PREDICTORS OF NARCOTIC ANALGESIC ADMINISTRATION IN THE FIRST 48 POST-OPERATIVE HOURS

Robin Weir, Jacqueline Roberts, Gina Bohn Browne, Joan Crook and William Barnes

Of the various types of pain problems, post-operative pain should be the least complex to manage because its source is usually distinct and its course is self-limiting (Keeri-Szanto, 1979). Nonetheless, there is widespread evidence that the management of pain in surgical patients is regularly and systematically inadequate (Angell, 1982; Cartwright, 1985; Marks & Sachar, 1973; Smith & Utting, 1976). Concern about this apparent failure in pain management has produced a substantial body of literature that addresses factors influencing the degree of pain reported, the analgesia required and the amount of analgesia administered post-operatively. A variety of demographic, clinical and treatment variables have been shown to be associated with the administration of post-operative analgesia. However, there are discrepancies in the results of the studies, and there is no indication as to the importance of these diverse variables in explaining the use of analgesics post-operatively.

The purpose of this prospective study was to weigh simultaneously the importance of selected patient characteristics, intra-operative procedures and the post-operative analgesic management regimen as factors that may combine to explain the frequency of administered analgesic doses. More specifically, the purpose of the study was to quantify the contribution of these selected variables to the use of analgesics in adult surgical patients in the first 48 hours post operation.

Among demographic factors associated with the frequency of post-operative analgesia, sex, height, weight, body surface area and age have been

Robin Weir, R.N., M.Ed., Ph.D. is Associate Professor in the School of Nursing; Jacqueline Roberts, R.N., B.Sc.N., M.Sc. is Associate Professor in the School of Nursing; Gina Bohn Browne, R.N., M.Ed,, Ph.D. is Professor in the School of Nursing and Associate Member, Clinical Epidemiology and Biostatistics; Joan Crook, R.N., B.Sc.N., M.Sc., is Professor in the School of Nursing: all are at McMaster University. William Barnes, M.D. is Associate Professor, Department of Surgery, Chedoke-McMaster Hospitals.

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investigated (Austin, Stapleton & Mather, 1980; Bellville, Forrest & Miller, 1971; Beyer, DeGood, Ashley & Russell, 1983; Faherty & Grier, 1984; Kaiko, 1980; Keeri-Szanto & Heaman, 1972; Nayman, 1979; Pilowsky, Manzap & Bond, 1969; Taenzer, Melzack & Jeans, 1986; Tamsen, Hartvig, Fagerlund & Dahlström, 1982). Pain reports by patients have been studied relative to these post-operative analgesic requirements (Angell, 1982; Cohen, 1980; Donovan, Dillon & McGuire, 1987; Marks & Sachar, 1973; Smith & Utting, 1976; Weis, Sriwatanakul, Alloza, Weintraub & Lasagna, 1983), as well as to their association with other clinical variables such as site, nature of the operation and type of incision (Bullingham, 1984; Pflug & Bonica, 1977) and the type of analgesia administered (Henderson & Parbrook, 1976). Treatment variables that have been examined include the prescribed dose of analgesia (Austin, et al., 1980; Cohen, 1980; Beyer, et al., 1983; Keeri-Szanto & Heaman, 1972; Marks & Sachar, 1973; Smith & Utting, 1976), the administered amount (Marks & Sachar, 1973; Smith & Utting, 1976; Cohen, 1980; Sriwatanakul, et al., 1983; Faherty & Grier, 1984) and the interdosing interval (Nayman, 1979; Bullingham, 1984, 1985). None of the studies that were reviewed examined the collective influence of all the above variables on doses administered. Across studies, the influence of each of the above variables is inconsistent. These discrepancies in study results have not only been attributed to problems in design and measurement, but also to attitudinal biases and knowledge deficits of physicians and nurses in making their decisions about the amount and frequency of analgesia requirements (Epstein, Read & Winickoff, 1984; Taenzer et al., 1986; Teska, Daut & Cleeland, 1983).

For this study, it was postulated that the number of doses and total amount of narcotic given would be a function of some combination of the personal characteristics of the patient, clinical variables including the type of surgery and surgical supports, and the prescribed pain treatment. In this case surgical supports refers to intra-operative procedures such as type of anaesthesia, insertion of drains, nasogastric tubes, etc.; pain treatment includes the dose and schedule of prescribed analgesics. It was also proposed that those patients with factors that are empirically associated with more predictable responses to narcotics (e.g. age and weight) would have more frequent doses and greater total amounts than those patients with factors assumed to pose a risk.

The present report was part of a larger study that examined the efficacy of regularly scheduled analgesia in the prevention of atelectasis in abdominal surgery patients (Barnes et al., 1985). Regular pain medication as a post-operative regimen was not superior to a PRN regimen in preventing or allowing the progression of pulmonary pathology following surgery. Clinically, the patients who received the "attention placebo" plus PRN medication had the lowest rate of post-operative lung pathology, while the PRN medication group without the regular attention had the highest rate.

It was proposed that minimal movement (and possibly minimal ventilatory change), which accompanied the regular attention of vital signs (the frequency of which was not controlled for in the other two groups), may have accounted for the direction of these results (Barnes et al., 1985). A number of subjects (27% of original 248) were lost from the analysis because they were not maintained on the appropriate regimen; as such, we wanted to examine the pattern of administration of analgesia to determine whether or not there was some explanation for this incomplete implementation of the experimental manoeuver.

This study was designed to examine, through the use of multivariate statistics, the influence of demographic and clinical variables alone and in combination with the randomly prescribed analgesic regimens on the frequency of narcotic dosing. The data source was the patients' medical charts, which included medication profiles, vital sign records and the operating room and recovery room records. Trained research assistants abstracted the required data from the chart record of the patients as they were enrolled into the trial.

The hypotheses were:

1. Surgical and post-surgical care variables, as compared to other demographic variables, would account for the most variance in the number of doses and total amount of narcotic administered.
2. Lower amounts and fewer doses of medication would be found for patients who were older, female and weighed less.
3. The number of narcotic analgesic doses and total amount administered would be related to the prescribed analgesic schedule, i.e. regular dosing or PRN.
4. The frequency of PRN dosing would be altered by scheduled, regular interactions between the patient and nurse.

Methods

Study setting and subjects

The subjects were 248 patients (68 male and 180 female), between the ages of 16 and 70 (mean = 45.95, SD 14.20), who underwent elective intra-abdominal surgery during the study period. They were recruited from the practices of six general surgeons who carried out the surgical procedures in one of three general hospitals in an industrial city with a population of 350,000, in southern Ontario.

Potential subjects were identified prospectively through the daily operating room schedule furnished by the surgeons' offices. Patients who met the

inclusion criteria (elective intra-abdominal surgery and aged between 16 and 70 years) were screened for existing chest disease, major thoracic deformity, specific medical conditions or problems and the ability to speak English, and then were asked to participate in the study.

Two hundred and seventy-eight consenting patients who met the inclusion criteria were then randomly allocated to one of three pain management regimes. These regimes included the intramuscular injection of analgesia every three hours; on a PRN basis; or, on a PRN basis with an attention placebo (four hourly vital signs measurement) during the first 48 hours. Vital sign measurement in the other two study groups was allowed to vary according to conventional practices of the institution. Of the 278 consenting and eligible subjects, 30 were excluded from the analysis because their medical conditions and treatment (nerve block, epidural anaesthesia, mechanical ventilation, i.v. morphine) prevented their adherence to the allocated analgesic regimen. Thus, 248 patients were followed for 48 hours post-operation.

Once the analgesia group was determined, a colour-coded card, with printed instructions for the implementation of the appropriate analgesic study regimen, was affixed to the patient's chart. The orders for the medication were written by the attending surgical resident or surgeon. The ward nursing staff carried out the prescribed medication regimen.

Variables and Sources of Data

Demographic variables

Subjects' age, gender and weight were obtained from their medical records, as they were enrolled in the study. The influence of weight, gender and age on the prescription and administration of analgesia is inconsistent across studies. However, narcotics are usually prescribed on a dose-per-weight basis and there is some evidence that older post surgical patients receive less than younger adults (Faherty & Grier, 1984).

The smoking history of patients was obtained; the number of cigarettes smoked per day was counted and summarized in five groups of ten. One additional group was made for those who smoked more than 41 cigarettes per day. Keeri-Szanto and Heaman (1972) demonstrated that smokers metabolize most analgesics faster than non-smokers; this could influence the amount of medication requested and administered.

Clinical variables

Subjects' surgeons were identified and coded. The clinical variables "primary diagnosis of cancer or not" and "seriousness of surgery" were selected

to attempt to probe the effect of nurses' attitudes on particular diagnostic categories. The label "cancer" was selected because of its association with suffering. All diagnoses were grouped into either "cancer" or "no cancer" groups. In addition, it was judged that the name of the surgical procedure itself might create an expectancy, among experienced surgical nurses, about narcotic requirements.

Patient diagnosis has been shown to have a significant effect on how nurses assess patient suffering (Davitz & Pendleton, 1969). It appears that conditions viewed as physically most painful, that is conditions associated with trauma, influence how nurses assess pain (Dudley & Holm, 1984). To test this assumption, two experienced surgical nurses were given the list of surgical procedures from the study sample and asked to rate which procedure they would expect would require more analgesia than the others. Nine surgical types were identified as serious in this manner, with an interrater agreement of K-.786. These nine types were entered into the analysis as "serious surgery", while the others were considered "not serious".

An additional factor associated with the degree of pain is the site of the operation. Specific incision sites were grouped according to whether they were in the upper or lower abdomen. Those incisions that involved both upper and lower abdomen were placed in the upper abdomen group because upper abdominal incisions are reported as more painful (Bullingham, 1984). Length of anaesthesia was included as an indicator of complexity of the surgical procedure; length of stay was included as a further reflection of complexity and seriousness. These variables were judged as possible influences on staff's prescribing and administering practices.

Treatment variables

The amount and frequency of doses of Demerol-equivalent narcotics administered in the first 48 hours were obtained from the patient's medication profile. In addition, individual counts were made, for each patient, on the presence or absence of drains, nasogastric tubes and routine physiotherapy. These treatments are associated with discomfort and pain and assumed to influence the assessment of pain, and subsequent administration of analgesia. There is some evidence that pulmonary atelectasis is, in part, caused by inadequate ventilation; this might be due to the inhibiting effects of abdominal pain (Benhamou, Samii & Doviant, 1983; Coleman, 1987). Consequently, pulmonary complications were considered to be an important indicator of pain that might explain analgesic administration practices. Finally, tallies also were made as to whether analgesia was administered in the recovery room. This was done because such an occurrence suggests that any intra-operative analgesia that was administered had lost its effect, and that the patient was in pain early in the post-operative period.

Analysis

Stepwise forward multiple-regression analyses were done, using analgesic treatment group as a covariate to explore the collective influence and order of importance of the demographic, clinical and treatment variables on the number of analgesic doses given, as well as on the total amount of narcotic analgesia administered. Sixteen variables were entered in the analysis (Table 1). These included demographic variables (age, gender, weight, history of smoking and number per day); clinical variables (surgeon, primary diagnosis of cancer or not as diagnosis, seriousness of surgery, incision site, length of anaesthesia and length of hospital stay); treatment variables (presence of drains, nasogastric tube, physiotherapy, recovery room analgesia and presence or absence of lung pathology). In addition, analysis of variance procedures were used to examine the difference in frequency of administered analgesics, by treatment group, within the first 48 hours. A t-test was used to compare the difference in the mean amount of analgesic administered between the regular medication group and the combined PRN group.

Table 1
Summary Table of Regression Variables

Variables	Measures
Dependent variable (Outcome)	
Number of analgesic doses	Continuous
Total amount of analgesia administered	Continuous
Demographic variables	
Age	Continuous
Weight	Continuous
Number of cigarettes smoked per day	Continuous
Gender	Categorical
Smoking history	Categorical
Clinical variables	
Surgeon	Categorical
Diagnosis	Categorical
Seriousness	Categorical
Operative site	Categorical
Length of anaesthesia	Continuous
Length of hospital stay	Continuous
Treatment variables	
Drains	Categorical
Nasogastric tubes	Categorical
Routine physiotherapy	Categorical
Pulmonary complications	Categorical
Recovery room analgesia	Categorical

Results

There was a statistically-significant difference among the three randomized treatment groups in the mean *number of doses* of analgesia given over the first 48 hours (ANOVA, $F_{2, 245}$=47.9, p<.001) (Table 2). The regular Q3H medication group received more doses than the other two groups (Scheffe p<.05). Similarly, there was a statistically-significant difference between the regular Q3H medication group and the combined PRN groups (t=5.39, df=246, p<.001) in the *mean amount* of narcotic administered (Table 3). The type of narcotic that was ordered did not differ significantly (x^2_6=4.9, p=.56) across the three study groups. Demerol was the most frequently administered narcotic and constituted 93-98% of the types; all non-Demerol narcotic doses were transformed into equivalent milligrams of Demerol.

Table 2

Comparison of Mean Number of Analgesic Doses Administered in First 48 Hours Under Three Schedules of Prescription

	Regular Q3H Medication group N=85		PRN Medication group N=75		RN Medication With Vital Signs N=88	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Number	13.86	(3.2)	9.93	(2.8)	9.77	(3.12)

ANOVA, $F_{2,245}$=47.9, p<.001

Table 3

Comparison of Mean Amount* of Analgesia Administered in First 48 hours Between Regular Medication Group and Combined PRN and PRN with VS Group

	Regular Q3H medication group N=85		Combined PRN & PRN with vital signs groups N=163	
	Mean	(SD)	Mean	(SD)
Amount	963.6	(284)	764.5	(260)

t=5.39, df 246, p<.001

*equivalent mg of Demerol

Within the regular Q3H medication group, 42% of the subjects received the maximum prescribed number of doses of analgesia on a three-hour schedule. On a more conservative schedule of every three-to-four hours, 79% of the group received the prescribed number of doses of analgesia. Conversely, within the PRN medication group and PRN with vital signs group, only 33% and 27% of the groups, respectively, received analgesia doses on a three-to-four-hour schedule.

After the covariate "group" was accounted for, only one of the sixteen variables had a statistically-significant association with the number of narcotic doses administered. "Serious surgery" (r=.22) contributed an additional 4% of the variance in the number of analgesic doses given over the first 48 hours. The more serious the surgery, the more analgesic was given. The results are shown in Table 4.

Table 4

Results of Forward Stepwise Multiple Regression Analysis to Determine Statistically-Important Predictors of Analgesia Doses Given in First 48 Hours (Groups 1, 2 and 3). (N=248)

Predictor Variable	Pearson r	R	Multiple R2	Change in R2	Beta	P (on entry)
Group	+.5297	.5297	.2806	.2806	.5297	<.0001
Seriousness of surgery	+.2242	.5641	.3182	.0376	.1942	<.0003

(Serious=1) (Non-serious=0)

To examine the possible predictors for number of analgesic doses administered more closely, the sample was separated into two groups, the regular Q3H medication group (n=85) and the combined PRN and PRN with vital signs groups (n=163). Tables 5 and 6 present the stepwise multiple-regression results. Gender and primary diagnosis of cancer were related to number of doses within the regular Q3H medication group. Males received more doses and cancer patients received fewer doses. These variables combined to account for 11% of the variation in the number of doses given.

Within the combined PRN and PRN with vital signs groups (n=163), where the administration was at the discretion of the nurse, seriousness of surgery, the administration of analgesia in the recovery room and gender were related to the number of analgesic doses. In this combined group, patients whose surgery was of the serious type, received medication in the recovery room, were female and received more doses of analgesia. These variables combined to account for 13% of the variation in the number of analgesic doses given. The results are show in Table 6.

Table 5

Results of Forward Stepwise Multiple Regression Analyses to Determine Statistically-Important Predictors of Analgesic Doses Given in First 48 Hours Within Regular Q3H Medication Group (Group I). (N=85)

Predictor Variable	Pearson r	R	Multiple R2	Change in R2	Beta	P (on entry)
Gender	+.246	.246	.060	.060	.246	.02
Primary diagnosis of cancer	-.226	.338	.114	.054	-.232	.03

Male=1, Female=0; Cancer=1, Non-cancer=0

Table 6

Results of Forward Stepwise Multiple Regression Analysis To Determine Statistically-Important Predictors of Analgesic Doses Given in First 48 Hours Within the Combined PRN and PRN with VS Groups (Groups 2 and 3). (N=163)

Predictor Variable	Pearson r	R	Multiple R2	Change in R2	Beta	P (on entry)
Seriousness of Surgery	+.273	.273	.075	.075	.273	.0004
Medications in R.R.	+.149	.317	.100	.025	.160	.0345
Gender	-.130	.363	.132	.032	-.179	.018

Male=1, Female=0

Discussion

The primary aim of the present study was to examine any relationship between the frequency of administered narcotic analgesia and a number of demographic and clinical variables under controlled schedules of narcotic prescription.

The most important predictor of the number of analgesia doses found in the stepwise regression analysis was the prescribed schedule of narcotic administration. Regularly-scheduled narcotic analgesia was associated with a higher number of administered doses. The expected difference between the PRN with vital signs group and the PRN group was not found. The

hypothesis was that the PRN with vital signs group had the advantage not only of being more flexible than the Regular Q3H Medication group, but also had access to a nurse on a regular basis and would not need to search for help. Hence this group should receive more doses than the PRN group and be more similar to the Regular Q3H group. In fact the two PRN groups did not differ in dose frequency. These results suggest that when dosing is a function of the interaction between patient and nurse (i.e., the discretion of the nurse and the request for, or acceptance by, the patient), then there is a reduction in the amount and frequency of administered narcotic.

Interestingly, even within the regular schedule of prescription, 21% of the subjects failed to receive the maximum number of doses prescribed. Furthermore, within the PRN scheduled groups, approximately 70% of the subjects also failed to receive all the doses of analgesia available by the prescription. This discrepancy between the amount of analgesic ordered and the amount received is congruent with other studies (Cohen, 1980; Donovan et al., 1987; Faherty & Grier, 1984; Marks & Sachar, 1973; Smith & Utting, 1976; Sriwatanakul et al., 1983), and may be indicative of the inadequacy of pain management.

From a different perspective, a 20% failure rate is consistent with the mean estimated error rate (range 1.6% - 38.5%) in drug administration in general (Girotti, Carrick, Tierney, Chesnick & Brown, 1985). It is also considered an acceptable level for defining provider compliance (Sackett, Haynes & Tugwell, 1985). Nonetheless, allowing for a 20% non-compliance rate in the groups, there were still 50% of the subjects within the PRN groups who did not receive the maximum prescribed doses. It is important to acknowledge that, from this study, it cannot be assumed that more analgesia would have been better or that PRN, in this case, was inferior to the regular regimen because this was not an efficacy study. The findings do, however, suggest that even on a regular dosing schedule, the rates of dose administration are influenced by factors other than physician orders. This might imply that physician's orders may be circumvented by important patient factors, such as sleeping or refusing the medication, rather than the availability and judgement of the nurse.

The multiple-regression analyses demonstrated the limited extent to which demographic, clinical and treatment variables influenced the administration of narcotics. These analyses predicted, at most, only 13% of the variance in dose frequency and showed, perhaps, the extent to which certain indirectly measured attitudes of nurses might influence narcotic administration. In this group of patients, their sex, diagnosis of cancer and perceived seriousness of the surgery only partially predicted the number of analgesic doses. The variance in dose frequency must be attributed to other variables not measured in this study. The failure to explain the major portion of the

variance makes it reasonable to assume that such clinical variables as those in the interaction between patient and nurse, administrative and instrumental problems, patient or nurse beliefs about analgesia and its risks or about pain, or problems in assessing pain in the patient, may be more important.

Because this study deals with narcotic administration by three schedules of administration, it is not intended to be an efficacy study because there are no data on the patient's response to the administered analgesic. While the results provide an insight into the pattern of narcotic administration post-operatively, they fail to illuminate many of the factors that could account for these patterns. Further research should be directed at identifying the factors in the relationship between patient and nurse that influence PRN medication administration, and perhaps other treatment decisions.

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RÉSUMÉ

Facteurs de prédiction de l'administration d'analgésiques narcotiques dans les 48 heures qui suivent une opération

Diverses variables démographiques, cliniques et thérapeutiques se rattachent à l'administration d'analgésiques narcotiques après une opération. Cette étude quantifie la contribution des diverses caractéristiques des patients, des procédures intra-opératives et la gestion des analgésiques post-opératoires par rapport à la fréquence des doses d'analgésiques administrées.

Deux cent quarante-huit patients subissant une chirurgie intra-abdominale élective qui ont reçu au hasard un analgésique sur les trois prescrits, ont été suivis de manière prospective pendant 48 heures après l'opération. On a procédé à des analyses de régression multiple en utilisant le groupe de traitement aux analgésiques comme covariant pour étudier l'effet collectif et l'ordre d'importance de certaines variables démographiques, cliniques et thérapeutiques sur le nombre de doses d'analgésiques administrées et sur la quantité totale d'analgésiques narcotiques administrés. Les analyses de régression multiple ont permis de ne prédire qu'un montant limité (13 %) de la variance dans la fréquence des doses. Ces résultats portent à croire que d'autres variables cliniques, notamment l'interaction entre le patient et le personnel infirmier, les problèmes d'ordre administratif et instrumental, les opinions du patient et(ou) du personnel infirmier sur les analgésiques, sur la douleur et(ou) l'évaluation de la douleur chez le patient post-opératoire, constituent sans doute des facteurs déterminants plus importants de la posologie et de la fréquence des analgésiques reçus après une opération.