Effects of an Opioid Taper Algorithm in Hematopoietic Progenitor Cell Transplant Recipients

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Purpose/Objectives: To examine the effects of an opioid taper algorithm on the length of taper, pain levels, withdrawal symptoms, and satisfaction with pain management in hematopoietic progenitor cell transplant (HPCT) recipients and nurse documentation of patient response to taper.

Design: Quasi-experimental.

Setting: A 32-bed HPCT unit in a large tertiary U.S. healthcare center.

Sample: 106 HPCT recipients, 5–64 years of age.

Methods: In phase 1, baseline data were collected from 45 patients during opioid tapers, with no study intervention. In phase 2, an opioid taper algorithm was implemented as the study intervention for 61 patients.

Main Research Variables: Phase 1 and phase 2 pretaper and taper opioid dosage, length of taper, nurse documentation, patient-reported pain and withdrawal symptoms, and nurses' perspectives about the use of tapers.

Findings: Use of the algorithm in phase 2 resulted in decreasing taper time by a mean of 0.4 days, a significant decrease in withdrawal symptoms, a significant increase in only 1 of 10 aspects of nurse documentation, and no significant differences in patient self-reports of worst pain or satisfaction with pain management. Nausea, vomiting, diarrhea, insomnia, and runny nose were the withdrawal symptoms reported most frequently.

Conclusions: Use of the algorithm improved tapering practice somewhat without disadvantaging patients.

Implications for Nursing Practice: Use of an opioid taper algorithm may promote consistency of tapering practice.

Key Points . . .

- ➤ Use of an opioid taper algorithm in transplant recipients can shorten the length of taper and significantly decrease withdrawal symptoms.
- ➤ Children receive significantly more opioids in morphine equivalents per kilogram (MEK) during opioid tapers and experience significantly longer tapers than adults.
- ➤ Length of opioid tapers correlates with length of pretaper opioid therapy and pretaper MEK.
- ➤ Patients were satisfied with their pain management and experienced low pain levels when opioids were tapered with and without using an algorithm.

Many hematopoietic progenitor cell transplant (HPCT) recipients receive opioids for several days or weeks to manage pain that typically escalates after transplant and decreases with engraftment (Ben David & Musgrave, 1996; Chapko, Syrjala, Schilter, Cummings, & Sullivan, 1989; Ford, 1991; Gaston-Johansson, Franco, & Zimmerman, 1992; Hill et al., 1990; Pederson & Parran, 1999; Syrjala & Chapko, 1995). Increasing amounts of an opioid are required to manage rising pain levels or to address the development of opioid tolerance (Anand & Arnold, 1994; McGuire, Yarbro, & Ferrell, 1995; Schug, Zech, & Grond, 1992). Physical dependence may develop after two to three days of opioid therapy (McGuire et al., 1995).

When pain resolves, opioids should be tapered gradually to prevent the development of withdrawal symptoms in physically dependent patients (Anand & Arnold, 1994; Jacox et al., 1994; McGuire et al., 1995). Tapering practice varies, and nurses state that patients often experience withdrawal symptoms (Pederson & Parran, 1997). Opioid tapering practice may affect patient outcomes, such as length of hospital stay and patient satisfaction with management of withdrawal symptoms and pain.

In the absence of an opioid taper guideline, clinicians rely on their knowledge of opioids, intuition, and past clinical experiences to guide decisions regarding the rate of taper and the assessment and treatment of withdrawal symptoms. Because clinicians vary in regard to knowledge and experience with opioid tapering, patients would benefit from a research-based guideline that provides decision-making cues for clinicians to observe when tapering opioids. With a guideline, clinicians would be able to individualize a taper for each patient and use an expedient taper for patients who have no withdrawal symptoms.

No research-based opioid taper guideline was found in the literature. The researchers reported baseline opioid tapering

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practice data in a previously published article (Pederson & Parran, 2000). In this article, the researchers describe a comparison between baseline practice with use of an algorithm. The algorithm was described previously (Parran & Pederson, 2000). The purpose of the current study was to examine the effects of an opioid taper algorithm on the length of opioid tapers, pain levels, satisfaction with pain management, and withdrawal symptoms in HPCT recipients and nurse documentation of patients' responses to taper.

Literature Review

Pain and Opioid Therapy in Hematopoietic Progenitor Cell Transplant Recipients

Candidates for HPCT undergo preparative regimens, including radiation therapy and chemotherapy in myeloablative or nonmyeloablative doses, which may affect the degree of mucositis and associated pain. HPCT recipients of various ages and transplant types experience severe pain and receive opioid therapy (Chapko et al., 1989; Gaston-Johansson et al., 1992; Hill et al., 1990; McGuire et al., 1993; Pederson & Parran, 1999). Opioids are the cornerstone of therapy for severe pain, and morphine is the standard for opioid therapy (Anand & Arnold, 1994; Jacox et al., 1994).

The duration of opioid use post-transplant varies widely. Dunbar (1995) found that 39 preteen bone marrow transplant (BMT) recipients received opioids for a mean of 19 days and that 8 children received opioids for greater than 10 days, 18 children received them for 10–20 days, 9 children received them for 21–30 days, and 6 children received them for greater than 30 days. Also, the chemotherapy and radiation conditioning regimen and doses used prior to transplant affect the duration of opioid use. In a study of 20 adults, Zerbe, Parkerson, Ortlieb, and Spitzer (1992) found that patients receiving busulfan as a conditioning chemotherapy for BMT received continuous infusion morphine therapy for an average of 9.71 days with a range of 5–14 days, whereas patients receiving total body irradiation received morphine for an average of 18.71 days with a range of 10–37 days.

Total opioid dosage differed significantly between adults and children in a study of pain and distress in 20 adults and 20 children 5–54 years of age during a 22-day post-BMT period (Pederson & Parran, 1999). Results indicated that children received 3–5.6 times greater total daily morphine equivalents per kilogram (MEK) than adults. Daily MEK means ranged from 0.03–0.63 in adults and from 0.09–1.88 in children. Daily means of adult and child self-reported pain were similar and indicated mild pain.

A study comparing patient-controlled analgesia (PCA) and continuous infusion (CI) was conducted with 20 adolescents undergoing BMT who were randomly assigned to groups (Mackie, Coda, & Hill, 1991). The PCA group received CI at night. Over the 10 days of the study, opioid dosage in the PCA group was significantly lower than in the CI group ($t = 3.262$, $p < 0.01$). Cumulative morphine was 12.17 mg/kg for patients receiving CI and 4.94 mg/kg for patients receiving PCA. Pain scores did not differ between groups.

Physical Dependence

Dependence is the requirement for continued administration of a drug to prevent withdrawal symptoms (Anand & Arnold, 1994). Clinicians should assume that dependence exists following repeated administration of an opioid for more than two or three days and dependence is very common after 10 days (Anand & Arnold; McGuire et al., 1995; Schug et al., 1992). Physical dependence requires the continued administration of the opioid to prevent withdrawal symptoms, including agitation, dysphoria, tachycardia, tachypnea, rhinorrhea, lacrimation, salivation, chills, goose flesh, hyperventilation, mydriasis, muscle aches and spasms, bone pain, yawning, restlessness, anxiety, insomnia, diaphoresis, abdominal cramps, nausea, vomiting, diarrhea, and fever (Jaffe, 1990; McGuire et al., 1995; Milhorn, 1992; Schug et al., 1992).

Physical dependence can lead to withdrawal symptoms during taper. To prevent withdrawal symptoms, clinicians can use the same pretaper opioid, an alternative opioid, or an alternative route when tapering. Nonopioid medications, such as clonidine, benzodiazepines, and barbiturates, also are used to manage withdrawal symptoms. These agents are not cross-tolerant with opioids and, therefore, are not appropriate as primary agents (American Pain Society, 1999; Anand & Arnold, 1994).

Opioid Tapering and Withdrawal Symptoms

Research reports of withdrawal symptoms during opioid tapering have included infants but not older children and adults. French and Nocera (1994) used the Neonatal Abstinence Scoring Tool (NAST) to measure withdrawal symptoms in 12 critically ill children less than 25 months of age receiving fentanyl. In 50% of subjects, the researchers observed a cluster of symptoms that included tremors with or without stimulation, increased muscle tone, insomnia, and increased respiratory rate and effort. NAST scores correlated with fentanyl dosage ($r = 0.76$, $p < 0.05$), length of fentanyl infusion ($r = 0.70$, $p < 0.05$), and chloral hydrate dosage ($r = 0.62$, $p < 0.05$). Findings suggested a need for an observation protocol and a possible weaning regimen.

Similarly, Katz, Kelly, and Hsi (1994) observed withdrawal symptoms in 57% of 23 critically ill infants and children, one week to 22 months of age. Fentanyl was tapered by 50% every 24 hours for two days then discontinued unless symptoms indicated severe narcotic withdrawal. Scoring with the NAST was performed every two hours for 24 hours then every four hours for 48 hours after the fentanyl was discontinued. Withdrawal signs primarily were gastrointestinal and neurologic, such as poor feeding, vomiting, tremors, and irritability. Infants who experienced withdrawal symptoms received significantly higher total fentanyl doses (2.96 ± 4.10 versus 0.53 ± 0.37 mg/kg, $p < 0.005$) and longer duration of infusion (13.1 ± 11.3 versus 3.8 ± 1.5 days, $p < 0.0001$).

Variability of Opioid Taper Guidelines

Few literature sources discuss opioid tapering, and no sources discuss opioid tapering in patients undergoing HPCT. Although taper guidelines have been suggested, guidelines have not been tested in research studies. General taper guidelines include reducing the opioid by 10% daily for 10 days or 5% daily for 20 days (McCaffery & Beebe, 1989); reducing by 25%–50% every 6 to 8 hours for opioids given for less than one week and a 20% initial reduction for opioids given for over a week with subsequent reductions of 10% every 12 hours (Anand & Arnold, 1994); and reducing 25% of the dose in four divided doses with subsequent reductions of 50% every two days (Foley & Inturrisi, 1987). The American Pain

Society (1999) recommended tapering 50% of the previous daily dose at six-hour intervals for two days, then reducing by 25% every two days until reaching a total dose of 30 mg a day of oral morphine in adults or 0.6 mg/kg a day in children. After two days at the minimum dose, the opioid is discontinued.

Gradually tapering the pretaper opioid dose over 5 to 10 days may be the most convenient strategy (Berde et al., 1990). A successful taper of low to moderate doses of opioids administered for fewer than five days can be accomplished within three to four days, but the time required for tapering increases proportionately if the opioid has been given for greater than five days (Anand & Ingraham, 1996). Ideally, tapering opioid dosages should result in a patient who is not agitated, distressed, overly sedated, or experiencing sleeplessness. Patients, however, may manifest signs of mild opioid withdrawal (Anand & Arnold, 1994). Controlled clinical trials in which researchers compare different regimens to prevent or treat opioid withdrawal in critically ill patients are clearly indicated (Anand & Arnold). In summary, despite the prevalence of opioid dependence and withdrawal symptoms, few researchers have examined opioid tapering or withdrawal symptoms. Few parenteral opioid taper guidelines were found in the literature, and some were complex. Studies of HPCT recipients' opioid dosages indicate that patients receive opioids long enough for clinicians to expect development of physical dependence.

Conceptual Framework

Implementing an opioid taper guideline is an innovation in practice for most clinicians. The rate at which people will adopt an innovation is determined by its (a) relative advantage, (b) compatibility with the user's values, beliefs, and past experiences, (c) low complexity, (d) ability to be used on a trial basis, and (e) observability (Rogers, 1995). Rogers' Model of the Innovation-Decision Process consists of five stages. **Knowledge** occurs when people learn about the innovation and how it works. **Persuasion** occurs when people form a favorable or unfavorable attitude toward the innovation. **Decision** occurs when people engage in activities that lead to adopting or rejecting the innovation. **Implementation** occurs when people use the innovation. **Confirmation** seeks reinforcement of the innovation-decision or reverses a previous decision to adopt or reject the innovation if people are exposed to conflicting messages about the innovation.

In the current study, the investigators proposed that an innovation, the opioid taper algorithm, provided HPCT nurses with the relative advantage of having a consistent, yet flexible, guideline. The algorithm was compatible with nurses' past experience of tapering in 10% increments and was not complex (Parran & Pederson, 2000). The researchers observed the use of the algorithm through nurse documentation of opioid dosage, and the present study was the trial basis.

During a one-hour in-service program, the researchers educated nurses about the algorithm and attempted to persuade nurses to use it. The researchers used commonly encountered clinical case examples to reinforce how nurses could use the algorithm to affect their patients' opioid taper and prevent or control withdrawal symptoms. Principles of pain management and managing discomfort from withdrawal symptoms were included with specific case examples. The nurses also were given standing written orders to use the algorithm. Implementation of the algorithm was evident in the nurses' documentation of opioid dosages. Following three presentations of the study results by the investigators, nurses confirmed their support for retaining the algorithm as part of their standard practice.

Using an algorithm to taper opioids following intense therapy may prevent or decrease withdrawal symptoms that result from physical dependence. Using this framework to implement the opioid taper algorithm may promote the adoption of a new opioid taper practice.

Method

Study Design

The investigators used a quasi-experimental design. Although the investigators implemented an intervention, they did not randomly assign study participants to groups.

Sample and Setting

The sample was 106 HPCT recipients. The researchers selected patients who had received HPCT within one month, had been on opioid therapy for at least two days, and were at least five years of age. Exclusion criteria were having a known history of drug abuse or diagnosis of veno-occlusive disease of the liver. The setting was a 32-bed unit in a large tertiary-care center in a large Midwestern city in the United States.

Study Intervention

An opioid taper algorithm, developed by the investigators (Parran & Pederson, 2000), was used in phase 2. In phase 1, the investigators examined baseline tapering practice with no intervention. Prior to the beginning of phase 2, nurses were paid to attend a one-hour program about the taper algorithm. The program consisted of a detailed explanation of the algorithm and rationale for each step. Case studies were used to illustrate application of the algorithm. A learning packet that provided the algorithm, standing orders, case studies, and appropriate forms was placed in the medication room. Signed standing orders and a taper medication form were placed in the chart of each patient participating in the study. A neon sticker on the chart cover and a statement in the care plan alerted nurses that a patient was in the study. The unit clinical nurse specialist repeatedly supported use of the algorithm throughout phase 2 and provided consultation to nurses regarding application of the algorithm in specific clinical situations. In a separate one-hour program, investigators informed physicians about the algorithm. Investigators asked the physicians to sign standing orders that would support the use of the algorithm for patients who had consented to participate in the study.

For patients who had been on opioids less than one week prior to taper, the algorithm directed nurses to taper the pretaper opioid dose by 10% every eight hours. For patients on opioids one week or longer, nurses were directed to taper the pretaper opioid dose by 10% every 12 hours. Thus, unadjusted opioid tapering every 8 hours would result in completed tapers in 3.33 days, and tapers decreased every 12 hours would be completed in 5 days. Nurses were instructed to use the taper algorithm to calculate the dosage decreases by 10% and make scheduled dosage adjustments and decisions

about when to hold, adjust, or discontinue a taper plan based on pain or withdrawal symptoms. For example, for a patient beginning a taper at 8 am who had been on a morphine CI for 10 days and has a pretaper dose of 3 mg an hour, the nurse would calculate a 10% decrease from 3 mg (0.3 mg) then taper the opioid by subtracting 0.3 mg from the current CI dose every 12 hours, at 8 am and 8 pm.

Instruments

0–10 Numeric Pain Intensity Scale: This scale was used to obtain pain self-reports from adult patients. The scale consisted of a horizontal line with the number 0 and the words "no pain" at the left end and the number 10 and the words "worst pain" at the right end. Patients recorded their pain level or reported it verbally to the research assistant. The validity of this tool has been established (Jensen, Karoly, & Braver, 1986).

Faces Pain-Rating Scale: This instrument was used to obtain pain self-reports from children. The scale consisted of six cartoon faces that ranged from a smiling face for "no hurt" to a tearful face for "hurts worst." Under each face were descriptive words and numbers ranging from 0–5, with higher numbers indicating more severe pain. Children recorded their pain level independently or reported it to a parent or research assistant. Reliability and validity of this tool have been established (Wong & Baker, 1988).

Patient log: Daily during the opioid taper, patients used this tool to record three aspects of their pain: worst pain level during the past 24 hours, average pain over the past 24 hours, and pain location(s). Patients also recorded the presence of 14 listed withdrawal symptoms: nausea, vomiting, abdominal cramps, diarrhea, agitation, insomnia, chills, sweating, goose flesh, muscle cramps, joint pain, headache, eye tearing, and runny nose. The content validity of this instrument was established based on literature sources (Jaffe, 1990; McGuire et al., 1995; Milhorn, 1992; Schug et al., 1992), accounts of expert nurses, and results of clinical practice on the unit where the current study was conducted. Results of a pilot study in which this instrument was tested indicated that 10 adult HPCT recipients reported all of the 14 withdrawal symptoms and no others (Paulson, 1996).

Interview guide: Each day that a patient reported pain or withdrawal symptom(s) in the patient log, the research assistant used an interview guide to record further data. Interview data included patients' perceptions of the reason for an increase in pain, how well the nurses relieved pain, and the extent to which pain kept the patient from desired activities over the past 24 hours. If a withdrawal symptom was reported, interview data included when the symptom began, duration, severity, and the extent to which it kept the patient from desired activities. At the end of the final interview, patients were asked to rate their overall discomfort from withdrawal symptoms during the taper. A four-point scale, ranging from "no discomfort" to "extreme discomfort," was used to allow varying responses. This item also was included in the primary nurse survey to measure the association between patient and nurse perceptions.

Medication form: The research assistant recorded data from the patients' records (e.g., opioid CI rate; time and amount of all rate increases and decreases; amount of nurse-initiated and patient-initiated boluses; oral and transdermal opioids administered). The time and amount of adjuvant medications administered to relieve withdrawal symptoms and demographic data also were recorded. Because of possible effects of decreased renal function or graft-versus-host disease (GVHD) on opioid tapers, the research assistant recorded the highest daily serum creatinine level or a diagnosis of GVHD.

Nurse documentation form: The research assistant used this form to record nurses' documentation of patient pain self-reports; pain-related behaviors and comments; interventions for pain relief; evaluation of effectiveness of interventions; time of onset, intensity, and duration of withdrawal symptoms; effectiveness of interventions for relief of withdrawal symptoms; and evaluation of effectiveness of interventions for withdrawal symptoms.

Primary nurse survey: After taper completion, each primary nurse was asked to complete a one-page survey. Survey items measured the nurse's perception of a patient's overall discomfort from withdrawal symptoms during taper, the appropriateness of taper length, consistency in tapering, ways in which the taper had (or had not) been handled well, whether completing the taper delayed the patient's discharge from the transplant unit, and any other comments. Consultation with expert HPCT nurses and pharmacists established content validity of the patient log, interview guide, medication form, and primary nurse survey.

Procedure

The clinical nurse specialist identified patients who met subject selection criteria. Prior to the opioid taper, a member of the research team informed qualified patients about the study and obtained consent (or assent) from patients who chose to participate. The research team was comprised of the principal investigator, co-investigator, and research assistant. The co-investigator and research assistant were experienced in nursing care of HPCT recipients. Investigators detected the beginning of a taper by monitoring opioid dosages and confirming with the patient's nurse whether a dosage decrease was the beginning of a taper or the opioid dose was being modified for another reason.

At the beginning of each taper, a member of the research team asked the patient to report pain and withdrawal symptoms daily on the patient log or by telephone. If a patient reported the presence of pain or withdrawal symptoms, a member of the research team used the interview guide to collect additional data. Patients who reported withdrawal symptoms on the last day of taper were asked to report withdrawal symptoms for a few additional days. At the completion of each taper, the research assistant gave the primary nurse a primary nurse survey to complete and return to the clinical nurse specialist. An opioid taper guideline was not used for the 45 patients enrolled in phase 1 of the study. In phase 1, taper practice varied widely and lacked consistency (Pederson & Parran, 2000). In phase 2, an opioid taper algorithm was used as a guideline to taper opioids in the 61 patients enrolled.

Data Analysis

Data were coded and entered into the Statistical Package for the Social Sciences® for Windows® 98 program. Fentanyl and hydromorphone doses were converted to morphine equivalents. These values were divided by the patient's body weight in kilograms to determine the MEK. Frequencies, ranges, means, and standard deviations of MEK; pain levels; with-

drawal symptoms; and incidences of nurse documentation of pain or withdrawal symptoms were calculated for each taper day, by phase. Distributions were examined to determine whether parametric or nonparametric tests should be used. Withdrawal symptoms were coded as related to taper or not related to taper. Symptoms were considered not related to taper if a symptom recently predated the beginning of opioid taper or if a condition, such as GVHD, or an alternate reason, such as receiving a blood transfusion, may have caused the symptom.

Investigators calculated the overall MEK sums, both pretaper and during taper. Percentages of daily adjustments in continuous infusion MEK during the taper were calculated by subtracting the present day dosage from the previous day dosage, then dividing this number by the baseline dosage (the amount given on the day preceding the beginning of taper). Rate of MEK change was measured using a slope of 20% for patients for whom the slower taper was indicated and a slope of 30% for patients for whom the faster taper was indicated. Correlations were calculated between the length of taper and the sum of pretaper MEK and number of pretaper days on opioid therapy. Also, a correlation was calculated between nurses' assessment and patient evaluation of overall discomfort from withdrawal symptoms.

Results

Table 1 presents sample characteristics. Calculations of missing data indicated that opioid dosage was obtained on only 96% of taper days because of incomplete nurse documentation of opioids. Patient logs were completed on 94% of taper days, patient interviews were completed on 90% of taper days, and 53% of primary nurse surveys were completed. All nurse narrative documentation data present in patient records were obtained. Five subjects discontinued their daily interviews before their tapers were complete, stating that they felt too stressed or too tired to continue interviews. A significant difference in patients' gender, age, weight, underlying disease, transplant type, highest daily creatinine level, or diagnosis of GVHD did not exist between phases.

Tapers

When compared with patients in phase 1, patients in phase 2 received more MEK and had slightly longer opioid therapy prior to taper (see Table 2). Neither of these differences was statistically significant. The mean length of tapers in phase 2 was 0.4 days shorter than in phase 1; this difference also was not significant. In both phases, the length of taper correlated with the number of pretaper days and pretaper MEK. Chemotherapy and radiation conditioning regimens were not compared between phases.

Although transplant types did not differ significantly between children and adults, adults had shorter tapers than children, both in phase 1 ($t[14] = 2.3$, $p = 0.03$) and in phase 2 ($t[59] = 2.0$, $p = 0.05$). Also, adults received less MEK than children during taper in phase 1 ($t[43] = 3.14$, $p = 0.003$) and in phase 2 ($t[12] = 2.04$, $p = 0.06$).

The sum of MEK given during tapers was somewhat less in phase 2 ($\bar{X} = 5.78$) than in phase 1 ($\bar{X} = 9.43$). On taper days five through nine, significantly less MEK was given in phase 2 than in phase 1 ($p = 0.01$–0.05). In phase 1, 60% of patients were on PCA, and in phase 2, 54% were on PCA. No significant difference in PCA MEK existed between phases.

In phase 2, 51 patients (84%) had received opioid therapy for a week or longer prior to taper, thus indicating the use of a longer taper. The algorithm recommended an unadjusted taper rate of 20% (i.e., a 20% dosage decrease each day for five days). The rate of change for the dosage data showed a 24% daily decrease, a number not significantly different from the target 20%. The 10 patients (16%) who had received opioid therapy for less than one week prior to taper experienced a 17% rate of change, a significantly slower opioid decrease than the 30% rate of change recommended with the faster taper ($t[9] = 5.48$, $p < 0.001$).

No difference in primary nurses' judgment of the length of tapers existed between phases. In both phases, primary nurses indicated that the length of the completed taper was "just about right." Some nurses indicated that they were not very familiar with some patients' responses to taper because they had not provided care for these patients often during taper.

The means of daily percentage decreases in CI MEK were similar in phase 1 and phase 2 (see Figure 1). In both phases, a wide variation in individual daily percentage MEK changes

Table 1. Demographic Data for Phase 1, Phase 2, and Total Sample

Characteristic	Phase 1 (n = 45)	Phase 2 (n = 61)	Total Sample (N = 106)
Age (years)			
$\bar{X}$	33.8	32.2	32.9
SD	16.4	16.6	16.4
Range	7–64	5–58	5–64
Sex			
Male	53%	54%	54%
Female	47%	46%	46%
Development			
Children	27%	28%	27%
Adults	73%	72%	73%
Race/ethnicity			
Caucasian	87%	95%	92%
African American	2%	3%	1%
Asian	9%	2%	6%
Native American	2%	_	1%
Hispanic	_	_	1%
Underlying disease			
Hematologic malignancy	62%	64%	63%
Solid tumor cancer	24%	7%	14%
Nonmalignant hematologic disorder	11%	20%	16%
Congenital immunodeficiency	2%	10%	7%
Transplant types			
Autologous	9%	5%	7%
Allogeneic	38%	46%	43%
Unrelated donor	20%	16%	18%
Peripheral blood stem cell	29%	30%	30%
Umbilical cord blood	5%	3%	4%

Note. Because of rounding, percentages may not equal 100.

Table 2. Opioid Taper Data in Phase 1 and Phase 2

	Opioid	Pretaper Days on Opioid Therapy	Pretaper Morphine Equivalents/Kg	Length of Taper (Days)	Correlations
Phase 1 (n = 45)	49% morphine	$\bar{X}$ = 11.84	$\bar{X}$ = 14.44	$\bar{X}$ = 6.60	Length of taper with pretaper days on opioid therapy, r = 0.28, p = 0.059
	27% fentanyl	SD = 7.06	SD = 20.28	SD = 4.24	
	24% hydromorphone	Range = 2–39	Range = 0.31–92.9	Range = 1–17	Length of taper with the sum of pretaper MEK, r = 0.63, p < 0.01
Phase 2 (n = 61)	56% morphine	$\bar{X}$ = 12.02	$\bar{X}$ = 20.63	$\bar{X}$ = 6.20	Length of taper with pretaper days on opioid therapy, r = 0.39, p < 0.01
	26% fentanyl	SD = 5.71	SD = 68.75	SD = 2.90	
	18% hydromorphone	Range = 3–31	Range = 0.77–537.9	Range = 1–14	Length of taper with the sum of pretaper MEK, r = 0.33, p < 0.01

MEK—morphine equivalents/kg

existed. In phase 1, individual daily dosage changes ranged from a 67% decrease to a 14% increase, and in phase 2, individual daily dosage changes ranged from a 100% decrease to a 75% increase. Thus, a patient experienced at least one day when the MEK was discontinued abruptly and days when the MEK dosage was increased substantially. The extreme increases and decreases were evidence that clinicians disregarded the algorithm. No significant differences in the number of upward or downward adjustments in continuous infusion MEK existed between phases.

Pain

No significant difference existed between phases in patients' self-reports of worst pain over the prior 24 hours. On a 0–10 scale, daily means of worst pain for adults ranged from 1.0–3.59 in phase 1 and from 0.0–2.33 in phase 2. On a 0–5 scale, daily means of worst pain for children ranged from 0.17–3.0 in phase 1 and from 0.0–1.29 in phase 2. Thus, pain levels were somewhat lower in phase 2 than in phase 1. In both phases, worst pain levels decreased as tapers progressed. Although patients also were asked to report their average pain over the prior 24 hours, data obtained were judged to be unreliable. On many days, patients were unable to provide this information, and patients occasionally reported an average pain level that was higher than the worst pain level they had reported for that day. Using a numeric scale, a significant difference did not exist between phases in patients' evaluation of how well nurses relieved their pain during opioid tapers, and both adults and children were somewhat more positive in phase 2 than in phase 1.

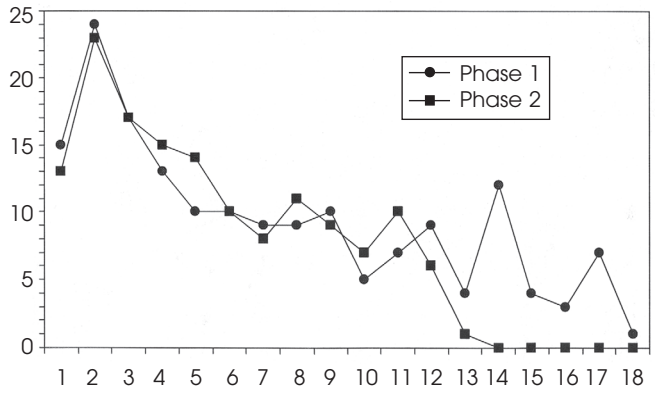


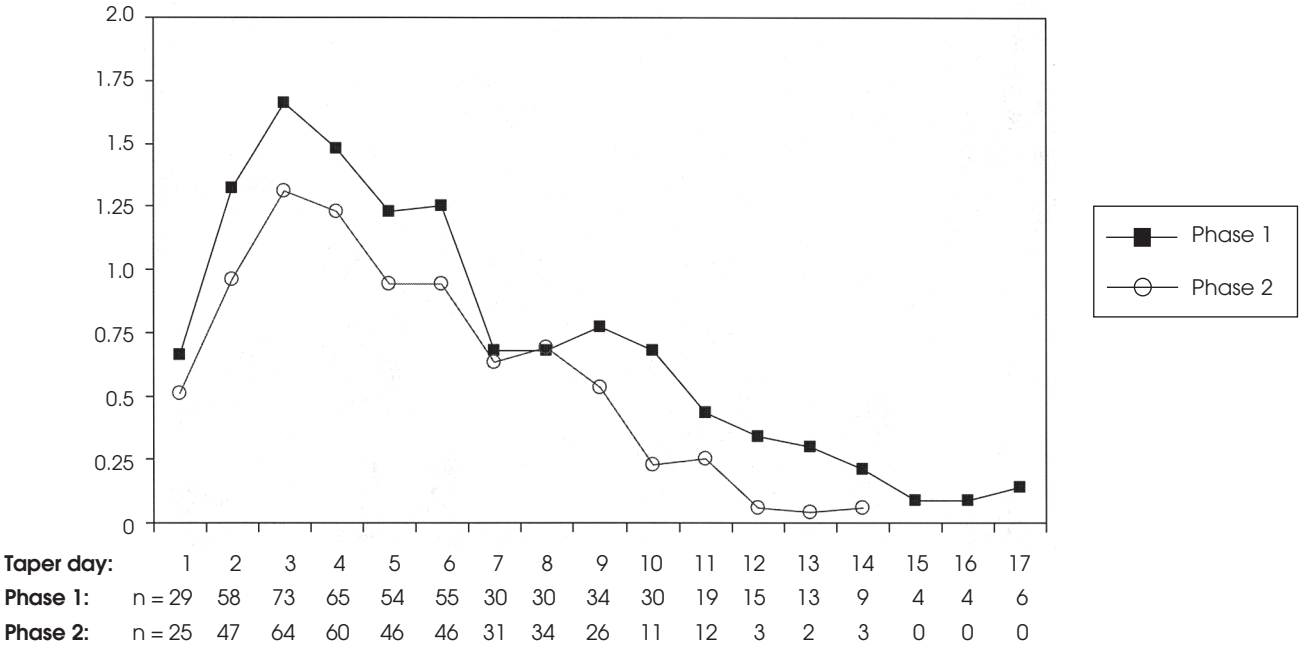
Figure 1. Means of Daily Percent Decreases in Continuous Infusion Morphine Equivalents Per Kilogram During Taper by Phase

Withdrawal Symptoms

The total number of daily self-reports of withdrawal symptoms was lower in phase 2 than in phase 1 (t[91] = 2.0, p = 0.05). The withdrawal symptoms most frequently reported were nausea, vomiting, diarrhea, insomnia, and runny nose (see Figures 2 and 3). A significant difference did not exist between phases in the total number of self-reports of any single withdrawal symptom. The mean number of withdrawal symptoms reported by those who remained on taper tended to increase during taper (see Figure 4). The total reports of withdrawal symptoms correlated with length of taper (r = 0.46, p < 0.001). No correlation existed between the total number of reports of withdrawal symptoms and pretaper MEK or the number of pretaper days on opioid therapy.

Frequently, the 14 symptoms reported in this study were not related to the taper. An examination of the number of patients who experienced symptoms revealed that in phase 1, 27% of patients reported symptoms related to taper, and 21% reported symptoms not related to taper. In phase 2, 16% of patients reported symptoms related to taper, and 20% reported symptoms not related to taper. When patients were asked at the end of their opioid tapers to evaluate their overall discomfort from withdrawal symptoms, a significant difference between phases was not found.

Patients who reported having a withdrawal symptom in daily interviews were asked two follow-up questions. When patients were asked, "How bad was this symptom?", no significant difference was found between phases in patients' responses about any of the symptoms. When patients were asked, "How much did the symptom keep you from doing what you wanted to do?", patients in phase 2 were signifi-



Taper day:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Phase 1:	n = 29	58	73	65	54	55	30	30	34	30	19	15	13	9	4	4	6	
Phase 2:	n = 25	47	64	60	46	46	31	34	26	11	12	3	2	3	0	0	0	

Figure 2. Mean Number of Withdrawal Symptoms Reported Daily Across Taper

cantly less negative than patients in phase 1 regarding one of the 14 symptoms, abdominal cramps (t[20] = 2.23, p = 0.04). No significant difference between phases was found regarding the 13 other withdrawal symptoms. Patient reports indicated that, of the 14 symptoms measured, nausea was the symptom that made patients feel the worst and most often kept them from doing what they wanted to do. No difference between adults and children in their responses to the above daily interview questions about their symptoms existed in either phase.

Patients' primary nurses also were asked at the end of the taper how much overall discomfort they thought withdrawal symptoms caused the patients. In phase 2, nurse assessments of patients' overall discomfort from withdrawal symptoms correlated with patients' reports of their overall discomfort from withdrawal symptoms (r = 0.53, p = 0.03). In phase 1, no correlation between these variables existed.

Nurse Documentation

Documentation of 10 aspects of pain and withdrawal symptoms were compared by phase. In phase 2, more incidences of nurse documentation of patient pain-related behaviors and comments existed (t[100] = 2.3, p = 0.02). No significant difference existed between phases in nurses' documentation of patient self-reports of pain, an aspect well documented in both phases. No significant differences and very little documentation in either phase regarding any other aspect of pain and withdrawal symptoms existed.

Discussion

The reduction in the mean length of taper by 0.4 days from phase 1 to phase 2 may have been a result of the use of the algorithm, which prescribed a tapering plan that reduced dosage faster than routine practice. Perhaps this reduction was small because when using the algorithm, nurses determined that patients' withdrawal symptoms or pain warranted slowing the taper, thus maintaining a tapering practice similar to phase 1. The scant documentation of rationale for taper adjustments leaves this in question. The mean taper length of 6.2 days in phase 2 may demonstrate that an unadjusted opioid taper, when using the algorithm, was not feasible. Patients whose taper length exceeded five days continued to have withdrawal symptoms, a condition that supports use of an individualized algorithm for patient comfort.

More rapid dosage decreases, recommended by the algorithm for patients who had been on opioid therapy for fewer than seven days, were not evident in the documentation. Nurses may not have regarded the algorithm directions for a more rapid taper in this group for several reasons. Few patients qualified for the shorter taper. Also, nurses may not have been comfortable tapering every eight hours because this was markedly different from their previous practice of tapering once a day. In addition, nurses may have slowed a taper unnecessarily because of difficulty in determining whether a symptom was related to taper.

Study findings that pretaper MEK and pretaper length of opioid therapy correlated with length of taper support findings of a previous study by French and Nocera (1994). French and Nocera found that the Neonatal Abstinence Syndrome Scores (number and intensity of withdrawal symptoms) increased in patients with higher pretaper fentanyl dosage and with length of fentanyl therapy. The study findings also support taper guidelines provided by Anand and Arnold (1994). Thus, tapering algorithms should be based on length of opioid therapy and pretaper MEK.

The wide fluctuations in both phases in daily dosage adjustments may have been based on the patients' withdrawal symptoms or pain. Also, phase 2 field notes indicated that physician orders, patient requests, the introduction of new and uninformed nurse caregivers, and onset of new pain related to procedures or growth factor medication influenced the dosage

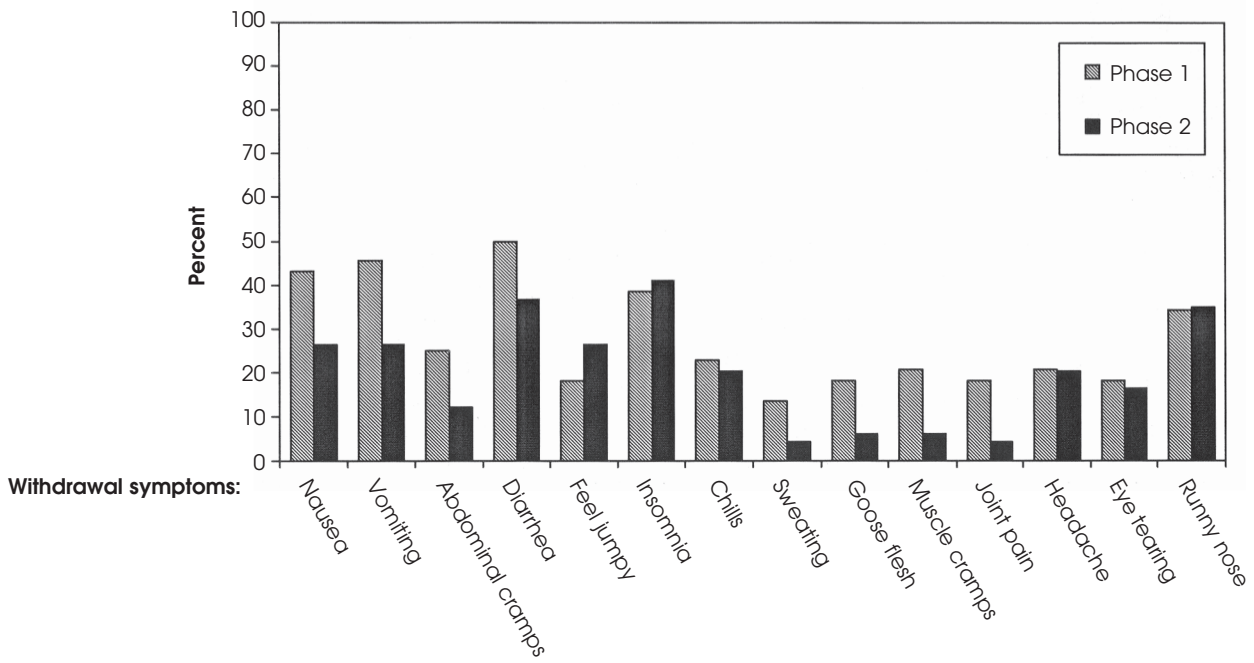


Figure 3. Percent of Patients Who Reported Withdrawal Symptoms on Taper

fluctuations. In addition, nurses may have chosen not to follow the algorithm and instead to continue their previous practice of individually determining patients' tapers. Most nurses did not follow the algorithm directive to document their rationale for daily variations from the prescribed taper rate; this may have occurred because a space was not provided on the medication documentation form or because a withdrawal assessment tool was not provided.

The investigators found that adults had faster tapers in both phases and received less MEK than children during taper in phase 2. This may have occurred because children develop tolerance to opioids faster than adults (Anand & Ingraham, 1996). Field notes indicated that pediatric HPCT nurses tended to be very protective of children's comfort and may have been more likely to provide analgesia than were nurses of adult patients. Also, many adult patients asked to decrease opioid dosage to end opioid therapy or to increase clarity of thinking.

The low self-reported pain levels in both adults and children indicate that pain management was adequate and use of the algorithm did not increase pain. Worst pain reports decreased as tapers progressed, which indicated that patients continued to recover post-transplant. In both phases, patients reported similar satisfaction with the management of their pain, thus demonstrating that the taper algorithm did not deter nurses from addressing pain.

The relatively high percentage of patients who experienced symptoms unrelated to taper signifies the difficulty nurses may have in discriminating between taper-related symptoms and symptoms caused by other factors, such as GVHD and infection. Some nurses stated in narrative notes that they held a taper to determine whether symptoms would subside. In other patient populations, nurses may have less difficulty identifying taper-related symptoms because patients may experience fewer unrelated symptoms.

In both phases, investigators received occasional anecdotal reports that nurses had forgotten to continue a taper by decreasing the opioid dose on their shift. Several nurses stated in surveys that they had not provided care consistently for a patient during the taper. The lack of continuity of caregivers, an inevitable situation in current acute health care, emphasizes the need for a taper guideline to promote consistency and the need for thorough documentation that includes rationale for changes in the planned taper dosage decreases.

The finding that fewer withdrawal symptoms were reported when a taper algorithm was used and that no difference in overall discomfort existed between phases indicates that the algorithm did not exacerbate withdrawal symptoms. The investigators have not identified a reason for the decrease in withdrawal symptoms when an algorithm was used. However, the algorithm may have caused nurses to be more observant of patients' withdrawal symptoms in phase 2, and nurses may have adjusted tapers accordingly. The finding that nurses' assessments of overall patient discomfort from withdrawal symptoms correlated with patients' reports in phase 2, but not in phase 1, supports the likelihood that the algorithm promotes awareness of patients' comfort levels.

The slight improvement in nurse documentation may indicate that nurse leaders need to employ other methods to improve documentation, such as educating nurses, developing better documentation tools, and rewarding excellent documentation. Systematic documentation of symptoms, such as the use of a symptom checklist with probable causes, could provide more comprehensive views of patients' responses to tapers.

Study results provide partial support for Rogers' (1995) Model of the Innovation-Decision Process, which states that when an innovation is compatible with the values, beliefs, and past experiences of its users, the innovation experiences a more rapid adoption rate. Nurses implemented the algorithm somewhat, especially with patients for whom the slower taper

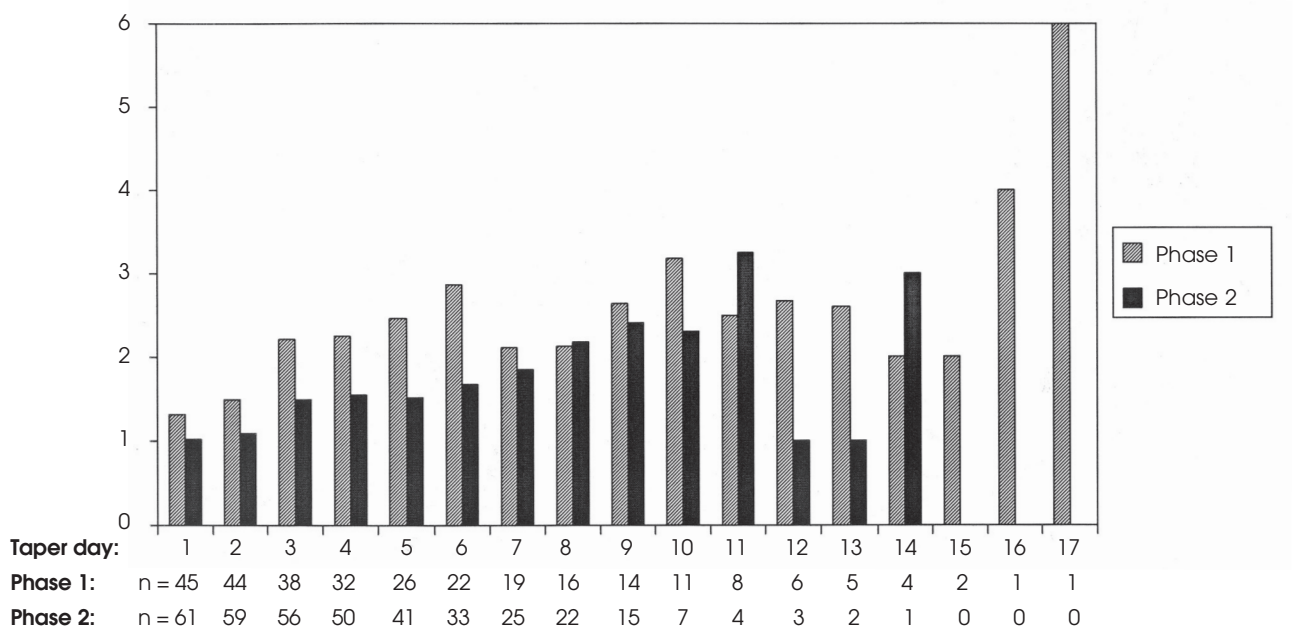


Figure 4. Mean Number of Withdrawal Symptoms Reported Daily by Patients Who Remained on Taper by Phase

was indicated, a situation more similar to their routine practice. They may not have understood the algorithm fully or completely been persuaded of its advantages. However, after study completion, nurses unanimously supported continued use of the algorithm, which supports Rogers' concept of confirmation in the innovation-decision process. After results were presented to physicians, they also were receptive to continued use of the algorithm.

Study Limitations

Generalizability of study results is limited by the small sample and single-site design. Some patients were somewhat sedated at times from adjuvant medications, which may have decreased the accuracy of self-reported pain and withdrawal symptoms. Investigators coded symptoms as unrelated to the taper when evidence for other causes existed, though symptoms may have been related partially to the taper. Also, the investigators had a low response rate for the primary nurse survey. The measurement of patient satisfaction with pain management was a broad question and, thus, may not be an accurate measurement.

Implications for Nursing Practice and Research

Use of an opioid taper algorithm may significantly decrease withdrawal symptoms and somewhat shorten the length of a taper. Patients undergoing HPCT experience considerable withdrawal symptoms that warrant the use of a guideline, such as an algorithm, to taper opioids and monitor pain and withdrawal symptoms.

Testing an opioid taper algorithm with other patient populations may result in more consistent tapers with fewer withdrawal symptoms. Researchers need to test more aggressive taper algorithms to determine the maximum rate of opioid dosage decreases while maintaining no more than mild pain or withdrawal symptoms. Also, in future studies, the opioid taper algorithms should include tools to measure withdrawal symptoms.

In summary, patients who experienced an opioid taper with the use of the algorithm received more MEK pretaper, yet they experienced fewer reports of withdrawal symptoms, a somewhat faster taper, somewhat less MEK during taper, and somewhat lower levels of self-reported pain. Use of the algorithm in other populations may have similar benefits. Nurses' responsibility to promote patient comfort underscores the need to continue examining ways to improve opioid tapering.

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➤ Cancer-Pain.org
www.cancer-pain.org/

➤ M. D. Anderson Cancer Center: Pain Management
www.mdanderson.org/topics/paincontrol/

➤ Roxane Pain Institute
http://pain.roxane.com/index2.html

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