Do Elderly Patients Use Patient-Controlled Analgesia Medication Delivery Systems Correctly?

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BACKGROUND: Although prior studies have shown patient-controlled analgesia (PCA) to be appropriate for use by children and adults, no studies have specifically evaluated the ability of elderly patients to use the technology correctly.
PURPOSE: To determine whether elderly, postoperative patients can properly use PCA devices.
METHODS: Using a descriptive study design, a convenience sample of elderly, postoperative orthopedic patients was observed while using a PCA device and surveyed about the proper use of the device. Participants were observed and surveyed 12 to 20 hours after admission to the postoperative patient care unit. Frequency and amount of analgesic medication administration over the postoperative time period were also recorded. Data were summarized with descriptive statistics and multiple regression analysis was used to determine whether confounding variables explained problems using the PCA device correctly.
RESULTS: A total of 58 orthopedic patients were studied during the first day after surgery. Patients had used the PCA device for 16.6 ± 3.0 (mean ± SD) hours at the time of the observation and survey. Virtually all patients correctly identified and depressed the PCA activation button when instructed, knew when to use the PCA device, and who was allowed to depress the PCA button. Slightly more than half of the patients (57%) correctly identified how often they could have PCA medication, with 38% not sure of PCA medication frequency. The PCA medication was requested an average of 23.3 ± 52.7 times during the study period. The majority of the patients (86%) requested PCA medication less than 25% of the times that they could receive PCA medication. All patients in the study had PCA devices programmed to deliver up to 5 doses per hour of PCA medication, yet an average of 11.2 ± 10.8 doses of PCA medication were actually delivered during the entire study period (average 16.6 hours). Average doses of fentanyl and morphine sulfate received by patients were 13.5 μg/hour and 1.0 mg/hour, respectively.
CONCLUSION: Elderly patients were very knowledgeable about how to use the PCA device but not about how often they could receive PCA medication. This lack of knowledge may have influenced how often they requested pain medication, because almost 90% of patients received less than 25% of the PCA allowable medication dose. This low usage of PCA medication delivery calls into question the cost-effectiveness of this method of medication delivery for the elderly. Additional studies are needed to verify these findings in other elderly patients.

Introduction

The most common method to provide pain medication after orthopedic surgery is the delivery of analgesic medications through an intravenous catheter as requested by the patient using a computer-controlled delivery system

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(Chumbley & Mountford, 2010). Termed "patient-controlled analgesia" (PCA), this method allows a patient to request pain medication as needed. The device is programmed to allow a set dose of the ordered analgesic drugs to be delivered within a set timeframe (e.g., 1 mg i.v. morphine sulfate every 10 minutes) whenever the patient depresses a PCA button. The device will not deliver medication when requested by the patient if the programmed maximum dose has been provided within the prescribed timeframe. When pain is not well controlled with PCA administration alone, additional intravenous analgesic doses can also be provided on the basis of the clinical judgment of the patient's nurse.

Patient-controlled analgesia was developed in the 1990s as a method to improve the time to delivery of pain medication when needed by the patient and avoid delays in medication administration inherent with having the patient's nurse obtain and give each requested dose. Studies on the efficacy of PCA delivery versus traditional nurse administered analgesic therapy found high patient satisfaction with the delivery method and better pain control after surgical procedures (Bainbridge, Martin, & Cheng, 2006; Chang & Cho, 2012; Dalury, Lieberman, & MacDonald, 2012; Dolin, Cashman, & Bland, 2002; Helfand & Freeman, 2009; Hudcova, McNicol, Quah, Lau, & Carr, 2006; Lewis, Gunta, Mitchell, & Bobay, 2012; Meftah et al., 2012; Miaskowski, 2005; Walder, Schafer, Henzi, & Tramer, 2001; Wu et al., 2005). Total analgesic doses received were also higher in the PCA delivery, supporting the belief that patients would obtain more pain medication if they did not have to go through others (Chumbley, Hall, & Salmon, 2002).

While prior studies have shown the device to be appropriate for use by children and adults, no studies have specifically evaluated the ability of elderly patients to use the technology correctly. Elderly patients frequently have more cognitive and physical impairments than younger patients, which may restrict their understanding of how to use the device, ability to remember directions for device use, and/or ability to physically use the device properly (Mann, Pouzeratte, & Eledjam, 2003). In addition, they may be less accepting of new health technologies than younger individuals (Fischer, David, Crotty, Dierks, & Safran, 2014; Or & Karsh, 2009; Peek et al., 2014). Qualitative observational research in 42 elderly postoperative patients found that some patients appeared overwhelmed by the PCA technology (Brown & McCormick, 2006). Compounding these issues is that most teaching of how to use a PCA device occurs in the early hours after surgery, when hearing aids and glasses are not available for use and patients may not be alert enough to comprehend directions on device operation.

The purpose of this descriptive study was to determine whether elderly postoperative patients could properly use their PCA devices. Proper use of the PCA device was determined by evaluation of three components of PCA use: (1) observation of the patient during simulated PCA use; (2) patient knowledge of when to use the device; and (3) frequency of PCA use and number of p.r.n. (as needed) pain medications given in the first postoperative day of PCA use.

Materials and Methods

This study was conducted in a 275-bed community-based hospital in the Southeastern region of the United States on a 19-bed orthopedic surgical unit. Study approval was obtained from the institution's investigational review board prior to data collection. Data collection was completed over a 4-month period.

Study Design

An exploratory, descriptive study design was used to determine whether elderly postoperative patients properly used their PCA devices. Participants were observed during a simulated PCA use and surveyed about their knowledge of when to use the PCA device. Reviews were conducted of medical records and PCA computer history to determine actual pain medication administration. Confounding variables included age, gender, type of PCA medication, type of surgical procedure, and analgesic administration within 2 hours of survey completion.

Sample Selection

A convenience sample of postoperative patients on an inpatient orthopedic unit was studied. Inclusion criteria included the following: able to speak and understand English; age 65 years or older; mentally competent and alert; S/P total joint replacement; preoperative attendance at an educational class for total joint replacement patients; presence of a PCA device; direct admission to the orthopedic unit from the postanesthesia unit; and absence of a chronic pain medical diagnosis. Sample size was determined a priori by power analysis for regression, based on an effect size of 0.25 (medium), five predictor variables, power of 0.8, and alpha of 0.05 (Cohen, 1977; Faul, Erdfelder, Lang, & Buchner, 2007).

Instruments

The survey tool used in this study to evaluate the proper use of a PCA device was developed by the study investigators (see Table 1). The first two components of the survey were based on the manufacturer's directions for proper use of the device (Alaris, 2011) and principles about PCA use provided to patients preoperatively in an educational booklet and mandatory preoperative educational class for all joint replacement patients at the facility (i.e., PCA as a method to provide analgesic therapy; how to use the PCA device; when to notify a nurse for additional analgesics). A study investigator observed the patient when asked to locate his or her PCA control button and to physically depress the control button. In addition, patients responded to four multiple-choice questions asked by the investigator about when and how to use the PCA device. The last component of the survey was a review of the medical record and PCA computer device history by a study investigator from unit admission to 6 A.M. the following morning to determine actual PCA use and the highest numeric pain score since unit admission. Prior to study use, the survey tool questions were tested with postoperative patients for clarity and ability to select from the multiple-choice options read by the investigators.

Table 1. Components of a Survey to Evaluate Patient-Controlled Analgesia Knowledge and Use by Postoperative Joint Replacement Patients

Components	Specific Items Evaluated
Patient observation by study investigator	Ask the patient to locate the PCA medication delivery button.
	Ask the patient to show you how to activate the medication delivery button.
Patient responses to survey multiple-choice questions	What should you do when you are in pain? (depress the button; call the nurse; not sure)
	Who is allowed to push the PCA button? (patient; nurse; family member; not sure)
	How often can you push the button? (all the time; every 12–15 minutes; don't know)
	Do you feel safe using this way to receive pain medications? (yes; no)
Review of medical record by study investigator	Number of patient requests for PCA medication.
	Number of times medication actually delivered with the PCA.
	Amount of PCA drug delivery.
	Type, amount, and frequency of non-PCA analgesic medications administered by the nursing staff.
	Highest numeric pain score recorded in the medical record from postoperative admission to 6 A.M. the following morning.

Note. PCA = patient-controlled analgesia.

Procedure

At 6 A.M. on the morning after surgery, just prior to removal of the PCA device, consenting patients were evaluated by a study investigator. Each participant was observed by a study investigator as they were asked to perform various activities with the PCA device and then responded to the survey questions asked by the study investigator about PCA use (see Table 1). The rationale for doing the evaluation the morning after surgery was that the effects of anesthesia would no longer be present, the patient would have had multiple opportunities to use the PCA device over the previous 12- to 18-hour period, and PCA principles and operation would have been reinforced by postoperative caregivers. Review of the medical records for PCA use and p.r.n. analgesic administration was also completed by the study investigator at 6 A.M. on the morning after surgery (see Table 1).

Data Analysis

Data were summarized using descriptive statistics. Logistic regression analysis was used to determine whether confounding variables (age; gender; type of PCA medication; analgesic administration within the past 2 hours) explained correct use of the PCA device by participants. Chi-square analysis was used to determine whether the highest level of pain postoperatively was similar for total hip and knee replacement procedures. The level of significance for all tests was $p < .05$.

Results

A total of 58 postoperative orthopedic patients were observed and surveyed at 6 a.m. the morning after surgery. Ages ranged from 65 to 90 years, averaging 72.9 ± 6.4 years (mean ± *SD*) (see Table 2). Length of time that patients had been using PCA at the time of the observation and survey ranged from 10 to 22 hours (16.6 ± 3.0 hours). The majority of patients had undergone a total knee replacement (single $n = 40$ [69%]; bilateral $n = 4$ [7%]), with a regional femoral nerve block for the first 24–36 hours postoperatively. Total hip replacement patients did not receive a regional block.

Fentanyl was the most commonly used analgesic medication for PCA delivery, with 9 patients receiving PCA morphine. The highest pain scores recorded in the medical record from admission to the surgical unit until 6 a.m. the following morning ranged from 0 to 10, with an average score of 4.1 ± 2.7. Eleven of the 58 patients (19%) had pain scores of 7 or higher recorded during that time, 7 of which were in patients with a total knee replacement and regional femoral block and 4 in patients with total hip replacement with no regional femoral nerve block. No statistical difference was found between type of surgical procedure and highest pain score ($p > .05$).

Investigator observation of the patient found that all but one of the study patients could correctly identify and depress the PCA activation button (see Table 3). Patient knowledge of when to use the PCA device and who could depress the PCA button was high (92% and 91%, respectively). Slightly more than half of the patients (57%) correctly identified how often they could have PCA medication, with 38% not sure of PCA medication frequency. More than 90% of patients felt safe using the PCA method for medication delivery. None of the confounding variables were found to significantly explain the correct use of the PCA device ($p > .05$).

Patients requested PCA medication an average of 23.3 ± 52.7 times, ranging from 0 to 346 requests, during the study period (unit admission to 6 a.m. the following morning) (see Table 4). The majority of the patients (86%) requested PCA medication less than 25% of the times that they could receive PCA medication.

Table 2. Patient Demographic and Characteristic Data in Postoperative Total Joint Replacement Patients ($N = 58$)

Age, $M \pm SD$ (years)	72.9 ± 6.4 (range: 65–90)
Sex	
Male	$n = 24$ (41%)
Female	$n = 34$ (59%)
Surgical procedure	
Total knee replacement	$n = 40$ (69%)
Total hip replacement	$n = 14$ (24%)
Bilateral total knee replacement	$n = 4$ (7%)
PCA medication	
Fentanyl 25 μg / request every 12 minutes	$n = 46$ (79%)
Fentanyl 12.5 μg / request every 12 minutes	$n = 3$ (5%)
Morphine 1 mg / request every 12 minutes	$n = 9$ (16%)
Highest pain score recorded during study period, $M \pm SD$	4.1 ± 2.7 (range: 0–10)
Patients with pain scores recorded during the study period of ≥ 7	$n = 11$ (19%)

Note. PCA = patient-controlled analgesia.

Table 3. Summary of Results From Patient Observation and Patient Response to a Survey on the Proper Use of Patient-Controlled Analgesia Devices in Postoperative Total Joint Replacement Patients ($N = 58$)

Patient observation by the study investigator	
Did the patient correctly locate the PCA medication delivery button when requested to do so?	
Yes	$n = 57$ (98%)
No	$n = 1$ (2%)
Did the patient physically depress the PCA button when requested to do so?	
Yes	$n = 57$ (98%)
No	$n = 1$ (2%)
Patient responses to survey questions	
What should you do when you are in pain?	
Depress the PCA button	$n = 54$ (92%)
Call the nurse	$n = 2$ (4%)
Not sure	$n = 2$ (4%)
Who is allowed to push the PCA button?	
Patient	$n = 53$ (91%)
Nurse	$n = 2$ (4%)
Family member	$n = 4$ (7%)
Not sure	$n = 0$ (0%)
How often can you push the button?	
Correct frequency	$n = 33$ (57%)
Incorrect frequency	$n = 3$ (5%)
Not sure	$n = 22$ (38%)
Do you feel safe using this route of medication?	
Yes	$n = 56$ (96%)
No	$n = 2$ (4%)

Only one patient requested PCA medication more than 50% of allowable times. All patients in the study had PCA devices programmed to deliver up to 5 doses per hour of PCA medication, yet an average of 11.2 ± 10.8 doses of PCA medication were actually delivered during the entire study period (average of 16.6 hours). The average doses of fentanyl and morphine sulfate received by patients were 13.5 μg/hour and 1.0 mg/hour, respectively.

Of the 11 patients with a high recorded pain score of 7 or more during the study period ($n = 7$ total knee replacement; $n = 4$ hip replacement), on average they received only 20.3% of their allowable PCA analgesic medication. Only two of the 11 patients requested PCA medication at least as often as allowed by the PCA device. One of those two patients depressed their PCA button four times more than the allowable number of doses that could be provided during the study period ($N = 346$ depressions) and was the only patient to receive multiple p.r.n. analgesic medications from their assigned nurse.

Only five of the 58 patients received additional analgesic medication by their assigned nurse during the study period, with four of the five receiving one additional dose and one patient receiving three additional doses. All but one of those patients had a total knee replacement with a regional femoral nerve block. Three of the five patients had received less than 20 μg/hour of PCA fentanyl during the study period, despite being allowed up to 125 μg/hour.

Discussion

Overall, we found that elderly patients were very knowledgeable about how to use the PCA device, but not of how often they could receive PCA medication. More than 38% of the patients surveyed said they were unsure of how often the PCA device could deliver requested medication. This lack of knowledge may have influenced how often they requested pain medication, since the overall number of times PCA medication requests were made was small compared with what was allowable. Almost 90% of patients received less than 25% of the PCA allowable medication dose. This is the first study to evaluate the PCA knowledge of elderly patients.

The highest postoperative pain scores recorded in the early postoperative period were less than 7 for the vast majority of patients, indicating that their perceived pain level was not too severe, contrary to prior reports about pain for joint replacement surgery (Dalury et al., 2012; Lewis et al., 2012; Meftah et al., 2012). Our observation of low postoperative pain scores may be related

Table 4. Descriptive Data on Patient PCA Requests for Analgesic Medication and Actual PCA Delivery of Analgesic Medication During the Study Period (Postoperative Unit Admission to 6 a.m. the Following Morning, Average of 16.6 ± 3.0 Hours) in 58 Postoperative Orthopedic Patients

Number of requests for PCA analgesic delivery over duration of study period	
All patients, *M* ±*SD*	23.3 ± 52.7 (range: 0–346 requests)
Requests ≤ 25% of PCA programmed allowable doses	*n* = 50 (86%) patients
Requests 26%–50% of PCA programmed allowable doses	*n* = 7 (12%) patients
Requests > 50% of PCA programmed allowable doses	*n* = 1 (2%)
Number of times PCA analgesic delivered over duration of the study period	
All patients, *M* ±*SD*	11.2 ± 10.8 (range: 0–45 times)
Amount of PCA analgesic delivery per hour	
Fentanyl PCA	13.5 ± 14.4 mcg/hour (*n* = 49; 84%)
Morphine PCA	1.0 ± 0.8 mg/hour (*n* = 9; 16%)

Note. PCA = patient-controlled analgesia.

to recent changes in total knee replacement analgesic standards, which include the use of regional femoral nerve blocks for the first 24–36 hours postoperatively in total knee replacement surgeries. Prior studies that reported on postoperative pain levels during the first postoperative day in joint replacement patients either had no or few patients with femoral blocks, different from the majority of patients in our study (Dalury et al., 2012; Lewis et al., 2012; Meftah et al., 2012).

An interesting finding was that while only a few patients received additional p.r.n. analgesic medications over and above the PCA medication, four of five of those patients had very low PCA usage (<20% of their allowable PCA medication doses). It is not clear from the data we collected in this study whether these patients had requested additional medication and/or whether the registered nurses providing care determined additional pain medication was needed on the basis of their assessment of the patient. Given the large percentage of patients who were not aware of how often they could receive PCA doses, this finding does raise the possibility that patients requested additional pain medication from the nurse because they did not realize that they could have been using their PCA devices more often.

Other than the qualitative study by Brown and McCormack (2006), which indicated elderly patients seemed overwhelmed by the technology, this is the first study to evaluate PCA device use in the elderly. Similar to studies in adults and children (Bainbridge et al., 2006; Chang & Cho, 2012; Chumbley et al., 2002; Dalury et al., 2012; Helfand & Freeman, 2009; Hudcova et al., 2006; Lewis et al., 2012; Meftah et al., 2012; Miaskowski, 2005; Wu et al., 2005), we found our elderly patients to be knowledgeable about the PCA device and how to use it, with the exception of medication frequency. But different from adult and pediatric studies that found frequent PCA medication delivery in response to patient requests, we found the total analgesic doses delivered with the PCA device to be very small in these elderly patients.

Clinical Implications

Elderly patients should be reminded frequently after surgery that they can and should depress their PCA button at least every 12–15 minutes if they are experiencing pain and desire more pain medication. Another suggestion would be to have some kind of a visual reminder for the patient and/or their family to encourage the use of the PCA medication delivery several times an hour to maximize pain relief. Nurses also need to ensure that patients understand that the PCA device can be used for mild to moderate pain management, not just severe pain.

The infrequent use of PCA delivery of analgesic medication observed in this study may call into question whether this is an efficient method for pain management in the elderly. Each patient consumed very limited amount of analgesic therapy over the less than 24-hour study period. The cost for the programmable PCA device, disposables, and total amount of analgesic medication mixed for potential device delivery may not be cost-effective, given the small doses delivered in this study. Having nurses administer p.r.n. doses of analgesic medications may be a more cost-effective approach. Given that few patients had high pain scores in this study, it is also possible that elderly patients with mild to moderate pain may not need the narcotic medication used in a PCA device, but would benefit from nonnarcotic analgesic medications delivered by more traditional methods.

Study Limitations

This study evaluated only elderly orthopedic patients at one point in time, on the morning after surgery. Different results may occur at various times after surgery, particularly in the immediate postoperative period. Another limitation of this study is that our patients had all attended a preoperative educational class and learned about the PCA delivery of medication when they were without pain and not under the influence of analgesic therapy. Different results may be found when the elderly are first taught how to use a PCA device in the early postoperative period. Finally, another limitation of this study

is that a large portion of our participants had undergone total knee replacement with a femoral nerve block catheter in place during the study period. Although we found no statistical difference in pain levels for patients with or without a femoral nerve block in this study, it is possible that in a larger sample of patients without a regional nerve block, different pain results may occur.

Conclusions

Elderly patients were very knowledgeable about how to use the PCA device, but not about how often they could receive PCA medication. This lack of knowledge may have influenced how often they requested pain medication, because almost 90% of patients received less than 25% of the PCA allowable medication dose. This low usage of PCA medication delivery calls into question the cost-effectiveness of this method of medication delivery for the elderly. Additional studies are needed to verify these findings in other elderly patients.

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