

THE FLORIDA STATE UNIVERSITY

COLLEGE OF MUSIC

THE EFFECTS OF MUSIC THERAPY AND DEEP BREATHING ON PAIN IN PATIENTS

RECOVERING FROM GYNECOLOGIC SURGERY IN THE PACU

By

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ABSTRACT

This study examined the effects of music therapy paired with deep breathing in the PACU. Dependent variables were amount of pain medication administered (measured in morphine equivalents), hospital length of stay, and perceptual data. Subjects were fifty (N=50) women undergoing gynecologic surgery requiring a hospital stay of at least one night. Subjects were randomly assigned to an experimental music group (N=25) or control group (N=25). Results showed no significant differences for pain medication between groups. The length of hospital stay was significantly shorter for the music group. Subjects in the music group also reported their post-PACU pain levels to be significantly lower than the control group. Further results and implications are discussed.

INTRODUCTION

It is early in the work day as the phone rings in a woman's office. She is hesitant to pick up the phone as she is already running late for a meeting, but she decides to answer. It is her doctor's office calling; they would like to schedule an appointment to discuss her test results. Immediately the worst is running through her mind . . . *What if it's cancer? What if I need to have surgery? How will I be able to take that much time off of work? I can't leave in the middle of the big project . . .* She jolts as the doctor enters the room to deliver the news. She will need to have a hysterectomy, and they would like to schedule the surgery within the next few weeks. The doctor continues to explain the procedure, the risks involved, and the lifestyle changes she will need to make as she is recovering. She nods as her physician, now surgeon, is going through the details, but she is not hearing most of what he is saying. *I'm too young to deal with this . . . We were planning on having more children . . . I don't understand . . . Why is this happening?* The nurse is now with her and is handing her brochures, forms, and instructions for her to look over before her pre-operative appointment at the hospital. The news is starting to settle in as the nurse discusses the medications the doctor will be ordering for pain management after her surgery. *Pain? I hadn't even thought about the pain.* She remembers needing stitches a few years ago and how badly that small cut was hurting afterwards. *How bad is this going to be?*

Researchers have studied the quality of life, psychological well being, and pain experienced in women suffering from gynecological disorders (Rannestad, Eikeland, Helland, & Qvarnstrom, 2000). Rannestad et al. surveyed women one week before their scheduled hysterectomy and found over 75% were currently experiencing pain. The amount and intensity of pain experienced was conversely related to their quality of life. Studies also show that high pre-operative pain, younger age, and female gender are predictors of postoperative pain severity (Thomas, Robinson, Champion, McKell, & Pell, 1998). Another study found similar results and also indicated that incision size and abdominal surgeries lead to greater postoperative pain

(Kalkman et al., 2003). Women have been shown to experience postoperative pain more intensely than men (Morin, Lund, Villarroel, Clokie, & Feine, 2000) and to be more emotionally focused on pain (Keogh & Herdenfeldt, 2002).

Considering the amount of pain and risk factors for increased pain as cited above, health care providers should consider the use of additional, non-pharmacological means of post-surgical pain management in women. Statistics from the U.S. Department of Health and Human Services show that over 62% of adults have used some form of complementary or alternative medicine within the previous twelve months (Barnes, Powell-Griner, McFann, & Nahin, 2004). Although music therapy was not included in this survey, the results indicate the majority of adults in the United States are interested in complementary, non-pharmacological means of treatment. The use of music to reduce pain has been widely researched (Zimmerman, Nieveen, Barnason, & Schmaderer, 1996; Laurion & Fetzer, 2003; Davis, 1992). In Standley's (2000) meta-analysis of music in medical treatment, several applicable results were found: music has a greater effect on women than men, live music provided by a music therapist has a greater effect than recorded music, and patient-preferred music is the most effective. Standley also reports the effects of music are highest when a patient is experiencing some pain; however, the effectiveness decreases as pain becomes severe. This study examined the effects of music therapy paired with deep breathing on pain in women who are recovering from gynecological surgery in the post anesthesia care unit (PACU).

CHAPTER 1

Review of Literature

Physiological Responses to Pain

Surgery and the pain that follows are stressful experiences. The pre-surgery experience is filled with uncertainty, and questions rarely bring about satisfying answers. The initial post-surgery experience often results in severe pain combined with anxiety about the surgery's effectiveness. Desborough (2000) discusses several effects trauma and surgery have on the stress response. Several metabolic and hormonal changes occur following the start of surgery, e.g. cortisol secretion substantially increases after surgery begins. Desborough also states that postoperative pain relief is essential for normal functioning. Migneault et al. (2004) researched the effects of listening to music intra-operatively through headphones on the neurohormonal stress response. Dependent variables in this study were measured by blood levels of epinephrine, norepinephrine, cortisol, ACTH, and post-operative use of morphine. No significant differences were found; however, it should be noted that subjects were only given a choice between four types of music, and music was only played while patients were under anesthesia (Migneault et al., 2004). These results are consistent with Standley's (2000) meta-analysis, which lists intra-operative music as being the least effective.

Milukkolasa, Obminski, Stupnicki, and Golec (1994) measured cortisol levels in subjects after presenting a stressor. Salivary cortisol levels were measured in three groups before and after subjects received information regarding their next-day surgery (stressor). The three groups were a music group, a non-music group, and a control group who were not having surgery. Cortisol levels increased 50% after the stressor, and were substantially higher in the non-music group after one hour. The music group's cortisol levels decreased to levels similar to the control group (Milukkolasa et al.).

Fauerbach, Lawrence, Haythornthwaite, and Richter (2002) measured procedure-related stress, tension during procedure, average experienced pain, and intrusive symptoms in the 30

minutes following the procedure in burn patients during dressing changes. Subjects rated tension and pain intensity every 10 minutes on a Likert scale. Music resulted in significantly fewer intrusive pain thoughts during this stressful and painful procedure. An additional study also discussed the physiological effects of pain (Lewis, Whipple, Michael, & Quebbeman, 1994). Lewis et al. listed pain as adversely affecting the stress response, inhibiting normal pulmonary function, and slowing recovering time from surgery. Listening to music for 30 minutes preoperatively resulted in a significant decrease in respiratory rate at the .02 level for women undergoing laparoscopic gynecological surgery. The same subjects also listened to music for 30 minutes postoperatively, which resulted in a significant decrease in blood pressure (Ikonomidou, Rehnotrom, & Naesh, 2004).

Side Effects and Risks of Opioids

Opioids are commonly used to treat chronic and acute pain; however their use is often accompanied by significant side effects. Health care professionals are constantly assessing better ways to manage pain and administer pain medications (McGeary, 1999). The following studies review the risks, side effects, and attempts to decrease opioid use in the treatment of pain. Christo (2003) researched the side effects of prolonged opioid use to treat chronic pain. A number of side effects listed by Christo were nausea, vomiting, sedation, cognitive dysfunction, constipation, and organ toxicity. Barratt and Power (1998) remark, “While opioids are powerful analgesics, they have significant adverse effects which delay the recovery of the patient after surgery, including nausea and vomiting, depression of gastrointestinal motility and disruption of sleep patterns” (p. 257). Kurz and Sessler (2003) state the most common side effect of opioid use to treat postoperative pain is bowel dysfunction.

Researchers are studying ways to reduce the amount of opioids needed to treat postoperative pain (Plummer, Owen, Ilsley, & Tordoff, 1996). Plummer et al. gave patients having lower abdominal gynecological surgery ibuprofen to see if it decreased their use of morphine. While subjects in the treatment group experienced significantly less pain at rest, the use of morphine did not significantly decrease. Another study gave patients gabapentin before undergoing a vaginal hysterectomy to reduce the need for additional pain treatment (Rorarius et al., 2004). This treatment reduced the need for further treatment of pain by 40% in the first twenty hours after surgery. Rorarius et al. also indicated that gabapentin reduced postoperative

nausea and vomiting. The use of ketorolac (a nonsteroidal anti-inflammatory drug) in patients recovering from lower abdominal surgery decreased PCA opioid use. Subjects in the ketorolac group also reported improved quality of sleep (Parker, Holtmann, Smith, & White, 1994).

High postoperative pain puts patients at a greater risk for developing postoperative delirium (Lynch et al., 1998). Lynch et al. found higher pain scores at rest were directly related to increased risk for postoperative delirium; however, neither the type of opioid used to control pain nor the dose administered were associated with delirium. Cohendy, Brougere, and Cuvillon (2005) claim postoperative cognitive dysfunction is common in older patients, and they are more susceptible to the risks and effects of opioids. McCaffrey and Locsin (2004) studied the effects of frequent music listening on confusion and delirium in elderly patients recovering from knee or hip surgery. The study defined confusion and delirium as disorientation, lack of awareness of safety needs, aggressive behavior, and inability to interact with other people. Patients listened to a minimum of three hours of music a day chosen from a selection of compact discs (CDs) provided by the researchers. All patients in the music group listened to the same CD while awakening from anesthesia. There was a significant decrease in confusion for the music group (McCaffrey & Locsin, 2004).

Pain intensity in the older patient after abdominal surgery is also an important variable for postoperative pulmonary complications (Shea, Brooks, Dayhoff, & Keck, 2002). Shea et al. found that patients who developed pulmonary complications had higher pain intensity scores, a significantly longer length of stay, and significantly higher pain with deep breathing on most postoperative days. Patients undergoing laparoscopic gastric bypass have higher pulmonary scores than patients undergoing open gastric bypass surgery (Nguyen et al., 2001). Nguyen et al. state upper abdominal surgeries frequently result in decreased pulmonary function. Ellstrom et al. (1998) also found that patients undergoing a hysterectomy had impaired lung function. However, patients who had a laparoscopic assisted hysterectomy had less impairment than those who had an abdominal hysterectomy (Ellstrom et al., 1998). Research to decrease opioid use in treating pain, and thus reducing side effects that delay recovery, is a continual need.

Deep Breathing and Relaxation

Deep breathing is a non-pharmacological way to counteract negative effects of surgery, such as reducing pain, and to refocus attention away from uncomfortable events. Withdrawal

symptoms in dependent smokers who refrained from smoking for 4 hours were significantly reduced by deep breathing (McClernon, Westman, & Rose, 2004). Experimental subjects were led in a series of deep breaths for 30 minutes while control subjects sat quietly for the same amount of time. The experimental group had a significant reduction in cravings and negative affect, and maintained baseline arousal levels (McClernon, Westman, & Rose, 2004). The effects of relaxation techniques combined with music have been researched in numerous studies (Pelletier, 2004; Good et al., 2001; Good, 1995). In a meta-analysis, Pelletier (2004) found music assisted relaxation techniques were effective in increasing relaxation when subjects were under stress. The meta-analysis also indicated music is most beneficial to females and adolescents, and subject preferred music is most effective. These results are consistent with prior music research (Standley, 2000).

Davis (1992) studied the effects of relaxation instruction and music on pain. Subjects were women undergoing in-office gynecological procedures who listened to preferred music via headphones during the procedure. Results showed control subjects had a significantly higher respiratory rate and overt pain score than experimental subjects during a punch biopsy (Davis, 1992). Good et al. (1999) randomly placed subjects having major abdominal surgery in a jaw relaxation group, music listening group, or a jaw relaxation combined with music listening group to study the effects of each on pain. Subjects received instruction on relaxation interventions pre-operatively. All experimental groups reported significantly less pain than the control group. In a review of studies combining relaxation and music to reduce postoperative pain, Good (1996) stated most studies were effective in reducing pain.

Roykulcharoen and Good (2004) studied the effects of systematic relaxation on postoperative pain, anxiety, and opioid intake. The relaxation technique used in the study consisted of focusing on relaxing muscles by group and smooth and relaxed breathing. The technique of contracting and relaxing muscles was not used given that contracting muscles after surgery may increase pain. A pre- and post-test was administered at the first postoperative ambulation. Subjects in the relaxation group had less sensation and distress of pain than the control group, and nearly all reported the relaxation technique reduced pain and increased sense of control (Roykulcharoen & Good, 2004). Breathing has also been used to reduce pain during an injection in pediatric dental patients (Peretz & Gluck, 1999). Children were instructed to take deep breaths and blow out air before and during the injection. Subjects in the experimental

group had significantly less eyelid squeezing and requested the same technique to be used at their next visit. Breathing and relaxation had beneficial effects on resting heart rate in myocardial infarction patients (van Dihoorn, 1998). Furthermore, Heffline (1990) states the need for deep breathing and other relaxation techniques to be used by patients in the PACU, as the pain may be too severe at times for the patients to wait for medication to reduce the pain.

Postoperative Pain

The severity of postoperative pain effects many variables in the treatment of a patient recovering from surgery and their perception of treatment. A strong correlation exists between severe postoperative pain and patient dissatisfaction with their hospital stay (Myles, Williams, Hendrata, Anderson, & Weeks, 2000). Assessing postoperative pain in gynecological patients has been studied by Webb and Kennedy (1994). Their study found significant relationships between a behavioral pain scale completed by nurses and patients' self reports of pain. Carr, Thomas, and Wilson-Barnet (in press) assessed 85 women having major gynecological surgery for pain, anxiety, and depression. Their results indicated pain scores increased as anxiety and depression increased. Factors influencing postoperative pain have been studied by Moddeman (2000). Eighty-five Caucasian women having abdominal hysterectomies participated in the study, which reviewed age, education, state anxiety, attitudes about pain, and prior pain experiences. Of the pain variance across subjects, 18% was accounted for by state anxiety. Results also showed older women received less analgesia, as reported in morphine equivalents (Moddeman, 2000). Patient positioning and its relationship to postoperative pain in the lower extremities have been studied (Power, 2002). Power compared women recovering from gynecological surgeries who were placed in either the supine or lithotomy position during surgery. While there was no significant difference between positions, women who were in either position for more than 60 minutes experienced significantly more pain in their lower extremities than women who were in either position for under 60 minutes (Power, 2002).

Music and Postoperative Pain

Due to the risks and side effects of pain medications as stated above, music has frequently been used to reduce postoperative pain. Non-pharmacologic means to reduce postoperative pain were used by 63% of subjects with breast or gynecologic cancer

(Kwekkeboom, 2001). Kwekkeboom also noted that use of relaxation techniques, including music, breathing, and imagery, was on the rise from previous studies. McCaffrey and Locsin (2002) discuss music as creating a comfortable, healing environment. Although they state music listening can be used by nurses at times with their patients, McCaffrey and Locsin stress the need for professional music therapists within the medical setting.

Listening to music intra-operatively versus postoperatively has been studied (Nilsson, Rawal, & Unosson, 2003). Nilsson et al. found patients who listened to music had significantly lower pain intensity during the first two hours after surgery. Another study used music and music paired with therapeutic suggestions intra-operatively, and found both experimental groups required less rescue analgesic, experienced more effective analgesia during the first day after surgery, mobilized sooner, and felt less fatigued at discharge (Nilsson et al., 2001). Pain decreased significantly in patients listening to sedative music who were recovering from open heart surgery (Voss et al., 2004). This study compared pre- and post-tests during chair rest for a rest group, music group, and control group. While both the rest and music groups showed significant decreases in pain when compared to the control group, the music group also had significant decreases over the rest group (Voss et al., 2004).

Pain in postoperative gynecologic or obstetrics patients was measured using the Overt Pain Reaction Rating Scale (OPRRS), devised by the study's author (Locsin, 1981). The scale rated pain in three areas: musculo-skeletal, verbal, and physiological/autonomic. Subjects who listened to music during recovery showed a significant decrease in musculo-skeletal behaviors and verbal pain reactions during the first 48 hours. Music has also shown to reduce the need for postoperative medication (Walters, 1996). Women awaiting gynecological surgery were placed in a music only group, vibrotactile stimulation group, or control. Results showed subjects in the music and vibrotactile stimulation groups received significantly less postoperative medication and had shorter PACU stays (Walters, 1996).

Music in the Post Anesthesia Care Unit

Shertzer and Keck (2001) discuss the need for combining pharmacological and non-pharmacological methods of pain management in the post anesthesia care unit (PACU). Pain pathways can be fully operational within twenty minutes due to anesthesia wearing off quickly. The authors also discuss neural pathways that suggest music can inhibit the perception of pain

intensity. Shertzer and Keck played music through headphones while patients were recovering in the PACU. There was a significant decrease in pain for the experimental group compared to the control group.

Heiser, Chiles, Fudge, and Gray (1997) played music through headphones during the last thirty minutes of surgery and the first hour in the PACU. While no significant differences were noted, subjects stated the music aided in relaxation and functioned as a distracter. Music listening and music paired with therapeutic suggestions significantly reduced pain intensity in patients in the PACU, as measured by a visual analog scale (Nilsson, Rawal, Enqvist, & Unosson, 2003). Other dependent measures in this study were analgesia, morphine requirements, nausea, fatigue, anxiety, headache, urinary problems, heart rate and oxygen saturation. Experimental groups also had higher oxygen saturation levels. Heitz, Symreng, & Scamman (1992) found music listening through headphones in the PACU resulted in subjects waiting longer before requiring analgesia and remembering the PACU as significantly more pleasant. Subject-reported pain levels, total morphine requirement, respiration, and length of PACU stay did not show a significant difference between the music and control groups.

The use of music in the PACU has also been researched specifically with women receiving gynecological surgery (Laurion & Fetzer, 2003; Taylor Kuttler, Parks, & Milton, 1998; Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002). Laurion and Fetzer studied the effects of music listening paired with guided imagery and music listening alone on postoperative pain in women having gynecologic surgery. Pain was assessed upon arrival to the PACU, one hour after arrival, and at discharge. Both experimental groups had significantly less pain at discharge than the control group (Laurion & Fetzer, 2003). In another study, women who had abdominal hysterectomies rated their pain every fifteen minutes while in the PACU (Taylor, Kuttler, Parks, & Milton, 1998). A quasi-experimental design was used, and no significant differences were found between the music and control groups. Good et al. (2002) divided 311 subjects into four groups: relaxation, music listening, relaxation paired with music listening, and control. All experimental groups reported significantly less post-test pain, measured by VAS. The positive effects of music in the PACU to decrease postoperative pain are encouraging and warrant further investigation in this area.

CHAPTER 2

Method

Purpose

The purpose of this study was to ascertain the differences in patients recovering from gynecological surgery receiving music and deep breathing in the post anesthesia care unit vs. standard treatment in: amount of pain medication administered/requested, length of hospital stay, levels of self-report pain, perception of pain management effectiveness (including music therapy), perception of overall comfort of PACU and hospital stay, and amount of sleep.

Design

The design of this study was post-test data collection only with control and experimental groups. The independent variable was music therapy paired with deep breathing, and the dependent variables were pain medication administered, length of hospital stay, and self-report perception data.

Subjects

Approval was obtained from the Human Subjects Committee at Florida State University (see Appendix A) and the IRB at Tallahassee Memorial HealthCare (see Appendix B) before the study began. Subjects were fifty (N=50) women undergoing gynecological surgery requiring at least one night's hospital stay. Table 1 below lists the procedures included in the study, abbreviations, and a brief description of each. All subjects were recruited through the Central Registration department at Tallahassee Memorial HealthCare. Surgery patients were scheduled for a pre-operative appointment in Central Registration (CR) 1-7 days prior to their surgery date. When patients meeting the study criteria for inclusion arrived in CR, the researcher was notified and met the patient during their appointment. Patients were given a brief explanation of the study and the option to participate. If they agreed to participate, informed consent was obtained

(see Appendix C), and the music preference form (see Appendix D) was completed for experimental subjects.

Table 1
Procedures and Descriptions

Procedure	Abbreviation	Description
Total abdominal hysterectomy	TAH	removal of the uterus and cervix through an abdominal incision; may also include removal of the fallopian tubes and ovaries (salpingo-oophorectomy)
Total vaginal hysterectomy	TVH	removal of the uterus and cervix through a small incision in the vagina
Laparoscopic assisted vaginal hysterectomy	LAVH	vaginal hysterectomy using a laparoscope
Anterior and posterior repair	a/p repair	repair of the bladder or urethra through a vaginal incision
Exploratory laparotomy	exp lap	examination of organs through a small abdominal incision
Myomectomy	myomectomy	removal of fibroids from the uterus

Subjects were randomized by surgery date as opposed to subject number. Each date during the study was marked a priori as a control or experimental day. This was done to prevent a control subject from possibly being in the PACU at the same time as an experimental subject, since beds are divided only by curtains. Based on the scheduled surgery date, subjects were placed in either the control or experimental group. Experimental subjects were limited to four per day to prevent voice and overall fatigue of the researcher from influencing results.

Table 2 below lists the distribution of procedures per group. Most procedures were evenly distributed across experimental and control groups, with more TVHs in the experimental group, and more TAH, a/p repairs in the control group being the exceptions.

Table 2

Distribution of Procedures and Ages

	Music	Control
Procedures		
TAH	13	14
TVH	4	1
LAVH	2	3
a/p repair	3	2
TVH, a/p repair	1	1
TAH, a/p repair	0	3
exp lap	1	0
myomectomy	1	1
Ages (in years)		
Mean	44.04	43.20
Range	22-75	23-75

Procedure

Experimental subjects received music therapy paired with deep breathing while recovering from surgery in the PACU. The researcher informed the unit secretary of the patients receiving music therapy each morning an experimental subject was scheduled. Upon a patient's arrival to the PACU, the unit secretary notified the researcher via a hospital issued pager. Patients listened to live music (soft guitar and singing) for approximately 45 minutes. Song selection was based on the preferences indicated by the patient during their preoperative appointment. A few subjects were alert enough to make spontaneous song requests while in the PACU.

Patients were also directed to take deep breaths and exhale slowly throughout the music therapy session. This is also a common instruction for PACU nurses to give patients. Because patients were just waking up from general anesthesia, specific instructions for deep breathing (e.g. counting while exhaling) were not given. Subjects were told to focus on the music while deep breathing to help relax their muscles. Music was played continuously regardless of the patient's level of consciousness.

Data Collection

All subjects completed a survey the day after their surgery (see Appendix E). Survey questions were answered using a 12-point Likert scale. Most surveys were collected around lunch time, as patients were usually awake. Patients who were sleeping when the survey was first attempted were not awakened, and a second attempt was made later the same day. Surveys for the control and experimental groups were identical except for one question pertaining to the perceived effectiveness of music therapy.

Data other than that collected by the survey were collected from patients' medical charts. Information collected from the chart included age, height, weight, length of PACU stay, length of hospital stay, pain medication administered, increased surgery risks (e.g. obesity, tobacco use, etc.), and any complications (see Appendix F). All chart data were collected by the researcher.

CHAPTER 3

Results

An initial N of 57 was reduced to 50 after all data collection was complete. One subject was removed from data analysis due to heavy bleeding complications that resulted in a second, emergency surgery. An experimental subject was excluded because the patient did not receive the treatment (due to the researcher not being notified). Another experimental subject did not receive the treatment due to severe respiratory distress. A control subject could not complete the survey on the first postoperative day due to extreme pain. A 78 year old patient was excluded due to severe postoperative confusion and delirium. And one subject from each group did not complete the survey before being discharged.

Amount of pain medication administered was analyzed in morphine equivalents. An equianalgesic chart (McCaffery & Pasero, 1999) was referenced to compute appropriate conversions for each medication (See Appendix G). Medications included in analysis were classified as either an opioid or nonsteroidal anti-inflammatory drug. Opioid drugs not included in analysis were belladonna and opium suppositories and Fentanyl. The mean amount of Fentanyl was identical for both groups. No concrete equianalgesic data could be located for converting B&O suppositories to morphine equivalents. B&O was given to patients for bladder spasms; however the opium has an analgesic effect. The mean for the music and control groups for B&O were nearly identical, with statistical analysis showing no significant difference between groups. See Table 3 for a complete list of analyzed medications.

All drugs included in the study analysis were administered parenterally (IV/PCA) or orally. Doses were charted in milligrams except for Dilaudid, which was converted from milliliters to milligrams. Percocet was given in tablets containing 325 mg acetaminophen (non-opioid) and 5 mg oxycodone (opioid). Only the amount of oxycodone was analyzed. Ketorolac was included in analysis because of its effectiveness and use in treating breakthrough pain in the

early postoperative period. Also, documentation exists in professional literature for converting ketorolac to morphine equivalents (American Pain Society, 2003).

Table 3

Medications Included in Analysis

Opioids	<i>Administration method</i>	
	Parenteral	Oral
Morphine	✓	
Hydromorphone (Dilaudid)	✓	
Meperidine (Demerol)	✓	✓
Oxycodone (in Percocet)		✓
Nonsteroidal anti-inflammatory drugs		
Ketorolac	✓	

Total morphine equivalents administered for the music and control groups was analyzed using an independent samples t-test. Results indicated no statistically significant difference between groups, although the mean for the music group was lower than the control group (music mean = 63.54, control mean = 64.23, $t = -.098$).

The length of hospital stay (LOS) was also analyzed using an independent samples t-test. The music group had a significantly shorter LOS ($t = -2.37$, $p < .05$), which was measured in whole days. Most patients were discharged between 0900 and 1700 hours. A full day was counted if patients were discharged after 1300 hours, and a day was not counted if patients were discharged before 1300 hours.

Perceptual data were analyzed by grouping related survey questions. Table 4 provides a complete listing of questions in their respective groups. The music group rated total perceived sleep since surgery higher than the control group, but a t-test analysis revealed no significant difference. PACU pain and post-PACU pain were analyzed using a Mann-Whitney U, and results showed a significantly lower post-PACU pain rating for the music group ($U = 193.0$, $p < .05$). There was no statistical difference between groups for PACU pain (music mean = 23.80, control mean = 22.16). Mann-Whitney U analysis of PACU comfort and hospital comfort revealed no differences between the music and control groups.

The average rating for music therapy on a scale of 0 (not effective) to 11 (very effective) was 8.69. See Table 5 for general statistics for the perceived effectiveness of music therapy.

Table 4

Grouping of Survey Questions

Questions	
Pain Level	
PACU Pain	Pain experienced in the PACU
Post-PACU Pain	Pain experienced after discharged from PACU
Pain Management	
PACU Management	Pain management in the PACU
Post-PACU Management	Pain management after discharged from PACU
Sleep	
Quality and Amount combined for a total score	Amount of sleep since surgery Quality of sleep since surgery
Comfort	
PACU Comfort	Overall comfort of PACU stay
Hospital Comfort	Overall comfort of hospital stay
Music Therapy	
Music therapy in the PACU	

Table 5

Music Therapy Effectiveness

Descriptive Statistics	
Mean	8.69
Median	9.00
Mode	9
Std. Deviation	2.10
Range Min.	4
Range Max.	11

Pearson’s Correlation was applied to the music group (see Table 6) and the control group (see Table 7) for all survey questions and total morphine equivalents administered. For the music group, there was a significant positive correlation between effectiveness of music therapy

and comfort level in the PACU ($r = .677, p < .01$). A significant positive correlation was also indicated for music therapy and post-PACU pain management ($r = .435, p < .05$). Other significant correlations included a positive correlation between hospital comfort and quality of sleep ($r = .618, p < .01$), a positive correlation between hospital comfort and amount of sleep ($r = .501, p < .05$), and a negative correlation between total morphine equivalents and PACU pain management ($r = -.459, p < .05$).

The control group also revealed significant positive correlations for hospital comfort and quality of sleep ($r = .460, p < .05$), and hospital comfort and amount of sleep ($r = .605, p < .01$). A significant negative correlation between total morphine equivalents and PACU comfort was noted ($r = -.456, p < .05$).

Prior research (Moddeman, 2000) indicated a relationship between age and amount of medication administered, with a higher age yielding less medication. A Pearson's Correlation was calculated for both groups for age and total morphine equivalents. Results revealed a negative correlation for the music group ($r = -.482, p < .05$) and the control group ($r = -.545, p < .01$).

Table 6

Music Group Correlations

		Total Morphine Equiv	PACU Pain	Music Therapy	PACU Manage	PACU Comfort	Pain Post	Post Manage	Quality Sleep	Amount Sleep	Hospital Comfort
Total Morphine Equiv	Pearson Correlation	1	-.347	-.064	-.459*	.076	-.210	-.248	-.374	.136	-.193
	Sig. (2-tailed)		.105	.784	.036	.736	.324	.243	.065	.518	.355
	N	25	23	21	21	22	24	24	25	25	25
PACU Pain	Pearson Correlation	-.347	1	.367	.711**	.486*	.113	-.058	.294	-.092	.333
	Sig. (2-tailed)	.105		.102	.000	.022	.608	.794	.174	.675	.120
	N	23	23	21	21	22	23	23	23	23	23
Music Therapy	Pearson Correlation	-.064	.367	1	.395	.677**	.217	.435*	.004	-.002	.295
	Sig. (2-tailed)	.784	.102		.085	.001	.345	.049	.987	.991	.195
	N	21	21	21	20	20	21	21	21	21	21
PACU Manage	Pearson Correlation	-.459*	.711**	.395	1	.565**	.347	.232	.275	-.207	.422
	Sig. (2-tailed)	.036	.000	.085		.009	.123	.312	.228	.368	.057
	N	21	21	20	21	20	21	21	21	21	21
PACU Comfort	Pearson Correlation	.076	.486*	.677**	.565**	1	.380	.185	.088	.071	.298
	Sig. (2-tailed)	.736	.022	.001	.009		.081	.410	.697	.755	.178
	N	22	22	20	20	22	22	22	22	22	22
Pain Post	Pearson Correlation	-.210	.113	.217	.347	.380	1	.239	.292	.164	.144
	Sig. (2-tailed)	.324	.608	.345	.123	.081		.261	.166	.443	.503
	N	24	23	21	21	22	24	24	24	24	24
Post Manage	Pearson Correlation	-.248	-.058	.435*	.232	.185	.239	1	.266	.112	.382
	Sig. (2-tailed)	.243	.794	.049	.312	.410	.261		.209	.601	.065
	N	24	23	21	21	22	24	24	24	24	24
Quality Sleep	Pearson Correlation	-.374	.294	.004	.275	.088	.292	.266	1	.708**	.618**
	Sig. (2-tailed)	.065	.174	.987	.228	.697	.166	.209		.000	.001
	N	25	23	21	21	22	24	24	25	25	25
Amount Sleep	Pearson Correlation	.136	-.092	-.002	-.207	.071	.164	.112	.708**	1	.501*
	Sig. (2-tailed)	.518	.675	.991	.368	.755	.443	.601	.000		.011
	N	25	23	21	21	22	24	24	25	25	25
Hospital Comfort	Pearson Correlation	-.193	.333	.295	.422	.298	.144	.382	.618**	.501*	1
	Sig. (2-tailed)	.355	.120	.195	.057	.178	.503	.065	.001	.011	
	N	25	23	21	21	22	24	24	25	25	25

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

Table 7

Control Group Correlations

		Total Morphine Equiv	PACU Pain	PACU Manage	PACU Comfort	Pain Post	Post Manage	Quality Sleep	Amount Sleep	Hospital Comfort
Total Morphine Equiv	Pearson Correlation	1	-.240	-.363	-.456*	-.508**	-.347	-.347	-.156	-.396
	Sig. (2-tailed)		.282	.097	.025	.009	.097	.090	.458	.050
	N	25	22	22	24	25	24	25	25	25
PACU Pain	Pearson Correlation	-.240	1	.720**	.590**	.094	-.103	.205	.225	.376
	Sig. (2-tailed)	.282		.000	.004	.678	.657	.359	.314	.085
	N	22	22	22	22	22	21	22	22	22
PACU Manage	Pearson Correlation	-.363	.720**	1	.689**	.010	-.006	.312	.241	.462*
	Sig. (2-tailed)	.097	.000		.000	.964	.979	.158	.280	.030
	N	22	22	22	22	22	21	22	22	22
PACU Comfort	Pearson Correlation	-.456*	.590**	.689**	1	.384	.285	.375	.205	.386
	Sig. (2-tailed)	.025	.004	.000		.064	.188	.071	.337	.062
	N	24	22	22	24	24	23	24	24	24
Pain Post	Pearson Correlation	-.508**	.094	.010	.384	1	.647**	.550**	.332	.387
	Sig. (2-tailed)	.009	.678	.964	.064		.001	.004	.105	.056
	N	25	22	22	24	25	24	25	25	25
Post Manage	Pearson Correlation	-.347	-.103	-.006	.285	.647**	1	.393	.250	.094
	Sig. (2-tailed)	.097	.657	.979	.188	.001		.057	.238	.663
	N	24	21	21	23	24	24	24	24	24
Quality Sleep	Pearson Correlation	-.347	.205	.312	.375	.550**	.393	1	.760**	.460*
	Sig. (2-tailed)	.090	.359	.158	.071	.004	.057		.000	.021
	N	25	22	22	24	25	24	25	25	25
Amount Sleep	Pearson Correlation	-.156	.225	.241	.205	.332	.250	.760**	1	.605**
	Sig. (2-tailed)	.458	.314	.280	.337	.105	.238	.000		.001
	N	25	22	22	24	25	24	25	25	25
Hospital Comfort	Pearson Correlation	-.396	.376	.462*	.386	.387	.094	.460*	.605**	1
	Sig. (2-tailed)	.050	.085	.030	.062	.056	.663	.021	.001	
	N	25	22	22	24	25	24	25	25	25

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

CHAPTER 4

Discussion

This study yielded many interesting results that should be taken into consideration for further research in the area of music therapy in the PACU. While the t-test analysis did not show a significant difference between groups for total morphine equivalents, there were several statistically significant differences that indicate positive benefits of music therapy. The length of hospital stay was significantly shorter for the music group. A fast yet effective treatment time is of interest to hospitals and other healthcare facilities. Patients in the music group who rated music therapy as very effective also rated their comfort level in the PACU significantly higher than the control group. Hospitals are generally interested in their patients' perceived comfort levels throughout their hospital stay, as evidenced by hospitals asking patients to complete surveys before being discharged. Patients who remember a good experience may be more likely to choose the same facility in the future.

Post-PACU pain levels were rated significantly lower by patients in the music group. This finding is intriguing considering there were no differences in the actual amount of pain medication administered/requested. Patients in the music group may have been taking medication they did not need to control their pain. Possible reasons for this may be the fear of pain reaching an uncontrollable level if pharmacological therapy does not remain on schedule.

The researcher returned to the data and analyzed the amount of pain medication for the PACU, the first 24 hours post-surgery, and the second 24 hours post-surgery. The mean was lower for the music group, however, the gap between the music group and control group continued to close as time progressed. This trend indicates future studies may want to include a second music therapy and deep breathing session with patients the day after surgery, and possibly two days depending on length of stay. A session the day after surgery may be more effective, as patients will be able to focus more on the treatment. The length of time a person is conscious during the initial music therapy session in the PACU may also impact its

effectiveness. This variable, however, would be extremely difficult to measure. The researcher encountered several instances when it appeared as though the patient was sleeping, only for the patient to make a comment about the music between songs.

Another result worth noting is the negative correlation in the music group between total morphine equivalents and the PACU pain management rating. One explanation may be that patients who experienced extreme pain in the PACU were given more pain medication, but because they remembered being in extreme pain, they gave PACU pain management a low rating.

Other significantly correlated results indicated by this study are to be expected. The control group and the experimental group both had significant positive correlations between amount of sleep and quality of sleep. These results indicate subjects think of amount and quality of sleep similarly. The control group also showed a significant negative correlation between total morphine equivalents and post-PACU pain levels. The more medication they took the less pain they perceived, as one would expect the results to produce. Finally, the significant negative correlation between total morphine equivalents and age is consistent with previous research (Moddeman, 2000). Moddeman cites explanations by Hofland (1992), who lists fear of addiction and effective coping strategies in older adults as possible reasons for less analgesic use.

The researcher noted several observations throughout the course of the study. All hospital staff involved in the research were extremely positive toward music therapy in the PACU. The PACU nurses often made comments after a favorite song was played, and some even sang harmony with the researcher. Upon seeing the researcher enter the unit nurses would say, "Oh good! We get music today!" The researcher recalls walking in on a particularly hectic day in the PACU. Nurses were moving quickly, pagers were sounding, phones were ringing, and voices were at a high level. Within ten minutes of the music starting the atmosphere became more relaxed, and a few staff members even commented on the difference they felt music had on the environment.

Patients in the music group often made comments to the researcher when completing the survey the day after surgery. One patient stated, "I am so glad you were there. The pain meds were not working, but once the music started I just focused on that and began to relax." Another patient said she found the music soothing, and she believes the music helped her wake up from the anesthesia. Other patients wished everyone could receive music as they wake up from

surgery. Some subjects were more alert in the PACU than others. One patient began requesting songs, maintained eye contact, and reflected a positive affect during the entire session. Other patients rested with their eyes closed and mouthed the words to the song being played. Many who woke up hearing the music initially had a look of confusion, and then smiled in recognition when they realized the source of the music.

Patient-preferred music has been shown to be more effective; however it is imperative to speak with the patient about their preferences before the surgery. For obvious reasons, obtaining this information in the PACU is not feasible. The stress and anxiety of an upcoming surgery may also change music preferences. One patient shared that she goes to church every Sunday, but she wanted nothing to do with religious music while waking up from surgery. Others swayed the opposite direction, requesting one type of music before surgery and requesting religious music while in the PACU. One patient requested all religious music during her pre-operative appointment, but this genre brought tears to her eyes in the PACU. An emotional response of this nature is contraindicated during a time when a patient's vital signs and physiological responses need to return to baseline levels. A general music preference may not hold true, so it is important that a music therapist be prepared to adapt to the needs of patients while in the PACU.

While a large amount of research with recorded music in the PACU exists, the area of live music paired with a relaxation technique is still new. Prior research with recorded music can be divided into two categories based on results: studies finding no significant differences in pain (Heitz, Symreng, & Scamman, 1992; Heiser, Chiles, Fudge, & Gray, 1997; Taylor, Kuttler, Parks, & Milton, 1998) and studies finding a significant decrease in pain perception for the treatment groups (Shertzer & Keck, 2001; Good, Anderson, Stanton-Hicks, Gras, & Makii, 2002; Nilsson, Rawal, Enqvist, & Unosson, 2003; Laurion & Fetzer, 2003). All studies measured patients' perception of pain; however different rating methods were used. One of the studies reporting no differences in pain noted patients' positive remarks of music aiding in relaxation (Heiser et al.), while another study found patients who received music remembered their PACU stay as significantly more pleasant (Heitz et al.). The present study found no significant differences in PACU comfort levels, however there was a significant positive correlation between perception of PACU comfort and perception of music therapy effectiveness. Studies reporting a significant decrease in perceived pain compared pain scores upon admission to the

PACU with pain scores upon discharge from PACU. Only one study (Nilsson et al.) measured total morphine equivalents and found no significant differences between experimental and control groups. These results are congruent with the results of the current study – a significant difference in post-PACU pain scores, but no significant difference in total morphine equivalents.

The results of this study call for further research in the area of live music in the post anesthesia care unit. Future studies might consider including an additional music therapy session on the first postoperative day. Tighter control of the types of procedures included in the study may result in a significant difference for pain medication, due to equivalent incision size and site across subjects yielding a more similar pain experience. Researchers may find new and/or different results with replication, and additional studies involving live music in the PACU are certainly indicated.

APPENDIX A

Human Subjects Committee Approval



Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2763
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 8/26/2004

To:

Kristen Adams
210 Westwood Dr
Tallahassee, FL 32304

Dept.: MUSIC SCHOOL

From: John Tomkowiak, Chair

A handwritten signature in black ink that reads "John Tomkowiak M.D.".

Re: **Use of Human Subjects in Research**
The effects of music therapy and deep breathing on pain in patients recovering from gynecologic surgery in the PACU

The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Exempt per 45 CFR § 46.101(b) 2 and has been approved by an accelerated review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If the project has not been completed by **8/25/2005** you must request renewed approval for continuation of the project.

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is IRB00000446.

Cc: Dr. Jayne Standley
HSC No. 2004.437

APPENDIX B

IRB Approval



Tallahassee Memorial
HealthCare

Institutional Review Board 1300 Miccosukee Road
Tallahassee, Florida 32308
850-431-5122
850-431-6489 Fax

July 2, 2004

Kristen S. Adams, MT-BC
TMH Music Therapy Dept.
1331 E. 6th Avenue
Tallahassee, FL 32303

IRB# 2004-10

Dear Ms. Adams:

I have reviewed your study entitled, "The effects of music therapy and deep breathing on pain in patients recovering from gynecologic surgery in the PACU".

I find that the study meets the criteria for Expedited Review and with receipt of this letter you are advised that you may proceed with your study at Tallahassee Memorial HealthCare. At completion of your study and after the data has been analyzed, please forward a copy of your results to the Medical Staff Office so that the findings can be shared with the Institutional Review Board.

Sincerely,

Richard I. MacArthur, M.D., MS
VP/Chief Medical Officer
Administrative Liaison/IRB

VHA
Member of the Voluntary
Hospitals of America (VHA)
System

APPENDIX C

Informed Consent

Informed Consent Music Group

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled “The effects of music therapy and deep breathing on pain in patients recovering from gynecologic surgery in the PACU.”

This research is being conducted by Kristen Adams, MT-BC, who is a master’s student at the Florida State University under the direction of Jayne Standley, PhD, MT-BC. I understand the purpose of her research project is to better understand the effects patient-preferred music has on pain. I understand that if I participate in the project I will receive live music while in the Post Anesthesia Care Unit and be directed in deep breathing techniques.

I am aware that my name will not be on data forms, that I will be identified by subject number only. I understand my medical chart will be reviewed for demographic information and prescribed medications, related to my current hospital stay only, to the extent allowed by law. The information will be reviewed by the researcher and directing professor only and will be kept confidential and secured in the music therapy clinical office. I also understand I will be asked to complete a short survey the day after surgery. My name will not appear on any of the results. No individual results will be reported, only group findings will be reported. All data will be destroyed upon completion of the study.

I understand there are minimal risks involved in participation of this study. I understand there is a possibility for me to find music irritating while recovering from general anesthesia.

I also understand there are benefits for participating in this research project. I may find my recovery to be more pleasant while listening to live music. I understand the information collected during the study may aid health care professionals with valuable insight into improved recovery after surgery.

I understand my participation is completely voluntary. I may choose not to participate, or I may withdraw from participation at any time without prejudice, penalty, or loss of benefits. I have been given the right to ask questions concerning this study. Questions, if any, have been answered to my satisfaction.

I understand I may contact Kristen Adams or Jayne Standley, (850) 644-4565, for answers to questions about this research. Further information is available by contacting the Florida State University Office of Research at (850) 644-9695. Group results will be made available to me upon my request.

I have read and understand this consent form in its entirety.

(Subject)

(Date)

Informed Consent Control Group

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled “The effects of music therapy and deep breathing on pain in patients recovering from gynecologic surgery in the PACU.”

This research is being conducted by Kristen Adams, MT-BC, who is a master’s student at the Florida State University under the direction of Jayne Standley, PhD, MT-BC. I understand the purpose of her research project is to better understand the effects patient-preferred music has on pain.

I am aware that my name will not be on data forms, that I will be identified by subject number only. I understand my medical chart will be reviewed for demographic information and prescribed medications, related to my current hospital stay only, to the extent allowed by law. The information will be reviewed by the researcher and directing professor only and will be kept confidential and secured in the music therapy clinical office. I also understand I will be asked to complete a short survey the day after surgery. My name will not appear on any of the results. No individual results will be reported, only group findings will be reported. All data will be destroyed upon completion of the study.

I understand my participation is completely voluntary. I may choose not to participate, or I may withdraw from participation at any time without prejudice, penalty, or loss of benefits. I have been given the right to ask questions concerning this study. Questions, if any, have been answered to my satisfaction.

I understand I may contact Kristen Adams or Jayne Standley, (850) 644-4565, for answers to questions about this research. Further information is available by contacting the Florida State University Office of Research at (850) 644-9695. Group results will be made available to me upon my request.

I have read and understand this consent form in its entirety.

(Subject)

(Date)

APPENDIX D

Music Preference Form

Please indicate your music preferences below by placing an "x" in the box.

Styles

- Country
- Jazz
- Rock
- Gospel/Hymns
- R&B
- Other: _____

Decades

- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- Current

Please list some of your preferred artists and/or songs.

Artists

Songs

APPENDIX E

Patient Surveys

Patient Survey – Music Group

Please respond to the following statements by circling the corresponding number.

Pain experienced in the PACU

Extreme Pain 0 1 2 3 4 5 6 7 8 9 10 11 No Pain

Pain management in the PACU

No Relief 0 1 2 3 4 5 6 7 8 9 10 11 Complete Relief

Music therapy in the PACU

Not Effective 0 1 2 3 4 5 6 7 8 9 10 11 Very Effective

Overall comfort of PACU stay

Not Comfortable 0 1 2 3 4 5 6 7 8 9 10 11 Very Comfortable

Pain experienced after discharged from PACU

Extreme Pain 0 1 2 3 4 5 6 7 8 9 10 11 No Pain

Pain management after discharged from PACU

No Relief 0 1 2 3 4 5 6 7 8 9 10 11 Complete Relief

Amount of sleep since surgery

No Sleep 0 1 2 3 4 5 6 7 8 9 10 11 Abundant Sleep

Quality of sleep since surgery

Poor Quality 0 1 2 3 4 5 6 7 8 9 10 11 High Quality

Overall comfort of hospital stay

Not Comfortable 0 1 2 3 4 5 6 7 8 9 10 11 Very Comfortable

Patient Survey – Control Group

Please respond to the following statements by circling the corresponding number.

Pain experienced in the PACU

Extreme Pain 0 1 2 3 4 5 6 7 8 9 10 11 No Pain

Pain management in the PACU

No Relief 0 1 2 3 4 5 6 7 8 9 10 11 Complete Relief

Overall comfort of PACU stay

Not Comfortable 0 1 2 3 4 5 6 7 8 9 10 11 Very Comfortable

Pain experienced after discharged from PACU

Extreme Pain 0 1 2 3 4 5 6 7 8 9 10 11 No Pain

Pain management after discharged from PACU

No Relief 0 1 2 3 4 5 6 7 8 9 10 11 Complete Relief

Amount of sleep since surgery

No Sleep 0 1 2 3 4 5 6 7 8 9 10 11 Abundant Sleep

Quality of sleep since surgery

Poor Quality 0 1 2 3 4 5 6 7 8 9 10 11 High Quality

Overall comfort of hospital stay

Not Comfortable 0 1 2 3 4 5 6 7 8 9 10 11 Very Comfortable

APPENDIX F

Data Collection Form

APPENDIX G

Equianalgesic Dose Chart

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TABLE 6.12

EQUIANALGESIC DOSE CHART

A Guide to Using Equianalgesic Dose Charts

- Equianalgesic means approximately the same pain relief.
- The equianalgesic chart is a guideline. Doses and intervals between doses are titrated according to individual's response.
- The equianalgesic chart is helpful when switching from one drug to another or switching from one route of administration to another.
- Dosages in this equianalgesic chart are not necessarily starting doses. They suggest a ratio for comparing the analgesia of one drug to another.
- The longer the patient has been receiving opioids, the more conservative the starting doses of a new opioid. (See discussion on conversion charts p. 174.)

Opioid	Parenteral (IM/SC/IV) (over ~ 4 h)	Oral (PO) (over ~ 4 h)	Onset (min)	Peak (min)	Duration ¹ (h)	Half-life (h)
Mu Agonists						
Morphine	10 mg	30 mg	30-60 (PO) 30-60 (CR) ² 30-60 (R) 5-10 (IV) 10-20 (SC) 10-20 (IM)	60-90 (PO) 90-180 (CR) ² 60-90 (R) 15-30 (IV) 30-60 (SC) 30-60 (IM)	3-6 (PO) 8-12 (CR) ² 4-5 (R) 3-4 (IV) ^{1,3} 3-4 (SC) 3-4 (IM)	2-4
Codeine	130 mg	200 mg NR	30-60 (PO) 10-20 (SC) 10-20 (IM)	60-90 (PO) UK (SC) 30-60 (IM)	3-4 (PO) 3-4 (SC) 3-4 (IM)	2-4
Fentanyl	100 µg/h parenterally and transdermally ≡ 4 mg/h morphine parenterally; 1 µg/h transdermally ≡ morphine 2 mg/24 h orally	—	5 (OT) 1-5 (IV) 7-15 (IM) 12-16 h (TD)	15 (OT) 3-5 (IV) 10-20 (IM) 24 h (TD)	2-5 (OT) 0.5-4 (IV) ^{1,3} 0.5-4 (IM) 48-72 (TD)	3-4 ⁴ ; 13-24 (TD)
Hydrocodone (as in Vicodin, Lortab)	—	30 mg ⁵ NR	30-60 (PO)	60-90 (PO)	4-6 (PO)	4
Hydromorphone (Dilaudid)	1.5 mg ⁶	7.5 mg	15-30 (PO) 15-30 (R) 5 (IV) 10-20 (SC) 10-20 (IM)	30-90 (PO) 30-90 (R) 10-20 (IV) 30-90 (SC) 30-90 (IM)	3-4 (PO) 3-4 (R) 3-4 (IV) ^{1,3} 3-4 (SC) 3-4 (IM)	2-3
Levorphanol (Levo-Dromoran)	2 mg	4 mg	30-60 (PO) 10 (IV) 10-20 (SC) 10-20 (IM)	60-90 (PO) 15-30 (IV) 60-90 (SC) 60-90 (IM)	4-6 (PO) 4-6 (IV) ^{1,3} 4-6 (SC) 4-6 (IM)	12-15
Meperidine (Demerol)	75 mg	300 mg NR	30-60 (PO) 5-10 (IV) 10-20 (SC) 10-20 (IM)	60-90 (PO) 10-15 (IV) 15-30 (SC) 15-30 (IM)	2-4 (PO) 2-4 (IV) ^{1,3} 2-4 (SC) 2-4 (IM)	2-3

May be duplicated for use in clinical practice. From McCaffery M, Pasero C: *Pain: Clinical manual*, pp. 241-243. Copyright © 1999, Mosby, Inc. Continued.

● ● ● ● ●
TABLE 6.12—cont'd

EQUIANALGESIC DOSE CHART—cont'd						
Opioid	Parenteral (IM/SC/IV) (over ~ 4 h)	Oral (PO) (over ~ 4 h)	Onset (min)	Peak (min)	Duration ¹ (h)	Half-life (h)
Mu Agonists						
Methadone (Dolophine)	10 mg ⁷	20 mg ⁸	30-60 (PO) UK (SL) 10 (IV) 10-20 (SC) 10-20 (IM)	60-120 (PO) 10 (SL) UK (IV) 60-120 (SC) 60-120 (IM)	4-8 (PO) UK (SL) 4-8 (IV) ^{1,3} 4-8 (SC) 4-8 (IM)	12-190
Oxycodone (as in Percocet, Tylox)	—	20 mg	30-60 (PO) 30-60 (CR) ⁹ 30-60 (R)	60-90 (PO) 90-180 (CR) ⁹ 30-60 (R)	3-4 (PO) 8-12 (CR) ⁹ 3-6 (R)	2-3 4.5 (CR)
Oxymorphone (Numorphan)	1 mg	(10 mg R)	15-30 (R) 5-10 (IV) 10-20 (SC) 10-20 (IM)	120 (R) 15-30 (IV) UK (SC) 30-90 (IM)	3-6 (R) 3-4 (IV) ^{1,3} 3-6 (SC) 3-6 (IM)	2-3
Propoxyphene ¹⁰ (Darvon)	—	—	30-60 (PO)	60-90 (PO)	4-6 (PO)	6-12
Agonist- antagonists						
Buprenorphine ¹¹ (Buprenex)	0.4 mg	—	5 (SL) 5 (IV) 10-20 (IM)	30-60 (SL) 10-20 (IV) 30-60 (IM)	UK (SL) 3-4 (IV) ^{1,3} 3-6 (IM)	2-3
Butorphanol ¹¹ (Stadol)	2 mg	—	5-15 (NS) ¹² 5 (IV) 10-20 (IM)	60-90 (NS) 10-20 (IV) 30-60 (IM)	3-4 (NS) 3-4 (IV) ^{1,3} 3-4 (IM)	3-4
Dezocine (Dalgan)	10 mg	—	5 (IV) 10-20 (IM)	UK (IV) 30-60 (IM)	3-4 (IV) ^{1,3} 3-4 (IM)	2-3
Nalbuphine ¹¹ (Nubain)	10 mg	—	5 (IV) <15 (SC) <15 (IM)	10-20 (IV) UK (SC) 30-60 (IM)	3-4 (IV) ^{1,3} 3-4 (SC) 3-4 (IM)	5
Pentazocine ¹¹ (Talwin)	60 mg	180 mg	15-30 (PO) 5 (IV) 15-20 (SC) 15-20 (IM)	60-180 (PO) 15 (IV) 60 (SC) 60 (IM)	3-4 (PO) 3-4 (IV) ^{1,3} 3-4 (SC) 3-4 (IM)	2-3

May be duplicated for use in clinical practice. From McCaffery M, Pasero C: *Pain: Clinical manual*, pp. 241-243. Copyright © 1999, Mosby, Inc. Continued.
Table 6.12 provides equianalgesic doses and pharmacokinetic information about selected opioid drugs. Characteristics and comments about selected mu opioid agonist drugs can be found in Table 6.3, pp. 179-180.

ATC, around-the-clock; CR, oral controlled-release; h, hour; IM, intramuscular; IV, intravenous; μ g, microgram; mg, milligram; min, minute; NR, not recommended; NS, nasal spray; OT, oral transmucosal; PO, oral; R, rectal; SC, subcutaneous; SL, sublingual; TD, transdermal; UK, unknown.

¹Duration of analgesia is dose dependent; the higher the dose, usually the longer the duration.

²As in, e.g., MS Contin.

³IV boluses may be used to produce analgesia that lasts approximately as long as IM or SC doses. However, of all routes of administration, IV produces the highest peak concentration of the drug, and the peak concentration is associated with the highest level of toxicity (e.g., sedation). To decrease the peak effect and lower the level of toxicity, IV boluses may be administered more slowly (e.g., 10 mg of morphine over a 15-minute period) or smaller doses may be administered more often (e.g., 5 mg of morphine every 1-1.5 hours).

⁴At steady state, slow release of fentanyl from storage in tissues can result in a prolonged half-life of up to 12 h.

⁵Equianalgesic data not available.

⁶The recommendation that 1.5 mg of parenteral hydromorphone is approximately equal to 10 mg of parenteral morphine is based on single dose studies. With repeated dosing of hydromorphone (e.g., PCA), it is more likely that 2-3 mg of parenteral hydromorphone is equal to 10 mg of parenteral morphine.

● ● ● ● ●
TABLE 6.12—cont'd

EQUIANALGESIC DOSE CHART—cont'd

May be duplicated for use in clinical practice. From McCaffery M, Pasero C: *Pain: Clinical manual*, pp. 241-243. Copyright © 1999, Mosby, Inc.

² In opioid-tolerant patients converted from continuous IV hydromorphone to continuous IV methadone, start with 10%-25% of the equianalgesic dose.

³ In opioid-tolerant patients converted to methadone, start PO dosing PRN with 10%-25% of equianalgesic dose.

⁴ As in, e.g., OxyContin.

⁵ 65-130 mg=approximately 1/6th of all doses listed in this chart.

⁶ Used in combination with mu agonists, may reverse analgesia and precipitate withdrawal in opioid-dependent patients.

⁷ In opioid-naïve patients who are taking occasional mu agonists, such as codeine or oxycodone, the addition of bupropion nasal spray may provide additive analgesia. However, in opioid-tolerant patients, such as those receiving ATC morphine, the addition of bupropion nasal spray should be avoided because it may reverse analgesia and precipitate withdrawal.

NOTE: This equianalgesic chart is based on the clinical experience of the chapter authors and the following references:

Information from American Pain Society (APS): *Principles of analgesic use in the treatment of acute and cancer pain*, ed 3, Glenview, IL, 1992, APS; Berryman D, Marketing Manager, Anesta Corp, Salt Lake City, UT: Personal communication by telephone with Chris Pasero, August 21, 1997; Bruera E, Pereira J, Watanabe S et al.: Opioid rotation in patients with cancer pain, *Cancer* 78(4):857, 1996; Coda BA, O'Sullivan B, Donaldson G et al.: Comparative efficacy of patient-controlled administration of morphine, hydromorphone, or sufentanil for the treatment of oral mucositis pain after bone marrow transplantation, *Pain* 72:333-346, 1997; Coda BA, Tanaka A, Jacobson RC et al.: Hydromorphone analgesia after intravenous bolus administration, *Pain* 71(1):41-48, 1997; Deglin JH, Vallerand AH: *Davis' drug guide*, ed 5, Philadelphia, 1995, FA Davis; *Drug facts and comparisons*, St. Louis, 1996, Walters Kluwer Co; Dunbar PJ, Chapman CR, Buckley FP et al.: Clinical analgesic equivalence for morphine and hydromorphone with prolonged PCA, *Pain* 68:226-270, 1996; Glare PA, Walsh TD: Dose-ranging study of oxycodone for chronic pain in advanced cancer, *J Clin Oncol* 11(5):973-978, 1993; Foley KM: The treatment of cancer pain, *N Engl J Med* 313:84-95, 1985; Foley KM, Inturrisi CE: Opioid therapy: General principles, advances, controversies, alternative routes and methods of administration, *Syllabus of the Postgraduate Course*, Memorial Sloan-Kettering Cancer Center, New York, NY, April 2-3, 1992; Kaiko RF, Lacouture P, Hopf K et al.: Analgesic onset and potency of oral controlled release (CR) oxycodone CR and morphine, *Clin Pharmacol Ther* 59(2):130-133, 1996; Lawlor P, Turner K, Hanson J et al.: Dose ratio between morphine and hydromorphone in patients with cancer pain: A retrospective study, *Pain* 72(1,2):79-85, 1997; Manfredi PL, Borsook D, Chandler SW et al.: Intravenous methadone for cancer pain unrelieved by morphine and hydromorphone: Clinical observations, *Pain* 70:99-101, 1997; Portenoy RK: Opioid analgesics. In Portenoy RK, Kanner RM, editors: *Pain management: Theory and practice*, pp 249-276, Philadelphia, 1996, FA Davis; Reisine T, Pasternak G: Opioid analgesics and antagonists. In Hardman JG, Limbird LE, editors: *Goodman and Gilman's the pharmacological basis of therapeutics*, ed 9, pp 521-555, New York, 1996, McGraw-Hill; Vogelsang J, Hayes SR: Bupropion tartrate (Stadol): A review, *J Post Anesthesia Nurs* 6(2):129-135, 1991; Weinberg DS, Inturrisi CE, Reidenberg B et al.: Sublingual absorption of selected opioid analgesics, *Clin Pharmacol Ther* 44:335-342, 1988; Wilson JM, Cohen RI, Kezer EA et al.: Single and multiple-dose pharmacokinetics of dezocine in patients with acute and chronic pain, *J Clin Pharmacol* 35:395-403, 1995.

- The appropriate starting dose for moderate pain is 50% of the starting dose for severe pain. The calculation is $1.5 \text{ mg} \times 50\%$ (or $1.5 \text{ mg} \div 2$) = 0.75 mg.
- The appropriate starting dose for patient No. 2 is 0.75 mg of hydromorphone by the IV route over 4 h.
- The calculation for the first bolus is $0.75 \text{ mg} \div 4$ (1/4 of the 4 h dose) = approximately 0.2 mg, titrating up or down using larger or smaller boluses depending on patient response (pain intensity and side effects).

Patient No. 3

- Steps 1 to 2 outlined for patient No. 1 are followed.
- Patient No. 3 reports a pain rating of 3/10 or mild pain.
- The appropriate starting dose for mild pain is 25% of the starting dose for severe pain. The calculation is $1.5 \text{ mg} \times 25\%$ (or $1.5 \text{ mg} \div 4$) = 0.375 mg.
- The appropriate starting dose for patient No. 3 is approximately 0.4 mg of hydromorphone by the IV route over 4 h.
- The calculation for the first bolus is $0.4 \text{ mg} \div 4$ (1/4 of the 4 h dose) = approximately 0.1 mg, titrating up or down using larger or smaller boluses depending on patient response (pain intensity and side effects).

As mentioned, the doses in the equianalgesic chart are made on the basis of a 4-hour dosing schedule. To determine the appropriate starting dose when the dosing schedule is other than every 4 hours, other calculations are necessary.

Patient Example

Mr. H. has cancer pain. Until now he has been controlling his pain with two Percocet (oxycodone, 5 mg, plus acetaminophen, 325 mg, per tablet) q4h ATC. He reports that his pain has been increasing. He rates his pain as 6/10. The decision is made to begin treatment with oral controlled-release oxycodone. The clinician calculates Mr. H.'s starting dose as follows:

- $10 \text{ mg oxycodone (2 Percocet)} \times 6 \text{ doses/day} = 60 \text{ mg/day}$.
- $60 \text{ mg} \div 2$ (number of doses/24 h with 12 h dosing) = 30 mg.

Mr. H. is started on 30 mg controlled-release oxycodone q12h. Acetaminophen 650 mg is continued ATC. This will provide the same analgesia at more convenient dosing intervals for the opioid.

NOTE: This approach for managing Mr. H.'s pain is logical and conservative. Other approaches may be used (e.g., starting at a higher dose [40 mg] of controlled-release oxycodone).

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