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A COMPARISON OF PAIN CONTROL IN POST-SURGICAL PATIENTS RECEIVING ANALGESICS VIA AN ABBOTT LIFECARE® PCA INFUSER SYSTEM WITH THOSE HAVING TRADITIONAL INTRAMUSCULAR INJECTIONS

A Thesis

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Degree

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Barbara W. Lowe

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ABSTRACT

This investigation compared postoperative pain management using two different treatment modalities, traditional intramuscular injections and patient controlled analgesia infusers. Data were collected on a total of 58 subjects who were admitted to either an orthopedic or a general surgical unit at Fort Sanders Regional Medical Center, Knoxville, Tennessee, and who needed relief of pain postoperatively. The sample was divided into two groups, 31 whose pain management regimen was the patient-controlled analgesia (PCA) infuser, and 27 whose pain control was by intramuscular (IM) injection of narcotic. Analyses of variance were applied to the data to inspect the differences between the PCA and IM groups with respect to dosage and length of stay. Patients' perceptions of pain intensity was rated in each group and a simple comparison of responses made. Preference for a regimen of treatment was evaluated by asking those presently on PCA who had previously had surgery which was controlled by traditional intramuscular injections to compare the two treatment modalities.

The results showed no significant difference between the two groups in amount of medication taken or length of hospital stay. A clear preference for PCA was made by patients who had experienced surgery previously and had been treated for pain with traditional IM injections. Pain intensity was consistently rated lower in patients using PCA versus those receiving analgesia via injections. Also concluded was that PCA offers an alternative regimen of pain control which is safe and more closely matches the dosage of analgesic with level of pain.

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CHAPTER I

THE PROBLEM AND ITS SETTING

Statement of the Problem

This study compared two pain management techniques used for post surgical patients on selected general surgical and orthopedic units at Fort Sanders Regional Medical Center (FSRMC) located in Knoxville, Tennessee. The two pain management techniques were: (1) administration of a narcotic analgesic via the standard intramuscular (IM) route; and (2) administration of a narcotic analgesic using the Abbott Life Care® Patient Controlled Analgesia (PCA) infuser.

Need for the Study

Pain has been credited with disabling more people than any single disease entity (McCaffery, 1979, p.3). The International Association for the Study of Pain, founded in 1974, had as one of its purposes the fostering of pain research. However, many of the studies were conducted in laboratory settings, which left their application to clinical pain questionable (McCaffery, 1979, p. 4). A nationwide survey conducted by the Regional Program for Nursing Development of the Western Interstate Commission for Higher Education (WICHE) suggested pain management as a topic for clinical nursing research (Lindeman, 1975).

Studies have primarily dealt with the specific mechanisms of pain, various treatment modalities for acute and chronic pain, and attitudes of health care professionals concerning pain. Relatively few studies were found concerning administration techniques used to deliver narcotic analgesics. The latter observation is especially important in light of

the fact that the most widely used therapy for severe pain is parenterally administered natural or synthetic opiates (Gilman, Goodman, Rall, and Murad, 1985, p. 491). The above observations suggested a need for additional research into administration techniques of narcotic analgesics, the focus of the study.

Definition

Clinical pain as defined by Melzack (1973, pp. 45-46) is a complex perceptual experience with a somatic contribution to the experience. Consistent with Melzack's definition is the one by McCaffery (1979) which states ". . . the patient's pain is viewed not as a sensation but as an affect, eliminating the idea that there will be a predictable relationship between noxious stimuli and the feeling of pain" (p. 7). Pain has been classified as either acute or chronic. Acute pain is ". . . an episode of pain lasting from a second to less than six months. Classically, organic disease or injury is present to account for the pain" (McCaffery, 1979, P. 5). Chronic pain is ". . . pain that lasts for six months or longer. It is further classified in a number of ways: (1) limited, where physical pathology usually exists and is known; (2) intermittent, when the patient has periods free from pain; and (3) persistent, which is synonymous with chronic, benign pain" (McCaffery, 1979, p. 5). Regardless of the classification, pain is generally characterized by peaks and valleys of intensity intermingled with static periods (Auxer, 1984). Prolonged, severe pain tends to cause physical and mental exaustion which adversely affects the quality of life. The individual is prevented from functioning productively.

Interventions for pain relief include: (1) those that modify the pain stimulus; (2) those that alter the mode of transmission; and (3) those that modify the reaction to pain. The primary focus of this study was altering the mode of transmission through use of narcotic analgesics administered via two different routes, intravenous (IV) by the patient, and intermittent, IM, on-demand, by the nurse. An analgesic is a medication that relieves pain. Narcotic analgesics are a subgroup of the broader classification, analgesics. Narcotic analgesics act in moderate doses by depressing the central nervous system to relieve pain. The two narcotic analgesics used in this study were morphine sulfate and meperidine hydrochloride. The specific action of each will be discussed later.

Scope of the Problem

This study dealt with the challenging problem of finding a more efficient treatment modality for parenteral analgesia. Efficiency, in this case, is defined as the administration of the minimal analgesic dose required to relieve the pain while avoiding untoward effects of excessive respiratory depression, sedation and marked fluctuation in the level of pain intensity.

The study included male and female patients between the ages of 18 and 70 years who were mentally alert, had no history of allergy to either morphine or meperidine, and who needed relief of pain post-operatively. Patients ineligible to participate in the study included: (1) those with a history of narcotic addition or abuse, (2) those who chronically used sedatives or tranquilizers, and (3) those who were pregnant or nursing unless morphine or meperidine was clearly indicated.

The patients' physicians made the initial selection of subjects following their assessment of the patients and wrote an order stating "may participate in patient controlled analgesia (PCA) study." When the patient was admitted to the clinical unit, a registered nurse made a random assignment to either the PCA group or the IM group.

Dates for the study were May 23 through August 13, 1985. One general surgical and two orthopedic units in the 575 bed urban hospital were selected for use in this investigation of clinical pain management. A total of 58 subjects, 23 females and 35 males, participated in the study.

Research Hypotheses and Questions

The two hypotheses tested in the study included:

1) There will be no difference in the mean amount of narcotic analgesic taken postoperatively between the patients in the PCA group and those in the IM group.
2) There will be no difference in the mean hospital stay between patients in the PCA group and those in the IM group.

In addition to the hypotheses, two questions were asked in the study:

1) Is there a difference in perceived intensity of pain by patients in the PCA group compared with those in the IM group?
2) Will patients in the PCA group who have experienced previous surgery for whom pain was managed by intramuscular injections of a narcotic analgesic express a preference for the PCA or the IM regimen of treatment for future pain management?

Theoretical Framework

Assumptions

The study was based on the following assumptions: (1) patients with postoperative pain comprised one major category for whom much needed observations of clinical pain could be made; (2) data could be gathered on what constituted an optimal dose of a parenterally administered narcotic analgesic and generalized to a larger population; (3) beliefs and values influence actions in nurses' and physicians' approach to the management of clinical pain; and (4) human beings need continuous self-maintenance and self-care whenever they reach a state of maturity and health that is enabling for consistent, controlled, effective, and purposeful action. The latter assumption is a basic premise of Orem's self-care deficit theory of nursing (Orem, 1985, pp. 35-37).

Two major theories serve as a framework for the study: (1) the gate-control theory of pain and (2) Orem's self-care deficit theory of nursing. The gate-control theory of pain as proposed by Melzack (1973) is described:

> ...a neural mechanism in the dorsal horns of the spinal cord acts like a gate which can increase or decrease the flow of nerve impulses from peripheral fibers to the central nervous system. Somatic input is therefore subjected to the modulating influence of the gate before it evokes pain perception and response. The degree to which the gate increases or decreases sensory transmission is determined by the relative activity in large diameter (A-beta) and small diameter (A-delta and C) fibres and by descending influences from the brain. When the amount of information that passes through the gate exceeds a critical level, it activates the neural areas responsible for pain experience and response (Melzack, 1973, p. 153).

The conceptual model offered by Melzack and Wall is shown in Figure 1.

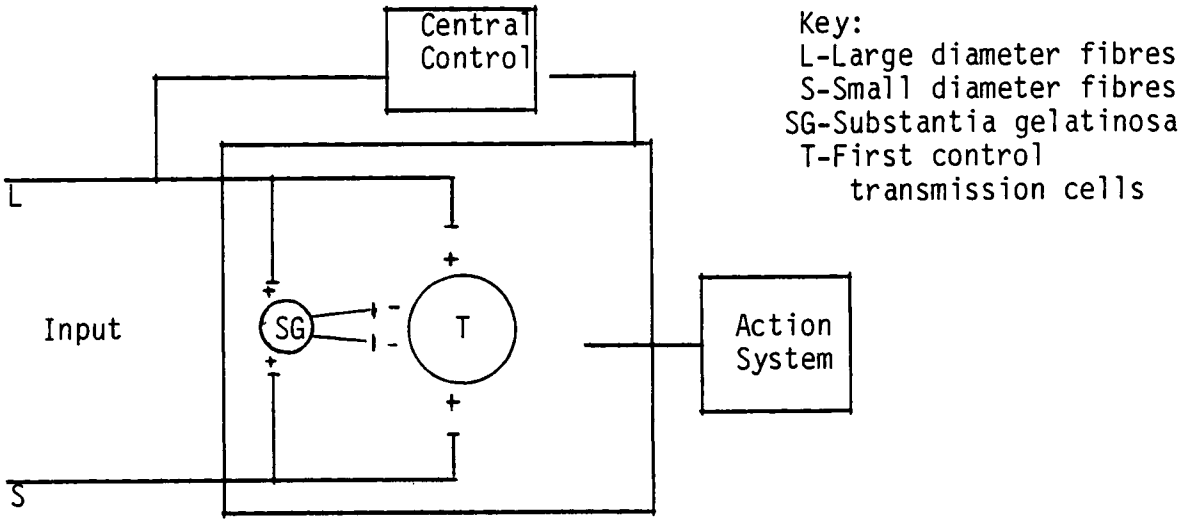


Figure 1 - Schematic Diagram of Gate Control Theory of Pain Mechanisms (cited in Melzack, 1973, p. 154).

An overview of the neuroanatomy and neurophysiology of pain provides a context in which to understand this phenomenon and its implications for nursing. The skin contains specialized nerve endings that serve as receptors for gathering information about pressure and temperature. Receptors associated with pain are termed nociceptors. Three types of cutaneous nociceptors are: mechanical, thermal and mechanothermal. Messages from cutaneous receptors come together in peripheral nerve fibers which are classified according to duration and wave form of the action potential. Two major fibers associated with pain are the A Delta myelinated fibers which carry sharp pain sensation and C unmyelinated fibers which are believed to carry the later aching or burning sensation from the same pain stimulus. The A Delta and C fibers are gathered into spinal nerves, each serving a dermatome (Dolphin, 1983, p. 255-256).

Each spinal nerve is composed of peripheral sensory nerve fibers which enter a segment of the spinal cord, and fibers that leave from the same segment going to the muscles. Approximately 50% of the unmyelinated fibers in the ventral root are sensory. Glutamic acid is thought to be the neurotransmitter released from peripheral sensory nerves. Substance P is thought to possibly be a transmitter. Pain messages enter the spinal cord via the dorsal and ventral roots. Nerve cells carrying pain messages are thought to interact with special inhibitory nerve cells (gelatinosa cells) which are enkephalin releasing cells to form a feed forward inhibitory circuit (Dolphin, p. 256). Yiannikas and Shahani (1984) report that other interneurons are also present in the dorsal horn that contain substance P, neurotensin and gamma-aminobutyrate (GABA). No definite function or neurotransmitter has yet been linked with a particular class of dorsal horn interneuron (p. 57).

Messages entering peripheral gray matter, lamina I, move via the spinothalmic tract to the brainstem and the thalamus. Pain messages entering laminae IV, V, VI travel to the reticular formation and other parts of the brainstem via the spinoreticular tract. Most pain pathways to the brain cross over and ascend the side of the spinal column opposite the point of entry. Research by White and Sweet (cited in Dolphin, 1983) indicates that alternate pain pathways exist.

The medulla appears to be the relay station to the thalamus and can either transmit or modify autonomic response to stimuli. Once the pain message leaves the brainstem it enters the cerebral cortex. The message is evaluated in light of knowledge, past experience and culture. The outcome of this process is an individualized perception of pain (Dolphin, p. 257).

In addition to messages about pain ascending to the cortex via the spinal tracts and brainstem, the brainstem and cerebral cortex send descending fibers to the dorsal horn of the cord. The descending influences are inhibitory in nature, possibly caused by the release of neurotransmitters serotonin, norepinephrine, and/or enkephalin. Descending influences from the brainstem are thought to be activated by painful stimuli, which form a feedback loop within the dorsal horn of the cord prohibiting additional pain messages from ascending to the cortex. In chronic pain this loop appears to become ineffective due to overstimulation (Dolphin, p. 258).

The second theory used in this study is Dorothea Orem's self-care deficit theory of nursing, a descriptive explanation of the human foundations of nursing and of nursing actions. The general theory has three related parts: a theory of self-care deficit, a theory of self-care, and a theory of nursing system. Self-care deficits, when health-related, are predictive of nursing requirements. Self-care, when continuously and effectively engaged in, regulates general human functioning and development. The nursing system is viewed as the product of nursing practice through which the capability of patients to engage in self-care is regulated (Orem, 1985, p. 34).

According to Orem each individual is a self-care agent with differing abilities or skills in practicing self-care (self care agency). When a self care need is unmet, a self-care demand is present. Self care deficits occur if an individual is unable to meet a self-care demand. The nurse is viewed as a dependent care agent who may be used in an educative or consultative relationship to help correct the deficit.

The dependent care agent role may be in any one of three nursing systems: supportive-educative, partly compensatory, or wholly compensatory (Orem, 1985, pp. 152-153). In the supportive-educative system the nurse acts as a consultant or teacher. In the partly-compensatory system the nurse collaborates with the patient to identify goals and assists the patient in performing those self-care skills that he/she is unable to perform alone. In the wholly-compensatory system the nurse identifies goals and performs the care.

Applied to patients in this study, the nursing goal is to help individuals to help themselves through learning a self-care skill useful in the recovery from illness. The self-care agent has a self-care demand present as a result of the illness and surgery. The self-care demand is the attainment of a maximum level of comfort. The self-care deficit is the lack of knowledge about the options available for post-operative pain relief, facts about the analgesic and how to obtain the medication. All three nursing systems are in use during the perioperative phase of a patient's hospitalization. The preoperative teaching is the supportive-educative phase. During the surgical procedure and immediately postoperatively, the patient is functioning within a wholly compensatory system where the nurse makes the decisions regarding analgesic administration based on his/her assessment of the patient and the physician's orders. After the patient is sufficiently recovered from the anesthetic to make rational decisions, he/she usually progresses to the partly-compensatory system. The nurse helps the patient with tasks such as turning, deep breathing, coughing, eating, and use of the patient-controlled analgesia infuser. Patient

functioning progresses once again to the supportive-educative system with reinforced teaching about the infuser system, support for the patient's decision to no longer take intravenous or intramuscular medication and provision of education necessary for care outside the hospital.

This pain management study offered an excellent opportunity to conceptualize nursing as a practice discipline and to represent nursing to others as a field of knowledge as well as a field of practice. As a result of the study, it is anticipated that both the knowledge domain and the practice domain of the field has been further developed and communicated to others.

CHAPTER II

LITERATURE REVIEW

The literature review will be organized into sections. The first section will include findings about beliefs, attitudes and values (affective dimension) of medical and nursing practice as these relate to pain management. The second section will incorporate studies on factors affecting patients' perception of and responses to painful stimuli. In the third section, experimental studies using patient controlled analgesia will be reported. A summary will relate the literature search to the present study.

Affective Learning Domain and Pain Management by Nurses and Physicians

Admission into nursing and medical programs of study has been based almost entirely upon past cognitive learning as evidenced by grade point average and performance on standardized tests. Once enrolled in schools, progression and graduation is based upon acquisition of knowledge (cognitive domain) in combination with performance of manual skills (psychomotor domain).

A surge of interest in a third learning domain, the affective, is becoming increasingly evident in recent articles and books that have been published (Cornish & Miller, 1976; Coletta, 1978; Costa, 1978; King, C.G. & Gerwig, 1981; and King, E.C., 1984). Davis defined affective behavior as "conduct that reflects attitudes, values, beliefs, needs, and emotion responses" (cited in King, 1984, p. 3). Planned affective

learning can take place in humanistic education. Humanistic education is that which allows the learner to realize and develop his/her full potentialities; it goes far beyond basic cognitive or psychomotor learning into the realm of attitudes and values, the affective domain.

The rationale for emphasis on affective learning in this study is grounded in concern that nursing and medical education must include content from the cognitive, psychomotor and affective domains if the approach to care is to be transformed from a mechanistic disease model to that of a holistic model. Such a transformation would result in heightened sensitivity to patients' need for pain control.

Some investigations that reflect a relationship between beliefs and values of professionals and their approach to the management of clinical pain are presented here. Taylor, Skelton and Butcher (1984) examined features distinguishing chronic from acute pain syndromes as these influenced nurses' estimates of patient suffering, pain relief actions, and attitudes toward patients. Participants in the study included 232 registered nurses including graduates from associate degree, diploma, and baccalaureate degree nursing programs who were employed in a variety of specialty and medical-surgical nursing units. A questionnaire was used which asked for an estimate of a hypothetical patient's pain, a rank of pain relief actions, and a rating of the patient on nine bipolar personality and behavioral trait dimensions.

The study found that nurses attributed significantly less suffering to hypothetical patients with chronic, long-term pain than to those with acute pain of short-term duration. Nurses further suggested a willingness to perform significantly fewer interventions for depressed

patients than nondepressed patients. In addition, patients without objective signs of pain were viewed more negatively than those for whom pathology was evident. Nurses in the study judged patients who had prolonged pain experience to have less intense suffering; more negative attitudes were evident toward these patients. In other studies, nurses have been found to be influenced in their assessment of pain by the category of illness or injury of the patient (Davitz & Pendleton, 1969, Dudley & Holm, 1984), and socioeconomic background of the patient (Davitz & Davitz, 1975).

Studies investigating the influence of the years of practice a nurse has had on his/her perception of a patients' pain have been varied. Dudley and Holm (1984) found no influence. However, Lenburg, Burnside and Davitz (1970, and Mason (1981) found that nurses with fewer years of practice inferred a greater intensity of physical pain than did those with several years of practice.

While it is important to examine nursing attitudes about pain, one must also consider physician attitudes. In typical clinical settings, it is the physician who orders the specific medication, the route of administration, and the frequency with which an analgesic can be provided. In a study conducted by Weis, Sriwatanakul, Alloza, Weintraub, and Lasagna (1983), a questionnaire was used to elicit responses on (1) the goal of postoperative analgesic treatment, (2) knowledge of the effects of combining a narcotic analgesic with either promethazine or an amphetamine, (3) the incidence of having addiction occur with intramuscular injections of meperidine every four hours for 10 days, and (4) the incidence of developing a respiratory depression with an IM

injection of morphine. Ninety-seven physicians and 147 nurses participated in the study which was conducted at Strong Memorial Hospital, Rochester, New York. Slightly over 20% of the nurses and physicians aimed for complete pain relief, a percentage that closely paralleled the finding that only 17% of the patients reported they were pain free during the 4 hour period sampled.

In response to question 2, misconceptions about additive effect of promethazine and amphetamine existed among both physicians and nurses. They strongly believed that promethazine increased the efficacy of the narcotic analgesics. However, only the sedative effect of narcotic analgesics is increased. In contrast, few physicians and nurses believed that amphetamine increased the analgesic properties of narcotics even though data from at least one other study showed that such action did occur (cited in Marks and Sachar, 1973).

In response to question 3, the fear of addiction on the part of nurses and physicians was demonstrated. Responses to question 4, however, demonstrated that few nurses or physicians believed that a significant proportion of patients would develop respiratory depression (Weis, et al. 1983). Based on these findings, inadequate treatment can scarcely be attributed to fear of respiratory depression. Moreover, the fear of addiction was needlessly exaggerated according to studies by Marks and Sachar (1973) and by Saunders (cited in McCaffery, 1979, p. 222). The problem of undertreatment of surgical pain is documented in at least one other study (Cohen, 1980).

Findings from the above studies suggest that values and attitudes are related to an inadequate use of the traditional, intermittent,

on-demand IM injections of analgesic medications. The answers to questions specifically related to action and interaction of drugs also suggest the need for additional knowledge on the part of health professionals.

Influence of Patient Perception on Response to Painful Stimuli

Pain is difficult to define and to quantify. This section of the literature review will relate to findings that show pain as "a complex perceptual experience with a somatic contribution to the experience" (Melzack, 1973, p. 45). A challenge to professionals in health care is understanding the private, subjective world of pain experienced by the patient in order to plan care. Since it is behavior rather than experience that the care giver observes, inferences, right or wrong, which are derived from beliefs and experiences of the viewer, tend to influence the plan for management.

The pain coping model described by Copp (1983) can be used as a guideline for the nursing assessment of pain, and closely relates to the theoretical framework of this study: the gate control theory of pain and Orem's self-care deficit theory of nursing. Copp described pain coping models based on patient self-images which were related to how pain was perceived. Five types of self-images and their corresponding views of pain include: (1) victim-pain is powerful; (2) combatant-pain is invading; (3) responder-pain is reality; (4) reactor-pain is cunning; and (5) interactor-pain is demanding.

An individual who sees himself/herself as a victim might function more in the wholly compensatory system, totally dependent upon the nurse for care. The individual who is combatant might function more in the partly-compensatory system where the nurse supplements his/her limited self-care ability, or in the supportive-educative system where the nurse provides assistance in the areas of support, teaching and guidance.

The gate control theory of pain has both a physiological and a psychological dimension. Physiologically, the theory explains the T cells that open and close the gate, and the central control trigger, both of which are common to all humans. The theory further recognizes the function of psychological variables on pain perception.

The relation of pain and perceptual style to the total pain experience has been explored using a physiological approach (Pickar, Cohen, & Dubois, 1983). A small sample of 9 patients, 7 males and 2 females, ages 18-60, who had laparotomies for the assessment of testicular or ovarian malignancy were studied. The clinical study measured levels of plasma cortisol and B-endorphin prior to, during and after major abdominal surgery. Between the first and third hour after awakening from surgery, each patient was given morphine 1.5 - 3.5 mg/hr IV. In six of the patients, plasma was collected immediately after intubation and during the period of postoperative morphine administration. Findings revealed that mean surgery levels of plasma B-endorphin were significantly negatively correlated with total morphine requirement; plasma cortisol showed a similar tendency. Presurgical

levels of plasma B-endorphin and cortisol predicted postoperative morphine requirement.

In summary, individuals with lower presurgical or surgically stimulated levels of plasma B-endorphin and/or cortisol were those who required greater amounts of postoperative analgesics. It is believed, however, that even surgically stimulated levels of B-endorphin are insufficient to exert direct analgesic effects themselves. The levels may reflect activation of central endorphin systems which, in turn, enhance analgesia. The patient's physiological response or arousal prior to surgery, which is thought to be dependent upon intensity of psychological stress, appears to be a major determinant of post-operative analgesic requirements. These findings suggest that post-surgical outcome measures, including the use of pain medication, may be predicted on the basis of how a patient copes the night prior to surgery (Pickar, Cohen, and Dubois, 1983).

Rankin (1983) examined whether an athlete has a consistently higher blood endorphin level than a non-athlete. He also questioned whether a higher blood level decreased verbal reports of pain more in the injured athlete than the injured non-athlete. Nineteen subjects participated in the study. Data were obtained through use of the individual subjective Vertical Visual Analogue Scale and the measurement of individual B-endorphin levels. Findings revealed no statistically significant differences between injured athletes and non-athletes in blood endorphin levels and in pain reports as measured by the Visual Analogue Scale. However, correlations of the total participants (injured athletes and non-athletes) showed that the higher the reports of pain, the lower the

endorphin level. This finding raises the question of whether blood endorphin levels mask the symptom of pain, especially in athletes. Also the question is raised of whether health professionals should rely on verbal reports of pain in assessing an injury and developing a management plan.

Voshall (1980) studied the effects of preoperative teaching on postoperative pain. Thirty patients who had elective cholecystectomies participated in the study. A significant difference in the number of postoperative analgesic doses taken was found between the experimental and control groups. The experimental group, given information about postoperative pain, took an average of 2.6 doses of analgesics compared to an average of 3.0 for the control group in a 24-hour period. In addition, patients in the experimental group were discharged sooner (average 6.6 days) than those in the control group (average 7.6 days). From this study it appears that information a patient is given preoperatively can make a difference in his/her postoperative course.

Cultural differences in reactions to pain have been studied. Hardy (cited in McLachlan, 1974) investigated thresholds for pain recognition in 150 subjects. No difference was found to exist in pain thresholds between cultural groups. Zborowiski (cited in McLachlan, 1974) also observed that people from different cultures had similar thresholds for pain, but an array of reactions ranging from stoic to overt expressions.

The transactional aspects of pain have been considered by Szasz (cited in Mastrovito, 1974). He suggested that there are two conditions inherent in circumstances involving pain. The first is a biologic function which alerts the individual that something is wrong. The

second is the communicative meaning of pain. The patient is crying for help, expressing fear, alleging injustice, or manifesting anger. Szasz concluded that when direct expression of an emotion or need is inhibited either by external reality or internal conflict, pain may develop, be intensified, and be expressed. Professionals must recognize these cues to avoid the pitfall of inadequate assessment and treatment of pain leading to frustration on the part of patients and staff.

Last in this section is an anecdotal report by the Senior Editor of Hospital Practice. What better way is there to examine patient perception of pain than to look through the eyes of one whose career role places him on the fringe of the health care provider system? Claiborne (1982) reported that his involuntary investigation into pain and its management began in 1966 while he was a patient in a well known Boston hospital. His experiences with pain management covered fifteen years and exposure to well known hospitals in New York and Boston. He called attention to the fact that providing analgesia was a clinical problem handled inadequately by professionals. Five very important points were made in this anecdotal report which relate directly to the present study of pain management: (1) professionals are reluctant or unwilling to give analgesics unless the patient is in pain when the drug is given; (2) the goal of pain management is not "zero pain", therefore complaints of inadequate analgesia are viewed as something of a nuisance to staff; (3) the adjustment of drug dose and timing is routine based on averages rather than individuals; (4) if a particular analgesic regimen involves minor risks, the patient should be allowed the option of accepting the risks, within stringent limitations, in the interest of

adequate relief; and (5) there is medical overconcern with the possible side effects of analgesics, stemming probably from the misapplication of the ancient, yet valid principle of doing no harm. Claiborne concluded that the harm produced by severe and prolonged pain could impede recovery. He challenged health care professionals to work on solving the problem. He expressed confidence in the professional's authority to determine whether analgesia can be achieved. He challenged them to recognize that the patient remains the primary authority on whether analgesia has been achieved. Further, Somerville (1982) contended that failure to properly manage a patient's pain should be considered as a breach of legal duty equivalent to actionable negligence.

To summarize, studies in this section suggest the need for an increasing commitment on the part of nurses and physicians to plan with, rather than for, patients who are experiencing clinical pain. The shared approach combines the physiological, psychological and pharmacological expertise of the professional with the private, subjective world of pain experienced by the patient. The stage is set for mutual trust and a greater potential for maximum control of pain.

Control of Clinical Pain Using Patient Controlled Analgesia

According to Gilman, Goodman, Rall, and Murad (1985), the most widely used therapy for severe pain is parenterally administered natural and synthetic opiates. Although an increasing number of analgesic agents has been introduced within the past two decades, the search continues for the optimal analgesic and mode of administration.

The ideal analgesic has been described as follows:

> An ideal analgesic should provide reliable pain relief for all patients--with no nausea, sedation, dysphoria, addictive potential, respiratory depression, sensory or motor blockade, urinary retention, or cardiovascular instability. In addition, it should be cheap, easy to administer, and allow early mobilization. Unfortunately, none of the modalities currently available possess all of these properties (Warfield, C.A. and Warfield, G.R., III, 1984, p. 85).

Both acute and chronic pain have been shown to be dynamic in nature with fluctuating levels of intensity. However, the standard treatment of pain has continued to be intermittent, on-demand, intramuscular injections of an analgesic at 4 hour intervals. Auxer (1984) showed that the problem inherent in this standard treatment is that the analgesic effect of the bolus of medication tends to be out of phase with the dynamics of the patient's pain. The result is that patients tend to have an analgesic dose that is either too much or too little for their varying levels of pain.

Forty-two investigations with a new method of analgesia administration, PCA, involving over 1000 patients, were done between 1968-1983 in the United States prior to the approval of PCA by the Federal Drug Administration. These studies were summarized by Graves et al. (1983). Eight of the PCA studies involved the use of morphine, ten involved the use of meperidine and three involved the use of both morphine and meperidine. The remaining studies used other analgesics. Twenty-seven of the 42 studies involved pain control in postoperative patients.

The more recent studies in this group were done at the University of Kentucky by R.L. Bennett and his colleagues. One of these studies

included 7 postoperative patients who used patient-controlled analgesia (PCA) for 60 hours in an attempt to determine optimal analgesic dose. An optimal narcotic dose was described as one that produced appreciable analgesia without producing subjective sedation. The mean total dose of morphine sulfate used by these 7 patients was 1.8 mg per hour. The greatest use of narcotic occurred in the first 36 post-operative hours when a range of 32 to 185 mg was observed (Bennett et al. 1982).

A second study conducted by Bennett and colleagues (1982) involved 24 patients. The major purpose of the study was to compare PCA with standard time-sequenced injections of morphine sulfate. Twelve patients were randomly assigned to each group. More patients in the PCA group reported an adequate state of analgesia without sleep or drowsiness than did those in the IM group, significant at the 0.01 level when analyzed using the Mann-Whitney U test. Patients in both studies were admitted to the University of Kentucky Medical Center for elective gastric bypass surgery for the management of obesity. In both studies, all patients were reported to rate PCA far superior to intermittent dosing techniques of narcotic in the control of pain. Less interference with physical activity was reported in the PCA group when compared with the IM group.

Atwell and associates (1984) studied postoperative pain control in 13 patients who had an open renal operation with a latus incision. An initial group of 7 patients was used to examine variability in narcotic requirement and to determine the optimal dose using a PCA device. A second group of 10 patients was then randomized to receive either PCA or a standard regimen of intramuscular morphine sulfate.

In the initial 7 patients, the morphine requirement ranged from 0.3 to 3.6 mg per hour, with an average dose of 1.50 mg per hour. A progressive decrease in narcotic need was noted during the postoperative course. Neither body surface nor weight showed any significant correlation with narcotic requirement.

In the study of the 10 patients who were randomly placed in PCA and IM groups, adequate analgesia without excessive sedation was noted for 63.3 percent of the time for patients in the PCA group compared to 34.3 percent of the time for patients in the IM group. Questionnaire data revealed that patients in the PCA group reported less pain, less sedation and a higher activity level when compared with patients in the IM group.

S.J. Bollish and his colleagues (1985) compared the efficacy of patient-controlled versus conventional intramuscular injections for postoperative pain control in 20 adult patients scheduled for abdominal surgery. Patients were randomly assigned to one of two groups. In group 1, morphine sulfate was administered via PCA for 24 consecutive hours after which the patients were given morphine sulfate IM for 24 hours. The treatment order was reversed for group 2. Nursing staff recorded the amount of narcotic administered, respiratory rate, levels of discomfort, activity, and sedation for each patient. At the end of each 24 hour treatment period, patients ranked their level of pain, amount of pain relief, level of sedation, ability to sleep, and ability to perform pulmonary toilet. In addition, patients were asked whether they would prefer PCA or IM analgesic therapy if future surgery were required. Findings revealed that patients reported significantly

less discomfort while on the PCA regimen than when receiving IM injections of morphine. No significant differences were noted in amount of narcotic used, respiratory rate, nausea and vomiting, or levels of activity or sedation. A majority of patients, though not statistically significant, showed a preference for future use of PCA.

The relationship between plasma morphine concentrations and pharmacologic effects in postoperative patients using PCA has been examined by Graves and associates (1985). Twelve patients were selected before surgery for postoperative pain control using morphine administered by PCA. No narcotic drugs were given prior to surgery. An initial morphine sulfate dose of 0.6 mg/square meter of body surface was selected and the dose was increased or decreased as needed based on assessment of the patient's pain. The nurse recorded the cumulative morphine dose, respiratory rate and sedation every 2 hours. In addition, the patient's evaluation of pain and liking for the drug was recorded. A plasma analysis for morphine was made every morning and evening. A statistically significant direct relationship existed between plasma morphine concentrations and pain rankings using regression analysis (R=0.16). Sedation and respiratory rate were independent of morphine concentration. Rankings of liking for the drug varied directly with plasma morphine concentrations.

Findings suggested that a continuous plasma morphine concentration in a range of 40 ng/ml to 80 ng/ml could safely control pain. According to Stanski and associates (cited in Graves et al. 1985) a dosing rate of 2.5 mg/hr resulted in plasma morphine concentrations of 40 ng/ml in normal, healthy volunteers. Certain pathologic states can alter this as

evidenced in the study by Sawe and associates (cited in Graves et al., 1985), in which a dosing rate of only 1.6 mg/hr of morphine was needed to maintain a plasma concentration of 40 ng/ml in cancer patients with substantial hepatic disease.

The investigators concluded that postoperative patients given control, within limits, over their analgesic regulation did not overuse, misuse or abuse morphine, therefore adding to the accumulating evidence that PCA is a safe method for pain control. This observation supported past research that described behavior of PCA dosing as a "closed-loop system" (Graves et al. 1985, p. 44). Patients simply balance the need for comfort with the need for a clear sensorium. The direct correlation of pain rankings with plasma morphine concentrations suggested that high pain rankings caused patients to self-administer morphine which obviously increased their plasma morphine concentration.

In summary, comparison of the PCA method and traditional methods for the control of pain have produced an impressive body of evidence that (a) cyclic nature of pain management (which results in fluctuating levels of pain) is avoided with the PCA method; and (b) patients reported better control with less sedation when receiving the narcotic via the PCA regimen as compared to the IM regimen. A limitation of PCA studies was that the number of subjects in the studies was small. The investigation by this researcher adds to the number and variety of patients for whom PCA has been reported to have been used for pain management. The methodology for the study is described in Chapter III.

CHAPTER III

METHOD

This study compared two pain management techniques in postoperative hospitalized patients on two selected units at Fort Sanders Regional Medical Center (FSRMC) in Knoxville, Tennessee between May 23 and August 13, 1985. The following hypotheses were tested in the study.

Hypothesis 1: There will be no difference in the mean amount of narcotic analgesic taken postoperatively between the patients in the PCA group and those in the IM group.

Hypothesis 2: There will be no difference in the mean length of hospital stay between patients in the PCA group and those in the IM group.

In addition to the two hypotheses, two questions were asked in the study.

Question 1: Is there a difference in the perceived intensity of pain by patients in the PCA group compared to those in the IM group?

Question 2: Will patients in the PCA group who have experienced previous surgery for whom pain was managed by intramuscular injections of a narcotic analgesia express a preference for the PCA or the IM regimen of treatment for future pain management?

Subjects

A total of 58 subjects participated in the study. Subjects were selected from patients who were anticipated to require relief of pain postoperatively and who met the following criteria: (1) male or female, 18 to 70 years of age; (2) mentally alert and able to comply with instructions and procedures; and (3) without a history of allergy to the analgesics (morphine or meperidine). Patients with the following conditions were ineligible to participate in the study: (1) those with a history of narcotic addiction or abuse; (2) those with a history of chronic sedative or tranquilizer use; and (3) women who were pregnant or nursing unless morphine or meperidine was clearly indicated.

Surgeons who admitted patients to the units where the study was being conducted made the initial determination of a patient's suitability for the study according to the criteria stated above. Once a physician's order was received, a registered nurse randomly assigned the patient to a group, either PCA or IM, by drawing a slip of paper from an envelope on which an A or a B was printed. If an A was drawn, the patient was placed in the PCA group; if a B was drawn, he/she was placed in the IM group.

Inservice education classes were provided for staff nurses on the clinical units where the study was to be conducted to further ensure safety of the patients. Following the classes, selected patients were placed on PCA so staff nurses could acquire experience with the patient controlled analgesia infusers. The same criteria for patient selection was used; however, patients were not randomly assigned to groups. These patients were excluded from the study data. A representative from Abbott Laboratory was available for consultation during this time.

Once the study began, 5 additional patients were excluded from the study data because physicians specifically ordered PCA rather than allowing the patients to be randomly assigned. A total of 71 patients participated in the study. Fifty-eight patients were eligible for inclusion in this research investigation. Table 1 shows the characteristics of subjects included in the study.

Table 1. Subject Characteristics

	PCA Group		IM Group	
	Female (N=14)	Male (N=17)	Female (N=9)	Male (N=18)
Age Range----------	20-62	30-70	20-63	18-70
Mean Age----------	48.7	52.4	39.8	49.1
Length of hospital stay range--------	4-9 days	3-19 days	1-16 days	2-18 days
Mean length of hospital stay-----	6.2 days	7.8 days	7 days	5.2 days

Procedures

The procedures utilized in this study were reviewed and approved by the Human Research Committee at the University of Tennessee, Knoxville, and by the Pharmacy and Therapeutics Committee at FSRMC where the study was conducted.

The study was conducted over a 90 day period with PCA infusers supplied by Abbott Laboratory, Chicago, Illinois. Prior to the initiation of the study, surgeons on the staff at the regional medical center were contacted via letter by James R. Burkhart, Vice-President of the medical

center to inform them of plans for the study (Appendix A). Attached to the letter were: Exhibit A (Appendix B), a list of the criteria for patients selected to participate in the study which had been approved by the medical staff; and Exhibit B (Appendix C), a physicians' consent form to participate in the study as explained in the letter. Twelve physicians returned the forms, and a list of these individuals was provided to the admitting office and to the units on which the study was conducted. Having this list available facilitated the process of obtaining the necessary physicians' orders for patient participation. Nurses from the units where the study was being conducted attended an inservice education program planned by the researcher. The class included information relative to the purpose of the study, instructions to be given to the patient and his/her family, the operation of the PCA machine, care of the patient, and the specific procedures to be followed to collect the data.

Following receipt of an order for a patient to participate in the PCA study, a registered nurse made the random assignment to a group as previously discussed. The nurse, using the appropriate informed consent form (Appendixes D and E), explained the purpose of the study to patients in both groups, the method of pain control to be used postoperatively, the procedure involved in obtaining the desired analgesic, and the anticipated time before the pain relief would be felt to the patient. For patients in the PCA group, a brochure developed by the researcher and approved for use by Fort Sanders Regional Medical Center Department of Nursing entitled Patient Controlled Analgesia Learning Program (Appendix F) was provided. An opportunity was provided for the patient to read the

brochure and the informed consent form, and to discuss any questions prior to giving written consent to participate in the study.

The method of treatment used for the PCA group was management of pain by self-administered small preset doses of prescribed analgesic through an intravenous line. The analgesic used was either morphine sulfate in a concentration of 1 mg per ml or meperidine in a concentration of 10 mg per ml. A loading dose in the range of 2 to 5 mg of morphine or 10 to 20 mg of meperidine was prescribed for use if the patient had experienced pain prior to the initiation of PCA. The Abbott Lifecare® PCA Infuser System has a programmable interval dosage and a maximum 4 hour dosage limit. A range for morphine of 1 mg to 2 mg (concentration 1 mg/ml) every 6 to 10 minutes, with a 4 hour dosage limit of 20 mg was recommended based upon a previous study (Bivens and Baumann, 1984). The recommended interval dose for meperidine using the PCA infuser was 5 to 15 mg (concentration 10 mg/ml) every 6 to 10 minutes. The recommended maximum dosage for meperidine using the PCA infuser was 150 mg over a 4 hour period.

The usual range for a single IM dose of morphine sulfate for an adult patient was cited to be 5 to 15 mg and for meperidine, IM, 50 to 150 mg, as needed every 3 to 4 hours. Dosages for either mode of administration were judged to be within the safe range (Gilman et al., 1985, pp. 505-515).

When the postoperative patient returned to the clinical unit from the recovery room, a nursing assessment of the patient's status was made including verification of the proper placement of an existing IV line. The PCA intravenous infuser set was connected to the existing IV line as

described in the inservice education classes. Copies of the procedure were available for reference. Patient/family teaching was reinforced by the registered nurse prior to initiation of the PCA. Throughout the time the patient was on the PCA, the IV bottle and line were checked every 1 to 2 hours. The IV tubing was changed every 48 hours as stipulated by hospital policy.

The method of treatment used for the IM group was administration, by the nurse, of a prescribed dose of morphine or meperidine following a request for an analgesic by the patient. A lapse of approximately 10 minutes was expected between the time of their request and the administration of the medication by the nurse, and an additional 20 to 30 minutes before significant pain relief would be perceived by the patient.

Members of both the PCA and the IM groups received the same observations by the nurses of their respiratory status and mental alertness. A recording of the dosage received was made on the medication administration record (MAR), a form which became a part of each patient's permanent hospital record.

Patients were grouped for data analysis into four surgical categories: orthopedic, genitourinary, rectal, and other. The category labeled "other" included: abdominal surgery, breast surgery, and vein ligation and stripping. The number of patients having each type of surgery in the "other" category was too small to create a separate group for each. Criterion for placement of patients into each of the groups was surgery of the anatomical part identified and/or its related structures.

Measures of the dependent variables, dosage of analgesic and length of hospital stay, and intervening variables, age, sex, and type of surgery were obtained from the patients' hospital records. A 10-point pain intensity rating scale, developed by the researcher, (Appendixes G and H) was used to measure perceptions of pain intensity by patients in both the PCA and the IM groups. A four item questionnaire, developed by the researcher, (Appendix I) was completed by patients in the PCA group who had a history of previous surgery and who had used IM injections to manage their pain postoperatively. Eighteen of the 31 patients (58%) in the PCA group completed the questionnaire. Although all were able to read, some requested that the investigator read and record their oral responses. The researcher complied with their requests. The dialogue gave additional information that probably would have been omitted if the respondent had been restricted to circling the choices on the questionnaire.

Instruments

A mean milligram per hour dosage was calculated as a basis for testing the first hypothesis, that there would be no difference in the amount of analgesic taken postoperatively between the patients in the PCA and IM groups. A mean length of hospital stay was calculated as a basis for testing the second hypothesis, that there would be no difference in the mean hospital stay between patients in the PCA group and those in the IM group. Analysis of variance was applied to the data to inspect for the differences between the PCA and the IM groups with respect to dosage and length of hospital stay.

To examine the first question whether there would be a difference in the perceived intensity of pain by patients in the PCA group compared to those in the IM group, two 10-point rating scales were developed by the researcher (Appendixes G and H). Each time the infuser button was pushed allowing the analgesic to be released for subjects in the PCA group or an injection was requested by subjects in the IM group, the pain intensity was rated by the subject by circling the number on the scale corresponding to the perceived level of pain. Discomfort was assessed by verbally requesting patients to rank their pain on a scale of 1 to 10 (1 = very comfortable, 10 = severe pain).

The second question whether there would be a difference in satisfaction of pain control using the PCA regimen of treatment when compared to an IM regimen for patients who have had previous surgery was answered from data collected using a four item questionnaire developed by the researcher (Appendix I) and completed by patients. Eighteen of the 31 patients in the PCA group (58%), completed the questionnaire. Chapter IV will detail results of the study.

CHAPTER IV

RESULTS

Morphine and meperidine were the two analgesics used in the study. For comparison and anlysis of the data, equianalgesic dosages were used: "1 mg of morphine = 10 mg meperidine" (Katcher, Young and Koda-Kimble, 1983, p. 52). Bollish and associates (1985) used the same concept of morphine equivalency in their study.

The mean analgesic dosage recorded in mg/hr, the mean length of hospital stay, the mean age, the route of analgesic administration, and the number of participants are summarized by type of surgery in Table 2.

Table 2. Summary Table for Patients Grouped by Type of Surgery

Type of Surgery	Route of Analgesic Administration	Number in each Group	Mean age in each Group	Mean Length of Stay/ days	Mean Analgesic Dosage/mg per hour
Other	IM	9	44.8	3.4	0.53
GU	IM	6	53.8	5.8	0.54
Ortho	IM	7	45.8	9.4	1.1
Rectal	IM	5	39.2	5.0	0.67
Total -		27	46.04	5.8	0.71
Other	PCA	10	54.0	6.0	2.40
GU	PCA	6	58.5	6.1	0.54
Ortho	PCA	10	47.2	10.3	1.70
Rectal	PCA	5	42.4	4.4	0.61
Total -		31	50.7	7.1	1.53

Data were analyzed according to a two-way analysis of variance. The two factors were: method of administration (2 levels) and type of surgery (4 levels). An interaction term was included to check for uniformity of preference of administration method across the four types of surgery. Unequal numbers of patients were available in each combination of surgery type and administration method. The design was unbalanced, and the general linear model (GLM) procedure of the SAS statistical package was used for analysis. The analysis of variance partitions the model sum of squares according to the two main effects and the interaction. However, since the design is unbalanced, the two sum of squares for main effects and interaction do not total the model sum of squares. A significance level of 0.05 was chosen as the criterion for use with all statistical tests. Findings related to the first hypothesis, that there would be no difference in the mean amount of narcotic analgesic taken postoperatively between the patients in the PCA group and those in the IM group, are shown in Table 3.

Table 3. Effect of Route of Administration and Type of Surgery on Dosage of Analgesic

Source	df	SS	MS	F	P
Model	7	29.53	4.21	1.55	0.1715
Administration (A)	1	4.88	4.88	1.80	0.1862
Surgery (S)	3	10.04	3.35	1.23	0.3078
A X S	3	9.51	3.17	1.17	0.3318
Error	50	135.82	2.72		
Total	57	165.35			

There was no significant main effect of route of administration (PCA and IM) on the dependent variable, dosage of analgesic taken per hour, $F = 1.80$, $df = 1$ and 50, $p = 0.1862$. There was no significant main effect of the type of surgery on mean amount of analgesic taken, $F = 1.23$, $df = 3$ and 50, $p = 0.3078$. The investigation also revealed that no significant interaction effect occurred for route of administration and type of surgery, $F = 1.17$, $df = 3$ and 50, $p = 0.3318$. The first hypothesis was not rejected.

The second hypothesis, that there would be no difference in the mean length of hospital stay between patients in the PCA group and those in the IM group, was also tested using a two-way ANOVA. There was no significant main effect of route of administration (PCA and IM) on the dependent variable, length of hospital stay, $F = 0.83$, $df = 1$ and 50, $p = 0.3658$. Results are shown in Table 4. The second hypothesis was not rejected.

Table 4. Effect of Route of Analgesic Administration and Type of Surgery on Length of Hospital Stay

Source	df	SS	MS	F	P
Model	7	327.52	46.79	4.63	0.0005
Administration (A)	1	8.41	8.41	0.83	0.3658
Surgery (S)	3	281.61	93.88	9.30	0.0001*
A X S	3	19.21	6.40	0.63	0.5964
Error	50	504.90	10.10		
Total	57	832.42			

* $p < 0.05$

A significant main effect was found for type of surgery on length of hospital stay in this investigation, $F = 9.30$, $df = 3$ and 50, $p = 0.0001$. No significant interaction effect was found for route of administration and type of surgery on mean length of hospital stay, $F = 0.63$, $df = 3$ and 50, $p = 0.5964$.

Tukey tests revealed ($\alpha = 0.05$) that the length of stay for the orthopedic group differed from that for all the other groups, while no differences were found among the genitourinary, rectal, and "other" patients. The orthopedic procedures included open reduction of fractures in patients with multiple injuries and total joint replacement in older patients. By comparison, many patients in the genitourinary group had transurethral resections; patients in the "other" category had breast biopsies or non-radical breast surgery, and those in the rectal group had uncomplicated hemorrhoidectomies. In addition to the complexity of the surgery, the essential postoperative therapy for the orthopedic group tended to favor prolonged hospitalization.

The question whether there would be a difference in perceived intensity of pain by patients in the PCA group when compared to those in the IM group was answered based upon data collected from a pain intensity rating scale (Appendixes G and H), developed by the investigator. Ratings from the pain intensity scale were grouped into three categories: 1-3, mild; 4-7, moderate; and 8-10, severe. Figures 1 through 3 show the percentage of patients within each group who rated their pain as severe, moderate, or mild.

A comparison of Figures 1 and 2 shows that a patient receiving an analgesic via the PCA method is more likely than a patient receiving an

IM analgesic to suffer moderate rather than severe pain. Figure 3 shows that within the sample being studied, mild pain ratings were given more frequently by the genitourinary and "other" surgical groups than by the orthopedic and rectal groups.

Perception of pain intensity is highly individualized. Pain messages travel over a peripheral sensory nerve fiber to the spinal nerve. Nerve cells carrying the pain messages are thought to interact with special inhibitory cells (gelatinosa cells) which are enkephalin producing to form a feed forward inhibitory circuit. Messages entering the peripheral gray matter move either to the thalamus or to the reticular formation. The medulla serves as the relay station to the thalamus which can either transmit or modify autonomic responses to stimuli. Once the message reaches the cerebral cortex it is evaluated in light of knowledge, past experience, and culture. The outcome is an individualized perception of pain which may account for the differences observed in the intensity rating scales in the investigation.

Data from the four item questionnaire (Appendix I) were used to answer the last question: Will patients in the PCA group who have experienced previous surgery for whom pain was managed by intramuscular injections of a narcotic analgesic express a preference for the PCA or the IM regimen of treatment for future pain management? Findings indicate that 88.8% of the patients rated pain relief using the PCA infuser far superior to that obtained with intermittent injections. Feelings of nausea were experienced less frequently while using the PCA infuser in 66.6% of the cases; 27.8% reported that feelings of nausea were about the same with the PCA and IM method; and 5.6% reported more nausea while using

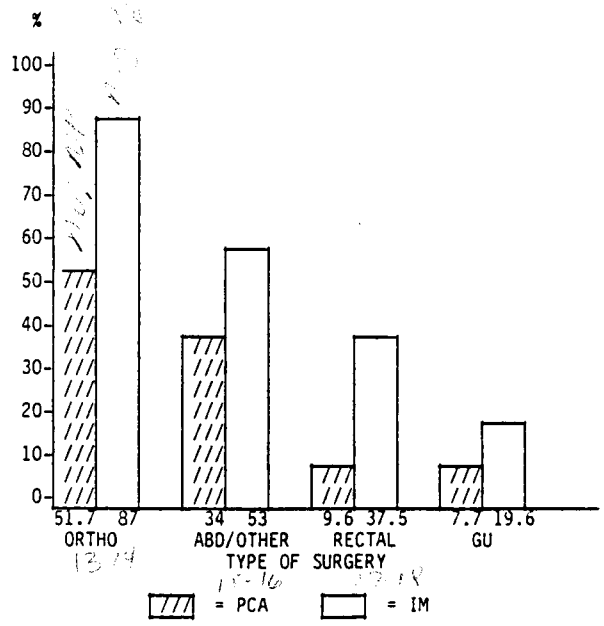


Figure 1: Severe Pain Intensity Rating

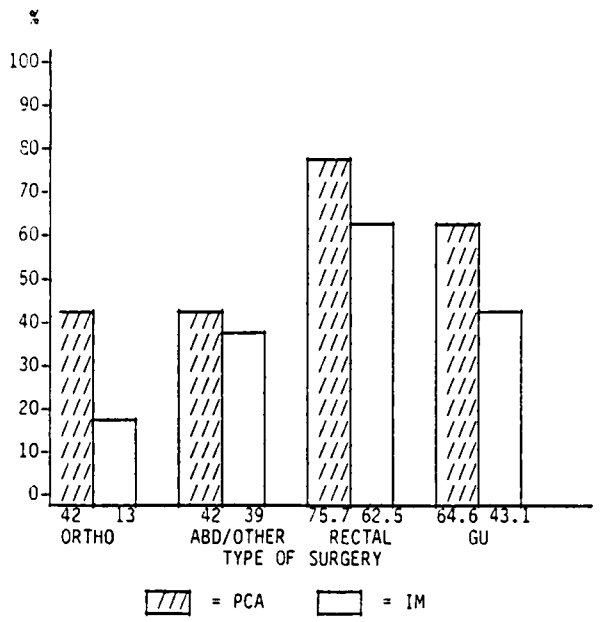


Figure 2: Moderate Pain Intensity Rating

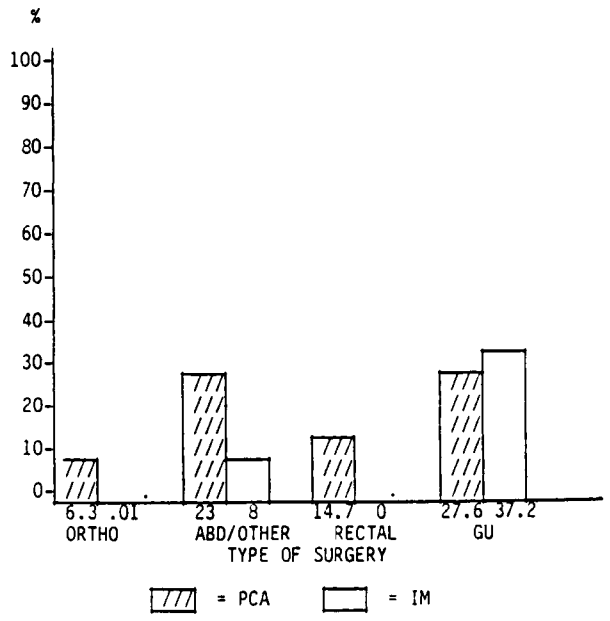


Figure 3: Mild Pain Intensity Rating

the PCA than with previous IM injections. Fifty-five percent reported less drowsiness with PCA while 38.9% reported drowsiness was about the same with both regimens of treatment, and 5.6% reported a greater feeling of drowsiness while using the PCA infuser. Of the 18 respondents to the questionnaire, 94.4% reported that PCA would be their future choice for postoperative pain control; 5.6% reported "either", a choice that was written in by the respondents on the questionnaire. Table 5 shows a summary of the results from the patient controlled analgesia questionnaire.

Table 5. Questionnaire Summary Comparing Patient Controlled Analgesia with IM Analgesia (N=18)

Questions	Choice of Response	Percentage of Responses
1. Pain relief using PCA regimen.	Greater	88.8%
	Same	11.2%
	Not as great	0.0%
2. Nausea using PCA regimen.	Less	66.6%
	Same	27.8%
	Greater	5.6%
3. Drowsiness using PCA regimen.	Less	55.5%
	Same	38.9%
	Greater	5.6%
4. Future choice for pain control.	IM injections	0.0%
	PCA infuser	94.4%
	*Either	5.6%

*Not a choice of response on the questionniare.

CHAPTER V

DISCUSSION

Only one other study found by the investigator compared mean dosage of analgesic between a PCA group and an IM group. The study was conducted by Bollish and associates (1985) on a total of 20 adult patients having abdominal surgery. Half of the patients received analgesic by the PCA method and half by the IM method for a period of 24 hours postoperatively. The route of administration was reversed for the second 24 hour period. Meperidine 100 mg was considered equipotent to 10 mg of morphine. Patients using the PCA device in the Bollish investigation received 9% less morphine than did patients receiving IM injections. The findings, however, compare to the present study in that no statistically significant difference was shown in the amount of analgesic taken by the two groups. A PCA dosage comparison based on the first 48 hour post-operative period showed a mean 24 hour dose of 34.1 mg in the Bollish study and a mean 24 hour dose of 26.4 mg in the present study.

In one small study of seven patients conducted at the University of Kentucky Medical Center, Bennett and associates (1982) attempted to determine the optimal narcotic dose in obese patients using a PCA infuser. Patients in his study were allowed to begin using the PCA device while still in the recovery room. The mean dosage of morphine during a 60 hour postoperative period was 1.8 mg per hour, greater than the 1.1 mg mean per hour for the first 48 hours or .55 mg per hour for the total time found in the present study. In the Bennett study (1984), the greatest use of the narcotic occurred during the first 36 hours when a range of

32 to 185 mg was observed. In this study, the greatest use occurred during the first 24 hours with a 1.2 mg mean per hour for the first 24 hours decreasing to .94 mg mean per hour for the second 24 hour period.

In an attempt to determine the optimal minimum effective plasma concentration of analgesic, Graves and associates (1985) observed that a concentration above 40 ng/ml was effective for pain relief. The maximum plasma concentration in their subjects was 82 ng/ml. In an earlier study by Stanski and associates (cited in Graves et al. 1985), a dosing rate of 2.5 mg/hr resulted in plasma morphine concentrations of 40 ng/ml in normal, health volunteers.

No other study of which the investigator is aware examined length of stay in relation to postoperative analgesia control, although it was suggested by Bollish and associates (1985). Another study alluding to a relationship between method of postoperative pain control and length of hospital stay was made by Atwell and his colleagues:

> Spontaneous activity appeared to be impaired less with the smaller, more frequent doses of medication provided with the controlled analgesia. On the other hand, intramuscular dosing, with its wide variation in serum narcotic levels, resulted in patients spending more time in pain and exhibiting heavier sedation. Either of these states may predispose to decreased cooperation with nursing staff and, with flank incision patients in particular, compromised pulmonary toilet. Sympathetic overactivity in patients with pain may have adverse cardiovascular effects and prolong postoperative gastrointentinal recovery (Atwell et al. 1984, p. 703).

The finding that orthopedic patients in this study sample had a significantly longer hospital stay than those who had rectal, genitourinary, and "other" surgery is a factor believed to have influenced the overall mean dose of analgesic and perceived pain intensity since the orthopedic group comprised 29.3% of the total patients in the study.

The mean length of stay and the mean analgesic dosage were greater for the orthopedic patients than for other patients in both the PCA and IM groups in this study. Many of the patients suffered from multiple fractures or total joint replacement and had rigorous postoperative therapy that was reportedly painful. The length of time required for multiple trauma healing as compared to healing time for non-radical breast surgery, transurethral resection, or hemorrhoidectomy is a factor that appeared to affect the length of hospital stay for orthopedic patients in this study.

Findings with respect to perceived pain intensity in this study are consistent with those of Bennett, et al. (1982): "Patients reported inadequate analgesia ('in pain') more frequently in the IM group (22 vs. 14%, p=NS)" (p. 702). Chakravarty, Tucker, Rosen and Vickers (1979), used a series of linear analogues on which a patient scored his/her integrated impressions of pain over a 24 hour postoperative period. The patient was instructed that the left-hand end of the line represented no pain at all, and the right-hand end represented the most pain he/she could imagine. The patient was requested to make a vertical mark across the line at the point perceived to appropriately describe the amount of pain throughout the 24 hours. The mean analogue scores for the overall rating of pain intensity were considerably lower than the scores for the IM postoperative analgesia regimen. The study by Bollish et al. (1985) in which patients were asked to rank their pain on a scale of 1 to 10 (1 = very comfortable, 10 = severe pain), over a 48 hour postoperative period failed to show a significant difference between PCA and conventional analgesia.

Consistent with previous research by Bennett and associates (1982), patients in the present study rated PCA far superior to intermittent dosing techniques. Reasons cited for superiority in the Bennett study include: (1) lack of delay between perception of pain and administration of analgesia; (2) absence of the helpless feeling generated by too much analgesia; and (3) control of the analgesic by the patient instead of by the doctor or nurse (p. 703).

Melzack and Dennis (cited in Field, 1984) offered an explanation of the influence of pain perception in terms of gate control theory. "As the noxious stimulus is perceived and evaluated, stimulation of the limbic system from both the cortex and spinal cord activates the aversive motivational drive which makes the pain experience unpleasant" (p. 53). The perceived difference in pain intensity supports the belief that pain is neither purely organic nor strictly functional. It is a perceptual phenomenon similar to yet different from other sensory perceptions (Mastrovito, 1974). Explained in terms of the gate control theory of pain, the pain messages are entering the spinal cord, move to the brainstem, and are relayed to the thalamus via the medulla. The pain message enters the cerebral cortex and is evaluated in light of knowledge and past experience. The fact that a patient in the PCA group has knowledge that control lies as close as the push of an infuser button while the patient in the IM group is dependent upon the nurse to provide pain relief may account for the difference in perception between the two groups. Although objective data in this study (mg of analgesia per hour) showed no significant difference between the groups, the researcher suggests that the nursing goal of helping the patient to help himself/herself was enhanced by use of

the PCA method of treatment. The self-care agent is learning a self-care skill that is meeting a self-care demand, attainment of a greater degree of comfort. The nurse is functioning mainly in the role of supporter by encouraging the patient to make a decision or perform a task that contributes to his/her level of comfort and degree of self-care.

Responses to item 2 on the questionnaire are compared to findings by Bollish, et al. (1985), who reported nausea and vomiting in 15% of the patients using PCA and 35% of the patients receiving intramuscular injections. In the present study, 66.6% reported less nausea using the PCA regimen, 27.8% the same, and 5.6% greater (Table 5). One factor noted while collecting data from patient records for this study was the physicians' orders for patients in the IM group. In most cases, orders included an antiemetic such as promethazine which could be given with the analgesic at the nurses' discretion. The practice of ordering an antiemetic to be given with a narcotic analgesic IM is common, whereas the patient taking his own analgesic by PCA had to show signs of nausea or verbalize a request for an antiemetic to a nurse before one would be administered.

Findings on item 3 of the questionnaire, feelings of drowsiness while using the PCA infuser compared to those felt while taking IM injections correspond to those reported by Atwell, et. al. (1984), who observed adequate analgesia without sedation in 63.3% of the observations for the PCA group compared to only 34.3% of the observations in the IM group (p. 702). Bennett, et al. (1982) found that 59% of the patients in the PCA group maintained adequate analgesia without sedative effects as compared to 40% in the IM group (p. 702).

Studies by Chakravarty, et al. (1979), Bennett, et al. (1982), and Bollish, et al. (1985) indicate an unquestionable preference for PCA as did responses to item 4 of the questionnaire used in the present study. This preference suggests to the researcher that a more informed consumer group is demanding to be involved in decision making. A further explanation for this preference is suggested based upon the gate control theory of pain. In the group completing the questionnaire, two different types of postoperative pain experience have entered the brain for evaluation. With the PCA experience, a perceived degree of control is present which is a psychological advantage for many patients.

Limitations

A major limitation of this study was the small sample size. In addition, the types of surgery clustered in a way that could limit generalizability of findings to other populations. Inclusion of breast surgery in the category labeled "other", most of which was limited to biopsies or excision of small lesions rather than more radical surgery, possibly altered findings with respect to dosage and length of stay. Inability to conduct a double blind study increased the possibility of influence secondary to patient awareness of participating in the study (Hawthorne Effect). The latter situation could potentially affect preference ratings for the newer PCA method.

Conclusions

This study supports observations by other researchers that finding improved methods to manage pain continues to be a very real need for patients, nurses, and physicians. The PCA mode of administering analgesia

was found to be a safe option for patients in regard to the total amount of analgesic taken. The perceived intensity of pain by subjects in the PCA group was less than for subjects in the IM group with comparable types of surgery. For patients who had previous surgical experiences with traditional IM analgesia management, a comparison of the two methods revealed: (1) a significantly larger percentage indicated greater relief with PCA; (2) feelings of nausea and drowsiness were less with PCA; and (3) PCA would be their choice of postoperative pain management in the future.

Suggestions for further study

Based on the study findings, a recommendation was made to the Pharmacy and Therapeutics Committee, Fort Sanders Regional Medical Center, to provide PCA as one method of pain management on all clinical units. Determination of usage will be made by physicians with input from patients and nursing personnel.

There is a need for additional study of theories applicable to a practice discipline such as nursing. Future studies of pain management could enable nurses to apply nursing theory thereby further developing nurses' abilities to practice within a nursing frame of reference.

Since cost for hospitalization is of great concern today, a replication of this study with a larger sample size is recommended to examine whether a difference in length of stay exists between patients receiving postoperative analgesia via a PCA infuser when compared with those receiving traditional IM injections. A comparison of feelings of nausea between patients receiving analgesia via the IM route and those

receiving analgesia via a PCA infuser when antiemetics are not ordered for either group is suggested. Also, a comparison of the dose of analgesic required to maintain a minimum effective plasma concentration of drug needed to provide a state of patient comfort is recommended. An interesting observation was that some patients in the IM group in this study elected to take no injections or only one injection before switching to an oral route of analgesic administration. Based on this observation, the researcher recommends a comparison of perception of pain associated with IM injections and amount of analgesic taken via the IM route.

On at least four occasions, patients in this study's PCA group verbalized a complaint regarding the cumbersome nature of the infuser with two IV tubes and a bottle of IV fluid. The equipment inhibits mobility of the patients. Companies marketing PCA infusers are therefore encouraged to conduct research in the development and use of smaller, more flexible devices.

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LIST OF REFERENCES

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APPENDIXES

APPENDIX A

May 3, 1985

Dear Dr. :

On May 13th Fort Sanders Regional Medical Center will conduct a pilot study on the effect of the Abbott Lifecare Patient Controlled Analgesia (PCA) Infuser. This pilot study will be conducted, with the physician's cooperation, on post-operative patients from both 3-North and 5-North. An inservice program will be given for physicians on May 13th by Peter C. Strasburg from Abbott, Kimberly Mashburn, R.N., and Barbara Lowe, R.N. in Staff Development Classroom #1 at 7:00 AM.

A detailed study of the benefits and drawbacks of the PCA will be conducted by Barbara Lowe, R.N., who is Director of the Fort Sanders School of Nursing and a graduate student at the University of Tennessee, College of Nursing. Mrs. Lowe will be compiling the results of this pilot study to fulfill her Master's Thesis requirements, while at the same time assisting physicians with patients whom they wish to have considered for PCA hookup. Exhibit A provides a list of the patient selection criteria approved by the Medical Staff and the method for random selection of the study participants. This method of selection will insure that all physicians with patients on the test floors have an opportunity to have patients connected to the PCA even though only ten infusers will be available to testing purposes.

The purpose of the study will be to compare two pain management techniques for post-surgical patients on 3-North and 5-North at Fort Sanders. An attempt will then be made to answer the following questions based upon the data collected.

1. Will there be a difference in total amount of morphine or meperidine taken post-operatively in patients who are treated with the PCA regimen when compared with the standard IM regimen of treatment?

2. Will there be a difference in intensity level of pain in patients who are in the PCA group when compared with those in the IM group?

3. Will there be a difference in length of hospital stay for patients in the PCA group when compared with those in the IM group?

4. Will there be a difference in satisfaction of pain control using the PCA regimen of treatment when compared with IM regimen of treatment for patients who have had surgery in the past?

To participate in the pilot study, please sign and return exhibit B to Mrs. Lowe expressing your desire to participate in the PCA study at Fort Sanders from May 13th through August 13th, 1985. Any questions concerning the study should be addressed to Mrs. Lowe at extension 1290.

Thank you in advance for your cooperation in this study and your continued support in seeking new ways to improve patient care and satisfaction.

Sincerely,

James R. Burkhart
Vice President

gb

Enclosures

APPENDIX B

Exhibit A:

PCA - Pilot Project
5N - 3N

Physician Use of PCA Infusers - Recommended Procedure

1. Select patients in office prior to admission who meet following criteria:

   a. Need relief of pain post-operatively.
   b. Male or female, 18-70 years of age.
   c. Mentally alert. They must be able to understand and comply with instructions and procedures.
   d. Do not have a history of allergy to the proposed analgesic (morphine or meperidine).

   Patients with the following conditions would not be suitable participants in the pilot project:

   a. History of narcotic addiction or abuse.
   b. Chronic use of sedatives or tranquilizers.
   c. Pregnant or nursing women unless morphine or meperidine is clearly indicated.

2. Write pre-admission order stating "May participate in PCA Study".

3. Upon admission, the nurse on 5N or 3N randomly assigns patient to group by drawing "A" or "B" slip of paper from envelope. A = PCA group, B = IM group.

4. Explanation of study is made by the nurse and informed consent to collect data is signed.

5. Preoperative teaching by the nurse will include information concerning use of PCA pump and rating scale.

6. Charts will be labeled: [PCA Group] [IM Group]

7. Order guideline sheet will be placed on chart for physician's reference in writing post-operative orders.

8. PCA Infuser will be connected upon return to 5N or 3N.

APPENDIX C

Exhibit B:

Physician's Consent Form

I would like to participate in the Pain Controlled Analgesia Study being conducted at Fort Sanders Regional Medical Center from May 13 through August 13, 1985. I understand that Barbara Lowe, R.N.,M.S., Director, Fort Sanders School of Nursing will be collecting and analyzing the data, and that a summary of the results will be made available to me.

Signed _____

Dated _____

APPENDIX D

FORT SANDERS REGIONAL MEDICAL CENTER
Knoxville, Tennessee 37916

PAIN CONTROL STUDY - INTRAMUSCULAR ANALGESIA
INFORMED CONSENT

In keeping with the goal to provide the best possible care for our patients, Fort Sanders Regional Medical Center Health Care Team is participating in a study to evaluate post-operative pain control. The researcher is Barbara Lowe, R.N., a graduate nursing student at the University of Tennessee College of Nursing, Knoxville, and the Director of Fort Sanders School of Nursing.

The purpose of this study is to evaluate different methods of post-operative pain control. You will be in a group in which either morphine or meperidine (Demerol®) will be ordered by your physician to be given intramuscularly for pain control. This is the standard practice for controlling post-operative pain. You call the nurse when you need the medication and in approximately 10 minutes, the medication will be administered. In another 20-30 minutes you should begin to feel pain relief. As is true for the injection of any pain medication, a feeling of drowsiness may result. The nurse, however, routinely monitors your pain relief and state of alertness.

The researcher will review your record and collect data such as age, sex, diagnosis, surgical treatment, amount and type of medication taken and length of hospital stay. In addition, you will be asked to circle a number on a rating scale describing the intensity of your pain each time you request an injection. This data will be recorded on a confidential form which does not include your name, and will be kept in a locked file in the researcher's office for a period of three years.

Signing below indicates your willingness to participate in this study comparing two methods of pain control. You may refuse to participate in the study or withdraw from the study at any time without adversely affecting your treatment. Findings will be presented in summary form only and no individual will be identified by name. The study findings should assist health care professionals in helping patients to manage pain more effectively.

If you would like a summary of the results, please indicate by checking YES in the space provided. The results can be mailed to you.

APPENDIX D
Page 2

If you have any questions, contact Barbara Lowe at 971-1290 Monday through Friday from 8:00 AM - 4:30 PM or you may ask your nurse.

Date _____ Patient: _____

Witness: _____

I would like a copy of the results of this study: YES ____ NO ____

APPENDIX E

FORT SANDERS REGIONAL MEDICAL CENTER
Knoxville, Tennessee 37916

PAIN CONTROL STUDY - PATIENT CONTROLLED ANALGESIA
INFORMED CONSENT

In keeping with the goal to provide the best possible care for our patients, Fort Sanders Regional Medical Center Health Care Team is participating in a study to evaluate post-operative pain control. The researcher is Barbara Lowe, R.N., a graduate nursing student at the University of Tennessee College of Nursing, Knoxville, and the Director of Fort Sanders School of Nursing

The purpose of this study is to evaluate different methods of post-operative pain control. You will be in a group in which either morphine or meperidine (Demerol®) will be ordered by your physician to be given using a Patient Controlled Analgesia (PCA) Infuser. This method of receiving medication allows you to push a button connected to a machine which puts a small dose of the pain medication into your intravenous (IV) line which is already in place to provide fluid needed post-operatively. The medication goes directly into your blood stream. You should feel the full effect of medicine in less than 5 minutes. No serious side effects have been seen from patient controlled analgesia in studies that have been conducted at other hospitals.

You have to be awake to give yourself a relatively small dose of the pain medication, and you cannot give it any more often than the safe, predetermined interval which your doctor has prescribed for you. You will be connected to the PCA machine when you return to your room. Your intravenous line may be left in place a few hours longer after your surgery than it would be if you received your analgesia (pain relief medication) intramuscularly. Minimal risks such as irritation to the vein or infection are associated with prolonged intravenous therapy. Your nurse will be monitoring the IV site closely to detect any early indications of irritation or infection and will remove the IV from that site should these signs appear.

The other method of pain control in the study is the traditional intramuscular (IM) injection of either morphine or meperidine. The IM method requires the patient to call the nurse and request the medication. In approximately 10 minutes, the medication is delivered and in another 20-30 minutes the patient should begin to feel pain relief. A larger dose of medication is ordered for a single IM dose than that used with the PCA method. A feeling of drowsiness may occur with larger doses given IM.

The researcher will review your record and collect data such as age, sex, diagnosis, surgical treatment, amount and type of medication taken and length of hospital stay. You will be asked to circle a number on a

APPENDIX E
Page 2

rating scale describing the intensity of your pain each time you push the button to give yourself medication. In addition, if you have had surgery before, you will be asked to complete a short four item questionnaire comparing your pain control using the PCA infuser with that of relief obtained from intramuscular injections. This data will be recorded on a confidential form which does not include your name and will be kept in a locked file in the researcher's office for a period of three years.

Signing below indicates your willingness to participate in this study comparing two methods of pain control. You may refuse to participate in the study or withdraw from the study at any time without adversely affecting your treatment. Findings will be presented in summary form only and no individual will be identified by name. The study findings should assist health care professionals in helping patients to manage pain more effectively.

If you would like a summary of the results, please indicate by checking YES in the space provided. The results can be mailed to you.

If you have any questions, contact Barbara Lowe at 971-1290 Monday through Friday from 8:00 AM - 4:30 PM or you may ask your nurse.

Date: _____ Patient: _____

Witness: _____

I would like a copy of the results of this study: YES ____ NO ____

APPENDIX F

Patient Controlled Analgesia Learning Program

Fort Sanders
Regional Medical Center
Department of Nursing
Patient Education

PATIENT CONTROLLED ANALGESIA LEARNING PROGRAM

"To provide for shared control of pain"



APPENDIX F

Patient Controlled Analgesia Learning Program

DO THESE COMMENTS AND QUESTIONS SOUND FAMILIAR?

"Gee, I dread that hospitalization and especially surgery."

"Will it be painful? If so, will I receive the necessary pain medication to keep me comfortable?"

"Will the pain medication keep me so drowsy I will stay knocked out and not remember what I've said or done?"

GOOD QUESTIONS!

We consider you, the patient, the most important member of the health care team. While we have the nursing and medical knowledge necessary to care for you, only you know first hand how you feel.

We want you to know as much as possible about your treatment and be involved in your care.

WHAT IS PATIENT CONTROLLED ANALGESIA?

Remember what patients did when they needed pain relief in the past? They called the nurse who evaluated the pain, checked to see when it would be time to give the medication according to the doctor's orders, and prepared the medication for administration.

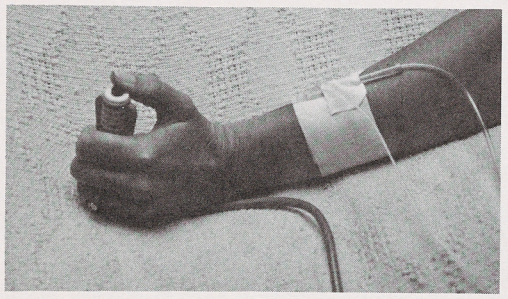
Time since request — an average of from 10 to 15 minutes and then another 10 to 15 minutes for the medication to work (relieve pain).

Now, the nurse and physician are still interested in relieving your pain but they have found a quicker, more evenly controlled method of accomplishing this . . . with your help!

This discovery is called a Patient Controlled Analgesic (PCA) Infuser. It is connected to an intravenous line through which fluids are going into your blood stream. When you feel discomfort and need relief, push and release the button. The right amount of medication as prescribed by your doctor to relieve the pain will be delivered.

CAN I OVERDOSE?

No. The PCA Infuser is a precision instrument, specially engineered by Abbott Laboratories. It is designed so that you cannot give yourself more medication than is planned just for you.



HOW TO USE THE PCA INFUSER

Each time you start to feel uncomfortable PRESS and RELEASE the button as shown here. Remember, built-in timers insure that you cannot get too much medication or too often.

Rolling over on the button will not activate the infuser. You have to push the button with your thumb or finger and release it to get any medication.

BALANCE PAIN RELIEF AND SLEEPINESS

Once you've pressed and released the button — relax. You have put yourself into the position of gaining that quickly needed relief, yet keeping alert and awake except for the desired sleep at night.

If your pain medication appears to stop working after you have pushed and released the button several times, call the nurse to check your IV. The nurse will know what to do.

Your nurse and physician will be keeping a close watch to help you evaluate your pain and the effectiveness of your pain medication.

Because of the control over your pain, you will be better able to prevent complications.

How? By doing deep breathing exercises as instructed, turning more frequently and ambulating earlier for greater distances.

Be sure, however, that the nurse is with you when you get out of bed to walk.

HOW LONG WILL I BE USING THE PCA INFUSER?

Your physician will make that decision with you.

PATIENT COMFORT AND SAFETY, OUR NO. 1 GOAL

Our goal is the same as yours — your comfort and safety.

Congratulations on your participation in making this goal a reality.

APPENDIX G

FORT SANDERS REGIONAL MEDICAL CENTER
Knoxville, Tennessee
PCA
PAIN RATING SCALE

Hospital # _____ Room # _____ Date _____
Drug _____ Primary Nurse _____ Shift _____
PCA Setting _____ (PCA Setting if changed _____; time _____)

Please rate the intensity of your pain on the scale of 1 to 10 by circling the number which corresponds to the way you feel at the time you punch the button to get pain medication. Move down to a new row and circle the number which best describes your pain each time you punch the button for pain medication.
(0=No Pain, 1-Very mild, 2-Mild.....9-Severe, 10-Very Severe)

0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10

Total Dosage Taken
for Shift _____

_____
Primary Nurse

APPENDIX H

FORT SANDERS REGIONAL MEDICAL CENTER
Knoxville, Tennessee
IM
PAIN RATING SCALE

Hospital # _____ Room # _____ Date _____
Drug _____ Primary Nurse _____ Shift _____

Please rate the intensity of your pain on the scale of 1 to 10 by circling the number which corresponds to the way you feel at the time you request pain medication. Move down to a new row and circle the number which describes your pain each time you request a "shot" for pain.

(0=No Pain, 1-Very mild, 2-Mild.....9-Severe, 10-Very Severe)

0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10
0	1	2	3	4	5	6	7	8	9	10

Total Dosage Taken
for Shift _____ Primary Nurse _____

APPENDIX I

FORT SANDERS REGIONAL MEDICAL CENTER
Knoxville, Tennessee 37916

PAIN CONTROL STUDY - PATIENT CONTROLLED ANALGESIA QUESTIONNAIRE

April, 1985

The following four questions are to be answered by individuals who have been using the patient controlled analgesia infuser post-operatively and who have also had surgery in the past after which pain control was by injections of medication.

Please circle the answer that best describes your feelings following surgery this time compared to how you felt in the first few days after your past surgical experience.

1. Pain relief using the PCA infuser compared to injections of medication in the past was:

    a. much greater
    b. about the same
    c. not as great

2. Feelings of nausea while using the PCA infuser compared to those felt while taking IM injections of pain medicine were:

    a. less
    b. about the same
    c. greater

3. Feelings of drowsiness while using the PCA infuser compared to that felt while taking IM injections of pain medication were:

    a. less
    b. about the same
    c. greater

4. If surgery were scheduled in the future, my choice of method for pain control post-operatively would be:

    a. intramuscular injections
    b. patient controlled analgesia infuser

VITA

Barbara Woody Lowe was born in Del Rio, Tennessee on December 19, 1938. She received her elementary and secondary education in the public schools of Cocke County, Tennessee, and graduated from Cocke County High School in 1955. In the fall of 1955 she entered Maryville College, Maryville, Tennessee where she completed two years of study before entering a school of nursing. She received a diploma in nursing from the University of Tennessee Memorial Research Center and Hospital School of Nursing, Knoxvile, Tennessee in 1961.

She held the position of nursing instructor at East Tennessee Baptist Hospital School of Nursing from 1962-1965, and at the University of Tennessee Memorial Research Center and Hospital School of Nursing from 1965-1974. She returned to school and earned a degree in Educational Administration and Supervision from the University of Tennessee, Knoxville, in 1971.

From 1974-1978 she taught at the University of Tennessee College of Nursing, Knoxville. In 1978 she accepted the position of Director of Nursing Education at Fort Sanders Presbyterian Hospital School of Nursing, a position she still holds. In September 1981, and while maintaining her present position at Fort Sanders, she began work toward a second master's degree. In March 1986, requirements for the Master of Science in Nursing were completed.