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The Relationship Between Functional Disability of Chronic Low Back Pain to Depression

Janice Ellen Looman

Effect of Proximal Thermal/Pressure Cutaneous Stimulation on the Discomfort of Intramuscular Injection

by

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Abstract

The discomfort from receiving an intramuscular injection is pain that may be reduced by proper nursing intervention if the gate control theory is applied. A group of 71 adult preoperative patients were randomly assigned to control and experimental groups. The experimental group received a warm (43.5°C), 800 gram pack proximal to the site of injection. The control and experimental group scores were compared using a Mann-Whitney U test of significance for the intervention. The intervention was not significant in reducing the discomfort from an intramuscular injection at the .05 level.

Acknowledgements

This project is but a small part of my graduate education. The encouragement I received from my professors and peers were most important to completion of this segment of my formal education. Those stimulating relationships will be sadly missed.

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My deepest appreciation and love to my wife, Nancy who gave up so much for my education. My children Aaron, Adam and Ashley deserve special mention because of their support and understanding. I wish to also acknowledge the influence of my parents and my aunt who instilled in me the determination to be the best that I can be.

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Chapter 1

Introduction

Professional nurses assume responsibility for the development and application of techniques that assist them in meeting their patient's needs. As they strive to improve the quality of patient care, they often look at improving these techniques. They look at traditional, as well as new, techniques and evaluate them for application to their patients.

One concern of nurses is the reduction of patient discomfort from various procedures. Nurses, while functioning in an interdependent role, assist physicians with many procedures that cause discomfort. One responsibility is to assist with the actual technique. However, their most important role, many times, is comforting the patient during what may be a frightening, as well as uncomfortable experience.

Nurses functioning in their independent role of treating patients responses to their health problems, many times become the professionals who actually inflict discomfort. Nurses' responsibility to patients are to inflict minimal discomfort while performing the necessary nursing techniques. This is evident during the many times a day when nurses administer parenteral injections.

Injections cause discomfort to many patients because of the actual trauma from insertion of the needle into body tissue and the irritation of the injectate on tissue. Nurses can do very little to change the chemical composition of the injectate, but may be able to reduce the discomfort of injection through application of scientific principles.

Problem Statement

Nurses, many times, feel frustration when they must inflict discomfort on their patients while performing nursing interventions. They identify with the patient and feel guilt about being the people inflicting the discomfort.

Many patients have experienced discomfort from intramuscular injections even though the injections have been administered by approved techniques. For years health care professionals have studied various techniques in an attempt to relieve the discomfort of injection for their patients.

Using knowledge of the physical and psychological sciences to decrease that discomfort has not made injection free of discomfort. However, using these sciences nurses can be assured that they are providing optimal comfort for their patients.

Purpose

Receiving an injection free of discomfort may not be attainable but any step toward that goal would be welcomed by

both patients and nurses. The purpose of this investigation was to add to the body of knowledge concerning alleviation of the discomfort from intramuscular injections. In particular, would application of a warm/pressure pack decrease the discomfort of receiving an intramuscular injection?

Hypothesis

The research hypothesis for this study was: subjects who receive intramuscular injections using a proximal warm/pressure pack placement technique will experience less discomfort from an injection than those who receive the injection without the placement of a warm/pressure pack. The independent variable in this study was the placement of a warm/pressure pack proximal to the injection site thirty seconds prior to the injection. The dependent variable was the intensity of the discomfort as rated by the subject on a graphic rating scale.

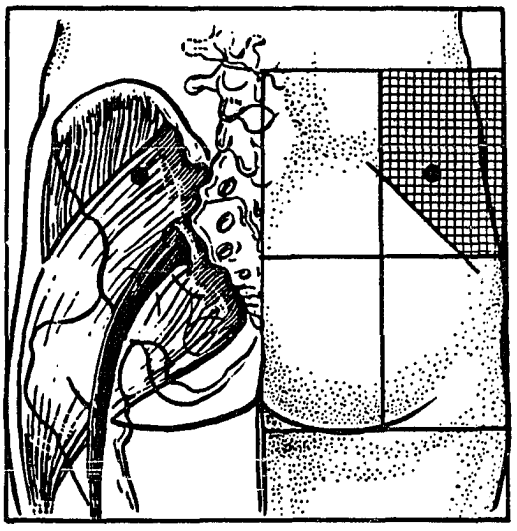
Definition of Terms

Chronic pain: pain lasting more than six months and being treated pharmacologically by a physician.

Discomfort: an unpleasant sensation as rated on a graphic rating scale by the subjects immediately following an intramuscular injection.

Dorsogluteal site: the intramuscular injection site located by dividing the buttocks into quadrants. The crest of the ilium and the inferior gluteal fold serve as the superior and inferior boundaries. The injection is given in the upper outer quadrant two to three inches below the iliac crest as illustrated in Figure 1.

Figure 1. Dorsogluteal site for intramuscular injection



(Dison, 1971)

Graphic Rating Scale: a subjective rating instrument that consists of a straight line with descriptors at each extreme and for the length of the line: specifically as shown in Figure 2.

Figure 2. Example of a graphic rating scale

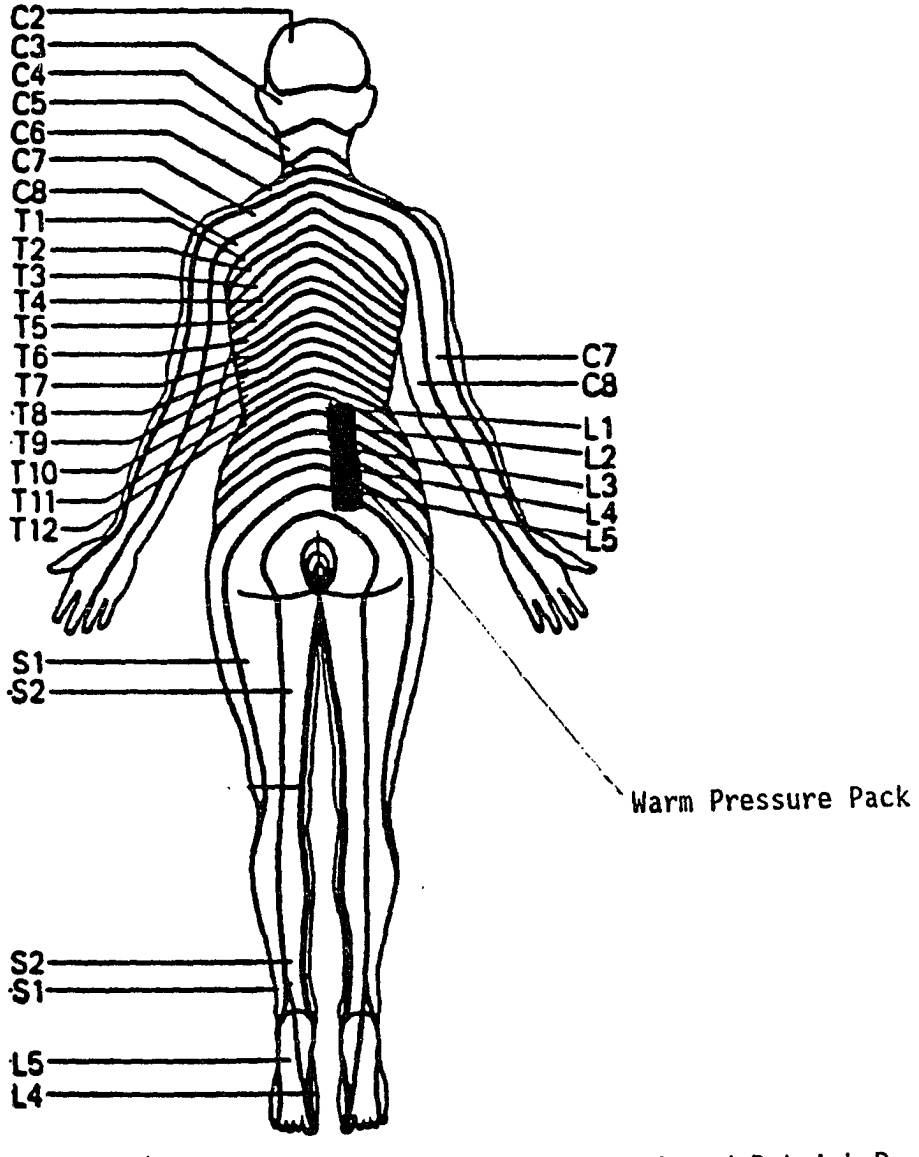
no discomfort _____ as bad as it can be
Slight-Moderate-Severe

Intramuscular injection: the administration of a liquid form of a medication into a muscle (gluteus maximus in this study) by use of a needle.

Mild Pressure: the cutaneous pressure necessary to stimulate pressure sensation but not so strong as to cause pain; approximately three grams per square centimeter.

Proximal placement technique: the placement of the warm gel-filled pack on the skin between the injection site and the spinal cord, stimulating the L1 through L5 dermatones as illustrated in Figure 3.

Figure 3. Illustration of the warm/pressure pack placement used in this study.



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Warm/pressure pack: an eight hundred gram plastic container filled with gel that retains heat. It measured 11 centimeters by 25 centimeters. The gel maintained a temperature of 43.5° Centigrade.

Z-track method of intramuscular injection: an injection technique that requires lateral displacement of the skin and subcutaneous tissue prior to the injection into the muscle. The skin is released following needle withdrawal. Theoretically this action seals the needle track to avoid leakage of medication from the muscle tissue to the subcutaneous tissue.

Chapter 2

Review of the Literature

There exist some concepts such as pain that defy clear definition. Pain is generally described as a discomfort even though all discomfort is not painful. Merskey (1979) defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. A nursing practice definition proposed by McCaffery (1979) states pain is "whatever the patient says it is, existing whenever he says it does."

Nurses confront pain or discomfort daily in their practice. They confront it when their patient's health problems require surgery and when it is one of the patient's symptoms. Nurses also confront it when they administer intramuscular injections, in which case they inflict the discomfort to achieve a therapeutic goal.

Injections elicit both a sensory and emotional response thereby meeting Merskey's definition of pain. The injection physically disrupts the tissue and the patient generally has an emotional response which, depending on the experience, is sometimes converted into a fear. MacKenzie (1954) states that this fear of injections is acquired during childhood with memories carried throughout life.

Early research by Shaffer (1929) discovered that medication absorption is related to the technique of administration. This research showed that the Z-Track technique decreased seeping of medication into subcutaneous tissue where most sensory discomfort is initiated. These results have limitations in that the research was performed on cadavers with oil based contrast media. Even with these limitations, the study has not been challenged and the technique is used today for many intramuscular injections.

Research by health care professionals on methods of intramuscular injections have met with some success in reducing the discomfort of injection. Zelman (1961) found that injecting into a relaxed muscle decreased muscular resistance and pressure on the nerve endings, producing less discomfort. More recently, Kruszewski, Lang and Johnson (1979) used this relaxation principle and found that the prone position with femurs internally rotated decreased the intensity of discomfort felt at the time of injection into the dorsogluteal site. This experimental study was conducted in a hospital setting with 44 human subjects. This study was carefully controlled and produced reliable information that may be applied to nursing practice.

Thermal applications have also been used to relieve the discomfort from intramuscular injections. Travell (1955) suggested the use of local refrigerant chemicals over the site, prior to the injection, to reduce the discomfort of injection. This experimental study took place in a hospital using human subjects and well-controlled variables. Eland (1985) suggested using the same technique whenever delivering an injection to pediatric patients.

Wing (1976), in a non-controlled study using ice packs proximal to the site of injection found a pronounced decrease in discomfort. This study of 75 patients was descriptive in nature. No other studies were found in the literature to support this observation.

Heat has been used for centuries to relieve discomfort. The use of heat in Turkish steam rooms and Roman baths is well known. Fuerst, Wolff and Wietzel (1974) state, "local application of heat usually relieves pain." They attribute this to the changes in muscular tension and vascular dilitation. The theory at that time was that the dilitation of arteries increased the blood flow and the oxygen to the tissues, thereby reducing the pain. Since 1974 increasing evidence in support of the gate control theory of pain transmission suggests that there are also sensory changes caused by the heat and pressure

stimulus during the application that closes the gate to pain stimuli.

Long and Carolan (1974) state that proximal stimulation of sensory nerve fibers can mask or modify the perception of pain. Small-diameter fibers of the peripheral nerves conduct excitatory pain, which can be blocked if large-diameter peripheral nerves are stimulated prior to the painful stimulation (Siegele, 1974). Small diameter nerves (A-beta) are stimulated by light pressure irrespective of the temperature of that pressure application.

No valid study was found using heat to relieve pain of injections or related to decreasing acute pain prior to a procedure. DeLateur (1974) states that either heat or cold applied to the skin raises the threshold of pain. Heat is generally preferred over cold if the patient is allowed to choose.

Conceptual Framework

This research study is based on the Roy adaptation model of nursing and the application of the gate control theory of pain transmission. The Roy adaptation model of nursing views man as a biopsychosocial being with modes of adapting to a changing environment. Nursing acts through the nursing process to

promote man's adaptation in each of these modes in situations of health and illness (Roy, 1976).

The goal of nurses functioning under the Roy model is to aid patients in their adaptation. However, nursing interventions can actually move the patient toward maladaptation, which may disrupt the integrity of the patient. This disruption is often temporary but can alter the patients time of recovery from an illness.

If patients can focus on recovery they recover more quickly with a greater sense of integrity. If the patient focuses on the therapeutic techniques due to their discomfort, the overall recovery period is longer. Some interventions by nurses, such as injections, if uncomfortable can cause this inappropriate focusing and delayed recovery.

Roy and Roberts (1981) state that "to promote adaptation, the nurse manipulates the stimuli so they fall within the patient's zone of positive coping." The technique of intramuscular injections is one area in which the nurse can decrease or modify a stimulus. With some patients the injection becomes a focal stimulus, which is the stimulus immediately confronting the patient. If the technique becomes more comfortable the patient can focus on adapting to his/her position on the health-illness continuum rather than on response

to the technique. Thus, through use of an intramuscular injection technique that has no adaptive meaning, the patient is aided toward adaptation and recovery.

The nurse can apply the scientific principles brought forth in the gate-control theory to minimize the discomfort of intramuscular injections. The nurse can use the specific scientific principle of afferent barrage, a group of incoming sensory information, to block the transmission of the pain stimulus. This afferent barrage has an inhibitory action which closes the gate to future pain transmissions. The large A-beta fibers and small A-delta and C fibers each send afferent messages when stimulated with light pressure (Melzack and Wall, 1983).

The gate control theory is based on the following propositions according to Melzack and Wall (1983) and illustrated in Figure 4.

1. The transmission of nerve impulses from afferent fibers to spinal cord transmission (T) cells is modulated by a spinal gating mechanism in the dorsal horns.

Figure 4. Illustration of the gate control theory

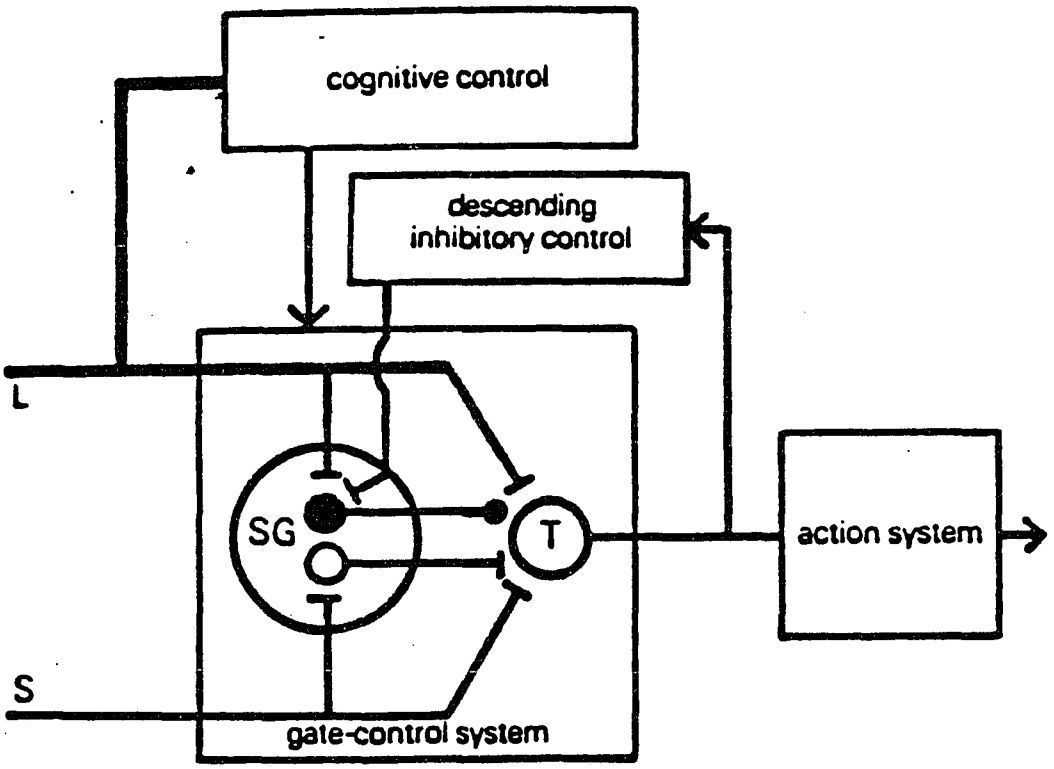


Figure 33. The gate-control theory: Mark II. The new model includes excitatory (white circle) and inhibitory (black circle) links from the substantia gelatinosa (SG) to the transmission (T) cells as well as descending inhibitory control from brainstem systems. The round knob at the end of the inhibitory link implies that its action may be presynaptic, postsynaptic, or both. All connections are excitatory, except the inhibitory link from SG to T cell.

2. The spinal gating mechanism is influenced by the relative amount of activity in large-diameter and small-diameter fibers: activity in large fibers tends to inhibit transmission (close the gate) while small-fiber activity tends to facilitate transmission (open the gate).

3. The spinal gating mechanism is influenced by nerve impulses that descend from the brain.

4. A specialized system of large-diameter, rapidly conducting fibers (the Central Control Trigger) activates selective cognitive processes that then influence, by way of descending fibers, the modulating properties of the spinal gating mechanism.

5. When the output of the T-cells exceeds a critical level, it activates the Action System, those neural areas that underlie the complex, sequential patterns of behavior and experience characteristics of pain.

The use of superficial heat for relief of deep structure pain is explained by two mechanisms. The first is implementation of the somato-visceral reflexes which are known to dilate deep blood vessels to clear the products of inflamation. The second mechanism theorizes that heated tissues generate nerve impulses which play a role in the afferent barrage and have an inhibitory effect by closing the gate in the

spinal cord. This would explain how the application of heat at a distance from the source of the damage and pain can be effective. The nerve impulses stimulated by heating the skin travel into the spinal cord and, at convergent synapses, inhibit impulses that originate in damaged tissue much deeper than the heated skin (Melzack and Wall, 1983). This theory also states that stimulation of cutaneous nerve fibers can close the gate to the transmission of the pain impulse from a distal portion of the same nerve (Nathan, 1976).

The goal in application of this theory is to stimulate the nerves that have inhibitory actions, the large diameter A-beta fibers, while minimizing the stimulation of excitatory fibers, the A-delta and C fibers. These thermal applications to the skin must be made within a proper range of temperature so the application does not cause harm to the subject. Aspinall and Tanner (1981) state that temperatures of 45°C or greater cause tissue damage and heat pain. Humans can sense heat in a range from 40° to 46°C, with the average being 42.8°C. The range for heat pain sensation is 43° to 51°C (Hensel, 1982).

The use of pressure to stimulate sensors is less well defined. A-beta fibers, the fastest of the afferent fibers, transmit the sensation of mild pressure or vibration. A-beta fibers supply the deep skin and subcutaneous areas from free and

specialized nerve endings which have a low threshold for stimulation. It is these fibers that if stimulated are most likely to close the gate to stimuli from the slower A-delta and C fibers that transmit pain impulses (Melzack and Wall, 1983).

These two stimuli, mild pressure and heat, serve as an afferent barrage in the gate control theory mechanism. This afferent barrage closes the gate to the future A-delta and C fiber transmissions, thus blocking some painful transmissions.

Summary and Implications of Study

The use of pressure and heat have not previously been studied in terms of decreasing the discomfort from intramuscular injections. With use of pressure and heat sensations to close the gate to painful sensation, this study intends to increase the knowledge base in these areas.

Coupled with the Roy adaptation model of nursing which calls for manipulation of stimuli to aid the patient's adaptation, patients may be able to avoid an unnecessary painful stimulus while receiving an intramuscular injection. This use of the gate control theory may aid the patient toward adaptation.

Chapter 3

Methodology

Design

An experimental approach was the design chosen for this study. Subjects were randomly assigned to control and experimental groups. Subjects in the experimental group were treated with a warm/pressure pack prior to receiving an intramuscular injection. The discomfort scores from a graphic rating scale were compared, using the Mann-Whitney U test of significance.

Population and Sample

The population for this study were all the patients who were admitted for out-patient surgery at a 200 bed hospital in a small midwestern city from August 5 through August 16, 1985. Three local hospitals serve the city's 100,000 residents. This hospital serves a diverse ethnic and cultural population for most acute care needs.

All out-patient surgery patients who met the following criteria over the two week period were admitted into the study. Those who:

1. had no sensory deficits in the dorsogluteal area by history.

2. were able to assume the prone position with toes pointed inward.
3. were willing and able to sign the consent form for the study.
4. were able to complete the questionnaire with assistance.
5. were free of mind altering drugs for eight hours prior to injection time. These include narcotics, tranquilizers, antidepressants and hypnotics.
6. were at least 18 years of age and
7. were oriented to time, place and person.

Procedures

Pilot study

A one day pilot study was conducted one week prior to the start of the research. A group of 8 subjects was studied to work out details for coordination of staff and evaluate methods. That study yielded information that lead to two changes in the proposed method.

The first change necessary was in relation to the questionnaire. Due to inability of 3 subjects to follow the directions on the questionnaire, the directions were read to the subjects.

The second change necessary was room assignments. During the pilot study some subjects were assigned to the same room so

they could overhear explanations to other subjects. Subjects were all assigned rooms in which they were either the only one present or the only subject participating in the study assigned to that room.

The site utilized in this study was the out-patient surgery department. Patients admitted for out-patient surgery require no hospitalization except for the immediate period surrounding the surgical procedure. The normal course of events includes pre-admission testing, admission, preparation for the procedure, the procedure and a short period to recover from the anesthesia. The patient usually returns home that day.

All pre-op medications for out-patient surgery are administered in the holding area. The area was divided into rooms and physically arranged so that no subject was present while another was being medicated or questioned.

The criteria were met by 72 patients. They were questioned prior to their injection time to solicit their participation in the research. After they accepted they were asked to read and sign the consent (Appendix A). One subject that met the criteria for the study refused to participate due to "nervousness."

When the 71 subjects were ready for their prescribed injection, the pre-injection questionnaire was administered.

See Appendix B. One nurse, the investigator, administered all questionnaires by reading the directions and demonstrating the graphic rating scale. The subject gave a return demonstration.

Subjects in the control group received an intramuscular injection by the same nurse who administered the questionnaires. The nurse used a standardized technique. All needles were 23 gauge, 3.8 centimeters in length. Some needles were manufactured by different companies. The Demerol and Morphine were supplied in pre-loaded syringes with attached needles. To provide consistency, the Z-track method was selected as the method for administration of all the medications as hospital policy required that method for Vistaril injections. The dorsogluteal site for intramuscular injections was chosen because it is the most common site selected by nurses for adult patients (Farley, Joyce, Long and Roberts, 1986).

The prone position with femurs internally rotated was also used for all subjects. Internal rotation of the femur is a movement in which the anterior surface of the thigh turns inward around a central axis without undergoing displacement of the axis (Barham and Wooton, 1973). The position is achieved when the toes are pointed inward and heels outward while the subject is in the prone position. This position relaxes the gluteus maximum muscle. See Appendix C for specific procedure.

The experimental group received the same procedure with the exception of a warm/pressure pack being placed proximal to the injection site thirty seconds prior to receiving the actual injection. This pack provided a mild pressure stimulus to the cutaneous area served by the same sensory nerves as the area of injection.

This pack was warmed in a microwave oven for 90 seconds to attain a temperature of 43.5° centigrade. It was removed from the oven 5 minutes prior to placement on the subject. The accuracy of this temperature was evaluated daily. The temperature remained constant for 10 minutes. It served as a warm/pressure stimulator for the large fiber sensory nerves within the temperature ranges necessary to stimulate but not cause heat pain or tissue damage. See Appendix D for specific procedure.

Instrument

Instruments for this research were a two page preinjection questionnaire (Appendix B), a one page graphic rating scale for actual discomfort (Appendix E) and a one page nursing information questionnaire used to compile data on the medication injected and procedure followed (Appendix F). Both questionnaires were developed for this study.

Demographic data were collected to compare variables in each group. Height and weight data were collected to calculate the subject's weight/height ratio. Weight/height ratio was the subject's weight divided by height to give an answer in pounds per inch of height. This number was used to indicate body surface area, which is also a fairly accurate indicator of thickness of subcutaneous tissue. Farley, Joyce, Long and Roberts (1986) suggested that many injections intended to be intramuscular actually ended in subcutaneous tissues. This is especially noted in those with a thick subcutaneous layer.

Data were also collected about previous injections to discover if the subject's injection experiences decreased or increased their anxiety, expected discomfort or actual discomfort. Differences in experience with intramuscular injections may cause subjects to report actual discomfort differently. It was also important to know if either the control or experimental groups were different in this aspect as it may have biased the results.

Subjects were also asked if they had a chronic painful illness. These data were important for the same reasons as the data about experience with injections. Clinicians recognize that the patient with chronic pain has developed behavior patterns that may alter their report of discomfort.

The subjects were asked if they had taken any medications in the last 12 hours. These data were important to identify those who may have had a medical reason for an altered sense of discomfort or medically altered state of anxiety. If the subjects had taken any medications, the researcher listed them for further determination of possible effects on the research. If they had received medications that altered their functioning within the 8 hours prior to injection, they were not included in the study.

Measurement of Injection Discomfort

Huskisson (1974), Scott & Huskisson (1976) and McGuire (1984) found that a graphic rating scale was the most sensitive tool available to measure the subjective experience of pain. It is important that the descriptors span the entire length of the line so that the subjects are not biased toward one point on the line.

Scott and Huskisson (1976) reported that these scales are the most accurate and sensitive tool for measuring pain even though the measurement is never totally accurate. There are other, possibly more accurate, measures that involve much time to complete and still lack the total accuracy desired for research.

Data obtained from this type of scale were ordinal level data for statistical calculation. Each position on the line was assigned a numerical value for computation of data, through use of a transparent overlay. Those numbers ranged from zero for no discomfort to 20 for the worst possible discomfort. These numerical values were unknown to the subjects at the time they marked the scale.

In this research this type of scale was used for anxiety, expected discomfort and actual discomfort measurements.

Measurement of Expected Discomfort

Each subject also completed a graphic rating scale for expected discomfort of injection prior to injection.

Figure 5. Graphic rating scale for measurement of expected discomfort

no discomfort _____ as bad as it can be
Slight-Moderate-Severe

Measurement of Preinjection Anxiety

Preinjection anxiety was measured because of the close relationship between discomfort and anxiety. Merskey (1979) states that pain reports correlate with anxiety. Anxiety, like

discomfort, is a subjective experience and exact measurement is impossible. Some elaborate tests of anxiety have included physiological as well as the subjective parameters in anxiety rating for more accurate measurement. No physiological measures were taken nor were any judgments made by the researcher of the level of anxiety. The subjects were asked to perform a self report of anxiety on a scale very similar to the scale used for discomfort (Figure 6).

Figure 6. Graphic rating scale for measurement of preinjection anxiety

no anxiety _____ as bad as it can be
S l i g h t-M o d e r a t e-S e v e r e

Bellack and Lombardo (1984) state that the Likert-type scale or fear thermometer, similar to the graphic rating scale, is one of the most accurate non-physiological measures for anxiety. This scale was chosen because its ease of administering, its relative validity and its similarity to the scale used for discomfort.

Chapter 4

Results and Data Analysis

Techniques

Data obtained in this study were ordinal and interval in nature. Statistics used to describe demographic variables were percent and means. Most data were analyzed through the use of a SpeedStat statistics package, designed for use in Apple compatible computers. The Mann-Whitney U test of significance was used to compute the relationship between the control and experimental groups to test the hypothesis. Mann-Whitney U calculations were performed by using a hand calculator.

Characteristics of the Subjects

The subjects were all Caucasian ranging in age from 26 to 85. Thirty six males and 35 females participated in the study. A comparison of variables between the control and experimental groups revealed similarity in age, number, gender and weight/height ratio.

The groups were also similar in relation to reported anxiety, expected discomfort and reports of prior injections. The groups, however, differed in the number of subjects who reported chronic pain. The control group contained more than 2 times as many subjects with chronic pain than did the experimental group. See Table 1 for specific comparisons.

Table 1.

Comparison of Control and Experimental Groups for Variables Important to the Study

Factor compared	Control	Experimental
N of group	36	35
No. with chronic pain	9	4
Mean height/weight ratio	2.62	2.52
Mean age	58.8	60.9
No. of males	18	18
No. of females	18	17
Prior injection median	4	4
Median expected discomfort	4.89	4.49
Median anxiety score	6.06	6.11

Subjects appeared to be randomly assigned to groups on all variables except reporting presence of chronic pain.

Hypothesis Test

The hypothesis tested in this study was: subjects who receive intramuscular injections using a proximal warm/pressure pack placement technique will experience less discomfort from an injection than those who receive the injection without the application of the warm/pressure pack.

The actual discomfort median scores for the control (2) and experimental groups (2.5) were compared using the Mann-Whitney U Test. See Appendix G for individual subject data. The value of the U obtained for the control versus the experimental comparison was 652, for the experimental versus the control the U was 607. The U's were compared using the z score for level of significance. See Appendix H for Mann Whitney U rank order of data. Neither was significant. See Appendix I for statistical calculations. The statistical hypothesis that control group discomfort scores are the same as the experimental group discomfort scores was accepted, therefore causing rejection of the research hypothesis.

The Likert type scale used to collect this subjective data is generally considered an ordinal scale. In this study each point on the line was assigned a number for calculation so it may be considered an interval scale. A t test was performed on

the data and the same conclusion was reached. The data are not significant to support the research hypothesis and the statistical hypothesis was accepted.

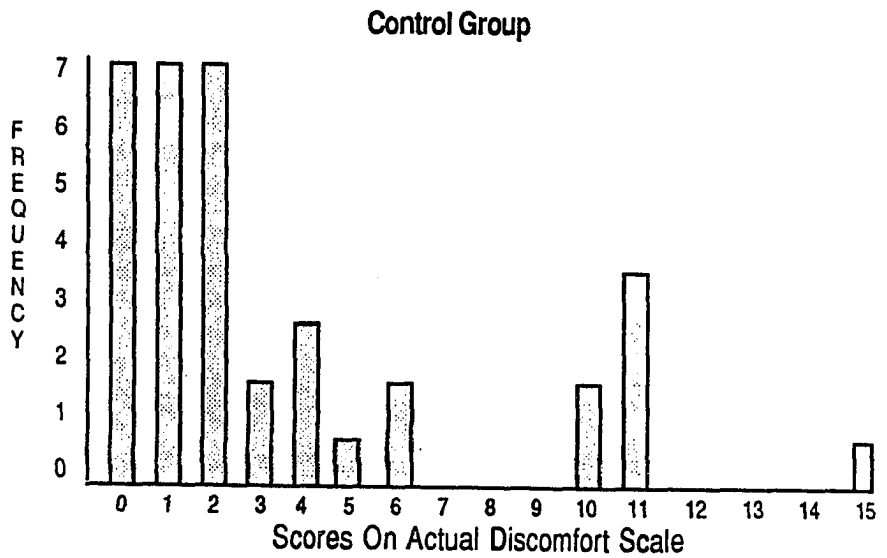
The comparison of actual discomfort between the control and experimental groups using frequency of scores shows a similar skewed distribution to the left but an additional skew to the right on the control group curve (Figure 7). This skew may have accounted for the mean score differences between experimental and control groups.

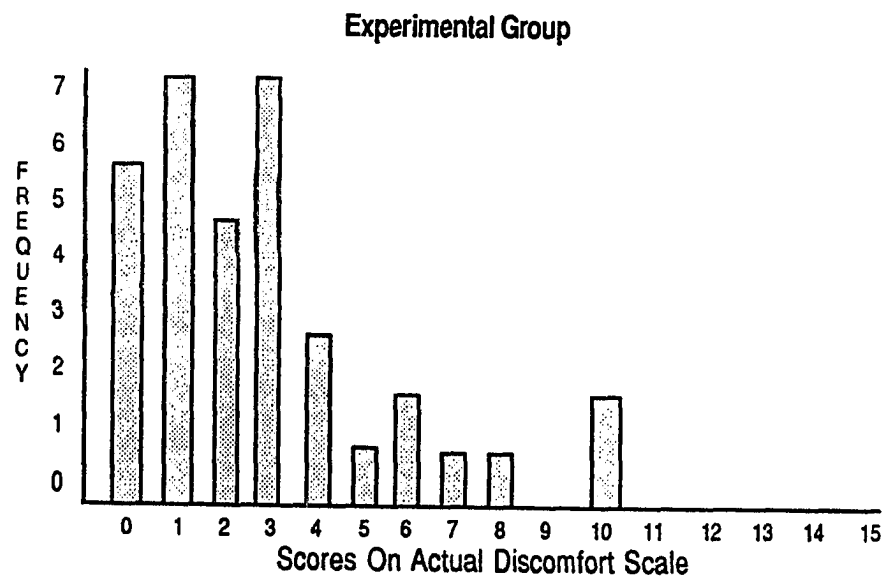
Interesting Findings

The subjects with chronic pain reported a median actual discomfort of 3.5 while those without chronic pain reported actual discomfort of 2. The 9 subjects in the control group with chronic pain reported a median actual discomfort of 2 while the 4 subjects in the experimental group reported 3.5. This chronic pain group data shows some irregularity but due to the subjective nature of the data and the n of 13, no conclusions were drawn from the data. It could have influenced the outcome because 9 of those subjects with chronic pain were in the control group.

The subjects who received sleeping pills, tranquilizers, narcotics or similar medications within 12 hours of injection,

Figure 7. A comparison of frequency distribution of actual discomfort scores





but not within 8 hours, showed a higher expected discomfort, actual discomfort and anxiety than those who received no medications. Those who received prior medications rated their median anxiety at 10 while those who received none rated it 3. Those medicated subjects rated their expected discomfort at 4.5 with the nonmedicated subjects rating it at 3.5. The median actual discomfort of the medicated group was 3 while the non-medicated group was 2. The n of the group receiving medications was 17. It is possible that those 17 subjects had prior medication because of the physician's knowledge of their emotional state.

McCaffery (1979) states that pain reports are directly related to anxiety. This research did not find similar results. When anxiety was correlated with actual discomfort a Pearson product moment correlation of .14 was not found to be significant (r= .24 or greater is significant at a .05 level). If true, the females should report proportionately higher pain; yet they did not.

As age increased, the report of actual discomfort scores decreased. A Pearson product moment correlation or r= -.36 existed when age was correlated with actual discomfort (r= -.24 or greater negative is significant at the .05 level). This is

consistent with Bellville, Forrest, Miller and Brown (1971) who report that as age increases pain sensitivity decreases. Jacox (1977) reports that studies on pain threshold most often report an increased threshold as age increases.

The weight/height ratio correlated with actual and expected discomfort. As the ratio increased the report of actual discomfort decreased at a Pearson product moment of -.25 (r= -.24 or greater negative to be significant at the .05 level). A similar relationship occurred between the weight/height ratio and expected discomfort with a Pearson product moment of -.27 (r= -.24 or greater negative to be significant at the .05 level).

The number of milliliters of solution each subject received was similar between groups. The belief that as the volume of the injectate increases, the discomfort increases was confirmed by this experiment. Injection volume ranged from .3 of a milliliter to 3 milliliters. The total milliliters injected correlated with actual discomfort for all medications (r= .25 at the .05 level of significance with r= .24 or larger being significant).

When the expected discomfort was correlated with actual discomfort a significant relationship existed. A Pearson

product moment correlation of .27 resulted from the correlation (r= .24 or greater needed for significance at the .05 level).

Data were also analyzed further to evaluate the relationship between the warm/pressure stimulus and the reports of discomfort. The data collected on all 71 subjects were sorted to decrease the number of variables. Demerol was the only injected medication for 32 subjects. Analyzing this group decreased a number of variables such as the quality of the needles and the irritability of the medication. The group of 32 subjects was equally divided between control and experimental groups. The groups were also similar in relation to most characteristics including the number of subjects who reported chronic pain (Table 2).

Analysis of these data lead to the same conclusion as that of the researched hypothesis. The results using only the data related to Demerol injections shows a U of 95.5 or 161.5 when a U of less than 83 was necessary to prove a significant relationship.

Results

This study did not show conclusive results about the warm/pressure application. Some patients found the process of injection free of discomfort. In fact 6 subjects in the control

Table 2.

Comparison of Data Using Subjects That Received Demerol As Their Only Medication

Factor compared	Control	Experimental
Mean age	64	67
No. of males	10	10
No. of females	6	6
No. in group	16	16
No. with chronic pain	4	4
Prior injection median	4	4
Mean height/weight ratio	2.65	2.60
Mean mls. injected	.62	.59
Median anxiety scores	3	5
Median expected discomfort	5.50	3
Median actual discomfort	2	1.50
Mean anxiety scores	5.10	5.82
Mean expected discomfort	5.18	4.81
Mean actual discomfort	3.44	1.75

group and 7 in the experimental group found the process free of discomfort. This shows that proper positioning and technique may relieve the discomfort without the addition of other modalities. In this study 13 of 71 subjects were discomfort free.

Chapter 5

Discussion

Limitations

There were many limitations in this study and its results should not be generalized to the general population of patients. In studying subjective experiences such as discomfort a major limitation exists in measurement due to its subjective nature. Human subject measurement of discomfort is, at best, inconsistent. It varies dramatically with many factors causing that inconsistency. At this time many measurement tools are available but all yield questionable results.

The graphic rating scales used in this study are proven to be the most accurate scale to measure self reporting of actual discomfort. However, the tool used in this study was tested on only eight subjects. The scales have not been validated for either anxiety or expected discomfort. The tool has not been validated.

About the same number of experimental and control subjects received Demerol, morphine and atropine. There were 11 experimental subjects who received Nembutal but only 4 control subjects receiving that medication. Only 1 experimental subject received other medication while there were 4 control group

subjects who received other medications. This placed fewer subjects with other medications in the experimental group than in the control group.

In addition the speed of injection and quality of the needles can affect the reporting of discomfort. Although a single researcher performed all the injections, the speed of injection is only assumed to be equal because it was not measured. The needle quality can also vary according to the manufacturers' criteria and at least two manufacturers' needles were used. Control was not used for this possible manufacturing difference.

The application of the warm/pressure pack may have been an insufficient afferent barrage because of its warm temperature. Stimulating the fast A-beta fibers with the light pressure in the hope of causing a sufficient afferent barrage should be sufficient to close the gate to the future painful stimulus. However, the warmth may have stimulated the slower C fibers which may not have closed the gate but perhaps opened it because of their excitatory actions.

Another limitation was that the groups were not randomized due to the unequal distribution of subjects with chronic pain between the control an experimental groups. The control group

included 9 subjects with chronic pain that reported a mean actual discomfort of 5.22 while the experimental group included 4 with a mean of 2.25.

The gate control theory remains in its early stages of application. Much is yet to be learned from human subjects research on application of the theory.

Applications to Practice

The application of these research findings to bedside practice is limited. All patients would not benefit from the placement of a warm/pressure pack proximal to the site of injection. However, some patients found the process free of discomfort with and without the pack. Proper positioning and technique may be of primary importance in relieving the discomfort of intramuscular injection.

This research found that females and males reported essentially the same actual discomfort of intramuscular injection even though reporting different levels of anxiety. Jacox (1977) reports that there is some consensus that the pain threshold does not vary significantly between males and females. And it has been reported that females have lower, higher and the same pain tolerance as males (Elton, Stanley and Burrows, 1983). Copp (1985) concludes that there is much

inconsistency in results of scientific tests relating pain threshold or pain tolerance to gender. Therefore gender should not be a factor to consider in application of nursing techniques for discomfort management.

The report of higher anxiety by females may be the result of cultural influence. Females seem to express their emotions more openly than do males. It does not necessarily mean the actual anxiety is different from that of males.

This study also found that anxiety does not correlate with actual discomfort. However, the subjects expected discomfort did correlate with actual discomfort. This could be assessed by nurses before performing a technique that will cause discomfort and prepare the patient accordingly. It may be more useful for nurses to simply ask a patient what their expectation of discomfort is instead of attempting to evaluate their anxiety.

The principle of decreasing the discomfort by decreasing the total volume injected is supported. The nurse performing intramuscular injections must strive to keep the volume to the minimum possible to inject the prescribed dose.

Suggestions for Further Research

The application of the warm pack may have been an insufficient afferent barrage due to its warm temperature, which may have had an excitatory action. This research was conducted with the heat application at 43.5°C to avoid the possibility of heat discomfort. The reaction of humans to the application of heat is variable and one may cause heat discomfort when only heat sensation is desired. Possible future research could use the same experimental design with cold application or a neutral temperature, the same as skin temperature. Future researchers may want to use the light pressure application with variations on the pressure. The use of a slightly heavier pressure or vibrating pressure may prove more effective.

Although the data concerning the placement of warm/pressure packs to reduce injection pain are inconclusive, nurses should not give up on application of the gate control theory at the bedside. The nursing profession needs to address research that validates the rationale for techniques. Nurses should not continue to inflict discomfort on their patients unless they have researched all methods to avoid it.

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Appendix A

INFORMED CONSENT FOR RESEARCH PROJECT

I, _____herewith agree to
(print your name)
serve as a subject in the investigation of INTRAMUSCULAR INJECTION under the supervision of Michael DesRocher RN. This research aims to evaluate a nursing technique for intramuscular injections.

I will receive no injection that I would not normally receive in the course of my surgery. The necessary injection I receive before my surgery will begraded by me to help determine the effect of the nursing technique.

My participation includes;

1. Signing this consent.
2. Completing the Questionnaire before the injection.
3. Completing the Questionnaire after the injection.

I understand that confidentiality will be protected, that I am free to withdraw from this research at any time, and obtain the best care otherwise available.

I have read and fully understand the foregoing information.

Your
signature_____.

Witness_____.

Date ___-___-___, Time_____:_____.

Appendix B

Subject Questionnaire

TO BE FILLED OUT BEFORE THE INJECTION

1. Your age is _____.

2. Your present weight is _____.

3. Your present height is _____.

4. Are a male ____ or female ____.

5. How many injections (shots) have you had in your life prior to today?

   --Mark an X to the left of the best answer--

   ____a. Never can remember having an injection.

   ____b. Less than 5 injections.

   ____c. More than 5 less than 10 injections.

   ____d. More than 10 less than 30 injections.

   ____e. More than 30 injections.

6. Do you have a chronic painful illness? Yes ___ No ___.
   Examples -- Arthritis, Back problems, Migraines, etc.
   If Yes please List:

7. Did you take any medications in the last 12 hrs?
   Yes ___ No ___
   if Yes please list, Med and time:

8. Example Answer

no anxiety _____ as bad as it can be
S l i g h t-M o d e r a t e-S e v e r e

Rate yourself about your present anxiety (nervousness) on the scale below, mark an X on the line corresponding to your answer. USE ANY POINT ON THE LINE.

Your anxiety (nervousness) now is

no anxiety _____ as bad as it can be
S l i g h t-M o d e r a t e-S e v e r e

9. Example Discomfort Scale

no discomfort _____ as bad as it can be
S l i g h t-M o d e r a t e-S e v e r e

On the scale provided below, rate how much discomfort you think a normal injection causes by marking an X at the appropriate spot. USE ANY POINT ON THE LINE.

Your Discomfort Scale

no discomfort _____ as bad as it can be
S l i g h t-M o d e r a t e-S e v e r e

Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop

Appendix C

This procedure was used for subjects in the control group.

1. Admit subject as normal.
2. Administer consent and get signature.
3. Prepare injection in nurses' area.
4. Approach subject.
5. Identify subject.
6. Administer pre-test questionnaire.
7. Position subject on abdomen (prone) with toes inward.
8. Cleanse skin with alcohol, tell subject, "I will tell you before I make the injection. It takes about 30 seconds for the alcohol to dry."
9. Allow 30 seconds for alcohol to dry.
10. Tell subject, "I will inject now."
11. Make injection according to hospital policy with a 21 guage, 3.8 cm needle using the Z-Track method.
12. Tell subject, "I am through now. Would you please fill out this part of the questionnaire?" Point to the post-injection scale.
13. Thank the subject for cooperation.
14. Return with the questionnaire and equipment to nurses' area.

Appendix D

This procedure was used for subjects in the experimental group.

1. Admit subject as normal.
2. Administer consent and get signature.
3. Prepare injection in nurses' area.
4. Heat "hot pack" in microwave oven for 90 seconds. Remove, insert into cover and carry to patient in pocket.
5. Approach subject.
6. Identify subject.
7. Administer pre-test questionnaire.
8. Position subject on abdomen (prone) with toes inward.
9. Position "hot pack" in proper position.
10. Cleanse skin with alcohol, tell subject, "I will tell you before I make the injection. It takes about 30 seconds for the alcohol to dry."
11. Allow 30 seconds for alcohol to dry.
12. Tell subject, "I will inject now."
13. Make injection according to hospital policy with a 21 guage, 3.8 cm needle using the Z-Track method.
14. Tell subject, "I am through now. Would you please fill out this part of the questionnaire?" Point to the post-injection scale.
15. When complete remove the "Hot pack."
16. Thank the subject for cooperation.
17. Return with the "hot pack," questionnaire and equipment to nurses' area.

Appendix E

To be completed immediately AFTER the injection

Rate the discomfort you felt at the injection site when you received your injection.

Discomfort Scale

no discomfort S l i g h t-M o d e r a t e-S e v e r e as bad as it can be

Comments:

Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop---Stop

Thank you! Return this to the Nurse now.

Appendix F

********** Nursing Information **********
to be completed by the nurse giving the injection

Your initials _____. The date ___-___-___
Time_____.

1. What medication was injected?_____.
2. What dose?_____.
3. How many ml's?_____.
4. Which hip? RT_____ or LT_____
5. Were you able to follow the procedure? Yes____ No____.
   If No Why?_____
6. Was the Hot Pack Applied? Yes____ No____.

Comments:

Appendix G

Individual Subject Data Report

Subject Number	1	2	3	4	5	6	7
Exp or Control	C	C	C	C	C	C	C
Age	56	70	62	71	62	72	40
Weight/Height	1.8	2.1	2.8	2.5	2.5	2.3	2.2
Male or Female	F	F	M	F	M	F	F
Prior injections	5	5	3	3	5	4	5
Chronic pain?	N	N	N	Y	N	N	Y
Meds past 12 hrs?	N	N	N	Y	N	N	Y
Anxiety score	3	0	6	5	11	5	13
Expected discomfort	9	6	6	10	3	5	4
Actual discomfort	1	6	10	2	11	1	10
Medication 1	M	D	D	D	D	D	N
No. of mls	.5	.3	.8	.5	1.0	.5	1.5
Medication 2	A	-	-	-	-	-	A
No. of mls	.3	-	-	-	-	-	.4
Total Ml's injected	.8	.3	.8	.5	1.0	.5	1.9
Rt or Lt dors glut	R	L	L	L	R	R	L

Medication key:

A= Atropine
C= Codeine
D= Demerol
I= Inapsine
M= Morphine
N= Nembutal
P= Phenergan
R= Robinul
S= Sublimaze
V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	8	9	10	11	12	13	14
Exp or Control	C	C	C	C	C	C	C
Age	58	39	77	63	46	56	63
Weight/Height	3.1	3.2	2.7	2.7	2.5	2.5	2.9
Male or Female	F	F	M	M	M	M	M
Prior injections	5	3	4	3	5	4	4
Chronic pain?	N	Y	N	N	Y	N	N
Meds past 12 hrs?	N	Y	N	N	Y	N	N
Anxiety score	13	12	5	1	4	2	7
Expected discomfort	1	7	2	11	3	4	6
Actual discomfort	0	1	0	11	11	1	3
Medication 1	N	D	M	D	M	D	M
No. of mls	1.5	.5	.3	.8	.7	1.0	.7
Medication 2	A	-	R	P	R	A	R
No. of mls	.4	-	1.0	1.0	1.0	.4	1.0
Total Ml's injected	1.9	.5	1.3	1.8	1.7	1.4	1.7
Rt or Lt dors glut	R	R	L	L	L	L	L

Medication key:

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V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	15	16	17	18	19	20	21
Exp or Control	C	C	C	C	C	C	C
Age	50	77	68	32	63	71	65
Weight/Height	1.9	3.0	2.3	2.1	2.6	2.6	2.5
Male or Female	F	F	M	F	M	M	M
Prior injections	4	4	3	2	5	2	3
Chronic pain?	N	N	N	N	N	N	N
Meds past 12 hrs?	N	N	N	Y	N	N	Y
Anxiety score	3	8	2	10	0	1	4
Expected discomfort	2	8	7	5	0	9	0
Actual discomfort	3	1	2	11	0	0	4
Medication 1	D	D	D	A	N	D	D
No. of mls	.6	.5	.5	.6	1.5	.8	.5
Medication 2	-	A	V	C	A	-	A
No. of mls	-	.3	1.0	2.0	.4	-	.4
Total Ml's injected	.6	.8	1.5	2.6	1.9	.8	.9
Rt or Lt dors glut	L	R	L	R	L	R	L

Medication key:

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N= Nembutal
P= Phenergan
R= Robinul
S= Sublimaze
V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	22	23	24	25	26	27	28
Exp or Control	C	C	C	C	C	C	C
Age	27	34	70	36	64	45	50
Weight/Height	2.8	3.6	3.3	1.9	3.3	2.3	3.1
Male or Female	F	F	M	F	M	M	F
Prior injections	4	4	5	5	5	4	5
Chronic pain?	N	N	N	Y	Y	N	Y
Meds past 12 hrs?	Y	N	N	Y	N	N	Y
Anxiety score	11	0	15	11	1	3	6
Expected discomfort	5	3	4	16	2	9	2
Actual discomfort	2	1	4	15	1	4	5
Medication 1	M	D	D	M	D	D	S
No. of mls	.6	.8	.5	.6	1.0	.5	2.0
Medication 2	-	R	-	A	-	-	R
No. of mls	-	1.0	-	.3	-	-	1.0
Total Ml's injected	.6	1.8	.5	.9	1.0	.5	3.0
Rt or Lt dors glut	L	R	L	L	R	L	L

Medication key:

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V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	29	30	31	32	33	34	35
Exp or Control	C	C	C	C	C	C	C
Age	61	61	68	57	70	75	60
Weight/Height	2.0	3.7	2.1	2.3	2.9	2.8	3.2
Male or Female	F	F	F	M	M	F	M
Prior injections	5	3	5	5	4	5	3
Chronic pain?	Y	N	N	N	Y	N	N
Meds past 12 hrs?	Y	N	N	N	N	N	N
Anxiety score	12	19	6	3	1	3	9
Expected discomfort	0	3	4	7	3	2	5
Actual discomfort	0	0	2	6	2	0	2
Medication 1	N	D	D	D	D	D	D
No. of mls	2.0	.5	.5	.8	.5	.3	.8
Medication 2	-	A	R	-	-	-	
No. of mls	-	.4	1.0	-	-	-	
Total Ml's injected	2.0	.9	1.5	.8	.5	.3	.8
Rt or Lt dors glut	L	L	L	R	L	L	L

Medication key:

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Appendix G (continued)

Individual Subject Data Report

Subject Number	36	37	38	39	40	41	42
Exp or Control	C	E	E	E	E	E	E
Age	79	67	68	54	74	58	53
Weight/Height	2.4	2.6	1.8	1.9	4.3	2.8	1.5
Male or Female	M	F	F	F	M	M	F
Prior injections	5	5	5	5	5	5	5
Chronic pain?	N	Y	N	N	N	Y	N
Meds past 12 hrs?	N	Y	N	N	N	Y	N
Anxiety score	3	6	1	7	11	1	10
Expected discomfort	3	4	11	6	1	4	3
Actual discomfort	2	5	1	6	3	2	9
Medication 1	D	M	D	D	M	N	N
No. of mls	.5	.4	.5	.5	.7	1.0	1.0
Medication 2	I	-	R	-	-	A	A
No. of mls	1.0	-	1.0	-	-	.4	.4
Total Ml's injected	.5	1.4	1.5	.5	.7	1.4	1.4
Rt or Lt dors glut	L	R	R	L	R	L	R

Medication key:

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R= Robinul
S= Sublimaze
V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	43	44	45	46	47	48	49
Exp or Control	E	E	E	E	E	E	E
Age	74	68	78	57	85	68	64
Weight/Height	2.6	2.4	1.7	3.2	2.1	1.7	2.1
Male or Female	F	M	M	M	M	M	F
Prior injections	4	5	4	5	3	5	4
Chronic pain?	N	N	N	N	N	N	Y
Meds past 12 hrs?	N	N	N	Y	N	N	Y
Anxiety score	2	1	3	10	2	0	15
Expected discomfort	6	1	3	5	8	7	6
Actual discomfort	7	4	4	1	2	0	0
Medication 1	N	N	D	N	D	N	D
No. of mls	1.0	1.0	.7	1.5	.4	1.0	.4
Medication 2	A	A	-	A	-	A	
No. of mls	.4	.4	-	.4	-	.4	
Total Ml's injected	1.4	1.4	.7	1.9	.4	1.4	.4
Rt or Lt dors glut	L	R	R	L	R	R	L

Medication key:

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V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	50	51	52	53	54	55	56
Exp or Control	E	E	E	E	E	E	E
Age	83	78	60	71	76	41	43
Weight/Height	3.5	2.1	2.5	3.1	2.3	2.6	1.8
Male or Female	M	F	M	F	F	F	F
Prior injections	4	4	5	5	5	5	4
Chronic pain?	Y	N	N	N	N	N	N
Meds past 12 hrs?	N	N	N	N	N	N	N
Anxiety score	3	10	1	2	7	2	17
Expected discomfort	2	1	7	2	5	0	3
Actual discomfort	2	0	0	1	1	1	9
Medication 1	D	D	D	D	D	D	N
No. of mls	.8	.4	.5	.5	.5	.8	2.0
Medication 2	-	-	-	-	R	-	A
No. of mls	-	-	-	-	1.0	-	.4
Total Ml's injected	.8	.4	.5	.5	1.5	.8	2.4
Rt or Lt dors glut	R	R	L	L	R	L	R

Medication key:

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S= Sublimaze
V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	57	58	59	60	61	62	63
Exp or Control	E	E	E	E	E	E	E
Age	68	26	69	75	56	55	56
Weight/Height	3.2	2.9	3.7	2.2	2.7	2.9	2.6
Male or Female	M	M	M	F	M	F	F
Prior injections	5	4	5	5	3	4	5
Chronic pain?	N	N	N	N	N	N	N
Meds past 12 hrs?	N	N	Y	N	N	N	N
Anxiety score	9	0	10	10	10	0	3
Expected discomfort	3	6	2	3	3	1	10
Actual discomfort	2	6	3	3	0	0	2
Medication 1	D	D	D	N	D	D	D
No. of mls	.8	.8	.8	1.0	.5	.8	1.0
Medication 2	-	A	-	A	-	-	A
No. of mls	-	.4	-	.4	-	-	.4
Total Ml's injected	.8	1.2	.8	1.4	.5	.8	1.4
Rt or Lt dors glut	R	R	R	L	R	R	R

Medication key:

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V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	64	65	66	67	68	69	70
Exp or Control	E	E	E	E	E	E	E
Age	81	21	56	25	60	69	67
Weight/Height	2.4	2.3	2.5	2.1	2.6	2.6	2.7
Male or Female	M	M	M	F	M	M	F
Prior injections	4	4	5	4	5	2	2
Chronic pain?	N	N	N	N	N	N	N
Meds past 12 hrs?	N	N	Y	N	N	N	N
Anxiety score	10	4	2	1	17	7	2
Expected discomfort	1	5	3	3	10	9	4
Actual discomfort	1	8	3	1	3	3	3
Medication 1	D	M	D	N	N	D	N
No. of mls	.7	.7	.8	2.0	1.5	.7	2.0
Medication 2	-	R	-	A	A	-	A
No. of mls	-	1.0	-	.4	.4	-	.4
Total Ml's injected	.7	1.7	.8	2.4	1.9	.7	2.4
Rt or Lt dors glut	L	L	L	R	R	L	L

Medication key:

A= Atropine
C= Codeine
D= Demerol
I= Inapsine
M= Morphine
N= Nembutal
P= Phenergan
R= Robinul
S= Sublimaze
V= Vistaril

Appendix G (continued)

Individual Subject Data Report

Subject Number	71
Exp or Control	E
Age	30
Weight/Height	2.1
Male or Female	F
Prior injections	5
Chronic pain?	N
Meds past 12 hrs?	Y
Anxiety score	18
Expected discomfort	9
Actual discomfort	4
Medication 1	M
No. of mls	.7
Medication 2	-
No. of mls	-
Total Ml's injected	.7
Rt or Lt dors glut	R

Medication key:

A= Atropine
C= Codeine
D= Demerol
I= Inapsine
M= Morphine
N= Nembutal
P= Phenergan
R= Robinul
S= Sublimaze
V= Vistaril

Appendix H

Mann-Whitney U Rank Order of Data

Control		Experimental	
Score	*Rank	*Score	*Rank
15	71	9	63.5
11	68.5	9	63.5
11	68.5	8	62
11	68.5	7	61
11	68.5	6	58.5
10	65.5	6	58.5
10	65.5	5	55.5
6	58.5	4	51.5
6	58.5	4	51.5
5	55.5	4	51.5
4	51.5	3	44
4	51.5	3	44
4	51.5	3	44
3	44	3	44
3	44	3	44
3	44	3	44
2	33.5	3	44
2	33.5	3	44
2	33.5	2	44
2	33.5	2	44
2	33.5	2	44
2	33.5	2	44
2	33.5	2	44
1	20.5	1	20.5
1	20.5	1	20.5
1	20.5	1	20.5
1	20.5	1	20.5
1	20.5	1	20.5
1	20.5	1	20.5
0	7	0	7
0	7	0	7
0	7	0	7
0	7	0	7
0	7	0	7
0	7		
N=36		N=35	
R2=1319		R1=1238	

Appendix I

Statistical Calculations Mann-Whitney U

$$U(1) = N(1)xN(2) + \frac{N(1)x[N(1)+1]}{2} - R(1)$$

$$U(1) = 35x36 + \frac{35x(35+1)}{2} - 1238$$

$$U(1) = 652$$

$$U(2) = N(1)xN(2) + \frac{N(2)x[N(2)+1]}{2} - R(2)$$

$$U(1) = 35x36 + \frac{36x(36+1)}{2} - 1319$$

$$U(2) = 607$$

$$Z(U) = \frac{U - \bar{X}(U)}{a(U)}$$

$$\bar{X}(U) = \frac{N(1)xN(2)}{2} = \frac{35x36}{2} = 630$$

$$a(U) = \frac{N(1)xN(2)[N(1)+N(2)+1]}{12} = \frac{35x36x[35+36+1]}{12} = 86.9$$

$$Z(1) = \frac{652-630}{86.9} = .25$$

$$Z(2) = \frac{607-630}{86.9} = -.26$$

The Z would need to be greater than 1.65 to be significant at a p= .05. Therefore, it is not significant.

Appendix J

April 17, 1987

Michael DesRocher, RN
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Appendix K

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