1997

Music: An intervention for pain during chest tube removal after open heart surgery.

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MUSIC: AN INTERVENTION FOR PAIN DURING CHEST TUBE REMOVAL AFTER OPEN HEART SURGERY

by

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A DISSERTATION

Submitted to the graduate faculty of The University of Alabama at Birmingham, in partial fulfillment of the requirements for the degree of Doctor of Nursing Science

BIRMINGHAM, ALABAMA

1997

ABSTRACT OF DISSERTATION
GRADUATE SCHOOL, UNIVERSITY OF ALABAMA AT BIRMINGHAM

Degree D.S.N. Program Adult Health Nursing

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Committee Chair Marguerite Kinney

Title: Music: An Intervention for Pain During Chest Tube Removal After Open Heart Surgery

Pain associated with the procedure of chest tube removal constitutes a major problem for patients who undergo open heart surgery. Because this pain is short lived, providing pharmacologic relief is difficult in terms of timing the administration and is therefore done inconsistently. Using Roy's adaptation model and the gate control theory, the purpose of this study was to examine the effect of music as an intervention for the intensity of self-reported pain in patients having chest tube removal after open heart surgery.

Using an experimental design, a total sample of 156 subjects who had open heart surgery (M age= 66, 69% males) was randomly assigned to one of three groups: control, white noise, or music. All subjects preselected the type of music they preferred hearing. Ten minutes prior to chest tube removal, pain, heart rate, systolic and diastolic blood pressure were measured; and the prerecorded audiotape of music or white noise was begun. Pain was measured again immediately after chest tube removal and 15 min later. Physiologic measures were assessed every 5 min and completed with the last numeric rating scale. The audiotape was also

ended at this time. The data were analyzed using descriptive statistics, ANOVA, and MANOVA.

Findings demonstrated no significant differences in reported pain intensity, physiologic measurement, or narcotic intake after chest tube removal between the three groups. In addition, no significant differences were found in reported pain intensity based on gender, body mass index, or age.

These nonsignificant findings may be related to the types of music used, differences between procedural pain and postoperative pain, contextual or residual stimuli not previously identified, lack of adaptation during a short procedure, or other areas related to strength and integrity of the study. Although the findings were not significant, most subjects enjoyed listening to the music; therefore, the use of music as an adjuvant to other therapies may be an appropriate nursing intervention. Further study on the type of music best suited for use as an intervention, differences between types of pain, and appropriate dose of the intervention is recommended.

ACKNOWLEDGMENTS

So many people have helped me in this dissertation process. First I must acknowledge Dr. Gary Yeisley for his support of my project and the surgeons of the Panebainco-Yip Heart Surgeons group for allowing me to contact their patients. In addition, I want to thank the patients, nurses, physician's assistants, and medical records staff associated with the Lehigh Valley Hospital in Allentown, PA, for their interest in my research, their encouragement, and their ever ready willingness to help make this process smooth.

I want to acknowledge the support of my committee for helping me learn the research process. My chairperson, Dr. Marguerite Kinney, shared her research expertise and guided me through this process. I am appreciative of the support I received from Dr. Linda Davis throughout my time as a student at UAB; Linda always helped me to focus on the trees when I was overwhelmed by the forest. Dr. Elizabeth Morrison shared not only her expertise but also her humor, which helped me through some stressful times. I am grateful to Dr. Carol Prickett, Department of Music Therapy at the University of Alabama at Tuscaloosa, for her encouragement and for sharing her musical expertise with me, and to her students for providing the audiotapes utilized in this study. I am also grateful to Dr. Judith LaMarche for her never-ending confidence in me.

Most important, I want to thank my family for their support through 7 years of school and 5 summers away from home. My husband, Joe, maintained the home fires while I was away at school. My guys, Joey and Tim, were always patient when Mom had schoolwork to do; they grew into wonderful young men during this time. Also, I must thank my parents, who have always been supportive through all of my educational endeavors.

I especially want to express my deep appreciation to my research assistants, without whom the total sample may not have been obtained. I thank my longtime friends, Mickey Midei and Carol Saxman, for their caring and encouragement, as well as two very enthusiastic and supportive student nurses, Eileen Hill and Mike Hrymack, who started on this project while they were still in school and completed the project as well as their licensing exams.

Finally, I am grateful to the Epsilon Chi Chapter of Sigma Theta Tau International for their grant support.

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CT	Chest tube
CTR	Chest tube removal
OHS	Open heart surgery
PACU	Postanesthesia Recovery Unit
PI	Primary investigator
RA	Research assistant
PA	Physician's assistant
NRS	Numeric Rating Scale
VAS	Visual Analog Scale
AHCPR	Agency for Health Care Policy and Research
TOHU	Transitional Open Heart Unit
OHU	Open Heart Unit
ml	Milliliters
OR	Operating Room
PT	Patient
VS	Vital signs (physiologic variables)
BP	Blood pressure
min	Minutes
hr	Hour
cm	Centimeter
ETS	Endotracheal suctioning
PCA	Patient controlled analgesia

CHAPTER 1

INTRODUCTION

Pain is a universal phenomenon that has been described throughout history as a human affliction. Philosophers, scientists, physicians, shamans, and others have attempted to define pain in order to prevent or treat it. "The treatment of pain is one of the oldest human needs" (Procacci & Maresca, 1992, p. 1). Baszinger (1989) describes pain as "one of the most common and potentially most disruptive experiences in peoples' lives" (p. 542). As a universal phenomenon, pain is a high priority for nursing care.

For the patient who has undergone open heart surgery (OHS), the trauma associated with the surgical procedure produces an inflammatory response and pain. Kehlet (1989) described this endocrine, metabolic, and inflammatory response in the body as the surgical stress response. Modification of this stress response primarily focuses on pharmacologic mechanisms. In addition to the pain associated with the surgical incision, as the patient begins to adapt to this initial insult, other insults to the patient in the form of medical procedures may alter the patient's pain experience. One of the most common postoperative procedures experienced by a patient after OHS is the removal of the chest tube (CT). Woolf (1989) uses the terminology physiological pain to describe transient pain that occurs in

response to noxious stimuli but is localized and does not stimulate a neural or inflammatory response. Removal of a CT can be classified as physiologic pain by this definition. Pain associated with chest tube removal (CTR) has also been documented by Gift, Bolgiano, and Cunningham (1991) and Puntillo (1994).

Purpose

The purpose of this experimental study was to examine the effect of music as an intervention on the self-reported intensity of pain in patients having CTR after OHS.

Problem

Because procedural pain is a short-lived experience, the use of opiates or other pharmacologic agents may not be appropriate. These agents can alter level of consciousness or depress vital signs, requiring intense, continuous monitoring until the effect of the drug has dissipated. In addition, other untoward effects may occur with pharmacologic interventions such as allergic responses, nausea, and vomiting. A nonpharmacologic intervention that does not alter level of consciousness or vital signs and is not associated with other untoward effects but can decrease or minimize pain or decrease the amount of analgesia required by the patient would be useful during the short-term pain associated with procedures.

In 1992, approximately 537,000 people underwent OHS in the United States (American Heart Association, 1995). All of

these patients had at least one CT in place which is usually removed during the 1st or 2nd postoperative day. The use of pharmacologic interventions prior to CTR has been found to vary widely (Kinney, Kirchhoff, & Puntillo, 1994) with lack of consistency shown in planning to prevent or alleviate the pain associated with CTR.

Significance

Acute pain has emerged as a health care problem of intense interest over the past 10 to 15 years. Widespread inadequacy of acute pain management has been reported (Agency for Health Care Policy and Research (AHCPR), 1992; Donovan, Dillon, & McGuire, 1987). Both the National Center for Nursing Research (Bloch, 1990) and the American Association of Critical-Care Nurses (Lindquist et al., 1993) have identified acute pain as a priority area for nursing research, underscoring the inadequacies of the science related to acute pain management. "Pain relief is desirable not only for humane and moral reasons, but also pain relief improves the patient's physiological and psychological welfare" (Carr, 1990, p. 901).

This study addressed an important but relatively neglected area of investigation: acute pain in adults related to a medical procedure. There are times when pain is inflicted on a patient because a procedure or treatment must be carried out (Sandroff, 1983). Nurses must anticipate this pain and remain sensitive to the patient's needs for pain

relief without becoming angry or rejecting the patient (Graffam, 1979; Puntillo, 1995; Sandroff, 1983).

Nonpharmacologic interventions for pain control provide an option in the comprehensive treatment of pain (ACHPR, 1992; McCaffery, 1990). Music, described as a cognitive-behavioral intervention, is one of these interventions. The outcomes of nonpharmacologic interventions include altering patients' perceptions of and response to pain and allowing them to have more control over the pain (ACHPR, 1992).

Pain

Pain is a multidimensional subjective experience. For the individual, pain is experienced whenever the person says the pain exists (McCaffery, 1979). The International Association for the Study of Pain (IASP, 1979) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (p. 250). Even brief pain may produce long-lasting changes in cells within spinal cord pathways (Cousins, 1991).

Melzack and Casey (1968) described the sensory-discriminative, motivational-affective, and cognitive-evaluative dimensions of pain. These three dimensions give support to the complexity of the phenomenon of pain, the interrelated aspects of the sensation of pain, the interpretation of the pain, and then attachment of meaning to the pain.

Numerous factors have been identified which can alter the way a person perceives pain or responds to pain. Chapman

(1977) identified sociocultural factors such as previous experience, ethnic and cultural background (including age and gender), and personality as influencing a person's response to pain. The classic finding by Beecher (1956) that the pain experience was altered by the way soldiers interpreted the impact of their injury is another example of a factor that influences the perception of pain. Ethnicity has been implicated as having an influence on the interpretation of pain (Calvillo & Flaskerud, 1993; Lipton & Marbach, 1984; Thomas & Rose, 1991; Woodrow, Friedman, Siegelaub, & Collen, 1972). The influence of ethnicity may be significant in guiding the development of interventions for pain which are specific for ethnic backgrounds. Gender has also been studied as a variable in the response to pain, although no differences have been identified (Lander, Fowler-Kerry, & Hargreaves, 1989; Thomas & Rose, 1991). One other frequently examined variable in relation to pain is age (Evans et al., 1992; Jensen, Rasmussen, Pedersen, Lous, & Olesen, 1992; Lasch, Castell, & Castell, 1997; Tucker, Andrew, Ogle, & Davison, 1989; Walsh, Schoenfeld, Ramamurthy, & Hoffman, 1989; Woodrow et al., 1972).

Significant to the critical care nurse is an understanding of not only the pain expressed by the patient but also the effect of pain on the body, particularly for the patient who has had a major surgical event and may be physiologically compromised (Liebeskind, 1991). Physiologic responses to acute pain include elevated heart rate, respiratory rate, and blood pressure; pallor or flushing;

dilated pupils; and diaphoresis. In addition, the following may occur: blood glucose elevation; decrease in gastric acid secretion; decrease in blood flow to the viscera, resulting in decreased motility; and decreased blood flow to the skin (Ludwig-Beymer & Heuther, 1994). Alterations of these physiologic responses in an already compromised patient can lead to an increase in myocardial oxygen demands which can stress the patient.

Because CTR is a short-lived experience, analgesia may not be effective in decreasing pain due to difficulty in timing the peak effect of the analgesic with removal of the CT. Since the nurse may or may not influence the exact time a procedure is completed, anticipating the peak of an analgesic to decrease pain associated with CTR can be complicated.

Seventeen years ago Melzack (1980) suggested that the use of cognitive strategies was at the forefront of psychological interventions for pain. Psychological interventions identified as effective in the preparation of patients for the postoperative period or for painful procedures have been categorized into four groups: providing information, teaching new behaviors such as relaxation techniques, using cognitive techniques such as music, and providing psychotherapy (Johnston, 1990).

McCaffery (1990) described distraction as a nonpharmacological intervention which allows the patient to focus on something other than pain, making the pain more tolerable. The use of distraction may be effective for brief

procedural pain (McCaffery, 1990). One method of distraction available to the critical care nurse is music. Puntillo (1991) described the use of music for pain as a cognitive-behavioral intervention. The neurological responses to pain are incompatible with the neurological responses to competing stimuli or distraction; therefore, distraction may be an effective mechanism in reducing pain (Long & Johnson, 1978; Stevens, 1990). In conclusion, music as a distraction may be an effective method of pain relief (Davis & Gfeller, 1992; Long & Johnson, 1978).

Pain ranks high among those nursing diagnoses frequently used (Herr & Mobily, 1992). Little information is known, however, about the pain associated with procedures. Much of the literature on pain focuses on acute postoperative pain or on chronic pain. Several studies have examined pain related to dressing change in burned patients (Barker, 1991; Christenberry, 1979). The effect of chest tube removal on patients and the resulting pain have just recently begun to be studied (Carson, Barton, Morrison, & Tribble, 1994; Gift et al., 1991; Puntillo, 1994). Gfeller, Logan, and Walker (1990) described the distress associated with a medical procedure as more than a sensory response. The distress also includes anxiety, fear of pain, and potential for loss of control. All of these factors must be considered when selecting and utilizing nursing interventions.

Interventions

The changing health care environment requires alternative ways of examining the impact of nursing on patient outcomes. Relman (1988) described the current revolution in health care as the "Era of Assessment and Accountability" (p. 1222). One method available to examine health care in terms of assessment and accountability is outcomes research. Outcome "refers to the results of care. The focus, then, of patient outcomes research is to evaluate the patient" (Jennings, 1991, p. 62). Jennings described an intervention or treatment as referring "to actions or techniques used in particular situations to elicit desired outcomes" (p. 62). Interventions focus on the activities of the nurse. "Nurses must seize the opportunity presented by patient outcomes research to empirically verify the relationship between nursing interventions and patient outcomes" (Jennings, p. 62). Outcomes research provides nurses with the opportunity "to demonstrate how nursing practice contributes to patient outcomes, to build a scientific base for nursing practice, and to influence health policy decisions" (Jennings, p. 60).

In critical care units, nurses assist patients in adapting to the stresses they encounter. Interventions that can assist the patient to adapt to a painful experience must be considered. Although numerous pharmacologic and nonpharmacologic interventions have been described in the literature (Herr & Mobily, 1992; Justins & Richardson, 1991; McCaffery, 1990; Peric-Knowlton, 1984; Whipple, 1987), the

use of interventions other than analgesics remains inconsistent. Nurses are accountable professionally for managing pain in patients, which includes not only assessing the pain but also providing appropriate interventions (Graffam, 1979).

Justins and Richardson (1991) described three factors involved in controlling acute pain--the variability of pain among patients, characteristics of the patient, and varying responses to pharmacologic agents. Some factors cannot be controlled. Factors that may also have an impact on a patient's response to pain include age, gender, ethnic background, social status, previous pain experience, and significance of the pain.

Based on the gate control theory, Herr and Mobily (1992) have described four areas in which pain can be modulated: the peripheral site of the pain, the spinal cord, the brain stem, and the cortex. They suggest that cognitive interventions alter the perception of pain in the cerebral cortex. In terms of the psychologic dimension of pain, Wepman (1978) described the "black box" phenomenon as those unknown variables that alter each individual's response to a noxious stimulus. These unknown variables include emotional, cognitive, and situational factors.

Interventions used to manage pain through cognitive factors are described as cognitive-behavioral therapy (Brown, Chen, & Dworkin, 1989). Cognitive skills are strategies taught to patients to produce a modulation of pain. These cognitive strategies may include ignoring the

pain, thinking pleasant thoughts, giving the patient instructions (i.e., preoperative teaching), and audio analgesia. The use of cognitive strategies to control pain can result in a decreased amount of pain experienced (Baker & Kirsch, 1991; Pick, Pearce, & Legg, 1990).

Conflicting results are found in the literature related to the effect of cognitive mediators as interventions for pain. The effects of these interventions on pain may even be related to the patient's level of expectation of the intervention or to the patient's ability to carry out a strategy (Marino, Gwynn, & Spanos, 1989). The exact mechanism of cognitive-behavioral strategies in altering perception of pain is unknown and may be related to the distraction of the intervention (Arntz, Dreessen, & Mercklebach, 1991; Marino, Gwynn, & Spanos, 1989; Miller, Hickman, & Lemasters, 1992) or expectancy of pain (Baker & Kirsch, 1991).

Music as a cognitive strategy, therefore, may affect a patient's response to pain through active listening and allowing the patient to gain control in the situation (Brown et al., 1989). Music may also alter the perception of pain through the sensory-discriminative domain by causing physical and mental relaxation, thereby relaxing muscles that may be tensed because of pain or in anticipation of pain. In addition, the motivational-affective domain of pain may be influenced through the production of a pleasant emotional state or improvement of coping strategies. The use of music as a distraction is supported by the gate control theory (Maslar, 1986). Music allows the patient in pain to

refocus attention (Whipple & Glynn, 1992). The purpose of distraction is to direct a person's attention to focus on something other than the pain (McCaffery & Beebe, 1989).

Music

Music and medicine have been associated in the therapeutic process since ancient times. The role of music in the treatment of illness has been described in the writings of early civilizations such as Sumeria, Babylonia, India, and China. "Both the Greeks and the Romans had theories of music therapy and its usefulness in arousing or suppressing passion, curing illness, molding character, or simply reaching a state of harmony" (Pratt & Jones, 1983, p. 377). With the development of the scientific method, the relationship between music and medicine began to disintegrate because the effects of music could not be scientifically measured (Weldin & Eagle, 1991). However, by the late 19th century, the use of music in treating mental illness was well documented (Davis & Gfeller, 1992). Florence Nightingale (1860/1969) was the first nurse to address the use of music in patient care. She identified wind instruments with continuous sound as having a beneficial effect on the patient. As early as 1899, Davison described a decrease in pain in patients in a hospital ward who listened to piano music. During the 20th century, music therapy developed as a profession. Music therapy programs were established in universities; professional music therapy organizations were formed and focused on academic and clinical training, as

well as on certification standards; and professional journals were published (Davis & Gfeller, 1992).

Factors identified as affecting individuals in the selection of music include "preferences for the music, familiarity with the music, cultural context, past experiences, and perceptions of the elements of the music such as structure, tempo, and dynamics" (Davis & Thaut, 1989, p. 184). The goal of music as an intervention is not to entertain but to assist in adaptation by decreasing pain.

The physiologic responses to music are not clearly understood. After stimulation of the auditory nerve, impulses travel to the thalamus and the frontal cortex, where interpretation of the stimulus occurs. The limbic system is also affected during this neural response to the music and in turn influences the endocrine system and physiologic responses by the body (McClellan, 1988).

Music has been found to have physiologic as well as psychologic effects on the body. Some of the physiologic effects measured include changes in heart rate (Barger, 1979; Landreth & Landreth, 1974; Wilson & Aiken, 1977); changes in heart rate and galvanic skin responses, although changes in heart rate were not significant (Zimny & Weidenfeller, 1963); and changes in respiratory rate and heart rate (however, heart rate changes were not significant; Ellis & Brighouse, 1952). Changes in skin resistance have been related to the type of music (Peretti & Swenson, 1974; Wilson & Aiken, 1977). McClellan (1988) contended that the body's physiologic responses to music are

related to the characteristics of the music. A relationship between music and the immune system has also been suggested, supporting the ability of music to increase immune system function (Rider, Floyd, & Kirkpatrick, 1985; Maranto & Scartelli, 1991). Goldstein (1985), Guzzetta (1989), and O'Sullivan (1991) proposed a connection between music and the release of endorphins in the modulation of pain.

Psychologic responses of the body to music include changing mood and altering level of anxiety (Altschuler, 1948; Cook, 1981). "Basic personality traits, traditions or language or culture, and geographic, economic, religious and education factors influence individual responses to music" (Cook, p. 261). "A distinct advantage of using music as a technique for pain control is that it has universal appeal, crossing cultural barriers" (McCaffery, 1992, p. 61).

Melzack, Weisz, and Sprague (1963) identified a number of factors that may alter the pain experience, in addition to the physical damage which initially produced the pain. Variables which should be manipulated to help reduce pain include "expectation, suggestion, level of anxiety, the meaning of the situation in which injury occurs, attention-distraction levels, competing sensory stimuli, and other psychological variables" (Melzack et al., p. 240). The effect of music on pain may be considered cognitive when attention is focused on the music or affective when the emotional aspect of the music is the focus (Brown et al., 1989; McClellan, 1988). Kryter (1970) posited that the effectiveness of music in decreasing pain may be related to

distraction, relaxation, or the interruption of neural impulses. It is unknown at this time how music affects pain perception due to the many factors that influence a person's response to pain (Maslar, 1986). Eagle and Harsh (1988) contended that music and pain share some of the same psycho-neurological processing areas, particularly the limbic system. Therefore, neural impulses from one can affect the other. The effect of music is not the same for everyone, and what the music means to the listener or how it makes the listener feel will alter its effect (Farnsworth, 1969).

No specific type of music has been identified for the relief of pain. Selection of music preference by offering the patient a variety of music is suggested (Davis & Thaut, 1989). Factors affecting the selection of music may include familiarity, culture, previous experiences with music, and the structure of the music, including tempo and dynamics. To have a therapeutic effect (i.e., the ability to reduce pain or anxiety), music must be attractive to the person (Herth, 1978; McClellan, 1988; O'Sullivan, 1991). Kolkmeier (1989) recommended music without words so the patient focuses on the music and not the words.

White Noise

White noise has been investigated to determine its effect on athletic performance (Ferguson, Carbonneau, & Chambliss, 1994), physiologic and cognitive performance (Harrison & Kelly, 1989), and pain (Zimmerman, Pierson, & Marker, 1988). White noise is described as being similar to

white light in that it has uniform distribution of noise energy (Peterson & Gross, 1967). As a form of distraction, white noise may have an influence on a patient's response to pain.

Conceptual Framework

The conceptual framework for this study incorporated the Roy adaptation model (Roy & Andrews, 1991) and gate control theory (Melzack & Wall, 1983). Theories not only help to explain and predict events, but also to examine them in an organized way. Nurses provide interventions to change stimuli which allows an individual to adapt through the use of coping mechanisms. This adaptation is also congruent with the gate control theory that conceptualizes pain as being modulated in the central nervous system.

Roy adaptation model

Roy's adaptation model (Roy & Andrews, 1991) and the gate control theory of pain (Melzack & Wall, 1983) provide the conceptual framework for this study. Roy's adaptation model is based on the philosophical concepts of humanism and veritivity. Veritivity is a term selected by Roy to affirm a "purposefulness of human existence" (Roy & Andrews, 1991, p. 5). Roy and Andrews describe an individual as being an adaptive system that is influenced by stimuli from the internal and/or external environment and who adapts to the environment or changes it through specific behaviors.

The stimuli from the environment that affect a person are categorized as focal, contextual, or residual. A focal stimulus is the input most immediately affecting the person. In this study, the focal stimulus is anticipated or actual chest tube removal. To cope with the stimulus, the person must concentrate and exert energy (Roy & Andrews, 1991). Contextual stimuli are those internal or external environmental factors that contribute to the effect of the focal stimulus. These stimuli are not the direct focus of the individual, but contribute to how the individual responds to the focal stimulus. A number of contextual stimuli have been identified that affect behavior in all of the adaptive modes. These common stimuli include culture, family, and developmental stage (Sato as cited in Roy & Andrews), along with integrity of adaptive modes, cognator effectiveness, and environmental consideration. Culture is described as including socioeconomic status, ethnicity, and belief system. Family includes structure and the individual's tasks. The developmental stage consists of age, gender, tasks, and hereditary and genetic factors.

Identification of these common contextual stimuli is important in the assessment of pain since all of these factors can have an impact on how an individual responds to pain. As seen in the conceptual-theoretical-empirical structure (Figure 1), several of these stimuli were assessed as empirical indicators in this study.

External stimuli consist of those factors outside the individual that influence the response to focal stimuli such

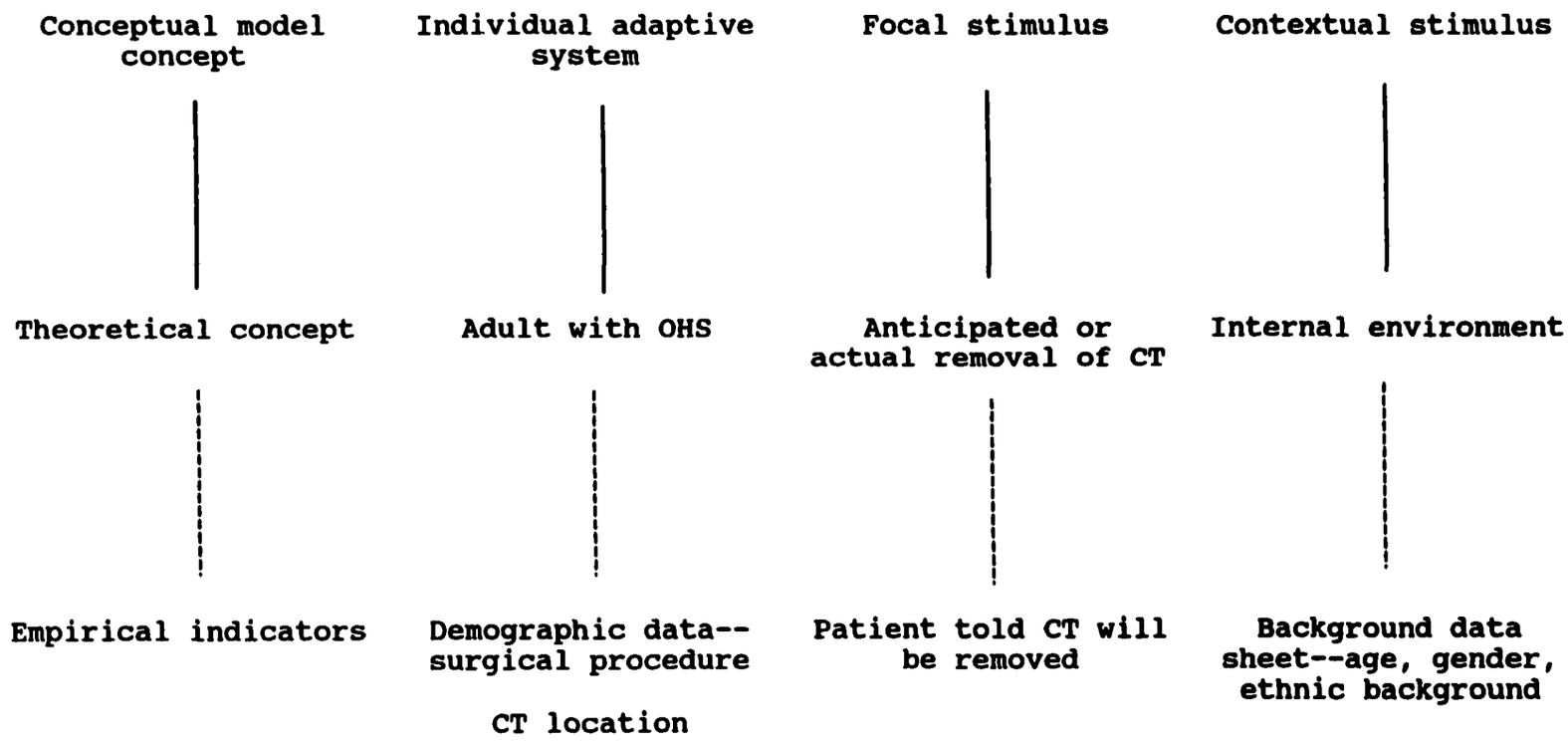

Figure 1. Conceptual-theoretical-empirical structure

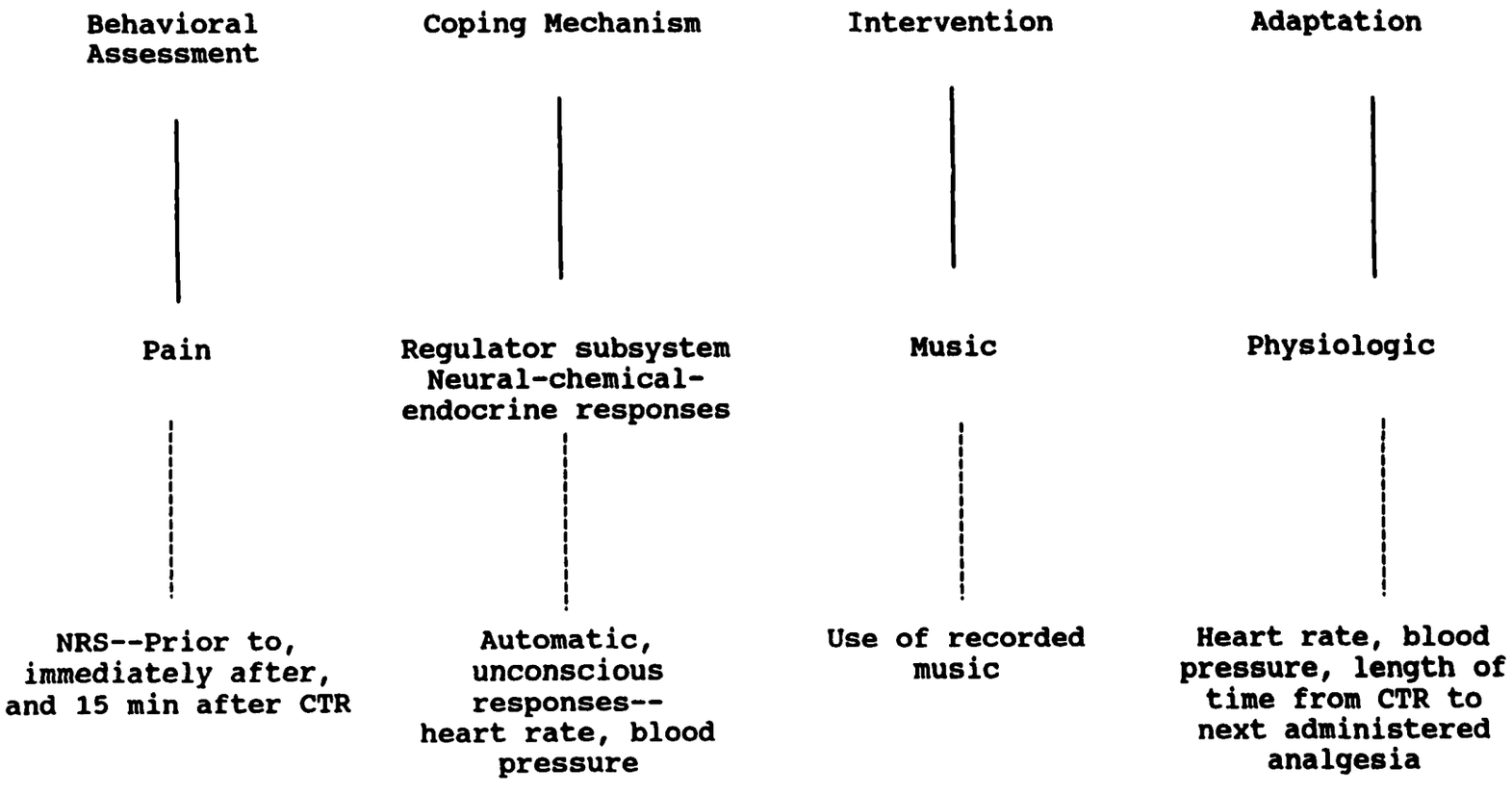

Figure 1. (Continued)

as smells, sounds, noise, interpersonal interactions, and length of time since analgesia. Length of time between analgesia and chest tube removal will be measured in this study. Residual stimuli are defined by Roy and Andrews (1991) as factors of which the individual may be unaware that have an impact on the present situation. These stimuli are not considered in this conceptual-theoretical-empirical structure.

Stimuli are acted upon by control processes or coping mechanisms which are identified by Roy and Andrews (1991) as the regulator or cognator subsystems. The regulator subsystem includes the neural, chemical, and endocrine processes of the body which are automatic processes and result in automatic, unconscious responses. The effects of the regulator subsystem can be observed through the physiologic mode of adaptation. Coping or adaptation also occurs through the cognator subsystem through four cognitive-emotive channels, one of which is perception. The ability of a person to respond positively in a situation is the individual's adaptation level (Roy & Andrews). Because of the relationship between the cognator and regulator subsystems, the Roy adaptation model fits well with this study.

By providing an intervention, music, which can manipulate the stimulus, chest tube removal, through perception in the cognator subsystem, the holistic nature of the individual is illustrated in that the physiologic responses of the regulator subsystem are also altered as the individual's level of adaptation changes.

Gate control theory

With the proposal of the gate control theory (Melzack & Wall, 1965), a unique view of the concept of pain was presented. The idea of pain impulses being altered in the spinal cord, brainstem, or cerebral cortex by inhibitory cells aided in the explanation of why people react differently to a painful stimulus. This integration of the nervous system allows a painful stimulus to be modulated.

Several types of pain fibers have been identified as having input into the perception of pain. Small myelinated A-delta fibers (fast conducting) and unmyelinated C fibers (slow conducting) allow transmission of a noxious stimulus from the periphery to the central nervous system. These fibers end in the dorsal horn of the spinal cord and the substantia gelatinosa which Melzack and Wall (1965) described as the gating mechanism. The gate is opened in response to stimulation from neurotransmitters such as substance P which is released by A-delta and C fibers. A third type of nerve fiber, A-beta, is a large myelinated fast-conducting fiber which releases inhibitory neurotransmitters, closing the gating mechanism and preventing the transmission of painful stimuli. Modulation of pain in the dorsal horn is controlled by the balance of input from the A-delta and C fibers and the A-beta fibers. The dorsal horn also contains opiate receptor sites which can bind with synthetic or endogenous opiates to block the transmission of painful stimuli (Paice, 1991). From the dorsal horn, impulses are transmitted to the spinothalamic tract which terminates in

the thalamus. From the thalamus, the third segment of the pain pathway is stimulated by axons which branch out into the cerebral cortex and limbic system (Clancy & McVicar, 1992; Wallace, 1992). It is at this time that the perception of pain occurs.

Melzack and Wall (1965) also described an inhibitory mechanism for pain. The corticospinal tract descends from the cerebral cortex to the dorsal horn of the spinal cord. Through the release of neuromodulators, the gating mechanism can be closed, inhibiting the transmission of painful stimuli. Other descending tracts are also described as originating in the periaqueductal gray area and the nucleus raphe magnus, which release serotonin and inhibit the transmission of painful stimuli (Bonica, 1990).

Of interest to this project is the proposition that an individual's range of coping or adaptation level is determined by the strength of the stimuli and that physiologic gating mechanisms act to modulate pain, thereby altering the intensity of the noxious stimuli. With the integration of the nervous system described by Melzack and Wall (1965), in which physiologic and psychologic factors can stimulate the descending tracts and alter pain perception, the gate control theory suggests that this study, in which a psychological intervention (music) is used, could result in psychological as well as physiological responses. Figure 1 describes the conceptual-theoretical-empirical model developed to guide this study through the integration of the Roy adaptation model and the gate control theory.

Definitions of Terms

Music is conceptualized as "an orderly arrangement of sounds consisting of rhythm, melody, harmony, tone, and pitch" (Moss, 1988, p. 64). Music was operationalized for this study as prerecorded music on a cassette tape.

An intervention is conceptualized as an action which modifies or changes the course of something (Guralnik, 1987). It was operationalized for this study as the use of a self-selected cassette tape to alter a patient's response to pain.

Pain is conceptualized as:

> a multidimensional experience that is unique for each individual. The experience is triggered by a noxious stimulus producing tissue damage or irritation which results in a neurophysiologic response and the sensing of the stimulus. Interpretation of this sensory stimulus is contingent upon the individual's past sociocultural, psychological, and cognitive experiences. (Broscious, 1993, p. 15)

Pain was operationalzied for this study as the score on a numeric rating scale.

White noise is conceptualized as a type of synthetic silence developed from a mixture of sound waves from a wide frequency range. It was operationalized for this study as the use of a selected recording of running water from a babbling brook.

Routine care is conceptualized as the usual nursing care provided to all patients with similar needs or conditions. It was operationalized in this study as the nursing care provided prior to, during, and after CTR as specified by the standards of care at the site of this study.

The overall goal of this study was to expand knowledge of the use of music as a nursing intervention in the treatment of acute pain during the removal of CTs following open heart surgery. The aims of this study were: (a) to test a nursing strategy designed to intervene in the experience of acute procedural pain, (b) to ascertain subjects' responses to music as an intervention to decrease pain intensity during CTR, (c) to document the effect of music on selected physiologic variables during CTR, and (d) to examine subjects' need for analgesia after CTR when music has been used as an intervention.

Hypotheses

1. The music treatment group will report less pain associated with the removal of CTs than the control group or the white noise group.

2. The music treatment group will have less change in heart rate and blood pressure than the control group or the white noise group.

3. The music treatment group will experience a longer time interval from CTR to requested analgesia than the control group or the white noise group.

Assumptions

1. Adaptation occurs as a response to pain.

2. Subjects can accurately identify their level of pain on a numeric rating scale.

3. Physiologic response to pain is incompatible with physiologic response to music.

4. Selection of music preference by subject yields the greatest physiologic response.

Summary

The Roy adaptation model focuses on a person's ability to adapt to or cope with stimuli from the environment. Kessler (1960) and Wostratzky, Braun, and Roth (1988) described the use of distraction with music as a means of coping or adapting. Therefore, the use of music as an intervention is congruent with Roy's model as a means of assisting a patient to adapt to stimuli. It is also congruent with the gate control theory in that perception of pain can be modulated at various levels in the nervous system, including the cerebral cortex, through the use of cognitive strategies.

A unique advantage of music is the ability of music to cross cultural boundaries (McCaffery, 1992). Culture has been identified as a factor influencing a person's response to pain, therefore music as an intervention may be an effective cognitive strategy regardless of cultural background.

Because people respond to and interpret pain differently, no single effective intervention for pain has been identified; therefore, exploration of a variety of interventions must be continued (Brown et al., 1989). Whipple (1987) described the testing of alternative interventions for pain

as appropriate areas for nursing research; therefore, music, an alternative intervention for pain, should be considered an appropriate topic for nursing research.

CHAPTER 2

REVIEW OF THE LITERATURE

The review of the literature begins with a discussion of the phenomenon of pain, focusing on the sensory component, followed by a discussion of the use of the Roy adaptation model in studies involving pain. The third part of the review includes studies in which music has been utilized. Next is a review of the literature examining the effects of music in the relief of pain. Finally, the use of music associated with painful procedures will be examined.

Pain

The gate control theory (Melzack & Wall, 1965) introduced the idea that pain not only is a perception of a physiologic phenomenon but also contains psychologic aspects, including past experiences, attention to the stimulus, anxiety, and suggestion. In addition, there is a motivational aspect that directs a person to enter into some activity to stop the pain. Melzack (1974) suggested that multiple approaches are needed to control pain. In a study of 14 patients with chronic refractory pain, distraction, suggestion, relaxation, and a voluntary control over pain by teaching the patients to increase the alpha waves on their electroencephalograms through meditation were used. Melzack

found the mean percent decrease of pain, 44%, to be statistically significant.

Factors Influencing Sensation of Pain

A number of studies have been reported examining the influence of ethnicity, age, and gender on response to pain. A major obstacle in comparing studies in which pain has been studied is interpreting the results of these studies. Some studies report pain results in terms of threshold to pain (Lasch et al., 1997; Nguyen, Lee, & Castell, 1995), while others report pain tolerance or intensity of pain (Thomas & Rose, 1991; Woodrow et al., 1972). Another issue in the review of studies related to pain is the type of pain used in the study. Studies reviewed include experimental pain produced by pressure, heat, cold, electrical, and visceral stimulation. It is unknown whether a person responds similarly to each type of pain. A recent study by Janal, Glusman, Kuhl, and Clark (1994) in which two groups of subjects, healthy subjects (n=60) and subjects with coronary artery disease (n=29), were studied found no correlation between pain threshold responses to experimentally induced noxious stimuli produced by heat, cold, electricity, or ischemia. Prior to this study, Harris and Rollman (1983) (n=40) examined pain threshold and tolerance and found stressors including cold, pressure, and electrical shock were not the same.

Ethnicity. Pain tolerance, the point at which a person requests that a painful stimulus be stopped, was found to be different among three ethnic groups (n=41,119): White, Black, and Oriental (Woodrow et al., 1972). Using experimental pressure pain to the Achilles tendon, pain tolerance was identified as greater in Whites than in Blacks with Orientals having the lowest pain tolerance. A significant difference between the groups ($p<.001$) was found.

Lipton and Marbach (1984) studied the pain experience in 250 patients with facial pain who represented five ethnic groups: Black, Irish, Italian, Jewish, and Puerto Rican. The pain experience was measured using a 35-item scale. Twenty-three of the items on the scale showed no significant differences between the five groups. The remaining items revealed significant differences related to emotional response to pain and the effect of the pain on activities of daily living.

Thomas and Rose (1991) examined ethnic differences in pain related to ear piercing. Utilizing three ethnic groups, ages 15-25 (Afro-West Indian, Anglo-Saxon, and Asian [n=84]), significant differences in pain ratings were found ($F(2,72)=12.51$, $p<.001$). Afro-West Indian subjects reported the lowest pain scores, followed by the Anglo-Saxon and then the Asian subjects. In addition, pain tolerance was lowest in the Asian subjects, which is supported by the study by Thomas and Rose with Asians reporting the highest pain score. However, Thomas and Rose found Anglo-Saxons to have the highest pain tolerance, whereas the study by Woodrow et

al. (1972) found Afro-West Indians to have the lowest pain scores and, thus, the highest pain tolerance. In addition, Calvillo and Flaskerud (1993) found no differences in the expression of pain between Anglo-American and Mexican American women after cholecystectomy.

Age. Pain tolerance and pain threshold have been examined in relations to subjects' age. Woodrow et al. (1972) found pain tolerance decreased with aging in both men and women; however, Walsh et al. (1989) (n=600), found pain tolerance in males decreased as age increased, while there was minimal change in women as age increased with experimental pain in which cold was used as the painful stimulus. Pain threshold was found to increase with age in studies reported by Jensen et al., (1992) (n=740), in which pressure pain was used as the stimulus; Tucker et al. (1989) (n=520), who used electrical stimulation; and Lasch et al. (1997) (n=27), who used intraesophageal balloon distention to produce visceral pain. In contrast, pain threshold was found to be similar in young and old subjects in a study by Kenshalo (1986) (n=48), who used tactile, vibration, thermal, and heat-pain stimulation. Elderly were found to be significantly less sensitive to mechanical stimuli ($p<.001$) and thermal stimuli on their feet ($p<.001$). Evans et al. (1992) (n=96), who used electrical stimulation found no significant differences in pain threshold based on age. Finally, Harkins, Davis, Bush, and Kasberger (1996) used heat as the painful stimulus in a

study to examine pain intensity (n=20). No significant difference was found for pain intensity related to age.

Gender. Another variable included in many studies examining factors influencing the sensation of pain is gender. Although Woodrow et al. (1972) found men to have a higher pain tolerance level than women ($p<.001$), Thomas and Rose (1991) found no significant differences for gender in relation to pain. Lack of differences in perception of pain between genders is also supported by Lander et al.(1989). In a study including 200 children, 75 postoperative patients, and 78 patients with osteoarthritis, pain perception was measured on an 11-point scale for adults and a 4-point scale for children. No significant differences in perception of pain were found related to gender.

Recent studies continue to reveal disparity in findings related to response to pain based on gender. Nguyen et al. (1995) used esophageal stimulation (visceral pain) to examine pain threshold responses in men and women (n=19). Women were found to have a significantly lower pain threshold than men ($p=.02$) during rapid inflation of the esophageal balloon. Ellermeier and Westphal (1995) used pressure pain to examine pain threshold and tolerance (n=20). No difference was found in pain threshold, but women were found to have a significantly lower pain tolerance than men ($p<.001$). Finally, Fillingham and Maixner (1996) used thermal pain and ischemic pain to examine pain threshold and pain tolerance by gender (n=48). No gender differences were

found when thermal pain was utilized. Men were found, however, to have longer ischemic tolerance times than women ($p<.05$).

In summary, culture appears to have an influence on the perception of pain; however, data from the study by Lipton and Marbach (1984) indicate more similarities than differences between expressions of pain and only a few characteristics of the expression of pain that truly vary between cultures such as degree of medical acculturation, duration of pain, or psychological distress associated with the pain. The effects of gender and age on pain perception are also not clearly identified. Studies in which experimental, surgical, and subject-selected pain (i.e., ear piercing) is used must be conducted to determine whether type of pain influences the subject's tolerance to pain and expression of pain. Continued research is needed to better understand the influence of culture, age, or gender on response to pain, which may also have an impact on the interventions utilized for pain.

Roy Adaptation Model

Calvillo and Flaskerud (1993) examined the adequacy and scope of the Roy adaptation model and gate control theory in a cross-cultural study of pain (n=60) using a convenience sample of Anglo-American and Mexican-American women who underwent cholecystectomy. Four adaptive modes were evaluated in this study. The physiologic mode was assessed through changes in the sympathetic nervous system (i.e.,

blood pressure, heart rate, and respiratory rate). Only blood pressure showed a statistically significant change before and after surgery (F=5.03, df=1.58, p=.02). The direction of this change is not described; however, the premise was that an increase in vital sign measures would occur after surgery as a result of pain. The psychologic mode was also evaluated in terms of subjects' responses to a focal stimulus (i.e., pain). Subjects with high self-esteem and high self-coherence reported less pain with no differences related to ethnicity.

Frederickson, Jackson, Strauman, and Strauman (1991) tested propositions derived from Roy's adaptation model in a study which focused on the relationship of the cognator and regulator systems in subjects with cancer who received interleukin-2 therapy (n=45). A significant positive relationship was found between subjects' physiological adaptation measured with the Symptom Distress Scale and psychologic adaptation measured with the Sickness Impact Profile (r=.60, p<.0001). Support was provided for the hypothesis that a response in one mode could act as a stimulus for other modes. This finding supports a holistic view of the body and provides support for nursing interventions which may focus on either domain as a means of helping a patient to adapt. In summary, these two studies are significant in that support for the use of the Roy adaptation model in the study of pain was found.

Music in Research

McClellan (1988) delineated two types of therapeutic music. The first is related to culture. Music from the Western culture particularly used in music therapy includes classical and folk music. The importance of considering ethnic background when selecting music as an intervention is also described by Campinha-Bacote and Allbright (1992). The second type of music consists of natural rhythms of the world such as wind or water in motion and is free of cultural bias (McClellan, 1988).

In addition, McClellan (1988) identified characteristics of healing music that he described as pan-cultural, as opposed to the Western traditional music that is usually used in the clinical setting. These characteristics include pulse, which should be greater than 72 if the music is to energize the patient or below 72 if the purpose is to relax the patient; smooth rhythm; slow and sustained melodies; gradual soft to moderately loud dynamics, with no sudden changes; minimal use of harmony; at least 15 min in duration and preferably 20 to 45 min; soft quality instruments such as flute, string, and voice or organ; and a maximum of three voices.

Long and Johnson (1978) identified 10 characteristics to be considered in the selection of music to provide pain relief: a variety of musical styles, volume adjustment for the patient to control, instrumental music as opposed to vocal, unfamiliar tunes to avoid any associations with familiar music that may alter the patient's response, simple

tunes in major keys, music without syncopation, music that flows continuously without interruptions with short pieces being connected smoothly, and predominantly piano and cello music.

The use of music in 23 studies was reviewed. The type of music most commonly used in these studies has been classical. Thirteen studies used classical music alone or as at least one option subjects had available to them. Other styles of music used in the studies included popular/ contemporary, country and western, jazz, blues, gospel, motion picture sound tracks, pop-rock, folk, easy listening, and New Age. One interesting study (Bruya & Severtsen, 1984) was found in which the effect of music on EEG patterns was examined (n=24). New Age music, which is marketed as being composed specifically to produce relaxation and improve coping, was compared to the classical music of Chopin. Alpha waves, which indicate a conscious state of relaxation, were assessed on the electroencephalogram. The results revealed no difference in the number of alpha waves with either type of music and therefore no difference in the relaxation resulting with either type of music. The type of music used in the studies reviewed was predominantly described as relaxing or sedating; 13 studies utilized this type of music. Of those 13, however, only 8 defined what they meant by relaxing or sedating music. Another criterion evaluated in the use of music was subject preference. In the 23 studies reviewed, 6 did not allow the subjects to select the music; subjects supplied their own music tapes in 2 of the

studies. In the remaining 15 studies, subject preference was permitted, with the subjects' selecting from a library of tapes provided by the investigator ranging from 4 to 50 tapes. The final characteristic of the music in the studies reviewed was the instrumentation of the music. Six studies specified that instrumental music was used; the remaining studies did not specify.

Two studies were found in which the type of music used was the focus. Davis and Thaut (1989) examined the effect of subject selected music on relaxation. In a laboratory setting, 18 subjects provided their own musical tapes with 68% of the music containing lyrics. Anxiety and relaxation were measured before and after listening to the music at 10- to 14-day intervals for a total of three sessions. State anxiety decreased significantly in all subjects ($F=2.753$, $p<.01$). Four physiologic parameters were measured: heart rate, vascular blood flow, skin temperature, and muscle activity. Evaluation of the parameters measured over time revealed a significant difference in muscle tension ($F=1.265$, $p=.019$) and vascular blood flow ($F=1.370$, $p=.007$) only. These results support the idea that individuals have idiosyncratic responses to music. The researchers concluded that psychologically a subject may be more relaxed with music, as indicated by self-rated relaxation measures, although these measures were not significantly different and although physiologically the autonomic nervous system appears stimulated. The results also support the theory that type of music did not affect the subjects' responses. The

investigators suggest that criteria for selecting music to decrease anxiety should consider "preference, familiarity, cultural context, past experiences, and perception of elements of the music such as structure, tempo, and dynamics" (Davis & Thaut, 1989, p. 184). A limitation of this study is the lack of information about validity and reliability of the instrument used to measure anxiety, which raises questions about measurement error.

In another study by Thaut and Davis (1993) subject-selected versus experimenter-selected music was evaluated. The experimenter-selected tape was relaxation music specifically composed and marketed to produce relaxation. In a laboratory setting, 54 subjects were assigned to either the control group or one of the two music groups. Results showed that all groups had an increase in relaxation ($p<.0001$) and a decrease in anxiety ($F=39.9$, $p<.0001$). The Multiple Affect Adjective Checklist was also used to assess anxiety, hostility, and depression. Anxiety in this test was significantly decreased for the music groups but not the control group ($F=4.7$, $p<.019$). The investigators concluded that music developed specifically for relaxation was no more effective than personal preference. Two limitations to this study include lack of description of validity and reliability for the instruments used and generalizability of the results since the age range was limited to young adults. The two studies above examined the effects of music in decreasing anxiety. The present study examined the effect of music on pain, which may be different than the effect of music on

anxiety. No studies have been reported, however, that have evaluated types of music and their effect on pain.

Two other factors to consider in the selection of music were described in the literature. The use of music with words was discussed by several authors. It is generally agreed that music should not have words because the subject may concentrate on the words and not the flow of the music (Guzzetta, 1988; Kolkmeier, 1989; Long & Johnson, 1978). The other factor discussed in the literature was subject preference. For music to be effective, it is also generally agreed that subjects should be able to select a style of music they enjoy (Guzzetta, 1988; Kolkmeier, 1989; Long & Johnson, 1978; Stevens, 1990; Stratton & Zalanowski, 1984).

As a result of evaluating the literature on the use of music in research, the following guidelines were applied to the selection of music for this study:

1. A library of 10 prerecorded cassette tapes with a variety of musical selections will be available.

2. Music will be instrumental only.

3. Music will be selected by the subject from the library of tapes available.

4. Music will not be classified or selected by the investigator for use based on whether it is thought to be sedative or stimulative.

Pain in Acute Care

In a study by Donovan et al. (1987), medical-surgical patients (n=353) were interviewed to ascertain the incidence

and characteristics of their pain. Seventy-five percent of the patients had experienced pain within the previous 72 hr and 53% had pain during the interview. However, the average amount of analgesia administered was less than one fourth of the average amount prescribed. Two hundred three patients described their worst pain as "excruciating" or "horrible." Twenty-one of the patients with excruciating pain associated their pain with a procedure. In addition to treatment with analgesics, other interventions for pain relief were examined. Distraction was used by almost all of the patients with 32% finding a decrease in their pain, although 62% found distraction had no effect. A limitation of this study was sufficient information was not reported related to the development and validity and reliability of the questionnaire, which raises questions about measurement error. In addition, usefulness of findings is limited by lack of a conceptual framework to guide the study.

Few studies have been reported related to pain experienced with medical or nursing procedures. In a study by Gift et al. (1991), sensations associated with CTR were examined. Using a sample of 36 patients, the most common sensations described were burning, pain, and pulling, in decreasing order of frequency. No difference was found in sensations experienced with the removal of mediastinal or pleural CTs. They also found only half of the patients had received analgesia within 2 hr prior to CTR, although no difference in sensations experienced by the subjects was found between those who received analgesia and those who did

not. This study is important because it provides support for the belief that CTR is a painful experience, although the weakness of the study is the lack of a conceptual framework to guide the study.

Puntillo (1994) studied the pain associated with endotracheal tubes and CTs. In examining CTR (n=35), the intensity and the sensory components of pain were analyzed. Chest tube removal was found to be a painful experience with removal of pleural CTs significantly more painful (p=.03) than mediastinal CTs. Similar to the findings by Gift et al. (1991), 17 of the 35 patients had no analgesia during the hour prior to CTR. Puntillo's study is valuable in that support is provided that CTR is a painful procedure. The study was theoretically based and therefore has greater generalizability.

In the recent study by Carson et al. (1994), four interventions to manage pain during mediastinal CTR were compared. These four interventions were intravenous morphine, intravenous morphine and subfascial angiocatheter lidocaine, intravenous morphine and subfascial normal saline, and subfascial angiocatheter lidocaine. No significant difference was found between the pain rating scales for any of the four methods, although subject qualitative reports indicated less pain with CTR associated with subfascial lidocaine. Limitations with this study include inability to control time frame from the time of analgesia to the time the CT was removed, the number of different people removing CTs in the study, and use of a visual analog

scale. Although validity and reliability have been demonstrated for the visual analog scale, subjects have been found to have difficulty conceptualizing its use. Another weakness of this study is the lack of a theoretical base to guide the study.

It is clear that CTR is a painful experience and that patients would benefit from management of this pain. Untoward effects of analgesics may be one reason patients are not routinely premedicated for CTR. Another reason may be that the procedure is short-lived and that therefore, the patient is expected to tolerate the pain. Whatever the reason, alternative interventions for pain may be effective during short-lived procedures when analgesics may not be appropriate to manage pain.

Interventions

Various interventions for pain have been identified in the literature. Cognitive pain control strategies such as distraction allow subjects to refocus their attention. Distraction has been found to be more effective when associated with suggestion (Jacox, 1977). Interest in a stimulus helps the person focus on the distractor, thereby having some control over a situation (Gfeller et al., 1990). Daake and Gueldner (1989) found a significant difference between scores on pain intensity in patients who used pleasant imagery as a distractor and those who did not use imagery ($t=4.82$, $p<.001$).

Blitz and Dinnerstein (1971) examined the impact of focused attention on the perception of experimental pain (n=36) using ice water in a group of subjects aged 17-50. They found significantly higher pain thresholds in the two groups who focused on the cold rather than the pain they were experiencing ($t=11$, $p<.05$, $n=12$) or who focused on interpreting the cold as pleasant ($t=9.5$, $p<.02$, $n=12$). Differences were also found based on gender with men having a higher pain threshold after focusing attention than women ($p<.01$).

Kaplan, Metzger, and Jablecki (1983) used cognitive and relaxation training to examine pain tolerance in the clinical setting. Pain related to electromyography was studied in a group of 40 adult males. Three experimental groups who utilized various methods of relaxation or controlled their attention were compared to a control group. Subjects in the experimental group reported receiving more benefits than the control group ($F=7.46$, $p<.01$), although no statistical difference was found in comparing the three experimental groups for superiority. Subjects in the control group were found to have more distress ($F=5.11$, $p<.05$) based on physician report and more self-reported pain ($F=6.00$, $p<.05$) than the experimental groups.

Attention and affect were also examined by Stevens, Heise, and Pfost (1989) using experimental pressure pain in a group of 40 subjects. The subjects were randomly assigned to one of four groups of high or low pleasure or high or low anger. Through the use of prescribed cognitions, subjects

were asked to recall the percentage of time they used these thoughts during the experimental pain. The results indicate that highly intense pleasurable thoughts resulted in a higher pain tolerance than angry thoughts ($F=3.95$, $p=.05$). The researchers concluded that the use of pleasant affect by the subject may be more significant in pain tolerance than the amount of attention paid to the pain by the subject.

The influence of anxiety and attention was explored by Arntz et al. (1991) using electrically produced painful stimuli (n=55). Subjects were randomly assigned to one of four conditions of low anxiety/attention, low anxiety/ distraction, high anxiety/attention, or high anxiety/ distraction. Results revealed subjects in the distraction group paid less attention to the painful stimulus than those whose attention was focused ($t=10.94$, $p<10^{-3}$). The effect of anxiety level on pain was not found to be significant.

In summary, if affect as well as attention have a significant impact on how a person perceives pain, music may be an effective intervention in that it could alter affect and distract the person at the same time. Weaknesses in the previous group of studies center around the lack of a conceptual framework to guide the studies, thereby limiting the usefulness of the findings; lack of information regarding validity and reliability of instruments; and sample size. In the studies by Kaplan et al.(1983) and Stevens et al. (1989), both had 40 subjects in their studies but divided them into four groups. In addition, Kaplan et al. utilized physicians to determine subject distress, but no information

is provided related to training of the physicians or reliability of their findings.

Music

Physiologic Responses to Music

Inconsistent physiologic responses have been noted in individuals in response to music with increases, decreases, or no changes in autonomic responses. Measurements most frequently assessed in terms of physiologic responses to music include heart rate, blood pressure, respiratory rate, and skin temperature.

Using a nonrandomized convenience sample of patients having plastic surgery (n=10), Updike and Charles (1987) measured systolic and diastolic blood pressure, mean arterial pressure, and double product index to evaluate stress. Physiologic indices were measured before and after listening to self-selected sedative music. All variables showed significant decreases, indicating the desired change toward relaxation (systolic blood pressure $t=6.4$, $p=.001$; diastolic blood pressure $t=4.67$, $p=.001$; heart rate $t=5.22$, $p=.001$; mean arterial pressure $t=24.65$, $p=.001$; and double product index $t=6.53$, $p=.001$). Qualitative data indicated the subjects enjoyed the music and felt relaxed. Although the study provides important information related to physical responses to music, the small sample size limits the generalizability of the study. In addition, the type of music used is not clearly identified.

Steelman (1990) examined the effect of tranquil music on systolic and diastolic blood pressure in a convenience sample of 43 subjects having outpatient surgery with local or regional anesthesia who were randomly assigned to the control or experimental group. In addition to measuring anxiety, systolic and diastolic blood pressures (BP) were measured. Both pressure parameters were found to be significantly different (systolic BP $t=2.098$, $p=.024$; diastolic BP $t=2.79$, $p<.01$) in comparing preoperative and postoperative pressures, indicating a positive physiologic response to the music. Limitations to this study include lack of clarity in identifying the types of music used, making replication difficult. In addition, validity and reliability of the instruments were not reported.

Using sedative music, Kaempf and Amodei (1989) examined preoperative anxiety in a group of 33 subjects who were randomly assigned to the experimental or control group. Physiologic parameters measured included systolic and diastolic blood pressure, heart rate, and respiratory rate. A statistically significant difference was found between the two groups for respiratory rate ($t=1.72$, $p=.047$), but no significant differences were found for the other parameters. A weakness of this study was lack of reported validity and reliability of the instrument used, which raises questions about measurement error.

In a pilot study ($n=10$), Whipple and Glynn (1992) explored the effect of soothing and stimulating music on pain threshold and tolerance, as well as on blood pressure

and heart rate, in experimental pain from pressure and heat. No significant differences were found with soothing or stimulating music in relation to vital signs. Pain threshold and tolerance were elevated with both types of music, indicating that type of music was not a factor in altering those thresholds. Although this was a pilot study, it is valuable because it provides information that provides support for the gate control theory. Validity and reliability of the instruments were clearly identified. A weakness of this study is that only females were used as subjects; therefore, generalizability of the study is limited. Their conclusion also supports the findings of Thaut and Davis (1993) in that the type of music used in a study may not be as important as originally thought in terms of altering subjects' responses.

These studies reveal the inconsistencies in the literature in findings related to vital signs as an indication of decreased pain or anxiety resulting from music intervention. The setting of the study, as well as other factors, may have to be considered in evaluating these studies. Subjects in the laboratory setting may not have the same factors influencing their response to pain or anxiety as a patient in the hospital would have, such as altering family and individual activities of daily living and unknown outcomes.

Music to Alter Anxiety

Numerous studies have used music as an intervention for anxiety. As previously described, Kaempf and Amodei (1989),

Moss (1988), Steelman (1990), and Updike and Charles (1987), all examined the effect of music on anxiety in perioperative patients. Updike and Charles, as well as Moss, found a significant decrease in anxiety levels in patients who listened to music. In contrast, Kaempf and Amodei, as well as Steelman, did not find significant differences in anxiety levels between the two groups. Physiologic parameters were used as a way of measuring anxiety in all but the study by Moss. The results of these studies have been previously discussed.

Music in Critical Care

Music has also been used as an intervention in the critical care setting, predominantly as a way to decrease anxiety. Bonny (1983)(n=26) found a significant decrease in anxiety before and after listening to music ($t=5.99$, $p<.001$) in patients in a coronary care unit. In addition, Bonny found a significant decrease in heart rate (4.612, $p<.001$) but not in systolic or diastolic blood pressure. The music used was described as sedative, based upon previous studies by the same primary investigator (PI). There is no theoretical base identified as guiding this study. In addition, there is a lack of information related to data collection. Training of data collectors is described, but no reliability measures are reported. Furthermore, no information is reported about the development or validity and reliability of the rating scales, which raises questions about measurement error.

Bolwerk (1990)(n=40), Zimmerman et al. (1988)(n=75), and White (1992)(n=40) examined the effect of music on anxiety in patients with myocardial infarction. The results showed deceases in anxiety in both the experimental and the control groups in all three studies. The experimental groups listened to music, while the control groups had a quiet rest period for the same length of time. Zimmerman et al. also had a third group which listened to white noise, a form of distraction. In addition, Zimmerman et al., as well as White, assessed vital signs as an indicator of change in anxiety. While White found significant decreases in heart rate and respiratory rate after listening to music, Zimmerman et al. did not. The music used in these three studies was described as relaxing. Only in the study by Zimmerman et al. were subjects given a positive suggestion that the music or white noise would help them to relax. The study by Bolwerk is important because adequate information is provided to allow replication of the study. The studies by Zimmerman et al. and White both lacked conceptual frameworks to guide the studies, thereby limiting the usefulness of the findings.

Guzzetta (1989)(n=80) also examined anxiety in the coronary care unit population using natural systems theory to show the relationship between body and mind but measured the results only in terms of physiologic findings. Relaxation and music plus relaxation were found to have a significant effect on decreasing apical heart rates ($t=9.77$, $p<.0001$), but there was no difference between the relaxation and the

music plus relaxation groups. Peripheral temperature as an indicator of decreased anxiety resulted in a statistically significant difference ($t=2.99$, $p=.004$) between the experimental and control groups. Also significant in this study was the finding that the effect of music and relaxation on apical heart rate was cumulative over time. Guzzetta's study is valuable because it provides information about the effect of music on patients in a critical care unit that is theoretically based.

Davis-Rollans and Cunningham (1987) investigated the effect of classical music on physiological responses in patients in a coronary care unit ($n=24$). Although heart rates were found to vary when music was played ($p=.04$), the difference was described as not being clinically significant. Additionally, no significant difference was found in respiratory rate with and without music. Two weaknesses in this study include lack of a conceptual framework to guide the study and lack of sufficient data about the development, validity, and reliability of the psychologic data questionnaire.

Finally, Updike (1990) studied physiologic responses to sedative music of patients in an intensive care unit. In a group of 20 patients, physiologic variables were measured before and after listening to music. Systolic blood pressure ($t=3.04$, $p\leq.01$), mean arterial pressure ($t=7.91$, $p\leq.01$), and double product index ($t=2.74$, $p\leq.01$) were found to be significantly lower in the group after listening to music. Subjects also verbally reported a decrease in their pain and

anxiety. Two limitations to this study include lack of a conceptual framework to guide the study and lack of information about the validity and reliability of the emotional status questionnaire, which raises questions about measurement error.

Music to Alter Pain

In a study by Goloff (1981), subjects responded to a questionnaire after participation in a music therapy program (n=46). Three broad areas studied were physical discomfort, affective responses, and subjective responses. Using a verbal descriptor scale prior to music, 19% reported "a lot" or "tremendous" pain; after therapy only 11% reported the same amount of pain ($t=2.46$, $p<.05$). The study involved singing and playing musical instruments, not just passive listening.

Music has been studied as an intervention for postoperative pain. Locsin (1981) examined the use of music in 24 postoperative patients. Subjects listened to music every 2 hr for the first 48 postoperative hr. The type of music used is described only in terms of subject preference (i.e., instrumental, popular, and vocal). A significant difference in pain was found between the control and music groups during the first 24-hr period ($t=3.6492$, $p=.05$) and the second 24-hr period ($t=3.2909$, $p=.05$). A significant difference in blood pressure ($Z=1.7213$, $p=.05$) and pulse (reported to be significant at the .01 level) was found during the second 24-hr period, with no significant diferences during the

first 24-hr period. These findings indicate less of an increase in blood pressure and heart rate in the music group during the second 24-hr period than in the nonmusic group. No significant differences were found between the groups for respiratory rate or requirements for analgesia. This finding about the cumulative effect of music supports the findings by Guzzetta (1989). One weakness of this study was the sample used: Only female subjects were used, which limits the generalizability of the findings. In addition, no conceptual framework was identified as guiding the study, thereby limiting the usefulness of the findings. Finally, there is lack of information reported about the development and validity and reliability of the rating scale used, which raises questions about measurement error.

Mullooly, Levin, and Feldman (1988) used easy listening instrumental music to determine its effect on postoperative pain. Twenty-eight women were assigned to a control or music group and monitored for 2 days. Pain scores on day 2 showed a statistically significant difference (p=.00) between the two groups, with the music group having less pain. Reported anxiety was found to be significantly different on both days also (p=.03), with the music group having less anxiety. This finding that music intervention has a cumulative effect over time is also supported by the findings of Guzzetta (1989). Validity and reliability were not reported for the instruments used, thereby raising questions about measurement error. In addition, only women were studied, which limits the generalizability of the findings.

Heitz, Symreng, and Scamman (1992) studied the effect of instrumental sedative and stimulative music on pain and hemodynamics in patients in a postanesthesia care unit (PACU) who had general anesthesia. Sixty subjects were studied and randomly placed into one of three groups: control, headphones with no music, and headphones with music. No significant differences were found in pain scores, heart rate, mean arterial pressure, or respiratory rate between the three groups. One significant finding revealed subjects who listened to music waited significantly longer for analgesia upon return to their hospital room than the group with the head phones, but no music ($p<.05$). Weaknesses of this study center around the lack of a conceptual framework to guide the study, which limits the usefulness of the findings, and lack of reported validity and reliability of the instruments used.

The effect of music on postoperative pain in patients who had open heart surgery was studied by Zimmerman, Nieveen, Barnason, and Schmaderer (1996). A convenience sample of 96 subjects was used, with subjects being randomly placed into one of three catagories: music, music video, or 30 min of rest. Pain scores were measured on the 2nd and 3rd postoperative days, and no significant differences were found among the groups, although pain scores decreased in all three groups over the 30-min intervention. In addition, pain scores decreased for all three groups over the 2 days. Although this effect over 2 days would seem to support Guzzetta's (1989) findings, postoperative pain would be

expected to decrease; therefore, it cannot be determined if the decrease was related to the interventions or the body's normal restorative response. One weakness of this study is the lack of a control group.

Music in Dental Procedures

Audio analgesia was reported to be used with dental procedures as early as the late 1950s. Gardner and Licklider (1959) described the use of auditory analgesia in patients having dental work. Of 600 subjects who used the Audio Analgesiac, 387 had always required a local anesthetic or gas. Of that group, 63% had total relief of pain and required no other analgesia. Audio analgesia was also used with 119 subjects during tooth extraction with no other analgesia being required by the subject. The Audio Analgesiac provided either music or random noise, similar to the sound of Niagara Falls, and the subject could select either sound. Additionally, the investigators submit there may be an element of suggestion in facilitating the effect of the sound. Limitations of this study are lack of a conceptual framework to guide the study, insufficient information about the validity and reliability of the instruments used, and lack of random assignment of the subjects.

Gfeller et al. (1990) examined the effects of auditory analgesia in 40 adolescents and young adults who received dental treatment. A local anesthetic was used along with self-selected music and suggestion. Although the mean pain score for the adolescents was lower than for the adults, it

was not statistically significant. The only statistically significant finding was related to helplessness, with adolescents perceiving less helplessness than adults ($t=2.97$, $p<.01$). No conceptual framework was identified as guiding this study. Also, because young adults were studied, generalizability of the findings is limited.

The influence of distraction during dental procedures was also studied by Wostratzky et al. (1988). Eighty subjects were assigned to one of four groups: a control group, a passive distraction group who just listened to music, an active distraction group who listened to music and held a button to maintain the music, and a last group in which all three methods were used on 3 different days. Subjective reports indicated less pain when distraction was used with active distraction being the most beneficial. Although this study is important in examining the effect of music and distraction on dental pain, the major limitation is that only a minimal amount of information about the study is reported in the literature. No review of the literature, conceptual framework, information about subject selection or assignment to group, information about the instruments used, or statistical analysis is reported.

Music in Medical Procedures

Angus and Faux (1989) studied the use of music with a moderate tempo and calm or happy quality during a painful nursing procedure. Twenty-six subjects, acting as their own control, were studied. One dressing change was conducted

with music and the other took place without music. The McGill Pain Questionnaire was utilized to measure sensory, affective, and total pain rating indexes, as well as present pain intensity. Each rating index was found to be significantly less with music than without (p=.005, .001, .008, .013, respectively). Eliminating the effects of order, significant differences were still found in relation to sensory, affective, and total pain rating indexes (p=.015, .007, .014, respectively). Changes in vital signs were not found to be significantly different with or without music. Several weaknesses were identified in this study. There is no theoretical base to guide the study, thus limiting the usefulness of the findings. Rationale for assignment of subjects into groups is not reported. Validity and reliability of instruments are not reported, which raises questions about measurement error. The statistical analyses used were also not reported.

Barker (1991) studied a group of 5 burned patients to determine the effect of music and relaxation on pain during debridement. Subjects served as their own control, receiving music/relaxation or routine care with every other treatment. Various styles of music were available. Heart rate was unchanged with music therapy (critical value=91, p=.01), while it increased when the standard routine was followed. However, no significant difference was found in mean pain intensity (x^2=1.28, p=.05) between the control and treatment groups. Subjects verbally reported enjoyment of the music. Lack of a theoretical base for the study and small sample

size are weaknesses of this study. A major problem with the study is lack of sufficient information about the development of instruments, training of observers, and validity and reliability of the instruments.

The effect of listening to audiotapes during femoral angiography was examined by Mandle et al. (1990). Forty-five subjects were randomly assigned to one of three groups: relaxation tape, instrumental music tape, and no sound. Pain was found to be significantly lower in those subjects who used the relaxation tape ($p<.001$). There was no significant difference between the subjects who heard music and those with the blank tape. No significant differences were found in heart rate or blood pressure among the three groups. Analgesic use was significantly less with the relaxation group ($p<.01$). Limitations of this study include lack of a theoretical base to guide the study, thereby limiting the usefulness of the findings. No information about the validity and reliability of the instruments, which can raise questions about measurement error, is provided. In addition, observers were asked to rate subject pain and anxiety, while no information is reported about the training of observers or interobserver reliability.

Menegazzi, Paris, Kersteen, Flynn, and Trautman (1991) used music as an intervention during repair of lacerations in an emergency room. Thirty-eight subjects were studied and randomly assigned to a control group or music group. Pain intensity was significantly lower in the group with music (mean 3.3, $p<.05$). No statistical differences were found

between groups in heart rate, systolic or diastolic blood pressure, respiratory rate, or level of anxiety. Weaknesses of this study center around the lack of a theoretical base to guide the study, and lack of information related to the validity and reliability of the instruments.

The use of distraction as a cognitive strategy during dressing changes for burned patients has also been studied by Miller et al. (1992). The distraction used was mural-vision, a combination of music and beautiful scenery. Seventeen subjects were studied and assigned to either the control or treatment group. A significant decrease in pain was found for the treatment group on the present pain intensity scale ($F=7.89$, $p=.01$) and in level of anxiety ($F=6.24$, $p=.02$). Two weaknesses of this study include lack of a conceptual framework to guide the study and insufficient information about the validity and reliability of the instruments used.

Summary

Although there is a growing amount of research related to the use of music as an intervention, findings of studies continue to be inconsistent. The use of music to decrease anxiety or decrease pain is significant in some situations and not in others. Interestingly, common variables measured in a large number of studies using music were physiologic variables. An effect of music on vital signs was considered to be supportive of the intervention whether it was decreas-

ing anxiety (Steelman, 1990; Thaut & Davis, 1993) or decreasing pain (Whipple & Glynn, 1992).

A number of issues must be considered in reviewing these studies. Although most of the studies indicated the music used for the intervention was sedative or relaxing, there was no consistency in the studies in using the same type of music; also, in some cases the type of music used was not identified. Most of the studies based their definition of sedative music on empiric literature, particularly the work of Gaston (1951), who differentiated between stimulative and sedative music. Another issue related to music is whether investigators suggested that music would have a positive result for the subjects. Several of the studies identified this idea in the procedure, but others did not. One final issue related to music is whether subjects selected the music. Most of the studies used classical music; some utilized only instrumental music, whereas others provided subjects with a wide variety of selections. In considering the type of music provided, only one study identified the need for an additional type of music because of the ethnic background of the subjects. If the effect of music is culturally related, this issue must be considered in providing music for subjects. Another issue to be considered is the use of several interventions in one study, particularly music and a relaxation technique. Having two interventions makes it more difficult to determine whether one is more effective than another or which one is producing the effect. Recruitment of subjects presents a methodolog-

ical issue in two studies. Only two studies (Kaempf and Amodei, 1989; Miller & Perry, 1990) describe specific recruitment patterns to eliminate any bias from subjects who may be expecting an intervention and become assigned to the control group. In both studies, subjects were all assigned to the same group one week and then to a different group the 2nd week. The assignments were then alternated each week (i.e., control 1 week and experimental the 2nd week).

The lack of a theoretical base was identified in many studies. The role of a theory is to provide a systematic way of interpreting observations. It is then through research that data are collected which test a theory or allow for the generation of new theories (Fawcett & Downs, 1992). A conceptual framework or model organizes a research study from the review of the literature, to the methodology, through data analysis, and to interpretation of results (Batey, 1977; Grant, Kinney, & Davis, 1993). Without an organizing framework, the ability to expand the body of nursing knowledge and contribute to the growth of nursing science is impaired. Other methodological limitations have been identified with each study and are predominantly insufficient or missing information about the development of instruments, training of observers, and validity and reliability of instruments.

The number of studies reported in the literature in which music was an intervention for pain during a procedure is small and the findings are inconclusive. Although findings to substantiate a decrease in pain through changes in

vital signs have been inconsistent, reduction of pain intensity when listening to music has predominantly been supported in the studies reviewed with subjective responses indicating the music is perceived as having a positive effect.

This study addressed the methodologic deficiencies identified in the review of the literature, predominantly the theoretical base of the study and validity and reliability of the instruments. In addition, subject-selected music was employed, as suggested in the literature. Assessment of physiologic variables was also evaluated to ascertain changes that may occur in relation to pain and the music intervention. Further studies are needed in which music is used in painful procedures to add to the body of literature in determining the effectiveness of music on pain.

CHAPTER 3

METHODOLOGY

Design

An experimental, single-blind, pretest-posttest three group design was utilized to examine the effect of music as an intervention for the intensity of pain in cardiac surgical patients having their CTs removed. Data were collected during the postoperative period at the time of CTR. For the music intervention group, initial baseline physiologic data and pain intensity score were collected, and the music intervention started 10 min before the CT(s) was removed. Pain intensity data were then collected immediately after the procedure and 15 min later. The intervention was terminated with the last data collection. Physiologic data were collected every 5 min from the initial baseline data to the termination of the intervention. For the white noise group, white noise was played instead of the music, but data collection in terms of pain intensity and physiologic variables was identical to the music group. The control group also had the same data collected, with routine care being provided. This chapter describes the methods utilized, which include setting, sample, instrumentation, protection of human subjects, data collection procedures, and data analysis.

Setting

A 350-bed urban teaching hospital in the northeastern United States was the study site. Approximately 1,000 open heart surgeries are performed each year by a group of seven surgeons. Three physician assistants (PAs) work with the surgeons and are primarily responsible for CTR on the morning of the 1st or 2nd postoperative day if criteria for CTR are met (less than 100 ml of chest tube drainage in the previous 8 hr and no air leak from the pleural chest tube). In addition, one PA who works part time and two cardiovascular technicians are also responsible for CTR, as needed. Subjects predominantly had two CTs placed in the mediastinum and a pleural CT as well. The mediastinal CTs were removed simultaneously. If a pleural CT was present, it may have been removed simultaneously with the mediastinal tubes or separately, depending on the preference of the person removing the tubes.

Sample

Subjects were predominantly recruited at the time of preadmission testing, which included a structured preoperative teaching session. Subjects who were inpatients were recruited in their hospital rooms preoperatively. Finally, some subjects were recruited after their cardiac catheterization, when the decision was made about their need for OHS. Because of a change in the institution's policy, some patients in the holding area after cardiac catheterization had their preadmission testing and teaching done at that

time to eliminate the need for them to return to the hospital until the day of their surgery. Therefore, they were recruited in the cariac catheterization holding area. Three subjects were recruited after their OHS because they were admitted the day of their surgery and had not been contacted preoperatively. Subjects were adults undergoing OHS, including coronary artery bypass grafting and cardiac valve replacement. An explanation of pre- and postoperative expectations was part of the instruction for all patients undergoing OHS. Criteria for inclusion in the study were (a) consent to participate, (b) free of a major hearing defect (determined at the time of recruitment if the patient can hear the recruitment video), (c) ability to read and understand English, (d) no impairment in level of consciousness, (e) hemodynamically stable, and (f) no previous untoward response to music. Patients having emergency OHS were excluded since they do not participate in the preoperative teaching class. Informed consent was obtained from all participants according to the requirements of the Institutional Review Board of the University of Alabama at Birmingham and the participating hospital (Appendix A).

Sample size for three group MANOVA with three variables, a power of .80, alpha .05, and moderate effect size is calculated to be 52 for each group (a total of 156 subjects) (Stevens, 1992).

Experimental Intervention

One experimental intervention with two comparison groups was proposed for the study.

Music

Subjects selected the type of music they preferred to listen to from a library of 10 prerecorded music cassettes (Appendix B). The music was without lyrics. The music cassettes were produced by students in the music therapy program at the University of Alabama at Tuscaloosa under the supervision of a music therapist.

White noise

White noise was selected for use with a comparison group based on the literature review that the effect ascribed to music may actually be distraction (Gardner & Licklider, 1959; Melzack et al., 1963). The white noise was a prerecorded tape selected by the investigator. Each subject in this group listened to the same tape.

Control

The second comparison group consisted of subjects randomized to the control group who received the standard care provided during CTR. There was no manipulation of the routine CTR procedure.

Instrumentation

Instruments used in this study included a demographic data sheet, numerical rating scale, and physiologic data.

Demographic Data Sheet

The Demographic Data Sheet was developed by the investigator to record individual and contextual stimuli information about the subjects based on the Roy adaptation model (see Appendix C). Information acquired included age, gender, ethnic background (from hospital chart), weight, height, and documented history of psychiatric illness.

Data were also collected related to the surgical procedure, number and location of CTs, amount of analgesia subjects received, and person removing the CTs. The analgesia received, route, and dosage were recorded for each subject from the time of arrival in the intensive care unit until CTR. In addition, time of analgesia administration, type of analgesia, route, and dosage were recorded after CTR. Finally, data were collected related to whether the subject received a sedative-hypnotic prior to CTR. The use of a sedative-hypnotic prior to CTR is standard practice for one surgeon in this particular group but is also occasionally ordered by others.

Physiologic parameters

Postoperative OHS patients return from the operating room with invasive hemodynamic pressure lines in place. These pressure lines usually include an arterial line for

continuous blood pressure monitoring and may include a central venous line and/or a thermodilution catheter. Heart rate and rhythm are also monitored continuously postoperatively with noninvasive electrodes placed on the chest. Arterial lines were balanced prior to beginning data collection to assure reliability of measurements. Heart rate and blood pressure were obtained from the memory of the Hewlett-Packard Component Monitoring System computer. Subjects who were transferred from the open heart unit with CTs in place had their cardiac rate and rhythm monitored by telemetry but had no invasive lines present to monitor blood pressure. For these subjects, blood pressure and heart rate were monitored by a DINAMAP™ (Model 8100 or 1846SX) at the bedside. Reliability of the Hewlett-Packard monitors and DINAMAPs™ is maintained through preventive maintenance by the institution's biomedical department as recommended by the manufacturer (M. Spleen, personal communication, June 1996).

Assuring accuracy and reliability of the instruments used to measure physiologic parameters has been described by Gassert (1990). During pressure monitoring there are various points at which accuracy of data can be altered. Therefore, steps to assure accuracy of data were followed by the PI and research assistants (RAs) and included checking placement and patency of catheters, balancing transducers, examining equipment for damage, and verifying data in the monitor's computer system.

Numeric Rating Scale

An 11-point numeric rating scale (NRS) was used to collect data related to the pain intensity perceived by the subject. The NRS is a horizontal line marked in equal segments from 0 to 10, with 0 being no pain and 10 being pain as bad as it can be. The scale was 10 cm in length, as recommended (AHCPR, 1992) (See Appendix D).

NO PAIN 0 1 2 3 4 5 6 7 8 9 10 PAIN AS BAD AS IT COULD BE

Therefore, the higher the score was, the more intense the pain. No standard directions for use of the NRS are available, in terms of whether subjects can select only whole numbers or mark anywhere on the line of the NRS, thereby allowing for decimals. The typical use of the NRS allows only selection of whole numbers with consistency of direction to subjects and consistency of grading being most important (K. Puntillo, personal communication, July 10, 1995).

An algorithm about pain measurement instruments developed by Chapman and Syrjala (1990) identified the NRS as an appropriate instrument to measure brief, acute pain that is self-reported. Kremer, Atkinson, and Ignelzi (1981) described two situations when the NRS is the preferred scale: in the elderly or for subjects with decreased ability to think abstractly, and in situations where there may be questionable compliance by subjects. "The numeric scale requires less cognitive energy and, therefore, is less likely to produce frustration" (Kremer et al.). Puntillo (1994) reported that all critically ill surgical patients in a

study of procedural pain (n=80) were able to respond to the NRS. Downie et al. (1978) also supported the NRS, describing it as providing more choices than an adjective scale and being less abstract than a visual analog scale (VAS). As determined in a pilot study with subjects who had OHS, the anchors must be in bold print and large type for easy reading by the subjects because subjects may not have glasses postoperatively or may have difficulty reading due to the effects of medications or position.

Reliability was addressed by Ekblom and Hansson (1988) using the test-retest method in 30 subjects with chronic pain. In evaluating pain intensity before and after afferent stimulation, using a 95% confidence interval, no significant difference was found for the 0-10 graphic rating scale or for the 0-100 NRS. While reliability for the NRS has not been reported in studies of acute pain, the scale has been found to be brief, simple, more sensitive than verbal descriptor scales, and less confusing than visual analog scales (NINR, 1994).

Support for content validity for the NRS is not described. The only content validity that may be appropriate in the development of an NRS would be a review of the anchors by experts to determine if the appropriate adjectives were used. The NRS anchors utilized in this study were reviewed by three experts for content validity and were found to be appropriate to measure pain.

Concurrent criterion validity is the type of validity most frequently described in the literature. Kremer et al.

(1981) compared the NRS, VAS, and adjective scale. A statistically significant correlation was found between the NRS and VAS (0.86) and between the NRS and adjective scale (0.59). Ekblom and Hansson (1988) found a statistically significant correlation ($p<.05$) between the 0-10 graphic rating scale and the VAS (.95) and between the 0-100 NRS and the VAS (0.94). Finally, Puntillo (1994) used the VAS and NRS in measuring pain associated with endotracheal suctioning (ETS) and CTR. Correlations between the two scales on both of these procedures were found to be strong and significant (ETS, $r=.85$; CTR, $r=.87$; $p<.01$). Validity is accepted for the NRS because the scale reflects a subjective rating and therefore must be valid (Frank-Stromberg, 1992; McGuire, 1984).

Protection of Human Subjects

Institutional consent from the Institutional Review Board of the University of Alabama at Birmingham, as well as the participating hospital, was obtained. In addition, support was obtained from the seven cardiovascular surgeons for their patients to be recruited for the study.

A potential but minimal risk to subjects existed in the form of the level of loudness of the music. Subjects were instructed in the use of the cassette player and how to adjust the volume to a comfortable level. Another possible consideration was the inconvenience of wearing headphones while listening to the music or white noise. One final consideration was the potential for seizure activity related

to listening to music. A rare seizure disorder, these psychomotor seizures are described as reflex epilepsy (Middleton, Attwell, & Walsh, 1981) or musicogenic epilepsy (Niedermeyer, 1983). Subjects were screened during the recruitment process to determine whether they had had any untoward responses to music or sound. It is hypothesized that the person may have an emotional attachment to the music (Middleton et al., Niedermeyer) which is related to the epilepsy. There were no direct costs involved for the participants. Subjects were informed at the time they signed the consent form that they could withdraw from the study at any time, including during the time of CTR.

To maintain confidentiality, names, code numbers, and hospital room numbers of subjects were kept by the investigator in a separate notebook in a locked briefcase. Subjects were identified by a code number on the data collection forms and confidentiality of all information was maintained. Data were reported in an aggregate form only and no information was utilized that would personally identify any subject. If a subject withdrew from the study, the care provided was not altered in any way.

Data Collection Procedure

Potential subjects were approached during their preadmission testing time. The purpose, benefits, and risks of the study were explained to the potential participants through a short video developed by the PI (Appendix E). The video described the study as collecting information related

to the sensation of CTR. Potential subjects were told they may be asked to listen to a tape through headphones. After the video, questions from the potential subjects were answered by the PI or RA. Subjects participating in the study signed the consent form and received a copy. After signing the consent form, subjects were asked to select the type of music they would prefer hearing.

Four RAs were utilized during the study. Two of the RAs were master's prepared nurses with over 10 years of critical care experience. The other two RAs were senior nursing students from a diploma school of nursing. All four Ras participated in the recruitment of subjects. Training of these assistants included review of the methodology, video, consent form, and selection of music preference. After reviewing the above information, the RAs observed the PI recruitting subjects and then recruited potential subjects while being observed. A checklist (Appendix F) was used to assure the recruitment procedure was followed, with a 90% agreement. Utilizing the recruitment protocol, review of using the daily census sheet to identify potential subjects resulted in a 100% agreement. The RAs were observed at the beginning of training and midway through the study.

The two senior nursing students also participated in the intervention protocol. Training for the intervention included review of the information included on the data collection sheet and where the information could be found in the chart, use of the NRS and how to assist subjects with its completion, and the intervention protocol. After obser-

ving the PI at least four times, the RAs implemented the protocol with the assistance of the PI three times and then independently while being observed. Three independent implementations were observed with a checklist completed to assure maintenance of the integrity of the intervention (Appendix G). Midway through the study, observation was again done with the protocol checklist to assure accuracy of the intervention delivery. There is little in the literature about the training of staff in following a protocol or what levels of adherence to the protocol are acceptable (Dunbar-Jacobs, 1994).

On the day of CTR, subjects were randomly assigned to one of the three groups (music intervention, control, or white noise). After assignment, the PI or RA completed the demographic data sheet. Ten minutes prior to chest tube removal, subjects were asked by the PI or RA to complete an NRS indicating the intensity of pain they were experiencing at that time, and blood pressure and heart rate were obtained. For those subjects in the music intervention group or white noise group, earphones were placed on the subjects' ears. The subject then listened to the preselected type of music or the white noise cassette. The 10-min preprocedure time frame was based on the study by Angus and Faux (1989), who played music for subjects 10 min prior to dressing changes. In addition, Eland (as cited in McCaffery, 1990) suggested that distraction be started prior to the onset of pain. Cassette players were approved prior to their initial use by the hospital biomedical department to assure safety

of the equipment (D. Brown, personal communication, June 1996). The arterial pressure line was balanced at this time also, if present. No other changes in the routine procedure for chest tube removal were made. Immediately after CTR and when the dressing was in place (i.e., approximately 5-7 min after the tube was removed), subjects were asked to complete a second NRS indicating the severity of the pain experienced during chest tube removal. Fifteen minutes later, subjects were asked to complete the third NRS indicating the amount of pain currently being experienced. Throughout this process, vital signs were collected via the Hewlett-Packard bedside monitor or DINAMAP™ and recorded every 5 min. If the subject was transferred out of the open heart unit prior to chest tube removal, heart rate and blood pressure were monitored via DINAMAP™. The physician assistant or cardiovascular technician removing the chest tubes was blind to the tape, thereby limiting bias in the study.

Recording of heart rate and blood pressure continued throughout the time the music or white noise tape was playing and concluded when the last NRS was completed. This time frame was based upon a pilot study conducted by the PI in which the intensity of pain associated with chest tube removal was measured at three intervals: before chest tube removal, immediately after, and 15 min later. The 15-min interval was selected because subject vital signs returned to baseline or close to baseline by that point in time. Total time of subject involvement was approximately 35-40 min.

Data Analysis Procedures

Quantitative data were coded and entered into a computer for analysis using the SAS (Statistical Analysis System Version 6.07) package. Frequency distributions and measurements of central tendency were calculated for all appropriate variables. Data analysis for each hypothesis follows:

1. The music treatment group will report less pain during the removal of CTs than the control group or the white noise group. MANOVA was used to determine the difference in pain intensity among the three groups before, during, and after CTR.

2. The music treatment group will have less fluctuation in heart rate, and systolic and diastolic blood pressure than the control group or the white noise group. The differences between the three physiologic variables were determined using MANOVA.

3. The music treatment group will experience a longer time interval from CTR to administered analgesia than the control group or white noise group. Analysis of variance was used to determine differences among the three groups related to administration of analgesia after CTR.

Limitations

1. The study population was derived from one urban hospital setting, thus limiting the generalizability of the results to those who have different characteristics.

2. The study involves only those patients who have had open heart surgery requiring mediastinal or mediastinal and pleural CTs, limiting the generalizability of the study to that population.

3. Although other factors such as education, previous pain experience, meaning of pain, personality, ethnicity, age, gender, and drug regimens may influence a patient's perception of pain, no attempt was made to control these contextual or residual stimuli.

CHAPTER 4

RESULTS

This section summarizes the results of this study. First, the subjects and surgical experiences will be described. Second, results pertaining to the hypotheses will be presented.

Sample

The sampling frame included all eligible subjects at the participating hospital. Two hundred fifty-five persons who were scheduled for OHS were invited to participate in the study with 189 consenting and 66 declining. In addition, several potential subjects were missed due to their being admitted the day of surgery with their preoperative teaching having been done in the recovery area of the cardiac catheterization laboratory or because they had not been informed by their physicians about their need for surgery while the PI or RAs were available.

Of the 66 persons declining participation, reasons for declining were lack of interest or a desire not to receive any more information about their surgery. Of the 189 subjects who consented, 156 remained in the sample, 4 withdrew, and 30 were excluded from the study because of ineligibility. Reasons for ineligibility included surgery canceled (n=3), CTR prior to collection of baseline data (n=11),

subject was confused (n=3), subject was unstable and CT not removed (n=10), equipment failure (n=2), and subject expired (n=1).

The demographic characteristics of the subjects are presented in Table 1. Subjects ranged in age from 42 to 87 years with a mean of 66.35 (SD = 9.7) years. The majority of the subjects were male (69%) Caucasians (97%).

Table 1

Frequencies and Percentages of Demographic Characteristics of Subjects

Characteristics	Number	Percent
Gender		
Male	107	69
Female	49	31
Ethnic background		
Asian/Pacific	1	0.6
Hispanic	1	0.6
White	152	97
Other	2	1
Psychiatric history		
Yes	3	2

The groups were not significantly different in gender, race, or documented history of psychiatric illness.

Surgical Experience

The majority of subjects had coronary artery bypass grafting done (CABG), while some had valve replacement surgery and others had both CABG and valve replacement.

The demographic characteristics by group are summarized in Table 2.

Table 2

Frequencies and Percentages of Demographic Characteristics by Group

Characteristics	Control n = 50	Noise n = 36	Music n = 70
Gender			
Male	32 (64%)	22 (61%)	53 (76%)
Female	18 (36%)	14 (39%)	17 (24%)
Ethnic group			
Asian/Pacific Is			1 (1%)
Hispanic			1 (1%)
White	50 (100%)	36 (100%)	66 (94%)
Other			2 (3%)
Psychiatric history	1 (2%)	1 (3%)	1 (1%)

Table 3 describes the surgical experiences of the sample. All of the subjects had mediastinal CTs in place; in addition, 80% had one pleural CT, while 20% had two. Ninety-four percent of the subjects had both a straight and a right

Table 3

Frequencies and Percentages of Surgical Experiences

Experiences	Number	Percent
Procedure		
CABG	126	81
Valve	14	9
Both	15	9
Other	1	0.6
Number of bypasses		
1	3	2
2	17	12
3	40	29
4	42	30
5	29	21
6-8	9	6
Type of mediastinal CT		
Straight	8	5
Right angle	2	1
Both	146	94
Type of pleural CT		
Straight	7	6
Right angle	116	94
Number of chest tubes		
2	32	21
3	116	74
4	8	5

angle mediastinal CT. Of those subjects who had pleural CTs, 94% had right angle CTs in place.

Table 4 describes the surgical experience by subject group. The groups were not significantly different in the

Table 4

Frequencies and Percentages of Surgical Experience By Group

Experiences	Control n = 50	Noise n = 36	Music n = 70
Procedure			
CABG	41 (82%)	27 (75%)	58 (83%)
Valve	4 (8%)	3 (8%)	7 (10%)
Both	5 (10%)	6 (17%)	4 (6%)
Other			1 (1%)
Number of bypasses			
1	1 (2%)		2 (3%)
2	4 (9%)	6 (18%)	7 (11%)
3	16 (36%)	12 (36%)	12 (19%)
4	12 (27%)	9 (27%)	21 (34%)
5	9 (20%)	6 (18%)	14 (23%)
6-8	3 (6%)		6 (10%)
Number of chest tubes			
2	9 (18%)	9 (25%)	14 (20%)
3	39 (78%)	23 (64%)	54 (77%)
4	2 (4%)	4 (11%)	2 (3%)

Table 4 (continued)

Experiences	Control n = 50	Noise n = 36	Music n = 70
Type of mediastinal CT			
Straight	5 (10%)	2 (6%)	1 (1%)
Right Angle	1 (2%)		1 (1%)
Both	44 (88%)	34 (94%)	68 (97%)
Type of pleural CT			
Straight	2 (5%)	2 (8%)	3 (5%)
Right Angle	39 (95%)	24 (92%)	53 (95%)
Chest tube removal			
Together	25 (50%)	17 (47%)	38 (54%)
Separate	25 (50%)	19 (53%)	32 (46%)

type of cardiac surgical procedure, number of bypass grafts done, number and type of CTs, or whether the CTs were removed together or separately. At the time of CTR two methods of removing tubes were utilized: Either the pleural and mediastinal CTs were removed together, or the mediastinal CTs were removed together and the pleural CT was removed separately.

Analgesia administration

Table 5 describes the various types of analgesia administered to subjects from the time the subject entered the intensive care unit until CTR.

Table 6 describes the frequencies and percentages of the various types of analgesia administered from admission into the intensive care unit to CTR by group. Most subjects received a combination of analgesics for pain control post-operatively, with morphine sulphate (97% of subjects) and Tylenol #3 (51% of subjects) being the drugs most frequently

Table 5

Frequencies and Percentages of Analgesia Administered

Drug	Number receiving	Percent
Morphine sulfate	152	97
Meperidine (Demerol)	9	6
Ketorolac (Toradol)	37	24
Tylenol #3 Acetaminophen 325mg Codeine 30 mg	80	51
Codeine	6	4

administered. Although a few subjects received meperidine for pain control postoperatively due to morphine allergy, several received meperidine to control postoperative shivering. The meperidine given for shivering was included in

the analgesic administration. For those subjects who had morphine sulfate patient controlled analgesia (PCA) pumps, the total amount of morphine received from the pump was included in the analgesic administration.

Table 6

Frequencies and Percentages of Analgesia Administered by Group

Drug	Control n = 50	Noise n = 36	Music n = 70
Morphine sulfate	48 (96%)	36 (100%)	68 (97%)
Meperidine (Demerol)	3 (6%)	4 (11%)	2 (3%)
Ketorolac (Toradol)	14 (28%)	5 (14%)	18 (25%)
Tylenol #3	27 (54%)	20 (56%)	33 (47%)
Codeine	3 (6%)		3 (4%)

Some of these totals are estimations because the documentation system used in the institution made it difficult to determine exactly when the PCA pumps were discontinued. There was no significant difference among the three groups in relation to analgesia administration.

Table 7 identifies the last medication subjects received prior to CTR. Midazolam (Versed) prior to CTR is routinely prescribed by one of the surgeons and is therefore included in this table. The predominant medications admin-

istered prior to CTR were morphine sulfate (40%) and Tylenol #3 (32%). The mean time interval from last medication prior to CTR was 321 min (SD = 343 min), with the minimum time interval 5 min and the maximum 2,340 min.

Table 7

Frequencies and Percentages of Medications Prior to Chest Tube Removal

Drug	Number Receiving	Percent
Morphine sulfate	63	40
Meperidine	2	1
Ketorolac	13	8
Tylenol #3	50	32
Midazolam	19	12
Codeine	6	4

The frequencies and percentages of the last medication administered to subjects by group prior to CTR are described in Table 8. Administration of Midazolam was equally distributed through the three groups.

Subjects chose the type of music they enjoyed listening to from a selection of 10 different prerecorded styles. Two subjects requested polka music, which was not available, but the subjects were able to select a satisfactory alternative. One subject planned to supply his own music, but the music made from the 10 available styles. Table 9 describes the frequencies and percentages of music styles selected by subjects.

Table 8

Frequencies and Percentages of Medication Prior to Chest Tube Removal by Group

Drug	Control n = 50	Noise n = 30	Music n = 76
Morphine sulfate	18 (36%)	13 (36%)	32 (46%)
Meperidine	1 (2%)		1 (1%)
Ketorolac	6 (12%)		7 (10%)
Tylenol #3	15 (30%)	18 (50%)	17 (24%)
Midazolam	7 (14%)	3 (14%))	8 (15%)
Codeine	3 (6%)		3 (4%)

Table 9

Frequencies and Percentages of Music Selected

Music	Frequency	Percent
Big Band	16	10
Blues	4	3
Classical	31	20
Country/Western	39	25
Easy Listening	38	24
Gospel	11	7
Movie Musicals	5	3
New Age	8	5
Patriotic	2	1
Rock	2	1

Table 10 describes the frequencies and percentages of music style selected by group. There were no significant

differences between the three groups in terms of musical preferences. The most commonly selected types of music for all three groups were classical, country/western, and easy listening.

Table 10

Frequencies and Percentages of Music Selected by Group

Music	Control n = 50	Noise n = 36	Music n = 70
Big Band	6 (12%)	2 (6%)	8 (11%)
Blues	3 (6%)	0	1 (1%)
Classical	11 (22%)	9 (25%)	11 (16%)
Country/ Western	6 (12%)	9 (25%)	24 (34%)
Easy Listening	17 (34%)	9 (25%)	12 (17%)
Gospel	3 (6%)	2 (6%)	6 (7%)
Movie Musicals	2 (4%)	1 (3%)	2 (3%)
New Age	1 (2%)	2 (6%)	5 (7%)
Patriotic		1 (3%)	1 (1%)
Rock	1 (2%)	1 (3%)	

Testing of Hypotheses

Hypothesis 1

The music treatment group will report less pain associated with the removal of chest tubes after open heart surgery than the control group or the white noise group.

Results. MANOVA and descriptive statistics were used to evaluate this hypothesis. Two dependent variables were examined: the difference between NRS 2 (pain intensity reported immediately after CTR) and NRS 1 (pain intensity reported pretreatment) and the difference between NRS 3 (pain intensity reported 15 minutes after CTR) and NRS 2 (pain intensity reported immediately after CTR). There was no significant difference among the three groups for the first pain intensity score differences (NRS 2-NRS 1) tested (F (2,145)=0.77, p =.47). There was also no significant difference among the three groups for the second pain intensity score differences (NRS 3-NRS 2) tested (F (2,145) =0.44, p=.64). A p value of .74 resulted when testing the multivariate hypothesis of no overall group effect using Wilks' Lambda as the test statistic. Eight subjects had missing variables and were not included in the analysis. Data were missing due to the effect of Versed and the subjects' being unable to respond to all three NRSs. Table 11 shows the mean pain intensity scores and standard deviations by group.

Although no significant difference was found, the reported pain intensity score 15 min after CTR in the music group was slightly lower (2.07) compared to the control group (2.22) and the white noise group (2.22). A wide variation can be seen in the range of pain intensity reported for all three groups; some subjects in each group reported no pain before, during, or after CTR, while others reported

intense pain, rating it as the worst pain they could imagine.

Despite lack of a statistical significance in perceived intensity of pain, many subjects in the music group reported that they enjoyed listening to the music and found it relaxing or distracting. Two subjects did report they found the

Table 11

Pain Intensity Prior to and After CTR

Pain intensity	Control	Noise	Music
NRS 1			
M	2.59	3.02	2.48
SD	2.79	2.91	2.78
Range	0-9	0-9	0-10
NRS 2			
M	5.43	5.58	5.86
SD	2.63	2.97	2.78
Range	0-10	0-10	0-10
NRS 3			
M	2.22	2.22	2.07
SD	2.29	2.07	2.36
Range	0-8	0-7	0-9

music annoying and of no help and one subject reported the music was not distracting enough. Of those subjects who heard the white noise tape, most commented that it was comfortable to listen to and only 2 did not like listening to the sound.

Hypothesis 2

The music treatment group will have less change in heart rate and blood pressure than the control group or the white noise group.

Results. MANOVA and descriptive statistics were used to evaluate this hypothesis. A total of 21 variables were recorded for each subject--heart rate, systolic blood pressure, and diastolic blood pressure for seven 5 min intervals (baseline; 5 min later and 10 min later; immediately after CTR; 5, 10, and 15 min after CTR). The seven sets of data were then used to form six dependent variable differences, with the baseline data being subtracted from each variable to produce a difference.

For the variable heart rate (n=138), there was no significant difference found among any of the six dependent variables (D1 p=.49, D2 p=.79, D3 p=.31, D4 p=.63, D5 p=.54, D6 p=.23). A p value of .56 resulted when testing the MANOVA hypothesis of no overall group effect using Wilks's lambda as the test statistic. There were 18 subjects who had missing data and were not included in the analysis. Reasons for missing data include equipment failure and inability to obtain equipment in time for CTR.

The variable systolic blood pressure (n=135) showed a significant difference in systolic blood pressure for the first dependent variable (the difference between the baseline and first systolic reading 5 min after the baseline) F (2,132)=3.95, p=.02. Post hoc Tukey's Studentized Range

indicates this difference was between those subjects in the white noise group and those in the control group. No other dependent variable differences were significant for systolic blood pressure (D2 p=.24, D3 p=.35, D4 p=.77, D5 p=.98, D6 p=.34). A p value of .45 resulted when testing the MANOVA hypothesis of no overall group effect using Wilks's lambda as the test statistic.

The final variable measured was diastolic blood pressure (n=135). The first three variable differences showed no significant differences among the groups (D1 p=.20, D2 p=.20, D3 p=.10). A significant difference was found, however, for the last three variable differences. D4 (diastolic blood pressure 5 min after CTR minus baseline) revealed F (2,132)=3.21, p=.04. D5 (diastolic blood pressure 10 min after CTR minus baseline) revealed F (2,132)=3.62, p=.03. D6 (diastolic blood pressure 15 min after CTR minus baseline) revealed F (2,132)=3.09, p=.048. Post hoc Tukey's Studentized Range indicates these significant differences were between the white noise group and the control group. A p value of .62 resulted when testing the MANOVA hypothesis of no overall group effect using Wilks's lambda as the test statistic.

Hypothesis 3

The music treatment group will experience a longer time interval from chest tube removal to administration of analgesia than the control group or the white noise group.

Results. ANOVA and descriptive statistics were employed to analyze this hypothesis. No significant difference was found among the three groups (n=121) for length of time from CTR to administration of next analgesia F (2, 118)=0.04, p=.96. Thirty-five observations were missing because these subjects had a time interval of greater than 24 hr from CTR with no analgesia being administered. The mean length of time from CTR to next dose of analgesia was 354 min (5.9 hr) with SD = 309 min. The minimum time was 5 min and the maximum time from CTR to next analgesic dose was 1,405 min (23.2 hr). Times greater than 24 hr were not documented. However, the mean time from CTR to next dose of analgesia was longer for the music group (361.8 min) compared to the white noise group (353.8 min) and the control group (343.9 min).

Additional Findings

Factors Influencing Pain

Gender. Gender is a contextual stimulus, part of a person's internal environment, and may therefore have an effect on the way a person responds to pain. The mean difference between NRS 2 and NRS 1 for men was 3.3 (SD 3.3), while the mean difference for the same two scales for women was 2.6 (SD 3.44) In addition, the mean difference between NRS 2 and NRS 3 for men was 3.82 (SD 3.02), while for women the mean difference was 2.83 (SD 2.62). Although there were differences in the means for gender, the differences were not statistically significant. Using ANOVA, difference 1

(NRS 2 - NRS 1) resulted in *F* (1, 147)=1.44, *p*=.23. Difference 2 (NRS 3 - NRS 2) resulted in *F* (1, 147)=3.70, *p*=.057, which is approaching significance.

Body Mass Index. Body mass index (weight[kg]/ height$[m]^2$)(BMI) is also a contextual stimulus, part of a person's internal environment, and may therefore have an effect on the way a person responds to pain. As an estimate of total body mass, BMI shows the highest correlation with actual body fat. Body mass index is classified as follows: <20, underweight; 20-25, normal weight for height; 25-30, overweight; and >30, obese (Davis & Sherer, 1994). Table 12 shows the mean pain intensity scores and standard deviations by BMI.

The reported mean pain intensity scores were lowest for those subjects with the smallest BMI and increased as BMI increased for NRS 1, pain intensity prior to CTR. Immediately after CTR, however, mean reported pain intensity scores were highest for those subjects who were underweight or normal weight, while those overweight subjects reported lower mean pain intensity scores. Using ANOVA there was no statistically significant difference for reported pain intensity scores based on BMI. NRS 1, *F* (3, 152)=1.74, *p*=.16; NRS 2 *F* (3, 147)=1.35; *p*=.26; NRS 3 *F* (3, 151)=1.20, *p*=.31. In addition, ANCOVA revealed no statistically significant difference in reported pain intensity for the original three groups (music, white noise, control) after adjusting for BMI (NRS 1, *F* (3,150)=.44, *p*=.64; NRS 2, *F* (3, 145)=.56, *p* =.57; NRS 3, *F* (3, 149)=.19, *p*=.83).

Table 12

Pain Intensity Scores by BMI

Pain intensity	BMI <20 n=5	BMI 20-25 n=32	BMI >25 n=63	BMI >30 n=54
NRS 1				
M	1.00	2.69	2.35	3.19
SD	1.15	3.13	2.63	2.86
Range	0-3	0-9	0-9	0-10
NRS 2				
M	6.14	6.39	5.21	5.71
SD	3.58	2.74	2.64	2.79
Range	1-10	0-10	0-10	0-10
NRS 3				
M	2.86	1.72	2.05	2.57
SD	2.97	1.89	2.42	2.29
Range	0-9	0-6	0-8	0-9

Age. Age is another contextual stimulus which may alter the way a person responds to pain. Using ANOVA, there was no statistically significant difference for mean differences in reported pain intensity (difference 1, F (4, 144)=2.10, p=.08; difference 2, F (4, 144)=1.13, p=.35). Of interest, however, was the age group 80-89 years (n=10), whose mean pain differences were higher than any of the other age groups (M=4.4, SD=3.13 for difference 1; M=-5.0, SD=3.16 for difference 2). The subjects in the youngest age group, 40-49 years (n=9), had the lowest mean differences in reported

pain intensity (M=.33, SD=2.73 for difference 1; M=-2.33, SD=3.35 for difference 2). In addition, a factorial model was created with all of the contextual variables included; no statistically significant findings were obtained.

Analgesia. The use of analgesia may alter a person's response to a painful stimulus. The effect of analgesia was examined by MANOVA. Those subjects who received analgesia within 4 hr of CTR (n=83) were compared by group for differences in the NRS. There was no significant difference for difference 1 (NRS 2 - NRS 1; F (2,80)=1.31, p=.28) or for difference 2 (NRS 3 - NRS 2; F (2,80)=1.80, p=.17). A p value of .40 resulted when testing the MANOVA hypothesis of no overall group effect using Wilks's lambda as the test statistic.

MANOVA was also utilized to examine the effect of analgesia within 4 hr of CTR on heart rate and on systolic and diastolic blood pressure. No statistically significant effects were found for any of the physiologic variables. For the hypothesis of no overall group effect for heart rate, the Wilks's lambda test statistic was used and resulted in p=.59. For the hypothesis of no overall group effect for systolic blood pressure, Wilks's lambda was used as the test statistic and resulted in p=.62. Least squares means resulted in p=.03, indicating a statistically significant difference in systolic blood pressure between the control and noise groups. This is the same finding from Hypothesis 2, in which analgesia was not considered. The effect of

analgesia within 4 hr of CTR and diastolic blood pressure resulted in $p=.30$ for the multivariate null hypothesis using Wilks's lambda as the test statistic. Similar to the diastolic results reported previously, least squares means resulted in a statistically significant finding for the difference between the control group and white noise group (D4 $p=.005$, D5 $p=.009$, D6 $p=.01$) and between the control group and music group (D4 $p=.02$, D5 $p=.02$, D6 $p=.03$) for the last three physiologic measurements, respectively.

CHAPTER 5

DISCUSSION, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

An experimental design was used to examine the intensity of pain associated with chest tube removal after open heart surgery from the perspective of Roy's adaptation model and the gate control theory of pain. One hundred fifty-six subjects were randomly assigned to one of three groups: music, white noise, or control. The style of music was preselected by the subjects and both the music and the white noise were prerecorded. Utilizing a 0-10 numeric rating scale, pain intensity was measured prior to, immediately after, and 15 min after CTR. The subjects' physiologic response to pain was measured by monitoring heart rate and systolic and diastolic blood pressure. The effect of the music also was examined by recording the time of the first administered analgesic after CTR for the first 24-hr period. Data from this study were analyzed using descriptive statistics, ANOVA, and MANOVA. In this chapter, findings are discussed and conclusions are presented. This discussion is followed by implications for theory, nursing research, practice, and education.

Discussion of Findings

Music and Pain

This study found no significant difference among the three groups for the first pain intensity score differences (pain intensity score immediately after CTR and baseline score). There was also no significant difference among the three groups for the second pain intensity score differences (pain intensity score 15 min after CTR and the score immediately after CTR). Although no significant difference in the NRS scores was found, at the end of the intervention the mean NRS for those subjects in the music group was lower than for those in the control or white noise group. Cognitive-behavioral techniques such as music can be effective in reducing the perception of pain. However, findings from this study indicate that music was not statistically significant in decreasing self-reported pain intensity during CTR.

The findings of the present study support those who found that music did not reduce self-reported pain (Barker, 1991; Good, 1995; Heitz et al., 1992; Mandle et al., 1990; Zimmerman et al., 1996). The studies by Barker and Mandle et al. involved procedural pain, whereas the studies by Heitz et al. and Zimmmerman et al. focused on postoperative pain. In addition, the study by Good focused on pain associated with postoperative ambulation. One consideration in the study by Heitz et al. is the fact that these subjects were in a recovery area after surgery and anesthesia may have influenced the subjects' responses.

In contrast to the findings of this study, others who studied the effect of music on pain (Angus & Faux, 1989; Locsin, 1981; Menegazzi et al., 1991; Mullooly et al., 1988) did find a decrease in reported pain intensity. This difference may be related to the type of music employed. Angus and Faux used music described as having a moderate tempo with a calm or happy quality with subjects only having a choice of two styles of music. Perhaps the tempo or style of music has a greater impact on the subject's perception of the music and response to pain than music that meets the subject's preference. Menegazzi et al., however, did provide music that subjects self-selected. Both of these previous studies used music during pain related to a procedure with the music being used only one time. In contrast, music used as the intervention in the studies by Locsin and Mullooly et al. was utilized over a period of 48 hr and focused on postoperative pain rather than pain related to a specific procedure. The cumulative effect of music as evidenced by repeated intervention (Locsin played music every 2 hr for the first 2 postoperative days; Mullooly et al. played music once a day for the first 2 postoperative days) may be another factor to consider when using music as an intervention for pain. The idea of a better response to music with repetition is also supported by Guzzetta (1989), although the variable studied by Guzzetta was anxiety.

A variety of methodological issues arise when reviewing the effects of music on pain from other investigators. Although all of these studies had the same focus, the

differences in methodology make comparisons among the studies difficult. Diversity in the type of music used in previous studies included no music choice to a choice from 50 tapes. Most of the music utilized was instrumental, but others either included vocal selections (Barker, 1991) or did not specify the type of music (Locsin, 1981; Menegazzi et al., 1991). The music that was used was described as soothing (Zimmerman et al., 1996) or sedative (Good, 1995) with the most recurring styles being classical or contemporary (Angus & Faux, 1989; Mandle et al., 1990; Heitz et al., 1992; Updike, 1990) or easy listening (Mullooly et al., 1988).

Another methodological concern is related to comparing procedural pain and postoperative pain. There may be a difference between the intensity or perception of pain associated with a procedure and that of the anticipated pain of recovery after surgery. Pain perception is altered by internal and external environmental factors and contextual stimuli such as culture, family, and developmental level (Roy & Andrews, 1991). Those investigators who utilized music to examine its effect on postoperative pain and reported positive effects (Locsin, 1981; Mullooly et al.,1988) provided the music intervention lasting for various periods of time and recurring at different time intervals. Locsin provided music for 30 min initially and then for 10 min every 2 hr for the first 2 postoperative days, whereas Mullooly et al. played a 10-min tape one time on each of the first 2 postoperative days. Studies in which music had a positive effect

on procedural pain also utilized varying lengths of listening time. Angus and Faux (1989) began the music 10 min prior to the start of the procedure, whereas Menegazzi et al. (1991) began the music with the onset of the procedure. In these studies, length of time required to complete the procedures likely varied depending on the size of the wound to be packed (Angus & Faux) or the size of the laceration to be repaired or the quickness of the physician doing the repair (Menegazzi et al.). The length of time the subjects listened to the music may have influenced their responses.

In addition, the studies in which music had no effect on reported pain intensity share the same methodologic issues discussed above. Listening time varied with the time required to complete the procedure (Barker, 1991; Good, 1995; Mandle et al., 1990), the length of stay in the recovery room (Heitz et al., 1992), and postoperative repetition of 30 min of music on the first 2 postoperative days (Zimmerman et al., 1996).

In the present study length of time for the procedure was controlled since CTR is a short procedure with a variation of about 5 min depending on the physician assistant removing the chest tubes. The total time for the intervention in the study was 35-40 min. The music or comparison white noise was started 10 min prior to CTR and continued for 15 min after CTR.

One other methodological issue that must be discussed is instrumentation. Although three investigators (Angus & Faux, 1989; Mandle et al., 1990; Zimmerman et al., 1996)

used the McGill Pain Questionnaire (MPQ) to assess pain, not all of the subscales were used in each study, making comparisons of perceived pain intensity more difficult. Other investigators (Barker, 1991; Locsin, 1981; Menegazzi et al., 1991) utilized instruments for which no psychometric information was provided. Another concern in the measurement of pain is the time required to complete the instrument. The MPQ requires approximately 20 min to complete. For those postoperative or postprocedural subjects who are having pain or are fatigued from their procedures, completion of a 20-min questionnaire may be difficult and may influence their responses. The final issue regarding instrumentation is the time when pain was measured. Although some investigators measured pain before and after the intervention (Good, 1995; Mullooly et al., 1988; Zimmerman et al., 1996), others (Locsin, 1981; Mandle et al., 1990; Menegazzi et al., 1991) measured pain only after the procedure or intervention, thereby losing baseline data of the subject's pain status prior to the study.

In the present study, pain was measured using the NRS, which took only a few seconds to complete. In addition, pain was measured before, immediately after, and 15 min after CTR, allowing subjects to serve as their own controls.

Despite the lack of significant findings in the present study for reported pain intensity when listening to music during CTR, a majority of the subjects reported that they enjoyed listening to the music and that it did distract them or help them to relax during CTR.

Music and Physiologic Variables

This study found there was no significant difference among the three groups for three physiologic variables measured--heart rate and systolic and diastolic blood pressure. Of the six systolic blood pressure readings, the difference between the first and second was found to be significant for the white noise group in comparison to the control group. In addition, the last three diastolic blood pressure differences were also found to be significant for the white noise group in comparison to the control group. Although these findings were statistically significant, they are not clinically meaningful. Another consideration related to the significant findings in the one systolic difference and the three diastolic differences is the use of multiple statistical tests and the probability of spurious results (Stevens, 1992) or probability pyramiding (Huberty & Morris, 1989). Because multiple tests were done on the same data, the overall alpha level of .05 could not be controlled and the probability of a false rejection (Type I error) increased. The use of the Bonferroni inequality with these repeated sets of data would have provided control for the overall alpha level. Although these findings were statistically significant, they were not meaningful clinically.

In the present study, physiological responses were measured every 5 min, beginning 10 min prior to CTR and ending 15 min after CTR, to track physiologic trends. Additionally, automatic equipment was utilized to decrease

human measurement error, and validity and reliability of the instruments were established.

Studies measuring changes in physiologic responses as indexes of anxiety to a music intervention revealed inconsistent findings. Bonny (1983) found significant decreases in heart rate but not in blood pressure; White (1992) found significant decreases for heart rate and respiratory rate; Guzzetta (1989) found a significant decrease in heart rate over a period of time; Steelman (1990) found significant differences for systolic and diastolic blood pressure; and Updike (1990) found significant decreases for systolic blood pressure, mean arterial pressure, and double product index but not for systolic blood pressure or heart rate. Although Davis-Rollans and Cunningham (1987) found statistically significant differences in heart rate between the music and control periods, the differences were described as not being clinically significant. In addition, there was no significant effect on respiratory rate. In contrast, Zimmerman et al. (1988) found no significant differences in heart rate or in systolic or diastolic blood pressure.

Only one research report was found in which music intervention was used to alter pain and physiologic responses were measured. Locsin (1981) found a significant decrease in blood pressure and heart rate after 48 hr.

The majority of studies in which music was used as an intervention for pain, however (Angus & Faux, 1989; Barker, 1991; Heitz et al., 1992; Mandle et al., 1990; Menegazzi et al., 1991), report no significant difference in vital signs

(heart rate, blood pressure, and/or respiratory rate), supporting the findings of the present study. As can be seen, study results have been conflicting, and even studies with significant results in one physiologic response may have had nonsignificant results in other physiologic parameters.

Again, methodologic issues related to physiologic measures must be addressed. Although most of the studies in which physiologic responses were measured included heart rate and blood pressure, instrumentation issues regarding validity and reliability of equipment were not discussed. Frequency of measuring physiologic responses also varied, although most investigators identified a pre- and post-measurement; additional measures varied from every 15 min (Heitz et al., 1992) to not being identified (Locsin, 1981; Mandle et al., 1990). Other considerations that may help to explain the inconsistencies in physiologic findings are the musical selections available to the subjects; design, such as whether there was a control group; the length of the music intervention itself; and the clinical populations studied (intensive care, coronary care, intraoperative, postoperative).

Another consideration related to the effect of music on physiologic responses is the possibility of idiosyncratic physiologic responses of subjects (Davis & Thaut, 1989). In a study of 18 subjects in which only self-selected music was utilized to induce relaxation, an increase in physiologic responses was found, although the subjects indicated having a reduction in anxiety. Research reported by DeJong, van

Mourik, and Schellekens (1973) indicated an increase in heart rate when listening to music that was considered pleasant. Perhaps the measurement of physiologic variables is not the best method for assessing pain relief when music is used as an intervention. Subjects who enjoy the music may reflect this through an increase in the physiologic measurements rather than the anticipated decrease. In addition, McCaffery (1992) describes lack of clinical evidence to support the assumption that increased pain is accompanied by changes in physiologic responses. Although it is anticipated that physiologic responses will decrease when patients listen to music, stimulation of the sympathetic nervous system in response to the focal stimulus of CTR may have a stronger effect than the music does and therefore may prevent adaptation from occurring.

A final consideration is the population of subjects selected for the study. Because these subjects have all had OHS, they have a documented history of cardiac disease and are therefore receiving a variety of drugs that may alter their physiologic responses compared to subjects who are not receiving cardiac drugs. These drugs include cardiotonics, antiarrhythmics, antianginal agents, antihypertensives, and vasopressors.

Music and Analgesia Administration

The effect of music in prolonging the time interval from analgesia after the intervention has also been explored. The current study found no significant difference

among the three groups (n=121) for length of time from CTR to administration of next analgesia. Again, the results of published research are conflicting. Heitz et al. (1992) found a significant increase in the time from the music intervention to the next analgesia administration. In contrast, studies by Good (1995) and Locsin (1981) found no change in the requirement for analgesia after the music intervention. Mandle et al. (1990) found analgesia administration during a procedure (femoral angiography) was not decreased with music. This finding of no significant effect on the next dose of analgesia is also supported by the present study. Although the difference between the three groups in the present study was not significant, the music group did have a longer mean period of time from the intervention to the next administration of analgesia than the control and white noise groups (361.8 min, 343.9 min, and 353.8 min, respectively).

The inconsistencies found among these studies again may be related to methodologic issues. The subjects in the study by Heitz et al. (1992) listened to music continuously in the PACU and were also under the influence of anesthesia. In the study by Good (1995), the music intervention occurred only once, during walking, and the amount of analgesia administered was measured over the following 24 hr. However, the time when the subjects first ambulated varied based on physician preference. Finally, in the study by Locsin (1981), in which the music was repeated every 2 hr for the first 2 postoperative days, it is unclear whether the music was

played only while the subject was awake and within what time frame analgesia use was measured.

During recruitment, all participants were told their pain medication would be available to them and they were encouraged to use it when needed. These instructions may have contributed to the findings of no significant difference between groups in analgesia administration after CTR.

The current study attempted to overcome some of the methodologic issues discussed above by maintaining consistency in the surgical procedure, in the timing of when the intervention was completed (all but 2 subjects had their CTs removed the 2nd postoperative day), and in the duration of the intervention.

Factors Influencing Pain

Age. Using ANOVA, no statistically significant difference was found for self-reported pain intensity by age. Findings from the present study support similar research reporting no significant difference in pain intensity based on age (Evans et al., 1992; Harkins et al., 1996; Kenshalo, 1986; Smith, 1997). Of interest, however, was the reported pain intensity of the age group of 80-89 years (n=10), whose mean pain difference was higher than any of the other age groups. In addition, the subjects in the youngest age group, 40-49 years (n=9), had the lowest mean differences in reported pain intensity. Although this finding was not significant, the noted trend is different from other research (Jensen et al., 1992; Lasch et al., 1997;

Tucker et al., 1989) in which pain threshold was found to increase with age. At issue here are whether there is a difference between the perception of experimental pain and clinical pain and, therefore, whether a difference in response to those two types of pain occurs based on age.

Gender. Using ANOVA, the two mean differences for the NRSs were determined for gender. The mean difference between self-reported pain intensity for women between NRS 2 and NRS 1 was 2.6, while the mean difference between NRS 3 and NRS 2 was 2.83. In contrast, the mean differences for men were 3.3 and 3.82, respectively. These findings indicate that women had less change in reported pain intensity between baseline pain and pain after CTR then men. In addition, women had less change in reported pain between pain after CTR and the end of the intervention 15 min later. Although there were differences in the means for gender, the differences were not statistically significant. The results of this study support those of others (Ellermeier & Westphal, 1995; Lander et al., 1989; Puntillo, 1994; Thomas & Rose, 1991) in which no difference was found between the perception of pain based on gender. The trend, however, of women having less change in reported pain intensity than men is contrary to other findings in which women had lower pain thresholds (Nguyen et al., 1995) and men had a greater tolerance of pain (Fillingham & Maixner, 1996; Woodrow et al., 1972). The same issue discussed above when considering age must be considered with gender differences in pain (i.e.,

whether there is a difference in perception and therefore response to experimental and clinical pain).

Body Mass Index. The relationship of body mass index to reported pain intensity was examined. Although no significant difference was found, the reported mean pain intensity for NRS 1, prior to CTR, was lowest for those subjects whose BMI was less than 20 (n=5, M=1.0) and highest for those whose BMI was greater than 30 (n=54, M=3.18). In addition, the trend for reported mean pain intensity for NRS 2, immediately after CTR, indicated a decrease in pain intensity with increasing BMI (BMI less than 20, M=6.14; BMI 20-25, M=6.38; BMI 25-30, M=5.20; BMI greater than 30, M=5.71). This finding is of interest since in a recent study by Smith (1997), subjects who had abdominal surgery and a higher BMI tended to report greater pain than those subjects with average BMIs. Although no published research was found on the relationship of BMI to pain intensity of CTR, perhaps those subjects with a greater body mass experience less pain with CTR than those subjects with less body mass. From the experiential point of view, two physician assistants who participated in CTR also described subjects who were thinner as having more pain with CTR (personal communication, D. Grazio, G. Walton June, 1996). Of interest, also, is the fact that 117 subjects fell into the obese category based on BMI, with obesity being a risk factor for coronary artery disease.

Ethnicity. Other researchers have identified ethnicity as a factor that alters the pain experience of a person. Because of the homogeneity of the subjects in this group, ethnicity was not considered a variable in relation to self-reported pain intensity.

Design Sensitivity and Strength

The success of intervention research is increased by maintaining the strength and integrity of the study. Numerous factors have been identified as contributing to the success of intervention research, including strength, integrity, effectiveness of the treatment, and sensitivity of instruments (Lipsey, 1990; Scott & Sechrest, 1989; Stewart & Archbold, 1993, Yeaton & Sechrest, 1981).

Scott and Sechrest (1989) identify 10 factors to be considered in developing and maintaining the strength of a treatment. For an intervention to be strong it must be theoretically based and pure. In the present study, the conceptual framework describes the connection of the intervention with the Roy adaptation model and gate control theory. It was anticipated that the physiologic changes of the regulator system, described by Roy and Andrews (1991) as the automatic responses of the body, would result in adaptation to the painful stimulus of CTR when the music intervention was utilized, stimulating the cognator subsystem. In addition, the gating mechanism described by Melzack and Wall (1965) indicated that the transmission of noxious stimuli to the central nervous system could be modulated by stimulating

descending spinal tracts by psychologic factors such as the pleasant effect of music. Although based on these two theories, the current study did not support these two theories. Possible reasons for lack of theoretical support include lack of time for adaptation to occur since CTR is a short procedure, the acute pain of CTR was too strong for the intervention, or the music intervention did not stimulate the cognator subsystem or descending spinal tracts to allow adaptation of the painful stimulus. The second factor to be considered in maintaining treatment strength is specificity or whether the intervention is relevant to the problem. Again, from the conceptual framework, the music intervention was relevant to the problem of pain.

Adequate dose is the third criterion that contributes to treatment strength. In the present study, the dose or amount of intervention was applied for a period of 35-40 min. The dose selected certainly could have an effect on the strength of the treatment. The appropriate time to start the treatment (i.e., prior to CTR) was determined from one previous study (Angus & Faux, 1989). It is unknown whether this was the best time frame or whether the intervention should have been started earlier (e.g., 20 or 30 min prior to CTR) or not started until the procedure itself started. There is no published research that has investigated the appropriate time interval to begin music prior to a painful experience or how long the music should last after the procedure or painful situation. Inadequate dose of the intervention maybe a weakness of this study. Perhaps training the subjects in

the intervention prior to CTR would improve the strength of future studies.

Intensity or frequency schedule of the intervention is the fourth criterion related to treatment strength. In the present study, frequency was limited by the focus of the study. Since CTR occurred only one time, the intervention occurred only once, making this a potential weakness of the study. Perhaps for the intervention to be effective, it must be repeated.

Duration of the intervention is the fifth criterion to consider. Duration was also limited in the present study and feasibly could only last as long as the procedure itself lasted. Again, the question of appropriate time to begin and end the intervention may be a weakness in the study and also relates to the issue of dosing.

The characteristics of the intervener play a significant role in the strength of the intervention. In the present study, the two research assistants who implemented the intervention were senior nursing students from a diploma school of nursing. Although their research background was limited, as were their critical care experience and therefore their comfort levels in the intensive care units, they were highly motivated. They received at least four training sessions in which they observed the intervention; then, they implemented the protocol at least three times while being observed before they implemented the protocol unobserved. The motivation and training of the RAs were a strength of the intervention.

The seventh criterion is the development of a formal protocol for the intervention, which was clearly done in this study. A step-by-step guide was developed which delineated each step in the intervention.

Characteristics of the research problem are identified as the eighth criterion that can help to strengthen an intervention. There are three aspects of this criterion. First is understanding the problem as it is identified in the OHS population and how the treatment would operate in this particular population. This problem identification was done through the conceptual framework. Pain with CTR is a problem after OHS and the treatment was planned to help decrease the pain experienced by the subjects. Next was the identification of the seriousness of the problem of pain associated with CTR. As noted previously, approximately 537,000 people underwent OHS in 1992 and therefore underwent CTR and the pain associated with it. The final aspect of the criterion is to have a clearly identified research aim. In the present study, the aim was to determine whether pain associated with CTR could be decreased with music.

Developing a theoretical description of how the treatment works is the ninth characteristic of treatment strength. In the present study, the conceptual framework again shows the connection between the theories utilized, the intervention, and the expected outcomes. The intervention was to improve adaptation and thereby reduce physiologic responses to pain and self-reported pain intensity.

The final characteristic of treatment strength is integrity, assuring that the intervention is delivered based on the protocol. This characteristic was the most difficult to control due to conducting the study in the clinical setting and led to weaknesses in the study. Although the protocol was well developed, implementation of the protocol was dependent upon other members of the health care team. There were numerous extraneous variables that may have had an impact on the intervention. Timing of the CTR was one variable. Although all but 2 (n=154) subjects had their chest tubes removed on the 2nd postoperative day, CTR occurred at any time during that day such as upon awakening, before or after meals, while the subject was bathing, while other physicians were in the room, while visitors were present who then had to be asked to leave, and while other staff were in and out of the room. The major variable was probably waiting for the PA to remove the chest tubes. Several times the intervention was begun and the PA was delayed, causing the intervention to be stopped and then restarted when the PA was available. In 5 cases, the intervention was started and the dosage of 10 min prior to CTR became 20-25 min until CTR because the PA became busy with something else. In addition, for those subjects in the control group, it was difficult to have the PA wait for the 10 min dictated by the protocol after the baseline vital signs were obtained; therefore, one of the seven vital sign sets collected was lost for 10 subjects.

Interaction with the interveners may also have had an effect on the strength of the treatment. Although the interveners were there as observers, some subjects, particularly those in the control group, frequently wanted to talk during the procedure, which could have had an effect on their responses as compared to those subjects who wore head phones. Another factor related to interaction with the interveners may be the number of PAs and cardiovascular technicians who removed chest tubes. Because they used different approaches to CTR in terms of explanations given and removal techniques, the strength of the intervention may have been affected.

A final variable was equipment failure, particularly with the DINEMAPP™. While monitoring blood pressure, moving or bending the arm with the blood pressure cuff resulted in the inability of the machine to detect a blood pressure. Subject movement resulted in loss of only one of the seven sets of physiologic variables collected in 16 subjects.

One final consideration in intervention studies is the sensitivity of the outcome measures to change (Stewart & Archbold, 1993). Lack of significant findings in an intervention study may be related to the outcome measures used. The equipment used to measure the physiologic variables in this study (Hewlett-Packard monitors and DINEMAPP™) was sensitive to change. Change of 1 heartbeat/min and 1-mm change in systolic or diastolic blood pressure could be detected. The equipment provided interval data and could measure a wide distribution of responses. In addition, the

NRS used in the study, although sensitive to change and providing interval data, may not have been sensitive enough. Subjects may have had difficulty grading their pain intensity in terms of whether the pain changed from a 6 to a 7, for example, or only to a 6.5, since the NRS allowed only whole number selection. In contrast, the visual analog scale, described by Lipsey (1990) as having fine-grained measurement intervals, may be more sensitive to change than the NRS. However, Puntillo (1994) found the visual analog scale to be more difficult for patients in ICU to use.

Conclusions

There are no published studies which examined the effect of self-selected music on procedural pain using a control and a comparison group. The findings from this study indicate that music does not reduce the reported pain intensity associated with CTR, nor does it alter (reduce) physiologic responses to pain or lengthen the time from the end of the procedure until the subject receives analgesia.

Using the intervention at the time of CTR may not have been effective because of the procedure involved. Other studies in which procedural pain was examined focused on dressing changes (Angus & Faux, 1989), repair of lacerations (Menegazzi et al., 1991), and femoral arteriography (Mandle et al., 1990). Perhaps the type of procedure (i.e., removing drainage tubes from the chest and the proximity of the chest incision to the heart) had a psychologic influence on subjects and made it difficult for them to focus on

the music compared to procedures that were perhaps less threatening (Angus & Faux, 1989; Menegazzi et al., 1991). In addition, CTR is a painful experience and perhaps the acute pain was too great for the music to be effective. Also, there may be other unknown confounding variables that were not considered in this study.

No verbal clues were given about listening to the music or relaxing as subjects listened to the music during CTR, and the use of a verbal clue may have been beneficial in helping subjects to focus on the music. In the present study, the researcher and research assistants had minimal contact with the subjects during the procedure. Minimal contact helped to eliminate bias from perceived experimenter expectations or the Hawthorne effect.

Finally, the cumulative effect of music must be considered. The positive effect of music on pain in some studies (Guzzetta, 1989; Locsin, 1981; Mullooly et al., 1988) suggests that music repeated over a period of time and not just a single intervention may be more effective in reducing pain and altering physiologic responses.

Implications

The findings of this study can be extended to other populations in which CTR is a procedure (e,g., trauma or thoracotomy patients). Implications for theory, nursing research, nursing practice, and nursing education are provided.

Implications for Theory

Roy's adaptation model. The lack of effect on reported pain intensity may have been due to a lack of treatment strength or integrity, intensity of pain in the subjects, or other contextual or residual stimuli not previously identified such as previous surgeries or previous experiences with pain.

Adaptation, the focus of Roy's model, is controlled by the regulator and cognator subsystems. The regulator subsystem represents physiologic adaptation. Through the use of a nursing intervention, music, it was anticipated that the cognator subsystem, particularly perception, would influence the regulator subsystem and that physiologic adaptation would be influenced. This result would reinforce the holistic nature of the individual. Perhaps the process of adaptation must occur over a period of time, and the short period of time of the intervention in the study was insufficient for the body's adaptive mechanisms to respond.

Gate control theory. Modulation of pain through psychologic factors that block the transmission of painful stimuli by closing the gate in the dorsal horn of the spinal cord was the premise in this study that supported the use of music, a psychologic factor, as a useful intervention in decreasing pain. Perhaps the intensity of the pain produced by CTR or other unknown factors associated with the procedure were too strong to allow the music to prevent or decrease perception of the painful stimuli from the pro-

cedure. In support of the gate control theory, however, subjects reported enjoying listening to the music; therefore, the psychologic part of the music was perceived but, as stated above, may not have been strong enough to close the gating mechanism.

Implications for Nursing Research

The findings from this study provide direction for nursing research. As a universal phenomenon and a high priority for nursing, it has been well documented that pain is inadequately managed in health care (AHCPR, 1992). Although the results of this study did not find music to be a significant intervention for pain related to CTR, the study did lead the way to plan for numerous future studies. If music is to be used as an adjuvant therapy to analgesia, issues related to the use of music must be resolved. Current scientific knowledge reveals many inconsistencies in the findings of studies in which music has been used as an intervention.

There are several issues that must be considered in studying the use of music as an intervention for pain. The type of music that may be best for pain intervention must be further reviewed. Studies are needed that compare the effect of music described as sedating or relaxing with stimulating music or patient-selected music. This study must be done initially without the variable of pain while looking at physiologic effects, and then used with subjects who have pain to determine whether there are differences in physio-

logic responses with and without pain. The answer to this question requires collaborative work between the nurse and music therapist. Clarification of these variables (type of music, effect of music on physiologic variables with and without pain) will help to strengthen the intervention.

Another issue to be considered is the type of pain being studied. Efforts should be made to determine whether there is a difference between the perception of intensity or the psychologic meaning to the patient of postoperative pain and procedural pain. If there is a difference between these types of pain, perhaps music will be effective in relieving one type and not the other. The possibility of other confounding variables (e.g., type of procedure and purpose of the procedure) should also be considered.

A final issue related to the use of music is the duration of the intervention, or the dose of the treatment. Again, there are two parts to this issue. If the music is to decrease procedural pain, research related to the most effective time to start the music in relation to the procedure (e.g., 10, 15, 20 min prior to the procedure or at the start of the procedure) must be conducted. In addition, if music is used for its effect on postoperative pain, the most appropriate length of time to listen (5 min or 30 min) and the frequency of listening (once a day or several times a day) must be determined.

Further study needs to be completed on instruments to measure pain. Although a variety of instruments are available, comparing studies in which different instruments are

used is difficult in terms of sensitivity of the outcome measure to change. Many investigators who study pain correlate pain with anxiety. Perhaps further research is needed to determine what role anxiety plays in the intensity of pain and how to differentiate between the two with a valid and reliable instrument.

One implication related to theory follows: If adaptation is expected to occur in the body as a response to an intervention, when is the ideal time to measure that adaptation and how should it be measured? Perhaps measuring physiologic responses as an indication of adaptation immediately after a painful experience is not the most appropriate time to expect adaptive responses to occur.

Implications for Nursing Practice

As professionals in health care settings, patients depend on nurses for health care service (Walker, 1992). Therefore, nurses must be knowledgeable about the most effective interventions available for patients, particularly in regard to pain control. Although most subjects enjoyed listening to the music or white noise, the results indicated that neither was effective in decreasing the reported intensity of pain. These findings suggest the search for other nonpharmacologic pain-reducing interventions should continue.

Positive responses from subjects, however, suggest that music can continue to be used as an adjuvant therapy for persons having chest tubes removed, since enjoyment of the

music itself may be beneficial to the person. In addition, nurses use physiologic variables, vital signs, to determine patients' responses to interventions. Because there are many variables that influence these physiologic responses, they should be used in conjunction with other assessment findings and not in isolation.

The implementation of a music program is easy to establish. Expenses related to initial purchase of tapes and tape players must be considered; however, other than a few minutes of nursing time to provide the patient with the tape and tape player and to collect them after the procedure, there are no other costs involved. In addition, there is no cost to the patient, a major factor in today's health care environment. Also, no deleterious side effects have been reported in the studies reviewed, although possible effects such as seizures have been identified. As an adjuvant to medications, an intervention with minimal to no side effects would also be beneficial to patients. In the present study, some subjects received Midazolam prior to CTR. Although this drug was effective in producing amnesia for the procedure, it did not obliterate the subjects' pain. In addition, the use of Midazolam requires careful monitoring of physiologic variables, particularly respirations and oxygen saturation, by the nurse for a period of 30 min after administration, perhaps adding unnecessary demands to the nurse's already busy day. The use of music requires no additional nursing time to monitor for potentially life threatening side effects.

Two other considerations for nursing practice associated with the findings in this study are related to BMI and age. Subjects who were underweight or of normal weight and those older subjects (ages 80-89) reported a higher mean pain intensity with CTR. Patients who have these characteristics may require special consideration by the nurse in terms of pharmacologic or other interventions with CTR.

Implications for Nursing Education

Finally, findings from this study provide implications for nursing education. First, the use of adjuvant therapy in pain control is an accepted intervention in nursing practice and is recommended by AHCPR (1992). Nurses must understand what these therapies are and how to implement them in their practice. Therefore, nursing curricula must introduce these therapies to students, and hospitals should encourage nurses to use these additional therapies in providing patient care. Nurses must attend continuing education offerings to learn appropriate use of these adjuvant therapies. Particularly with the use of music, information such as how to establish a music library in a hospital and how music as an intervention can best be used by patients must be learned. With managed health care and shortened hospital stays, nurses must include these therapies early in the patient's stay so the patient can use these techniques at home.

Summary

Based on the results of this study, music was not an effective intervention to decrease pain associated with CTR, aid the body in adaptation, or lengthen the time for analgesia administration after the procedure. As an intervention study, measures to increase the strength of the treatment and integrity of the study have been discussed. Although not statistically significant, the issue of clinical significance for this study must be addressed. LeFort (1993) described social validation as a technique to evaluate clinical significance. As a value, clinical significance is best determined by those who receive the intervention. In this study, most of the subjects who listened to music during CTR found it to be relaxing and distracting. Therefore, although further research has been recommended, based on the results of this study, music as an adjuvant to other therapies may be useful in clinical practice.

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APPENDIX A

INFORMED CONSENT

Principal Investigator: Sharon K. Broscious RN, MSN, CCRN

Participation:

I understand that I am being asked to participate in a research study about my response to chest tube removal after open heart surgery. I will be assigned to a group in which I may or may not be asked to listen to a tape through headphones. I will also be asked to circle on a form the amount of pain I have before, during, and after the removal of the chest tube. I will be involved in the study for about 30-45 minutes.

Exclusion Criteria:

I understand that I will not be able to participate in the study if I cannot hear, cannot read English, or do not have my chest tube removed the first or second day after surgery.

Risks or Discomforts:

I understand that a potential, but small risk may be from the sound level of the cassette player. I understand that I will be able to adjust the sound to a level that is comfortable to me. The only discomfort from the study may be having the earphones on my head from the cassette player. There may be other risks not yet known.

Benefits:

I understand that I may receive some direct benefit from participation in the study through a change in the amount of pain I feel when my chest tube is removed, but this is not guaranteed.

Alternative Treatments:

I understand no standard treatment for pain will be withheld from me if I participate in this study.

Costs and Payments:

I understand that there will be no cost to me for participating in this study. I also understand that there will be no payment for my participation in the study.

Confidentiality:

I understand that all personal information learned about me during this research will be kept strictly confidential and that my records will be protected within the limits of the law.

I also understand non-personal information learned from this study could be used in reports, presentations and publications, but I will not be personally identified.

Withdrawal Privilege:

I understand I may withdraw from this study at any time. If I do withdraw I will receive exactly the same health care at this hospital as I would normally receive. I also understand it may be necessary for Sharon Broscious, RN, to withdraw me from the study. If I do withdraw, or am withdrawn, I agree to undergo all evaluations necessary for my safety and well-being.

Compensation for Illness or Injury:

The University of Alabama at Birmingham (UAB) has made no provision for monetary compensation in the event of physical injury resulting from the research, and in the event of such injury, medical treatment is provided, but not free of charge.

Voluntary Consent:

I certify I have read all of this consent form or it has been read to me and that I understand it. If I have any questions pertaining to the research or my rights as a research subject I may contact Sharon Broscious, RN, whose phone number is 463-8559. A copy of this signed consent form will be given to me. My signature below means I freely agree to participate in this research study.

_____ _____

Date Signature of Participant

_____ _____

Date Signature of Witness

Investigator's Statement:

I certify I have explained to the above individual the nature and purpose of the study, potential benefits, and possible risks associated with participation in this study. I have answered any questions that have been raised and have witnessed the above signature. I have explained the above to the volunteer on the date stated on this consent form.

_____ _____

Date Signature of Investigator

If you have any questions concerning any part of this study or consent form beyond those answered by the investigator, please contact Dr. Marguerite Kinney, Professor, University of Alabama at Birmingham (205) 934-6490.

APPENDIX B

DISCOGRAPHY

Style: Country/Western
1. Sweet Dreams
2. I'll See You In My Dreams
3. Tears
4. Tahitian Skies
5. Bowtie
6. Traveller's Ridge
7. Granny White Special
8. Cat In The Bag
9. Dance Of The Ol' Swamp Rat
10. Orange Blossom Special
11. Nashville Shuffle Boogie
12. Pick It Apart

Style: Easy Listening
1. How Great Thou Art
2. Jambalaya
3. Danny Boy
4. Song From MASH
5. Some Enchanted Evening
6. Just One Of Those Things
7. Long Ago
8. Tara's Theme
9. The First Time Ever I Saw Your Face
10. So In Love
11. Ebb Tide
12. I Have Dreamed
13. Love Theme From Romeo And Juliet
14. Almost Like Being In Love
15. If Ever I Would Leave You
16. Climb Every Mountain

Style: Music from Movies or Musicals
1. Star Wars Theme J. Williams
2. Blue Moon Rogers/Hart
3. Somewhere My Love Jarre/Webster
4. Superman Theme J. Williams
5. Some Enchanted Evening Rodgers/Hammerstein
6. All The Things You Are Kern/Hammerstein
7. Flying Theme From E.T. J. Williams
8. That's Amore Brooks/Warren
9. Edelweiss Rodgers/Hammerstein
10. March From The Raiders Of The Lost Ark J. Williams
11. Bali Hai Rodgers/Hammerstein
12. Moonlight In Vermont Snesdorf/Blackburn
13. Overture From The Cowboys J. Williams

Style: Rock/Popular
1. Always With Me, Always With You J. Satriani
2. Ruined Instrumental - We Will Rock You Queen
3. Echo J.Satiani
4. YYZ Rush
5. Surfing With The Alien J. Satriani
6. Where's My Thing? Rush
7. Ice 9 J. Satriani
8. Rockit H. Hancock
9. Crushing Day J. Satriani
10. Midnight J. Satriani
11. The Enigmatic J. Satriani
12. Driving At Night J. Satriani

Style: Classical
1. Piano Concerto No. 2 (Adagio) Rachmaninov
2. Carmen (Entracta) Bizet
3. Moonlight Sonata (Adagio) Beethoven
4. Carnival Of The Animals (The Swan) Saint-Saens
5. Bolero (Exert) Ravel
6. Air From "Suite In D" Bach
7. String Quartet No. 2 (Notturno) Borodin
8. The Firebird (Berceuse) Stravinsky
9. Daphnis et Chloe (Lever du Jour) Ravel
10. Oboe Concerto (Adagio) Albinoni
11. Prelude No. 4 Chopin

Style: Big Band/Jazz
1. In The Mood
2. The Jersey Bounce
3. Georgia On My Mind
4. The World Is Waiting For Sunrise
5. Airmail Special
6. April In Paris
7. Stardust
8. Take The A Train
9. Do Nothing 'Till You Hear From Me
10. Serenade In Blue
11. Hamp's Boogie Woogie
12. Jumpin At The Woodside

Style: Blues

1. Say Hey
2. Knocked Out The Box
3. Again Never
4. Mo' Better Blues
5. Beneath The Underdog
6. Brother Veal
7. And The Band Played On
8. The Jubilee Suite
   - I. Day to Day
   - II. Running and Rambling
   - III. Grace
9. Sometimes It Goes Like That

Style: Patriotic

1. Fanfare And Theme (The Star Spangled Banner)
2. A Stephen Foster Medley
3. It's A Long Way To Tipperary
4. A Sousa Salute
5. George M. Cohan Medley:
   - I. Give My Regards To Broadway
   - II. Mary
   - III. It's A Grand Old Flag
6. Liberty Fanfare
7. March From "Midway"
8. March From "1941"
9. Sketch In Blue And Gray
   - I. Bonnie Blue Flag
   - II. Aura Lee
   - III. Battle Cry Of Freedom
10. Minstrel Melodies
    - I. Oh! Susanna
    - II. Old Folks At Home
    - III. Ring de Banjo
11. America The Beautiful
12. H.M.S. Pinafore Medley
    - I. We Sail The Ocean Blue
    - II. A Maiden Fair To See
13. Semper Fidelis

Style: New Age

1. After The Sunrise
2. The Mermaid
3. Quiet Man
4. Nostalgia
5. Almost A Whisper
6. The Rain Must Fall
7. Acroyali
8. Farewell
9. Swept Away
10. True Nature
11. First Touch

Style: Gospel

1. Sweet Little Jesus Boy
2. Three Spirituals
   - I. Ain't That Good News
   - II. I Didn't Hear Nobody Pray
   - III. I Ain't Got Time To Die
3. How Great Thou Art
4. Amazing Grace
5. Just A Closer Walk With Thee
6. Send The Light
7. Church In The Wildwood
8. Just A Closer Walk With Thee
9. Mansion Over The Hilltop
10. The Old Rugged Cross
11. Power In The Blood
12. When The Roll Is Called Up Yonder
13. Count Your Blessings
14. Love Lifted Me
15. Leaning On The Everlasting Arms

APPENDIX C

DATA COLLECTION SHEET

Demographic Data:
Surgical procedure:
CABG:_____ Number of Bypasses:_____

Valve:_____ Valve repaired or replaced: M T A P
(Circle letter to indicate valve)
Number of chest tubes: (circle one) 1 2 3 4
Location of chest tubes: (circle) mediastinal pleural
Type of chest tube: (circle) straight right angle

Contextual Data:
Age:_____ Gender:(circle) M F Weight:_____

Ethnic Background: American Indian ___
Asian/Pacific Islander ___ Black ___ Hispanic ___
White ___ Other ___
Documented history of psychiatric illness: (circle) Y N

Physiologic Adaptation:
1. Analgesia administered postoperatively (from admission to ICU until CT removal):(place letter next to drug and total amount drug administered on corresponding dosage line)

Drug: Morphine sulfate:_____ Demerol:_____
Nubain:_____ Other:_____

Total Dosage:a._____ b._____ c._____

Route:(circle) IV IM

2. Time interval from last medication to CT removal:_____

Last drug administered: Morphine sulfate:_____ Versed:_____
Other:_____

Dosage:_____ Route: IV IM (circle one)

3. Time interval from CT removal to first analgesic administration:_____
Drug administered: Morphine sulfate:_____ Other:_____
Dosage:_____ Route: IV IM (circle one)

Other Variables:
1. Person removing CT: PA:_____
Physician:_____

Code#____

APPENDIX D

NUMERIC RATING SCALES

PLEASE CIRCLE THE NUMBER ON THE LINE TO INDICATE THE AMOUNT OF PAIN YOU ARE HAVING RIGHT NOW.

												PAIN
NO PAIN	0	1	2	3	4	5	6	7	8	9	10	AS BAD AS IT COULD BE

CodeA #:_____

PLEASE CIRCLE THE NUMBER ON THE LINE TO INDICATE THE AMOUNT OF PAIN YOU REMEMBER HAVING WHEN YOUR CHEST TUBE WAS REMOVED.

NO PAIN	0	1	2	3	4	5	6	7	8	9	10	PAIN AS BAD AS IT COULD BE

CodeB #:_____

PLEASE CIRCLE THE NUMBER ON THE LINE TO INDICATE THE AMOUNT OF PAIN YOU ARE HAVING RIGHT NOW.

NO PAIN	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**PAIN AS BAD AS IT COULD BE**

CodeC #:____

APPENDIX E

RECRUITMENT VIDEO SCRIPT

Hello, my name is Sharon Broscious. I am a registered nurse and I am a doctoral student at the University of Alabama at Birmingham. I am conducting a nursing research project at the Lehigh Valley Hospital. You are invited to participate in a study of hospital patients and their responses to chest tube removal after open heart surgery. I hope to learn about ways to increase patients' comfort during this procedure after surgery. I have spoken to your surgeon and he has given me permission to talk to you about this project. As you learned in your class, you will have a drainage tube in your chest after your surgery. This tube is usually removed a day or two after your operation. If you should decide to participate I will have you sign a form today giving me permission to include you in the study. In addition, I will ask you about the type of music you like to listen to and whether you have had any unusual reactions to music or noise.

After you have your surgery, you will be randomly assigned to one of three situations. Before your chest tube is removed, I or an assistant will ask you to circle a number on a scale of one to ten which indicates the amount of discomfort you are having. Then, you may or may not be asked to listen to a tape through headphones. If you do listen to a tape, the sound you listen to will not be uncomfortable to you. You will be able to adjust the sound to a level that is comfortable for you to listen to. The only discomfort to you may be from the head phones you are asked to wear. After your chest tube is removed by your surgeon or his assistant, you will be asked to circle a number on the scale of 1-10 to indicate the amount of discomfort you have. Finally 15 minutes later, I will again ask you to circle a number on the same type of scale to describe your discomfort. This entire process will take about 30-40 minutes.

Whether you listen to a tape or not, there will be no change in the care you receive in the open heart unit after your surgery. No standard treatment will be withheld from you. I cannot and do not guarantee or promise that you will receive benefits from this study, although you may.

Any information obtained in connection with this study will be confidential. Your name will not be connected with the study. In any presentations or published reports, I will refer only to patients who had open heart surgery. There is no cost to you to participate in this study and no payment for participating in the study.

If you decide to participate, you are free to withdraw your consent and discontinue your participation at any time or I may withdraw you from the study, should I feel the need to for your safety and well-being. Withdrawal from the study will not affect the care you receive in the intensive care unit.

Please feel free to ask any questions on any part of this study that is unclear to you. If you decide to participate in the study, you will be asked to sign a consent form today before you leave. You will also receive a copy of the consent form to take with you. My name and

telephone number will be on the form should you have any questions. Thank you.

APPENDIX F

RECRUITMENT PROTOCOL

1. Recruiting is done Sunday through Thursday.

2. Obtain daily census sheet for surgical group in TOHU conference room. Center section will list patients (pt) for potential surgery.
   a. If pt in house, go to unit and review chart to determine whether pt has consented to surgery.
   b. Check preadmission testing schedule on 4A for elective surgeries.
   c. Check cardiac cath holding area for any pts scheduled for surgery or having preadmission testing done.
   d. After 3 PM, check operating room (OR) schedule for next day for in house pts or pts being transferred from other hospitals.

3. Take video tape and blue notebook to pt's room which contains consent forms, music selection list, and NRS sample.

4. Introduce self to pt &/or family.
   a. Say you are a nurse and want to talk to them about a project we are doing at the hospital this summer related to patients who have OHS.
   b. Tell them surgeon has given you permission to talk to the pt about the project.

5. Ask if they have seen the video about surgery or read any of the booklets about it.

6. Give brief explanation of project: after your surgery you will have some drainage tubes in your chest, this is normal. These tubes are usually removed two days after your operation. Sometimes there is a little discomfort associated with taking the tubes out, because you can feel the tubes moving. We are looking at ways to make pts. more comfortable during this procedure.

7. Introduce short video (video about the project, not about the surgery). (approximately four mins)

8. Answer questions.

9. Give copy of consent form to pt and family members. Tell the pts. that the form basically says the same thing that is on the video, but sometimes if they see it in print it's clearer than listening to the video.

10. Reinforce: pain medicine is always available and this project is something additional they may receive; lasts only 30-40 minutes while in the hospital, no follow-up at home; no change in usual procedure; may or may not listen to tape.

11. Have pt sign consent. Give pt a copy of the form to keep.

12. Show the pt the list of music and ask pt to select a type of music. Write type of music on bottom of consent form.

13. Show NRS and explain how it is used.

14. Thank them.

15. Add pt's name to master list in notebook. Place signed consent form in brown envelop in drawer.

Below is an example of the type of numerical rating scale that will be used during the study. On the scale of 0 to 10, you will be asked to circle the number, or tell the researcher, which number indicates the amount of discomfort you are having, with 0 being no pain and 10 being pain as bad as it could be. You will be asked to complete this scale three times during the study.

NO PAIN	0	1	2	3	4	5	6	7	8	9	10	PAIN AS BAD AS IT COULD BE

As a participant in this study, you may be asked to listen to an audio tape. This tape may have music on it. Please review the list below and identify the type of music you would like to listen to, if given the opportunity.

BIG BAND/JAZZ

BLUES

CLASSICAL

COUNTRY/WESTERN

EASY LISTENING

GOSPEL

MOVIE MUSICALS

NEW AGE

PATRIOTIC

ROCK

Checklist for Following Recruitment Protocol

		Yes	No
1.	Check daily census list, 4A preadmit list, and OR schedule.		
2.	Introduce self.		
3.	Give brief explanation.		
4.	State surgeon has given permission.		
5.	Show video.		
6.	Provide consent form, give copy to pt after signed.		
7.	Ask for questions.		
8.	Have subject select music preference, write on bottom of consent.		
9.	Review use of NRS.		
10.	Add name to master list and assign code number.		

APPENDIX G

NURSING INTERVENTION PROTOCOL

1. Check in office drawer for list of subjects and code number. Data sheets and NRS forms will be identified with subject code numbers and clipped together. Randomize subjects into group using marked chips. Obtain cassette players and appropriate tapes.

2. Locate subject in OHU or TOHU.

3. When PA (or tech) arrives, tell him which subjects are in study.

4. If in OHU:
   a. Subject must be in bed for CTR. If out of bed, nurse will get into bed. Assess pain intensity (Form A) before moving subject.
   b. Be sure subject has arterial line in place to monitor BP. Ask nurse to zero arterial line. If no arterial line in place, obtain non-invasive BP cuff for HP monitor or DINAMAP.
   c. Obtain base line VS, NRS 1 (if subject in bed), and start tape if indicated.
   d. Tell PA when 10 minute time frame is completed.
   e. PA will remove CTs. After dressing in place, assess pain intensity of CTR (NRS 2).
   f. Continue tape for 15 more minutes, or 3 sets of VS. Try not to talk to or disturb subject.
   g. After last VS, stop tape and complete NRS 3. Record VS.

5. If in TOHU:
   a. Obtain DINAMAP.
   b. Set DINAMAP to cycle every five minutes. Obtain baseline VS and NRS 1. Start tape if indicated.
   c. Tell PA when 10 minute time frame is completed.
   d. PA will remove CTs. After dressing in place, assess pain intensity of CTR (NRS 2).
   e. Continue tape for 15 more minutes, or three sets of VS. Try not to talk to or disturb subject.
   f. After last VS, stop tape and complete NRS 3. Record VS.

6. Obtain post-CTR analgesia information for subject from previous day.

Checklist for Following Intervention Protocol

	Yes	No
1. Locate subjects.		
2. Randomize subjects into group.		
3. Select appropriate tapes.		
4. Obtain subject data sheets and NRSs by code.		
5. Obtain DINAMAP if needed or have an arterial line zeroed.		
6. Coordinate with PA to start intervention.		
7. Monitor VS every five minutes from baseline to completion of intervention and record.		
8. Obtain NRSs at appropriate times.		
9. Complete demographic data sheet.		
10. Obtain analgesia record of subjects from previous day.		

GRADUATE SCHOOL
UNIVERSITY OF ALABAMA AT BIRMINGHAM
DISSERTATION APPROVAL FORM
DOCTOR OF SCIENCE IN NURSING

Name of Candidate Sharon K. Broscious

Major Subject Adult Health Nursing

Title of Dissertation Music: An Intervention for Pain During Chest Tube Removal After Open Heart Surgery

I certify that I have read this document and examined the student regarding its content. In my opinion, this dissertation conforms to acceptable standards of scholarly presentation and is adequate in scope and quality, and the attainments of this student are such that she may be recommended for the degree of Doctor of Science in Nursing.

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