclusions: This study revealed that few analgesics administered in the emergency department and the in-patient unit to patients with lower extremity fractures provide adequate pain relief. In the emergency department, all analgesics administered resulted in at least minimal improvement of pain. On the in-patient unit 13 analgesic doses resulted at least minimal improvement in pain while nine doses did not even reach 20% change in pain. Findings from this study can be used guide the treatment of fracture pain in the hospital.

Effective treatment of acute pain is critical in the immediate hospitalization period after injury to improve short-term patient outcomes (i.e., healing, stress response, hospital length of stay, cost) (Ahmadi et al., 2016; Wells, Pasero, & Mccaffery, 2008) and minimize negative long-term patient outcomes (i.e. delayed return to work, disability, chronic pain) (Goldsmith & Mccloughen, 2016; Holmes et al., 2010; Rivara et al., 2008). Many patients with lower extremity fractures report poorly controlled pain during hospitalization, putting them at high risk for negative short- and long-term outcomes. Studies have indicated that nearly 30% do not receive any pharmacologic treatment for pain (analgesics, adjuvant analgesics) while in the emergency department (Minick, Clark, & Dalton, 2012; Ware, Epps, Clark, & Chatterjee, 2012) and 60% report moderate to severe pain at the time of discharge from the hospital (Archer, Castillo, Wegener, Abraham, & Obremskey, 2012). Therefore, identifying which analgesic, combination of different analgesics, or analgesic and adjuvant analgesic combination most effectively

This work was supported by the National Institute of Nursing Research of the National Institutes of Health (grant number F31NR014986, 2016) and a University of Delaware School of Nursing internal grant. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.
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https://doi.org/10.1016/j.pmn.2018.09.008
1524-9042/

decreases acute pain after lower extremity fracture is vital to improve patient outcomes during and after hospitalization, reduce health care cost, and minimize the risk of developing chronic pain.

The definition of what constitutes effective pain relief varies. The standard in the literature is to calculate the percentage change between two pain intensity scores (Cepeda, Africano, Polo, Alcala, & Carr, 2003; Katz, Paillard, & Ekman, 2015; Moore, Derry, McQuay, & Wiffen, 2011; Teater, 2014) because it has been reported to be more consistent than calculating the raw difference between two pain scores (Farrar, Polomano, Berlin, & Strom, 2010). The Numeric Rating Scale (NRS) is the most commonly used pain assessment tool and measures the magnitude, strength, or intensity a person assigns the pain experience (The Joint Commission, 2011). In general, a reduction of 45%-50% on the 0-10 NRS is considered "very much improved" pain because it allows for increased functional ability and improved quality of life and is considered a clinically beneficial outcome (Cepeda et al., 2003; Katz et al., 2015; Moore et al., 2014; Teater, 2014). A 35% decrease is considered "much improved"; 20% is "minimal improvement" and considered a minimal clinically important difference (Cepeda et al., 2003). However, it remains unclear which analgesic, combination of different analgesics, or analgesic and adjuvant analgesic combination most effectively reduces acute pain in hospitalized patients with lower extremity fractures.

Our primary aim in this study was to identify the analgesic, combination of different analgesics, or analgesic and adjuvant analgesic combination that generated the largest percentage change from pre- to postanalgesic pain score. A sub-aim was to examine the percentage change in pain score of analgesics administered based on the potency calculated in intravenous (IV) morphine milligram equivalents. A second sub-aim was to describe the most often ordered and administered analgesics and adjuvant analgesics.

Methods

Design, Setting, and Sample

This study was conducted under a protocol approved by the University of Maryland, Baltimore, and the R. Adams Cowley Shock Trauma Center Institutional Review Boards before the enrollment of any participants. This is a secondary analysis of unpublished data collected in the course of a retrospective study examining chronic pain after lower extremity fractures in trauma patients (Griffioen et al., 2017). Participants were recruited from an urban trauma center where patients are first treated and stabilized on arrival in the emergency department (ED), before being admitted to an inpatient unit for further treatment. The majority of participants enrolled in this study were men (73%), white (72%), had fibula and/or tibia fractures (66%), and had a mean age of 46 years (standard deviation [SD] = 13.6).

Data Collection

Name, dose, and frequency of analgesics and adjuvant analgesics administered were obtained from the ED flowsheet and the electronic medication administration record (eMAR). All data from arrival in the ED to discharge were collected. The ED flowsheets are handwritten medication administration records that are scanned and uploaded into the electronic patient medical record. The eMAR automatically tracks all medications from order to administration during hospitalization after patients are admitted to the inpatient unit after initial evaluation and workup. Analgesics included nonopioids (e.g., acetaminophen and nonsteroidal anti-inflammatory drugs), nonopioid/opioid combinations (e.g., Percocet, Lortab), and opioids (e.g., morphine, oxycodone, hydromorphone).

Medications with a primary indication other than pain management, but with documented analgesic effects in some pain conditions (adjuvant analgesics) (Pasero & McCaffery, 2011, pp. 761-779) were also included in the change in pain score analysis when they were administered at the same time as an analgesic. These adjuvant analgesics were muscle relaxants (baclofen, cyclobenzaprine,) antidepressants (duloxetine), and anticonvulsants (gabapentin, pregabalin).

The IV morphine equivalence dose (morphine milligram equivalents [MME]) was calculated to examine percent change in pain score based on potency of analgesic administered (McPherson, 2009, p. 4). The dose was calculated using an online opioid analgesic converter (Globalrph, 2014) and double-checked using cross multiplication [× milligrams of IV morphine/milligrams of current opioid] * [multiplied with equianalgesic factor of IV morphine/equianalgesic factor of current opioid] (McPherson, 2009).

Change in pain Score

Pain scores with an associated date and time stamp, obtained using the 11-point Likert NRS (0 = no pain to 10 = worst pain imaginable) and recorded in the ED flowsheet and the eMAR, were used for the analyses. To calculate the percentage change in pain, the following formula was used: 100 * (postanalgesic pain score−preanalgesic pain score)/preanalgesic pain score (Farrar et al., 2001; Salaffi, Stancati, Silvestri, Ciapetti, & Grassi, 2004). The protocol at this center is to document the preanalgesic pain score at the time of the medication administration and the postanalgesic pain score within 1 hour of administration of oral (PO) analgesics and within 10-15 minutes of IV analgesics. Change in pain score was categorized as follows: very much improvement (≥45%), much improvement (35%-44%), minimal improvement (20%-34%), and no response (<20%) (Cepeda et al., 2003).

The initial data collection consisted of analgesics administered and associated pre- and postanalgesic pain scores. Analgesics were grouped by the type of analgesic administered, method of delivery, and dose. If two or more analgesics or an analgesic and adjuvant analgesic were administered at the same time, they were grouped together and reported as a combination. Pain scores documented >10 were recoded to 10; two pain scores in the ED were documented as 11 and 12; and four pain scores on the inpatient unit were documented 12, 15, 20, 21. There were no noninteger values. The mean preanalgesic pain score on day 1 was 7.05 (SD = 1.59, n = 129), on day 2 it was 7.18 (SD = 1.85, n = 114), and on day 3 it was 5.87 (SD = 1.96, n = 86). The mean postanalgesic pain score for day 1 was 4.66 (SD = 1.82, n = 129), on day 2 it was 4.51 (SD = 2.13, n = 114), and on day 3 it was 4.29 (SD = 2.13, n = 86).

A total of 984 analgesic doses were administered in the ED and 3,330 on the inpatient unit. The following variables were required for the analyses: (1) date field, analgesic name, and pre- or postanalgesic pain score; (2) adjuvant analgesic administered at the same time as an analgesic; (3) pre- or postanalgesic pain score not documented as "patient asleep—respiratory rate within normal limits and no pain" (it is not possible to determine what the pain score would have been); (4) preanalgesic pain score not documented as zero (unable to calculate change in pain score); (5) analgesic/adjuvant analgesic administered >10 times. We chose a cutoff of at least 10 times to achieve variability in the data because we were unable to find a previous study to conduct a sample power analysis. Five percent of analgesics were administered fewer than 10 times in the ED, and 23% of analgesics were administered fewer than 10 times on the inpatient unit. Variables collected were not mutually exclusive. If they could have fit more than one category, they were only counted once (e.g., a variable could have both date and pain score missing but was only counted in the date missing

category). The final data set on 129 lower extremity fracture patients included 70% of analgesics administered in the ED, and 40% analgesics administered on the inpatient unit.

Data Analysis

Statistical analyses were conducted using Base SAS and SAS/STAT software, Version 9.4 of the SAS System for Windows (SAS Institute Inc., Cary, NC, USA). Continuous variables were summarized using means and standard deviations, and categorical variables were summarized using frequencies and percentages. To examine differences based on percentage change, we used a linear mixed effects model. A random participant effect was included to account for multiple observations from the same participant. Tests for mean differences were conducted using the Kenward-Roger approximation for the degrees of freedom. To control for α inflation because of repeated t tests, we used the Tukey-Kramer method to adjust for multiple comparisons. The normality of the residuals was assessed using established graphical methods to check for the validity of the normality of errors (residuals) assumption of the linear mixed effects model. The model has no assumption regarding the distribution of the raw data values. Potential outliers were assessed via a sensitivity analysis conducted by fitting models with and without the potential outliers. In all but one case (detailed in the results section), the potential outliers did not influence model results and results including all data points were recorded. The α value was set at .05.

Results

Change in Pain Score for Analgesics Administered in ED

In the ED the largest percent change from preanalgesic to postanalgesic pain score for type of analgesic administered was for hydromorphone IV (mean [M] = 43%, SD = 27.6), followed by fentanyl IV (M = 35%, SD = 27.5), and morphine IV (M = 32%, SD = 15.4) (Table 1). There were no statistically significant differences among hydromorphone, fentanyl, and morphine. The largest percentage change in pain score for a specific analgesic dose was for hydromorphone 2 mg IV (M = 53%, SD = 29.8), followed by hydromorphone 0.5 mg IV (M = 50% SD = 26.3) and fentanyl 75 mcg IV (M = 43%, SD = 16.2) (Table 1). The mean percentage change for the most often administered analgesic doses was 32% (SD = 27.5) for fentanyl 50 mcg IV and 37% (SD = 27.5) for fentanyl 100 mcg IV. However, the differences based on the percentage change in pain scores for specific analgesic doses were not significant.

Change in Pain Score for Analgesics Administered on Inpatient Unit

When combining all doses that were administered on the inpatient unit, morphine IV had the largest change in pain score (M = 54%, SD = 30.6), followed by hydromorphone IV (M = 30%, SD = 24.9), acetaminophen (M = 27%, SD = 43.5), and oxycodone (Oxycontin) (M = 26%, SD = 36.6) (Table 2). There was a statistically significant difference between morphine IV and morphine sulfate (MS Contin) PO ($t = 3.46$, $df = 417$, $p = .043$, Tukey-Kramer) when examining percentage change. This difference was influenced by two potential outliers. When these points were removed, the significant result disappeared. The analgesic dose creating the largest percentage change in pain score was morphine 4 mg IV (M = 54%, SD = 30.6), followed by oxycodone 15 mg PO (M = 36%, SD = 29.6) and hydromorphone 0.4 mg IV (M = 34%, SD = 22.4) (Table 2). The percentage change for the most often administered analgesic, oxycodone 10 mg PO (n = 464), was 21% (SD = 33.3). No statistically significant differences were found between the different analgesic doses based on percentage change. The mean preanalgesic pain

Table 1
Categories of Change in Pain Score for Analgesics Administered in the Emergency Department

Variable	Very Much Improvement (≥45%)	Much Improvement (35%-44%)	Minimal Improvement (20%-34%)
Analgesic type		Hydromorphone IV (M = 43% SD = 27.6, n = 92)	Morphine IV (M = 32%, SD = 15.4, n = 17)
		Fentanyl IV (M = 35%, SD = 27.5, n = 499)	Fentanyl IV–midazolam IV (M = 26%, SD = 24.5, n = 52)
Analgesic dose	Hydromorphone 2 mg IV (M = 53%, SD = 29.8, n = 12)	Fentanyl 75 mcg IV (M = 43%, SD = 16.2, n = 12)	Fentanyl 50 mcg IV (M = 32%, SD = 27.5, n = 252)
	Hydromorphone 0.5 mg IV (M = 51%, SD = 26.3, n = 11)	Fentanyl 50 mcg IV–midazolam 0.5 mg IV (M = 41%, SD = 32.8, n = 10)	Morphine 4 mg IV (M = 32%, SD = 15.4, n = 17)
		Hydromorphone 1 mg IV (M = 41%, SD = 27.1, n = 69)	Fentanyl 100 mcg IV–midazolam 1 mg IV (M = 23%, SD = 24.2, n = 20)
		Fentanyl 150 mcg IV (M = 38%, SD = 31.6, n = 16)	Fentanyl 50 mcg IV–midazolam 1 mg IV (M = 23%, SD = 21.1, n = 11)
		Fentanyl 100 mcg IV (M = 37%, SD = 27.5, n = 219)	Fentanyl 100 mcg IV–midazolam 0.5 mg IV (M = 18%, SD = 14.4, n = 11)

IV = intravenous; mg = milligram; mcg = microgram; M = mean percentage change; SD = standard deviation; n = number of times administered.

Table 2
Categories of Change in Pain Score for Analgesics Administered on the Inpatient Unit

Variable	Very Much Improvement (≥45%)	Much Improvement (35%-44%)	Minimal Improvement (20%-34%)	No Response (≤20%)
Analgesic type	Morphine IV (M = 54%, SD = 30.6, n = 24)		Hydromorphone IV (M = 30%, SD = 24.9, n = 178) Acetaminophen PO (M = 27%, SD = 43.5, n = 115) Oxycodone (Oxycontin) PO (M = 26%, SD = 36.6, n = 88) Oxycodone PO (M = 23%, SD = 36.5, n = 650) Acetaminophen PO– oxycodone PO (M = 22%, SD = 37.9 n = 20)	Hydromorphone PO (M = 18%, SD = 31.4 n = 100) Oxycodone/acetaminophen (Percocet) PO (M = 17%, SD = 52.4, n = 15) Baclofen PO–oxycodone PO (M = 15%, SD = 48.4, n = 31) Oxycodone (Oxycontin) PO (M = 15%, SD = 58.1, n = 25) Morphine sulfate (MS Contin) PO (M = 6%, SD = 78.8, n = 47) Acetaminophen PO– baclofen PO (M = 5%, SD = 17.1, n = 11)
Analgesic dose	Morphine 4 mg IV (M = 54%, SD = 30.6, n = 24)	Oxycodone 15 mg PO (M = 36%, SD = 29.6, n = 29)	Hydromorphone 0.4 mg IV (M = 34%, SD = 22.4, n = 32) Hydromorphone 1 mg IV (M = 31%, SD = 25.7, n = 98) Acetaminophen 1,000 mg PO (M = 31%, SD = 37.0, n = 35) Oxycodone 5 mg PO (M = 27%, SD = 46.5, n = 147) Oxycodone 10 mg PO (M = 26%, SD = 36.6, n = 88) Acetaminophen 650 mg PO (M = 26%, SD = 46.2, n = 80) Hydromorphone 0.5 mg IV (M = 24%, SD = 24.2, n = 48) Hydromorphone 2 mg PO (M = 24%, SD = 35.8, n = 55) Acetaminophen 60 mg PO– oxycodone 10 mg PO (M = 22%, SD = 37.9, n = 20) Oxycodone 10 mg PO (M = 21%, SD = 33.3, n = 464) Oxycodone 10 mg PO– baclofen 5 mg PO (M = 21%, SD = 34.4, n = 18)	Oxycodone/acetaminophen (Percocet) 325-5 2 tabs PO (M = 17%, SD = 52.4, n = 15) Oxycodone (Oxycontin) 10 mg PO (M = 15%, SD = 58.1, n = 25) Hydromorphone 4 mg PO (M = 13%, SD = 26.8, n = 30) Morphine sulfate (MS Contin) 15 mg PO (M = 11%, SD = 21.4, n = 14) Hydromorphone 6 mg PO (M = 8%, SD = 17.0, n = 15) Oxycodone 5 mg PO– baclofen 5 mg PO (M = 7%, SD = 63.6, n = 13) Oxycodone 30 mg PO (M = 6%, SD = 9.9, n = 10) Acetaminophen 1,000 mg PO–baclofen 5 mg PO (M = 5%, SD = 17.1, n = 11) Morphine sulfate (MS Contin) 15 mg PO (M = 5%, SD = 93.4, n = 33)

IV = intravenous; PO = per os [oral]; mg = milligram; mcg = microgram; M = mean percentage change; SD = standard deviation; n = number of times administered.

Table 3
Categories of Change in Pain Score Based on IV Morphine Equivalence Dose (MME)

Variable	Very Much Improvement (≥45%)	Much Improvement (35%-44%)	Minimal Improvement (20%-34%)	No Response (≤20%)
MME in ED	13.3 (M = 53%, SD = 29.8, n = 12) 2.2 (M = 51%, SD = 26.3, n = 11)	7.5 (M = 43%, SD = 16.2, n = 12) 6.7 (M = 39%, SD = 27.1, n = 69) 15.0 (M = 38%, SD = 31.6, n = 16) 10.0 (M = 35%, SD = 27.2, n = 250)	5 (M = 32%, SD = 27.5, n = 273) 4 (M = 32%, SD = 15.4, n = 17)	
MME on inpatient unit	4 (M = 54%, SD = 30.6, n = 24)	7.5 (M = 36%, SD = 29.6, n = 29)	2.7 (M = 34%, SD = 22.4, n = 32) 6.7 (M = 31%, SD = 25.7, n = 98) 2.5 (M = 25%, SD = 48.2, n = 160) 0 (M = 25%, SD = 42.3, n = 126) 3.3 (M = 24%, SD = 24.2, n = 48) 13.3 (M = 24%, SD = 35.8, n = 55) 5 (M = 22%, SD = 34.5, n = 605)	10 (M = 15%, SD = 58.1, n = 25) 26.7 (M = 13%, SD = 26.8, n = 30) 9.9 (M = 11%, SD = 21.4, n = 14) 40.0 (M = 8%, SD = 16.9, n = 15) 15.0 (M = 6%, SD = 9.9, n = 10) 5.0 (M = 4%, SD = 93.4, n = 33)

IV = intravenous; MME = IV morphine milligram equivalents; ED = emergency department; M = mean; SD = standard deviation; n = number of times administered.

score for nonopioids was 5.6 (SD = 2.6); for nonopioid and opioid combinations it was 6.1 (SD = 2.0), and for opioids it was 6.2 (SD 2.2).

Change in Pain Score by IV Morphine Equivalence Dose

The largest percentage change in pain score based on IV morphine equivalence dose in the ED was 13.3 MME (M = 53%, SD = 29.8), followed by 3.3 MME (M = 50% SD = 26.3), and 7.5 MME (M = 43%, SD = 16.2) (Table 3). The largest percentage change in pain score based on IV morphine equivalence dose on the inpatient unit was for 4.0 MME (M = 54%, SD = 30.6), followed by 7.5 MME (M = 36%, SD = 29.6) and 2.7 MME (M = 34%, SD = 22.4) (Table 3). No statistically significant differences were found between the different MME doses when examining percentage change.

Most Often Ordered Analgesics and Adjuvant Analgesics

There were 692 analgesic orders in the eMAR. The most often ordered analgesics were oxycodone (27%), hydromorphone (24%), and acetaminophen (17%). Other medications ordered less often were Oxycontin (12%), morphine (7%), MS Contin (4%), and acetaminophen/oxycodone (2%). Analgesics were ordered when necessary (PRN) 62% of the time, routinely 24% of the time, once 12% of the time, and via patient-controlled analgesia 2% of the time. Of the adjuvant analgesics, baclofen was ordered most often (64%), followed by gabapentin (24%) and pregabalin (10%).

Most Often Administered Analgesics and Adjuvant Analgesics

The most often administered analgesics in the ED were fentanyl IV (73%), hydromorphone IV (13%), fentanyl IV—midazolam IV (8%), and morphine IV (2%). Fentanyl 50 mcg IV (37%), fentanyl 100 mcg IV (32%), and hydromorphone 1 mg IV (10%) were the most common analgesic doses administered. On the inpatient unit, the most often administered analgesics were oxycodone PO (50%), hydromorphone IV (14%), and acetaminophen PO (9%). Baclofen was the most popular adjuvant analgesic administered 82% of the time, followed by gabapentin at 10%.

Discussion

In an effort to minimize negative short- and long-term outcomes because of inadequate pain relief, effective pain management is crucial. However, in this study of 129 hospitalized trauma patients with lower extremity fractures, few of the analgesics or analgesic and adjuvant analgesic combinations administered in the ED or on the inpatient unit resulted in a very much improved pain score, which would indicate increased functional ability for the patient. In the ED, all the analgesics administered resulted in at least minimal improvement of pain. Of the 22 analgesic doses administered on the inpatient unit, only 1 (morphine 4 mg IV) was highly effective by reducing the pain score by more than 45%, oxycodone 15 mg PO was moderately effective (≥35%), 11 achieved at least a minimally effective pain relief (≥20%-34%%), and 9 analgesic doses did not even achieve 20% improvement in pain.

Consistent with the published literature, IV fentanyl, hydromorphone, and morphine were the preferred analgesics for treating acute pain immediately on arrival in the hospital (Ahmadi et al., 2016; MacKenzie, Zed, & Ensom, 2016). Fentanyl can be expected to be the most often administered analgesic because it has a fast onset and short half-life (MacKenzie et al., 2016), but none of the fentanyl doses administered in the ED reached a 45% decrease in pain score. However, hydromorphone IV did, and it has been previously reported to be more efficacious in treating acute pain than other drugs such as morphine (Chang et al., 2006). Once admitted to the inpatient unit, the analgesic administration switched from IV to PO, of which oxycodone was overwhelmingly the most often administered analgesic, which is consistent with the literature (Hoppe et al., 2015). In our analysis, we did not find statistically significant differences between oxycodone and other analgesics, but acetaminophen did have a slightly larger decrease in pain score compared with oxycodone. This was also reflected when examining the morphine equivalence dose because analgesics with no opioids resulted in pain relief similar to that of analgesics with opioids. It has been reported that there is no difference in pain score between oxycodone 5 mg PO or placebo (Moore et al., 2011) or between acetaminophen and ibuprofen combination compared with acetaminophen and opioid combination (Chang, Bijur, Esses, Barnaby, & Baer, 2017).

It has to be remembered that achieving 100% reduction in pain is difficult (Ahmadi et al., 2016) and relies on the severity, frequency, and extent of pain itself; the underlying disease pathologic condition; genetic factors; and people's attitudes, emotional makeup, and beliefs, as well as the meaning of the experience for them (Pizzo, Clark, & Pokras, 2011). In general, analgesic treatment of pain during the acute phase after injury is based on the World Health Organization pain ladder, where the pain intensity score reported by the patient determines the type and dose of analgesia (Ahmadi et al., 2016). According to this guideline, analgesics such as nonopioids (i.e. acetaminophen) are administered for mild pain (NRS 1-3), acetaminophen/opioid combinations for moderate pain (NRS 4-7), and opioids (i.e. codeine, hydromorphone, fentanyl, morphine, oxycodone) for severe pain (NRS 7-10) (Ahmadi et al., 2016; Bergman, 2007; Blondell, Azadfard, & Wisniewski, 2013; Pasero & McCaffery, 2011). In this study, after transfer from the ED, there were no differences in participants' preanalgesic pain score whether the analgesic administered was a nonopioid, an acetaminophen/opioid combination, or an opioid. The use of nonopioids for scores of greater than 5 in this study does not follow the World Health Organization ladder guidelines for treatment of moderate pain.

This is one of the first studies to examine the administration of opioids concurrently with nonopioids and adjuvant analgesics. Combining medications with different analgesic properties has the potential to provide superior pain relief and reduce adverse events (Raffa, Pergolizzi, Segarnick, & Tallarida, 2010). In the ED, midazolam was often administered at the same time as an analgesic. Midazolam, a benzodiazepine, is often used for procedural sedation, and although it does not have analgesic effects, it does induce sedation and may have an amnesic effect (Hennessy, Kirkby, & Montgomery, 1991; Pasero & McCaffery, 2011). However, benzodiazepines administered with an analgesic could increase the risk of respiratory depression with no evidence of a benefit to the patient. On the inpatient unit, oxycodone 10 mg PO administered concurrently with baclofen 5 mg PO resulted in a 20% decrease in pain score.

This study, as with many retrospective chart reviews, had limitations such as missing data and variability in recording some data. The standard deviation was large for many of the analgesics, which is indicative of a large amount of variability in the data. As the pain score is a subjective phenomenon, the same dose of analgesic could result in different pain relief for individual patients. Often the pain scores were documented as “patient asleep,” which makes it difficult to determine whether the patient's pain decreased or whether the central nervous system effects of the analgesic resulted in sleepiness regardless of the patient's pain. In addition, we did not control for injury severity, which is associated with higher pain scores (Kim et al., 2017) Also, a higher preanalgesic pain score can result in a larger pre- to postanalgesic difference compared with a lower preanalgesic pain score (Breivik et al., 2008).

Implications for Nursing Practice

Nurses in EDs and trauma resuscitation units are involved in the direct care of patients with acute pain after traumatic injuries. Nurses are in an excellent position to determine whether pain management is adequate for patients and can initiate an alternate treatment if pain relief is inadequate. Findings from this study provide critical information on the effectiveness of medications administered for pain during hospitalization for patients with lower extremity fractures. There is an opportunity to use the information from this study to guide pain management protocols, which have been found to improve outcomes such as decrease in mean time to analgesia and percentage of patients who achieve pain relief (MacKenzie et al., 2016).

Conclusion

This study revealed that few analgesics administered to trauma patients with lower extremity fractures in the ED and inpatient provide adequate pain relief. Seven different analgesic doses had a 33% or larger change in pain score, which is considered a moderately effective pain reduction, and all 13 doses administered 10 or more times produced a change in pain score of at least 15%. Findings from this study can be used guide the treatment of fracture pain in the hospital.

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