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Pain Assessment and Management in Critically Ill Postoperative and Trauma Patients: A Multisite Study

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• **Background** *Pain in critically ill patients is undertreated.*
• **Objectives** *To examine patients' perceptions of pain and acute pain management practices in a large metropolitan area to provide direction for improvements in pain relief.*
• **Methods** *In a descriptive, correlational study, data were collected from 213 patients in 13 hospitals. Interviews with patients, chart reviews, and interviews with nurse leaders were used to examine institutional and individual approaches to pain management.*
• **Results** *Twenty-eight percent of patients did not recall an explanation of a pain management plan, and 64% were often in moderate to severe pain while in the intensive care unit. High pain intensity correlated with wait for an analgesic (P<.001), expectations of less pain (P<.001), and longer stay in the intensive care unit (P<.001). Low satisfaction correlated with expectations of less pain (P<.001), often being in moderate to severe pain (P<.001), and long wait for an analgesic (P<.001). In the first 24 hours postoperatively, only 54% of patients had a numerical pain rating documented; 91% had a pain description. The amount of opioid given on postoperative day 1 was influenced by pain intensity (P<.001), the patient's age (P=.03), type of surgery (P=.002), and route of analgesic (P<.001). Only 33% of patients had nonpharmacological pain interventions documented.*
• **Conclusions** *Despite moderate to severe pain, patients are generally satisfied with their pain relief. Measuring patients' satisfaction alone is not a reliable outcome for determining the effectiveness of pain management. Realistic expectations of patients about their pain may enhance coping, increase satisfaction, and decrease pain intensity after surgery. (American Journal of Critical Care. 1999;8:105-117)*

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Many obstacles in critical care impede effective pain management: Critically ill patients often cannot report the pain they experience.[1,2] Because of competing priorities, pain management can be a secondary concern to healthcare providers.[3] Limited use of reliable documentation tools can hinder effective pain assessment,[4] and lack of knowledge often precludes appropriate pain interventions.[5] Finally, disciplines and departments often do not coordinate patients' pain management plans.[6] Consequently, pain continues to be undertreated.[7-11]

Research on pain management in critically ill patients is a priority.[12,13] Evaluating the overall quality of a pain management program is multifaceted and involves exploring the perspectives of both patients and healthcare providers and the actual practice of administering medications.[14] Each facet is complex and is influenced by numerous factors, a situation that makes measuring pain-relief outcomes difficult. Both quantitative and qualitative studies are necessary to best understand pain management practices.

The purposes of this study were to examine patients' perceptions of pain, describe the pain assessment and management practices in a large metropolitan area, determine patients' outcomes that best reflect effective pain relief, and provide recommendations for pain assessment and intervention practices for the critically ill. The following research questions were addressed: (1) What are patients' perceptions of pain and its management? (2) What are the predictors of pain intensity? (3) What are the predictors of patients' satisfaction with pain relief? (4) What are the current pain assessment practices? (5) What are the current pain intervention practices?

Methods

Research Design, Setting, and Sample

A descriptive, correlational design was used for the study. Thirteen community, teaching, and government hospitals in a large metropolitan area were included. Groups of nurse leaders were interviewed at each hospital to determine current practices of pain assessment and interventions. Each group consisted of 2 to 4 persons in the following types of positions: critical care manager, clinical nurse specialist, and charge nurse or full-time staff nurse with 5 years of critical care experience. The proposed study sample was 20 adult surgical or trauma patients from each hospital who met inclusion and exclusion criteria. Inclusion criteria were as follows: surgery or trauma with or without surgical repair within the past 72 hours, age 18 years or more, stable hemodynamic condition, ability to speak and understand English, and fulfillment of mental status requirements. Exclusion criteria were neurological surgery or trauma, burns, ischemic cardiac pain, chronic pain requiring narcotics preoperatively, current or recent drug or alcohol abuse, pregnancy, marked liver or kidney disease, and intubation in patients who could not write. Cardiac surgery patients were limited to 10 per hospital to encourage diverse sampling. Data were collected from March to December 1994.

Instruments and Measures

Two data collection forms and one survey were used for the study. The major points of emphasis from the clinical practice guideline for acute pain management published by the Agency for Health Care Policy and Research[15] were used as a framework to guide the content and selection of tools.

The Nursing Leadership Group Interview Form was used to describe the overall approach to pain management at each hospital. The interview consisted of focused and open-ended questions. Information was obtained on standards of care, documentation practices, pain teams or programs, clinicians' roles, involvement of patients and their families, quality improvement monitoring, educational programs, and innovative interventions.

The Medical Record Review Form was used to extract data from each patient's medical record and included information on demographics, intraoperative pain medications, methods and frequency of postoperative pain assessment, and interventions used to relieve pain in the first 72 hours after surgery or trauma. We developed the Nursing Leadership Group Interview Form and the Medical Record Review Form on the basis of our clinical expertise and an extensive review of the literature. The tools were reviewed for content validity by 5 experts in pain research to ensure inclusion of all important aspects of pain management. Tools were finalized after the incorporation of experts' recommendations, such as adding information about documentation of behavioral and physiological indications of pain.

The Postoperative Pain Management Quality Assessment Survey from the Total Quality Pain Management Program (TQPM) was used to evaluate patients' perceptions of pain and pain management. The survey contains 5 areas of focused questions on education, impressions of pain management and the side effects of pain medication, duration of pain, intensity of pain, and satisfaction with pain relief. The tool was a combination of Likert-type agree or disagree questions and a visual, horizontal, numerical

pain intensity rating scale with 0 = no pain and 10 = worst possible pain. The survey was designed to evaluate patients' satisfaction with postoperative pain relief and used the Patient Outcome Questionnaire[6,16] of the American Pain Society as a starting point. Using more than 1400 responses from patients at 8 institutions, Abbott Laboratories (Abbott Park, Ill) did validation analysis for the TQPM survey. Construct validity was supported by examining 4 relationships. Patients' satisfaction correlated significantly with wait time for analgesic (r=–0.30, P< .001), pain expectations (r=0.54, P<.001), frequency of moderate to severe pain (r=0.46, P<.001), and worst pain intensity (r=–0.25, P<.001). Wait time for analgesic and worst pain intensity were inversely related because of the scoring system used.

Procedures

After selection and development of the tools, a pilot study was done with 4 patients and 1 group of nurse leaders. The formats of the 2 forms used were modified to improve the ease of data collection and entry. Approval from the appropriate institutional review board was obtained at each hospital.

The group of nurse leaders at each hospital was interviewed about pain management practices. The interviews were conducted by 2 investigators (an interviewer and a recorder) in a confidential manner. In order to avoid bias, investigators did not conduct the interview at the institution in which they worked, and they were not included as members of any group of nurse leaders.

In order to facilitate data collection for the interviews with patients and the reviews of medical records, a site coordinator and a data collector were designated at each hospital. The site coordinators and data collectors were all employed by their respective hospitals and collected data only at their hospital. All site coordinators and data collectors participated in a 2-hour instructional session. The session addressed the study protocol, tools, interviewing technique, and informed consent. Informed consent was obtained from each patient before the patient was interviewed and his/her medical records were reviewed. To ensure reliable data collection, a research assistant independently rated 1 of the first 7 medical record review forms for each data collector. No errors in data collection were detected. Hence, even though interrater reliability was not statistically tested, it appears that concordance across the raters was acceptable. The principal investigators and the research assistant in the study were available to data collectors for questions.

The Nursing Leadership Group Interview Form was completed before collection of data on individual patients at each hospital. The Medical Record Review Form was completed by the data collector after the interview with the patient. A bedside interview using the TQPM survey was done once before the patient's discharge from the intensive care unit (ICU) or at 72 hours postoperatively if the patient was to remain in the ICU. In the event that a patient was discharged from the ICU before the interview, the data collector could complete the interview up to 6 hours after discharge from the ICU. During the interview, patients were instructed to consider their entire ICU stay when answering interview questions.

Data Analyses

Descriptive statistics were used to analyze the demographic and clinical variables of the sample, all questions used in the interviews of patients, the amount and type of opioid ordered and given, the frequency of documentation of the results of pain assessment, the type of surgery, the route of administration of analgesics, and nonpharmacological interventions. Descriptive data from the Nursing Leadership Group Interview Forms were summarized.

The relationships between the 3 primary study variables (pain intensity, patients' satisfaction, and amount of opioid given) and selected independent variables were evaluated. Independent variables were selected on the basis of a review of the literature, input from the 5 experts on pain research, and the clinical expertise of the principal investigators. The relationship between pain intensity and the following 7 variables was evaluated: wait for an analgesic, ICU length of stay, the patient's pain expectations, the patient's sex, the patient's age, type of surgery, and explanation of the pain management plan. In addition, the relationship between patients' satisfaction and the following 8 variables was evaluated: pain intensity, pain expectations, wait for an analgesic, frequency of moderate to severe pain, the patient's age, the patient's sex, type of surgery, and explanation of the pain management plan. Route of analgesic administration was not included in these 2 analyses because most patients had analgesics given by more than a single route, and the route of administration was influenced by the surgical procedure performed. Finally, the relationship between the amount of opioid given on postoperative day 1 and the following 5 variables was evaluated: pain intensity, type of surgery, the patient's age and sex, and the route of analgesic administration. The significant univariate variables were used in exploratory regression analyses to determine which variables were predictive of

pain intensity, patients' satisfaction, and the amount of opioid given on postoperative day 1.

Data were missing for certain questions in the interviews with some patients because occasionally a patient did not or could not answer a question; therefore the sample size varied between questions. We found no differences in any characteristics (eg, the patient's age or sex) between patients with missing data and those with completed interviews. In order to explore the effect of assessment practices on pain intensity, patients' satisfaction, and the frequency of pain rating, data were sorted into 2 groups according to whether or not the hospital had a dedicated area on the ICU flow sheet for pain assessment.

In order to analyze the effects of the route of analgesic administration on the amount of opioid given and on patients' side effects and impressions, the sample was segmented into 7 groups according to route of administration (Table 1).

In order to analyze the effects of type of surgery on pain intensity, patients' satisfaction, and amount of opioid given, data were sorted into 5 groups according to type of surgery: patients who had sternal incisions (n=94), patients who had abdominal incisions (n= 39), patients who had vascular surgery (n= 38), patients who had thoracotomy incisions (n=27), and patients who had orthopedic surgery (n=10). The 6 trauma patients were grouped according to their primary injury or surgery. Five patients were deleted from the surgery group analysis because their surgery did not fit any of the 5 surgical groups.

In order to analyze the amount of opioid ordered and given, all doses of opioids were converted to morphine equivalents by using the equianalgesic charts of the Agency for Health Care Policy and Research[15] and the American Pain Society.[17] Opioids are reported in milligrams per hour for postoperative days 1 and 2.

Table 1 Distribution of route of analgesic administration used to analyze the amount of opioid given on postoperative day 1*

Route	No. of patients
Intravenous only	76
Intravenous plus oral	66
Patient controlled†	24
Spinal only‡	15
Spinal plus intravenous‡	13
Oral	6
None (no opioid analgesic while in the intensive care unit)	9

*Four patients were deleted from the analysis because of multiple routes of administration.
†All patients who had patient-controlled analgesics; 8 were given drugs by this route only; 16 had supplemental intravenous or oral analgesics.
‡Spinal administration includes all opioids received via epidural or intrathecal route during surgery or postoperatively by continuous infusion or injection (one-time or intermittent).

Results

Thirteen hospitals participated in the interviews of nurse leaders. Eleven hospitals provided data on individual patients, for a total of 219 patients. A total of 213 patients were included in the study; 6 patients were terminated from the study because data were missing (n=3), inclusion criteria were not met after informed consent was obtained (n=1), and one hospital could not recruit enough patients (n=2). Data on individual patients were not collected at 2 hospitals; patients did not meet the English-speaking criteria at 1 hospital and research support became unavailable at the other. Nine hospitals had 20 or more patients, 1 hospital had 15 patients, and 1 had 8 patients. Three patients were intubated at the time of the interview but could communicate with nonverbal gestures and therefore were interviewed. Table 2 summarizes the demographic characteristics of the sample.

What Are Patients' Perceptions of Pain and Its Management?

Table 3 is a summary of the main questions included in the interviews with patients and the patients' responses. Three themes were evident in the specific comments on how pain relief could have been improved: better explanation for patient-controlled analgesia (PCA), administration of medication before procedures, and patients' desire to have experts make decisions for them. Specific comments included the following: "I was not informed about how bad the pacer wires would hurt when being pulled out." "I feel doctors are the experts and should make the decisions." "I'm not a doctor; I don't know." "I don't think I was knowledgeable enough to give input."

Twenty-eight percent of patients did not recall an explanation of a pain management plan. Patients who reported that a pain management plan was not explained were more likely to be older than were patients who recalled receiving an explanation (69± 13.3 years, n=59 vs 62±12.7 years, n=154; t=–3.32, df=211, P<.001). Whether or not an explanation of

Table 2 Demographic characteristics of the study sample (N = 213)

Characteristic	Mean	SD	Range	Patients n	Patients %
Age, years	64	13.6			
Weight, kg	84.9	49.7			
Length of stay in the intensive care unit, hours*	30	16	4-88		
Sex					
Male				155	73
Female				58	27
Ethnicity†					
White				186	88
Hispanic				17	8
Black				5	2
Asian/Pacific islander				4	2
Type of surgery					
Coronary artery bypass graft and/or valve replacement				92	43
Abdominal surgery that included abdominal aortic aneurysm repair				37	17
Vascular (carotid endarterectomy, femoral-popliteal artery bypass)				36	17
Thoracotomy				25	12
Other surgeries				11	5
Trauma with or without surgery				6	3
Orthopedic surgery				6	3

*Three patients were included in the study who were interviewed in the intensive care unit after 72 hours (79, 84, and 88 hours); however, all other inclusion criteria were met.
†Data on one patient are missing.

the pain management plan was given did not significantly influence pain intensity or patients' satisfaction.

According to the interviews with the nurse leaders, some degree of preoperative teaching on pain management is offered at the majority of hospitals that participated in the study. However, at several hospitals, formal education of patients is routinely provided only for selected types of patients, such as cardiac surgical patients. The majority of education on pain is provided by nurses and anesthesiologists. The nurse leaders stated that the ICU nurses were usually not aware of what specific content was covered preoperatively or by members of other healthcare disciplines.

Patients' impressions and side effects for each route of analgesic administration were compared by using χ^2 analysis. Patients who received intravenous plus spinal analgesics reported significantly more itching than did patients who received analgesics via other routes. No other impressions or side effects were significantly different among the groups (Tables 4 and 5).

What Are the Predictors of Pain Intensity?

Patients had significantly higher pain intensity (1) when they had to wait longer for an analgesic than they did when the wait was short and (2) when they had more pain than expected. Patients who stayed in the ICU longer had significantly higher pain scores than did patients whose stays were shorter. The correlation coefficient between sex and pain intensity was not significant. However, according to the literature, women report a lower pain threshold than do men[10,18]; therefore, a one-tailed t test was done. The results revealed that women had significantly higher pain intensity scores than did men (6.9±2.8 vs 6.1±2.9; t=1.84, df=207, P=.04). The patient's age, type of surgery, and an explanation of the pain management plan did not significantly correlate with pain intensity. The exploratory regression analysis of the 4 significant univariate variables and the bivariate correlation coefficient between pain intensity and each predictor are presented in Table 6. The overall model was significant and accounted for 30% of the variation. All variables except sex were significant predictors of pain intensity.

What Are the Predictors of Patients' Satisfaction With Pain Relief?

Patients who had higher pain intensity, who

Table 3 Selected interview questions from the TQPM survey with patients' responses*

Patient interview question	Pain intensity			Responses	
	Mean	SD	Range	n	%
Please rate the worst pain you had after surgery.	6.4	2.86	1-10		
Please rate the least amount of pain you had after surgery.	1.5	1.78	0-9		
How often were you in moderate to severe pain after surgery?					
Always				9	4
Almost always				16	8
Often				39	18
Sometimes				106	50
Never				42	20
When you needed more pain medicine, what was the longest time you had to wait to get it?					
Less than 5 minutes				153	72
5-30 minutes				35	16
30-60 minutes				6	3
More than 1 hour				6	3
No pain medication or missing data				13	6
Compared with what you expected, how much pain did you have after surgery?					
Much more than expected				34	16
A little more than expected				24	11
As much as expected				53	25
A little less than expected				53	25
Much less than expected				45	22
How satisfied were you with the pain relief you received after surgery?					
Very dissatisfied				8	4
Dissatisfied				7	3
Neutral				19	9
Satisfied				71	34
Very satisfied				106	50
Did anyone from the hospital explain how your pain would be relieved after surgery?					
Yes				153	72
Before surgery				65	43
After surgery				22	15
Before and after surgery				63	42
No				60	28
If you ever need surgery again, would you like your pain treated the same way as this time?					
Yes				184	88
No				26	12
Please let us know how we could have improved your pain relief.					
Better explanation of pain-relief method				36	17
Better pain relief				41	19
Faster pain relief				45	21
More of a say in pain-relief method chosen				16	8
No improvement needed				103	53
No comment				17	8

*Not all percentages equal 100%, and sample sizes vary because more than a single answer was accepted for some questions and occasionally a patient did not or could not answer a question.

TQPM, Total Quality Pain Management program

Table 4 Patients' impressions of pain management by route of analgesic administration

Question asked during interview	Percentage of patients who answered yes to the question*						
	All routes (n = 209)†	IV only (n = 76)	IV/PO (n = 66)	PCA (n = 24)	Spinal (n = 15)	IV/spinal (n = 13)	PO (n = 6)
The method of pain relief was painful.	NA	14	11	12	20	31	17
I had to wait too long to get pain medicine.	NA	13	11	12	13	0	0
The pain relief was too slow.	NA	12	21	29	14	0	17
I never had good pain relief.	NA	11	18	21	27	0	0
I was concerned about bothering the nurse to ask for pain medicine.	16	16	18	25	7	8	17
I was concerned about becoming addicted to the pain medicine.	14	15	12	17	27	8	17

*Questions from the TQPM survey, Total Quality Pain Management Program. Data from 4 of the 213 patients were excluded from this analysis because of multiple routes of analgesic administration.
†Nine patients received no analgesic while in the intensive care unit; their responses are included for the last 2 questions, and a no analgesic group was included in significance testing.

IV, intravenous; NA, not applicable; PO, oral; PCA, patient-controlled analgesia alone or in combination with PO and or nurse-administered IV analgesic.

reported frequently being in moderate to severe pain, who had to wait longer for an analgesic, and who had more pain than expected had significantly lower satisfaction scores than did patients without these characteristics. Age, sex, type of surgery, and explanation of a pain management plan did not significantly correlate with patients' satisfaction.

A correlation matrix of the 4 significant independent variables indicated that pain intensity and 2 variables, frequency of moderate to severe pain and

Table 5 Frequency of patient-reported side effects by route of analgesic administration

Question asked during interview	Percentage of patients who answered yes to the question*					
	IV only (n = 76)	IV/PO (n = 66)	PCA (n = 24)	Spinal (n = 15)	IV/spinal (n = 13)	PO (n = 6)
I had lots of itching.	9	17	17	20	54†	17
I had numbness or tingling in my legs.	4	11	5	20	15	0
I felt sleepy too often.	34	47	46	27	54	0
I often felt nauseous or sick to my stomach.	14	23	17	7	0	0

*Questions from the TQPM survey, Total Quality Pain Management Program. Data from 4 of the 213 patients were excluded from this analysis because of multiple routes of analgesic administration. Nine patients received no analgesic while in the intensive care unit (their responses were not included in this table) and a no analgesic group was included in significance testing.
†Significantly more patients in the IV/spinal route of administration group reported itching than in the other groups ($\chi^2 = 18.32$, $df = 6$, $P<.01$)

IV, intravenous; PO, oral; PCA, patient-controlled analgesia alone or in combination with PO and or nurse-administered IV analgesic.

Table 6 Exploratory simultaneous regression to determine predictors of pain intensity (N = 193*)

Predictor	r	Beta
Wait for an analgesic	0.24†	.17‡
Expectations of pain	−0.52†	−.42†
Length of stay in intensive care unit	0.23†	.16‡
Sex (female, 2; male, 1)	0.13	.08
R^2 0.30		
Adjusted R^2 0.29		
$F(4, 188)$		20.45†

*N does not equal 213 because of missing data on one or more of the variables.
†$P<.001$.
‡$P<.05$.

r, bivariate correlation coefficient between the dependent variable and each predictor; beta, standardized beta. Negative beta values indicate an inverse relationship between variables.

Table 7 Exploratory simultaneous regression to determine predictors of patients' satisfaction with pain relief (N = 197*)

Predictor	r	Beta
Wait for an analgesic	−0.29†	−.22‡
Expectations of pain	0.30†	.12
Frequency of moderate to severe pain	−0.36†	−.27†
R^2 0.20		
Adjusted R^2 0.19		
$F(3, 193)$		16.38†

*N does not equal 213 because of missing data on one or more of the variables.
†$P<.001$.
‡$P<.01$.

r, bivariate correlation coefficient between the dependent variable and each predictor; beta, standardized beta. Negative beta values indicate an inverse relationship between variables.

expectations of pain, had *r* values greater than 0.50. An exploratory regression analysis with 3 of the 4 significant univariate variables was done to determine predictors of satisfaction. In order to minimize multicollinearity, pain intensity was not entered into the regression analysis. The exploratory regression analysis of the 3 selected variables and the bivariate correlation coefficient between satisfaction and each predictor are presented in Table 7. The overall model was significant and accounted for 20% of the variation. All variables except expectations of pain were significant predictors of patients' satisfaction.

What Are the Current Pain Assessment Practices?

Assessment Tools. According to the interviews with the nurse leaders, all nurses used a 0-to-10 verbal numerical scale to assess pain; in addition a 0-to-10 visual numerical scale was used at 3 hospitals. Nurse leaders at only 4 hospitals reported having alternative tools available for patients who did not speak English and for patients who had functional deficits (eg, were blind, deaf, or intubated). According to the nurse leaders, when alternative tools were not available or were not used, nurses used subjective assessment, physiological signs and symptoms, interpreters, gestures, or pencil and paper to assess pain in these patients.

Assessment at Hospital Admission and During the Initial Nursing Shift. A patient's current pain status was the only pain variable routinely included in the assessment done at the time of admission at the majority of hospitals. Patients' past experience with pain and an acceptable level of pain were included in the hospital admission assessment at only 3 hospitals. A preprinted area for pain assessment was included on the ICU record or flow sheet used during each shift by nurses at 10 of the 13 hospitals. The majority of the preprinted areas included only pain intensity, location of pain, and associated symptoms.

Frequency of Reassessment. In hospitals that had a written standard for reassessment of pain, the frequency of reassessment was every 2 to 4 hours or as needed. Data on individual patients revealed that some hospitals documented pain assessment almost every 2 hours, whereas others documented it less than once in 24 hours. However, according to the interviews, many nurse leaders thought that pain most likely was assessed more often than it was documented.

In the first 24 hours after surgery, only 116 patients (54%) had a numerical pain rating documented; however, 193 (91%) had a pain description (eg, physiological or behavioral cue) documented. The higher the pain intensity, the more frequently the pain rating was documented on postoperative day 1 (r= 0.25, $P<.001$). In order to explore the influence of a

preprinted area for pain assessment, patients were placed into 2 groups according to whether or not the hospital had a dedicated area for pain assessment on the flow sheet used for overall assessment of patients' condition. Patients at hospitals with a dedicated area (n=178) had pain ratings documented significantly more often than did patients at hospitals without a dedicated area (n=35; $F[1,195]=13.58$, $P<.001$). However, we found no significant difference between these 2 groups for patients' satisfaction or patient-reported pain intensity.

What Are the Current Pain Intervention Practices?

Amount of Opioid Given. The maximum amount of opioid ordered, the amount given, and the percentage for each group based on routes of analgesic administration are listed in Table 8. The amount of opioid given each patient was not compared with the patient's body weight. Patients who reported higher pain intensity scores received more opioid than did patients with lower pain scores ($r=0.26$, $P<.001$). The older the patient, the less opioid he or she received on postoperative day 1 ($r=-0.15$, $P=.03$). The patient's sex did not significantly correlate with the amount of opioid given. The amount of opioid given on postoperative day 1 was also significantly related to the type of surgery ($F[4,203]=4.39$, $P=.002$), and route of analgesic administration ($F[6,202]=7.65$, $P<.001$). An analysis of the means with the Tukey HSD (honestly significant differences) test revealed differences in the amount of opioid received on postoperative day 1 for the 5 surgical groups. Patients who had either a thoracotomy or abdominal surgery received significantly more opioid (mean=1.7 mg/h, SD=1.72, and mean=1.6 mg/h, SD=2.05, respectively) than did patients who had cardiac surgery (mean=0.8 mg/h, SD=0.56). An analysis of the means with the Tukey HSD showed that patients in the PCA group received more opioid than did patients in the intravenous, oral, or intravenous plus oral groups. Differences between the spinal, spinal plus intravenous, and PCA groups in the amount of opioid given were not significant.

An exploratory hierarchical regression analysis was used to further analyze the relationship of pain intensity, age, type of surgery, and route of analgesic administration with the amount of opioid given on postoperative day 1. Pain intensity and age were entered simultaneously, and each had a significant individual contribution accounting for 8% of the variation. Then the 5 types of surgery were dummy coded and entered before the analgesic routes of administration because the route of administration is often determined by the type of surgery. The surgical groups were significant and accounted for 8% of the variation. The 7 routes of analgesic administration were dummy coded and entered last; the results showed that they were significant and accounted for an additional 9% of the variation. The overall regression model was significant, accounting for 25% of the variance (Table 9).

Nonpharmacological Interventions Used. Patients who reported higher pain intensity had nonpharmacological interventions documented more often than did

Table 8 Amount of opioid ordered and given in the first 48 hours after surgery by route of analgesic administration*

Route of administration	Day 1 (n = 209)	Maximum amount ordered, mg/h		Amount given, mg/h		Percentage of ordered given†	Day 2 (n = 98)	Maximum amount ordered, mg/h		Amount given, mg/hr		Percentage of ordered given†
		Mean	SD	Mean	SD			Mean	SD	Mean	SD	
All routes	209	9.4	8.1	1.1	1.3	14	98	30.4	64.6	1.2	2.6	10
IV	76	8.9	6.6	0.9	0.7	12	26	25.5	44.0	0.6	0.6	6
IV/PO	66	7.7	4.0	1.0	0.6	15	43	19.2	45.0	0.7	0.9	9
PCA	24	17.3	15.5	2.4	1.6	21	15	74.0	118.0	4.3	5.8	19
Spinal	15	8.3	7.6	1.8	3.3	8	4	37.3	65.4	0.2	0.2	12
IV/spinal	13	7.5	5.7	1.4	1.7	29	6	37.9	70.0	1.0	1.3	17
PO	6	11.2	10.5	0.3	0.3	4	3	2.7	3.3	0.1	0.1	6
None‡	9	8.0	6.5	00	00	0	1	00	00	00	00	0

*Four patients were excluded from this analysis because of multiple routes of analgesia. All opioids were converted to morphine equivalents (see text).
†The percentage reflects the ratio of the amount given to the maximum amount ordered for individual patients.
‡All of these patients received IV opioid in the operating room.

IV, intravenous; PO, oral; PCA, patient-controlled analgesia.

Table 9 Exploratory hierarchical regression to determine predictors of amount of opioid given on postoperative day 1 (N = 205*)

Predictor	Beta	R^2 change	F	df
Pain intensity and age				
Pain intensity	.24†	0.08†	9.15	2,202
Age	-.14‡			
Type of surgery		0.08§	4.72	4,198
Route of analgesic administration		0.09§	3.88	6,192
Overall model		0.25†	5.43	12,192

*N does not equal 213 because of missing data or exclusion of patients from 1 or more of the variables.
†$P<.001$.
‡$P<.05$.
§$P<.01$.
Beta, standardized beta. Negative beta values indicate an inverse relationship between variables. Surgical type and analgesic route were dummy coded and betas are not shown.

patients with lower pain intensity ($r=0.15$, $P=.04$). Nonpharmacological interventions were documented 83 times on 67 patients on postoperative day 1, 14 times on 84 patients on postoperative day 2, and 3 times on 25 patients on postoperative day 3. The most common intervention was "positioning" (52 times); the second most common, massage (11 times); and the third most common, a relaxation exercise (8 times).

Discussion and Implications

Patients' Perceptions and Predictors of Pain Intensity and Patients' Satisfaction

Patients' satisfaction with pain relief is influenced by a multitude of factors, and many patients report satisfaction with pain management despite high pain levels.[7,8,14,19-25] Therefore, measuring patients' satisfaction alone is not a reliable outcome for determining the quality or effectiveness of pain management. Miaskowski et al[15] state several recommendations for enhancing the validity of surveys of satisfaction and advocate a descriptive, numeric scale to evaluate both patients' satisfaction with pain relief and staff members' responsiveness. Thomas et al[26] found that low satisfaction among patients was influenced by high preoperative pain severity, high anxiety, younger age, female sex, and high willingness to report pain. Further qualitative research is needed to explore the incongruity between high pain levels and satisfaction with pain relief.

Our study revealed that in addition to pain intensity, frequency of moderate to severe pain and how long patients must wait for an analgesic were predictors of satisfaction with pain relief. Patients' expectations of pain also correlated with satisfaction, although the expectations were less important in the context of the other variables. Patients' expectations as a variable may be less important when pain is relieved and staff members are responsive to patients' reports of pain. In general, patients expect to have pain after surgery.[8,19,23,24,27] Information provided to patients about how much pain to expect after surgery should be realistic. Minimizing expectations about the level of postoperative pain may lessen patients' preparation to cope with pain,[27,28] and overemphasizing pain may induce anxiety. Further qualitative research is needed to explore variables that influence patients' expectations of pain and how those expectations influence both pain intensity and satisfaction with treatment.[15]

The American Pain Society recommends that patients receive pain medications within 15 minutes of a request for pain relief.[16] Reducing the wait for an analgesic is a method of showing patients that pain management is a high priority. Empathizing with patients' pain and treating pain rapidly or preemptively can positively influence both patients' satisfaction and their pain intensity.[1,22] Further research is needed on factors that influence the perception of pain, including ethnicity, sex, age, education level, functional status, income status, depression, anxiety, severity of illness, and type of physician or team managing pain.

More than 25% of the patients in our study reported receiving no education on pain management. Our results indicated that providing an explanation of a pain management plan did not affect patients' pain intensity or satisfaction; however, the explanation as a variable was not controlled. Our results also indicated that older patients were less likely than younger patients to report that they were given an explanation of a pain management plan. Whether this correlation reflects that elderly patients did not receive an explanation or that they did not recall the explanation, it emphasizes the need to thoroughly assess learning style and barriers to learning. Reinforcement of the pain management plan is important, especially for elderly patients.[11] Until patients are adequately educated about the hazards of pain and the available options for pain relief, healthcare providers cannot expect them to fully participate in pain management.[29] Improvement is needed in the coordination of the pain management plan and the education of patients among the various healthcare disciplines and across the continuum. Bookbinder et al[1] reported that

patients' satisfaction can be improved when pain management is well coordinated and is evaluated by using interdisciplinary quality improvement programs.

The differences between groups of patients for routes of analgesic administration and patient-reported side effects and impressions of pain relief were not significant, perhaps because of the small sizes of the subgroups. Nevertheless, the prevalences of itching, concern about becoming addicted, and bothering the nurse were high. Therefore, practitioners should anticipate that patients will experience itching when the spinal route is used and give patients medications as needed, should educate patients about the low risk of addiction, should effectively communicate that pain relief is a high priority, and should encourage patients to report pain.

Patients who were in the ICU longer reported higher pain intensity than did patients who were in the unit for a shorter time. This finding most likely reflects severity of illness, extensiveness of surgery, and comorbidities that were not controlled for in our study. Controlled studies that examine patients' pain-related outcomes, such as length of stay and specific complications, are needed. The type of surgery did not significantly correlate with pain intensity; this finding may reflect use of the appropriate route of analgesic administration and appropriate opioid dosing for certain surgical categories. Patients in the PCA group received the greatest amounts of analgesics, but the amounts were not statistically different from those received by patients in the intravenous plus spinal and spinal groups. However the majority of patients who had PCA also received supplemental intravenous or oral analgesics. Thus, nurse-administered analgesics also contributed to the PCA group's receiving more opioid. Our analyses revealed a weak relationship between patients' sex and pain intensity, with women reporting high pain levels. Other studies[4,18] have indicated that women had higher pain intensity, a lower pain threshold, and less tolerance than did men, but these results were not conclusive. Women may be more likely than men to express pain, but sex-related difference in reporting pain is only one variable. Other related variables not controlled for in our study include patients' activity level and body weight and the sex of the caregiver, which may also influence patients' expression of pain.

Pain Assessment

Assessment of pain in the critical care environment is difficult because patients often cannot communicate their pain. In our study, use of alternative tools was uncommon when a patient's functional status did not allow communication with a visual or numerical rating scale. Behavioral or physiological cues were documented more often than a pain-rating score. Although these cues may assist in assessing the presence of pain,[2] they may be unreliable and can cause nurses to underrate pain[30,31] or to confuse pain with anxiety.[3] Therefore, research-based assessment tools that use physiological and behavioral cues of pain are needed.[2,32] Pain assessment should be multidimensional whenever possible.

Pain cannot be adequately treated unless it is adequately assessed. Assessment practices are often determined by the tools provided to the nurses.[15,20,33-35] Voigt et al[34] found a decrease in reported pain intensity when use of a pain flow sheet was implemented. Our results indicated an increase in the frequency of pain assessment when a preprinted area for this purpose was provided on an assessment flow sheet. However, inclusion of a preprinted area on the flow sheet did not influence pain intensity or patients' satisfaction. In our study, a variety of documentation tools were used by the participating hospitals; therefore, speculating on the impact of a preprinted pain documentation tool on the basis of these findings is inappropriate. Furthermore, nurses may not document every pain rating that is obtained, or they may not effectively treat pain on the basis of the assessment.

Pain Intervention Practices

Factors other than pain intensity that determined how much analgesic was given included the patient's age, type of surgery, and the route of analgesic administration. Older patients received less opioid in the first 24 hours after surgery than younger patients, a result that is consistent with previous findings.[36] Interestingly, Duggleby and Lander[11] found that the elderly often describe pain as fatigue or weakness. They also found that pain, not analgesic intake, predicted decline in mental status in elderly patients. Additional research is needed on how the elderly describe their pain and on the effect of pain on mental status. The type of surgery a patient had influenced the amount of analgesic given. Also the route of analgesic administration influenced the amount of opioid given. Therefore, selecting the most appropriate route of analgesic administration, guided by the type and extensiveness of surgery, is important in ensuring adequate pain relief.

The amount of opioid needed may be reduced when nonpharmacological pain interventions are used.[37,38] In our study, only 33% of patients had nonpharmacological interventions documented, a finding that is consistent with other reports.[5,39] Either nurses

perform the interventions but do not document the procedures, or they are reluctant to use nonpharmacological interventions because of a lack of knowledge, lack of time, disbelief in the value of such interventions, or concern that patients will not accept these interventions. Instructing patients about nonpharmacological pain interventions preoperatively and providing reinforcement postoperatively can enhance pain relief.

Our results indicated that most opioid orders specified that the drugs be given as needed and that the dose of opioid administered was considerably less than the maximal dosage allowed by the physician's order; these findings are congruent with those of other studies.[9,40,41] As previously noted,[4,36,41,42] critical care nurses are given substantial latitude to choose which opioid, which dose, and, many times, which route of administration are best for a particular patient. It is primarily the nurses' responsibility to administer the proper drug and dose at the proper time. Therefore, critical care nurses must accurately assess and recognize pain, differentiate pain from anxiety, have a thorough understanding of the pharmacology of and possible adverse reactions associated with each analgesic, and administer sufficient medication.[43,44] Nurses are in a position to facilitate an interdisciplinary approach to pain management. Recent articles[45,46] have reported the cost-effectiveness of designating an advance practice nurse to manage acute pain programs. Reports[41,42] also indicate that collaborative interdisciplinary relationships among nurses, pharmacists, and physicians are important to the success of effective prescribing practices. An aggressive, organized approach to pain assessment and management can reduce pain and increase patients' satisfaction with pain management.[1,7,14,20]

Limitations

Study of pain in the critically ill is difficult. A patient's report of pain is a multidimensional variable; that is, pain is influenced by numerous variables (eg, patients' perceptions, type of surgery, and amount of opioid received) that are difficult to isolate. Also, the patients' satisfaction is a multidimensional variable, and a full understanding of its significance and impact on analgesic practices is difficult. In our study, data on individual patients were limited by 4 primary factors. Information on the pain management interventions were obtained via a chart review; therefore, interventions not documented were not included. A nonrandomized sample of patients was used and may not have accurately represented the population of patients, level of nursing skill, or types of physicians. Patients in the ICU often receive numerous medications that could affect the ability to recall even recent events. In addition, patients' doses of analgesics and pain intensity were not controlled for during the interviews. A single interview may not reflect patients' experience throughout their ICU stay.

Summary

Patients are generally satisfied with their pain relief even though they often have moderate to severe pain. Measuring patients' satisfaction alone is not a reliable outcome for determining the effectiveness of pain management. Explanations provided to patients about how much pain to expect should be realistic. Healthcare providers should treat pain rapidly to show that pain management is a high priority.

Improvement is still needed in pain assessment and reassessment. Alternative tools, such as a communication board, for patients with functional deficits should be readily available and routinely used. Preprinted areas on assessment and flow records can help ensure consistent assessment of pain and reassessment after pain interventions. The development of physiological and behavioral pain-rating tools would improve pain assessment in patients with altered consciousness.[2,29] These tools would be particularly helpful in the critical care setting, where healthcare providers rely on physiological and behavioral cues to assess pain. However, improved assessment skills and tools must be accompanied by appropriate treatment.

An effective pain management plan requires selection of an appropriate route of analgesic administration, an emphasis on "around the clock" rather than as-needed administration of analgesic, management of side effects, and use of nonpharmacological interventions. For elderly patients, particular attention should be paid to explaining the pain management plan and providing postoperative reinforcement. A pain management plan for all patients should be established preoperatively and should be coordinated across disciplines and throughout patients' hospitalization.

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