

Effects of Music Therapy on Physiological and Psychological Outcomes for Patients Undergoing Cardiac Surgery

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Background: Cardiac surgery is a common interventional procedure for ischemic and valvular heart disease. Cardiac surgery is accompanied by postoperative pain and anxiety. The use of music therapy has been shown to reduce pain, anxiety, and physiological parameters in patients having surgical procedures.

Objectives: To compare the effects of music therapy versus a quiet, uninterrupted rest period on pain intensity, anxiety, physiological parameters, and opioid consumption after cardiac surgery. **Subjects and methods:** An experimental design was used. A total sample of 86 patients (69.8% males) were randomized to 1 of 2 groups; 50 patients received 20 minutes of music (intervention), whereas 36 patients had 20 minutes of rest in bed (control). Anxiety, pain, physiologic parameters, and opioid consumption were measured before and after the 20-minute period. **Results:** A significant reduction in anxiety ($P \leq .001$) and pain ($P = .009$) was demonstrated in the group that received music compared with the control group, but no difference was observed in systolic blood pressure ($P = .17$), diastolic blood pressure ($P = .11$), or heart rate ($P = .76$). There was no reduction in opioid usage in the 2 groups. **Conclusions:** Patients recovering from cardiac surgery may benefit from music therapy.

KEY WORDS: anxiety reduction, cardiac surgery, music therapy, pain

Coronary artery bypass (CAB) and valve replacement are 2 common cardiac surgical procedures performed more than 510,000 times a year in the United States.¹ Nurses and physicians recognize that cardiac surgery is accompanied by pain and anxiety. Patients reported chest incision pain as a problem after CAB,² and anxiety has been a common response

for patients undergoing CAB.³ In addition, pain and anxiety after cardiac surgery continue to be inadequately managed.³⁻⁵

The Agency for Healthcare Research and Quality (AHRQ)⁶ recommendations regarding pain management included cognitive-behavioral interventions such as relaxation, music, distraction, and imagery. These nonpharmacological interventions have been shown to reduce pain, anxiety, and the amount of drugs needed to control pain.⁶ Nonpharmacological interventions have been supported as effective for patients after myocardial infarction⁷⁻¹³ but have been rarely tested to manage pain and anxiety after cardiac surgery.

Review of the Literature

Several researchers have examined the effects of music or music with relaxation on patients who have experienced a cardiac event, such as a myocardial infarction or angina, and demonstrated significant reductions in heart rate (HR),^{8-10,13} systolic blood pressure,^{8,11} diastolic blood pressure,⁸ mean arterial blood pressure,¹¹ respiratory rate,^{9,10} myocardial oxygen demand,¹⁰ increased peripheral temperature,^{8,12} anxiety,^{7,9,10} happier emotional state or mood,^{11,12}

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and decreased incidence of cardiac complications.¹³ Further studies in patients waiting for cardiac catheterization¹⁴ and in patients on bed rest after cardiac procedural sheath insertion or intra-aortic balloon pump¹⁵ demonstrated significant reduction in blood pressure (BP),¹⁵ respiratory rate,¹⁵ anxiety,¹⁴ and psychological distress,¹⁵ whereas another study examining the effect of music on patients undergoing coronary angiogram found no difference in anxiety, pain intensity, HR, or BP when compared with the usual care group.¹⁶

In examining the effects of music on patients undergoing surgical procedures, some studies demonstrated decreases in anxiety,¹⁷⁻²⁰ pain,¹⁸⁻²³ pain distress,^{20,22} systolic BP,^{17,18,24} diastolic BP,^{17,24} HR,²¹ oxygen saturation,¹⁷ requirements of morphine sulfate,²¹ and mood shifting to a more desirable state of well-being,¹¹ whereas others found no difference in pain.²⁵

Summary of Literature Findings

A cardiac surgery population was the focus of this study because there is a large volume of patients undergoing cardiac surgery, the literature supporting both pain and anxiety as postoperative problems, and the affirmation of music therapy as an effective intervention for anxiety, pain, and physiological parameters. There is a beginning body of knowledge suggesting that music therapy positively affects psychological and physiologic outcomes for patients having myocardial infarction or surgery. In contrast, there is a paucity of studies of the effects of music on pain and/or anxiety in patients undergoing open-heart surgery. The purpose of this study was to test the effect of music therapy compared to rest in bed on patient's pain intensity, anxiety levels, HR, and BP, as well as opioid consumption on patients undergoing open-heart surgery (CAB and/or valve replacement).

Theoretical Framework

The idea that music therapy and guided imagery may reduce the pain experience by closing the gating mechanism is espoused by this study. The Gate Control Theory²⁶ advocates that pain impulses are transmitted from the nerve receptor to synapses in the gray matter (the substantial gelatinosa) of the dorsal horns of the spinal cord. The synapses are thought to act as gates²³ that may close to keep the impulses from reaching the brain or open to allow the impulses to ascend and therefore reach higher levels of conscious awareness of pain. Whether these gates are open or closed depends on what other kinds of sensory impulses are simultaneously bombarding the gates. Music therapy and guided imagery

may provide sufficient (deviation) sensory input to cause impulses from the brainstem to close the gating mechanism and thereby reduce the pain experience.

Methods

Research Question: The primary research question was: Does music therapy delivered on postoperative day(s) (POD) 1 to 3 decrease anxiety, pain levels, HR and BP, and amount of parenteral opioid equivalents consumed by patients undergoing cardiac surgery, compared with those patients who receive standard therapy (rest in bed)?

Design

A randomized, controlled trial was used.

Setting and Sample

Data were collected in cardiovascular units in 3 hospitals within 1 healthcare system in the Midwest where approximately 1,500 patients undergo cardiac surgery per year. All patients scheduled for non-emergent CAB and/or valve replacement surgeries were eligible for study participation. Exclusion criteria were non-English speaking, intubated, and physician-documented psychiatric disorder.

Measures

Demographic and Clinical Data

Demographic data, surgical information, and medication usage were collected from the patient's chart. Previous or current use of music therapy was asked as a yes or no question. All narcotics were changed to parenteral morphine equivalents and summed for POD 1 to 3.²⁷

Pain

Pain was defined as "an unpleasant sensory and emotional experience arising from actual or potential tissue damage or described in terms of such damage."^{6(p3)} Pain was measured by asking the patient to rate pain intensity on a scale from 0 to 10 (from "no pain" to "most pain possible"). The numeric rating scale has widespread use in clinical practice for the assessment of pain. Strong concurrent validity for the numeric rating scale of 0 to 10 has been documented with a correlation coefficient of 0.92 for a vertical visual analog scale and 0.91 for a verbal descriptor scale.²⁸

Anxiety

An abbreviated measure of anxiety, State Personality Inventory patterned after a parent instrument,^{29,30}

was used in order to reduce subject time and burden. The State Personality Inventory consists of 6 subscales substantiated by factor analysis: state anxiety, state anger, and state curiosity.²⁹

The 10-item State Anxiety Inventory has response anchors of 1 (not at all) to 4 (very much); a higher score reflects higher anxiety. Anxiety relates to feelings of tension, nervousness, and fright. Internal consistency reliability for the scale has been supported by α coefficients ranging from .80 to .92 (N = 550) on a navy recruit and college age sample.^{29,30} Criterion-related validity was supported by correlations ranging from 0.93 to 0.97 with the parent scale, the state anxiety scale of the State-Trait Inventory.^{29,30} Only the state measure of anxiety was used in this study to measure the patient's current state of anxiety as this study was interested in the effect of a music intervention on patient's state anxiety at that moment, and not the impact of the stable personality trait of anxiety.

Physiological Parameters

Heart rate, recorded from the bedside monitor, was defined as beats per minute. Blood pressure was measured indirectly from the noninvasive BP module on the monitor or via cuff BP. The bedside monitors are tested and calibrated annually by the bioengineering departments. Research assistants were trained in BP measurements before data collection.³¹

Music Intervention

Music intervention in this study was defined as "using music to help achieve a specific change in behavior or feeling."^{32(p346)} The taped music chosen for use in this study met the criteria for eliciting a relaxation response identified in the literature and included the following: (1) no dramatic changes, (2) consonance, (3) instrumental music, and (4) 60 to 70 beats per minute.⁷⁻¹³ Patients chose the type of music that would be most relaxing for them: easy listening, classical, and jazz.

Procedure

Institutional review board approval was obtained. Two research assistants, both credentialed in integrated therapies (one a certified massage therapist and the other a certified occupational therapist), or 1 of 3 registered nurses involved in the protocol, identified patients undergoing either CAB and/or valve replacement surgery from a surgical roster, assigned patients to 1 of 2 groups by the flip of a coin (music/relaxation or rest in bed group), delivered the study intervention, and collected the data. Five patients declined to participate. Patients as-

signed to the control group (rest in bed) were advised to rest for 20 minutes in bed. A comfortable position was encouraged, but no relaxation suggestions were given to them.¹⁰ Music equipment and tapes were not available to patients in this group.

After music selection, the music therapy group was encouraged to assume a comfortable position in bed. During delivery of the music intervention, the environment was made conducive to rest, and the research assistant delivered a brief session of relaxation (preprinted script) before the music started. This script adapted from White (personal communication, September 24, 1999) advised patients to clear their minds and allow their muscles to relax. The research assistants were available to ensure that the patient was not interrupted. Based on previous studies in the literature, the music was delivered on tape by headphone for 20 minutes twice per day, in the morning (between 8 AM and 10 AM) and in the evening (between 4 PM and 9 PM) on POD 1 to 3.¹⁰⁻¹⁴ For both groups, measures for pain intensity, anxiety, HR, and BP were obtained immediately before and after each 20-minute intervention period in a consistent fashion.

Measures were taken to reduce the effect of potential confounding factors on the measured outcomes while patients were listening to music, or resting in bed per the research protocol. A sign was placed on the outside of the door to the patient's room stating that the patient was currently listening to music and to stop back at a later time.

Statistical Analysis

Statistical analyses were performed using SPSS (version 10.0). Descriptive statistics (means, medians, SDs, and ranges) were computed for age and the psychological (anxiety and pain), physiologic (pulse and BP), and opioid equivalents. For assessing the difference between groups, the *t* test was used to analyze interval data, χ^2 test for nominal level data, and repeated-measures analysis of variance was used to analyze pain and anxiety.

Results

Description of the Sample

The typical subject was 63 years old, male (69.8%), had CAB surgery (69.8%), and had seldom used music therapy (81.2%). Other demographic characteristics of the sample are given in Table 1. The 2 groups were found to be equivalent on the demographic characteristics with the exception of type of surgical procedure. The music therapy group had not only more CAB and valve replacement procedures but also less combination CAB/valve surgeries ($P \leq .05$).

TABLE 1 Demographic Characteristics of the Sample*

Variable	Entire Sample (N = 86)	Control Group (Rest in Bed) (n = 36)	Intervention Group (Music Therapy) (n = 50)	P
Age, Mean (SD)	63.3 (13.5)	64.7 (11.4)	62.3 (14.8)	.43
Gender				.065
Male	69.8%	80.6%	62.0%	
Female	30.2%	19.4%	38.0%	
Procedure				.051
CAB	69.8%	66.7%	72.0%	
Valve	19.8%	13.9%	24.0%	
CAB/Valve	10.5%	19.4%	4.0%	
Study location				.58
Hospital A	77.9%	83.3%	74.0%	
Hospital B	8.1%	5.6%	10.0%	
Hospital C	14.0%	11.1%	16.0%	
Previous use of music or relaxation				.14
Yes	18.8%	11.4%	24.0%	
No	81.2%	88.6%	76.0%	

*To demonstrate differences between groups on these characteristics, χ^2 analysis and *t* tests were used for nominal and interval variables, respectively.

Research Question: Does music therapy decrease pain, anxiety, HR, systolic BP, diastolic BP, and amount of parenteral opioids equivalents between groups?

A repeated-measures analysis of variance was conducted to examine the differences between groups. Although the original study design included measures on POD 1 to 3, due to a high rate of missing data, change scores were only calculated on the outcome variables for the first 3 time points (POD 1 AM and PM sessions, and POD 2 AM session only). Missing values were substantial; sample sizes for the repeated-measures procedures ranged between 27 and 38 out of a potential 86.

When examining the between-group differences, we found anxiety to be significantly lower in the

music group than in the control group throughout the time period ranging from day 1 AM to day 2 AM ($P < .001$), as seen in Figure 1, and in pain ($P = .009$) in the music group, as seen in Figure 2. There were no differences between groups in regard to systolic BP, ($P = .17$), diastolic BP ($P = .11$), or HR ($P = .76$). Mean scores of HR, systolic and diastolic BP, pain, and anxiety before and after for both groups (music and control group) are noted in Table 2.

t Tests were used to determine if there were differences in opioid use between groups (Table 3). Mean parenteral morphine equivalents were calculated for POD 1 to 3 for each group according to a readily available source.²⁷ One patient having severe migraine headaches ingested 364 mean parenteral morphine equivalents from POD 1 to 3, as compared

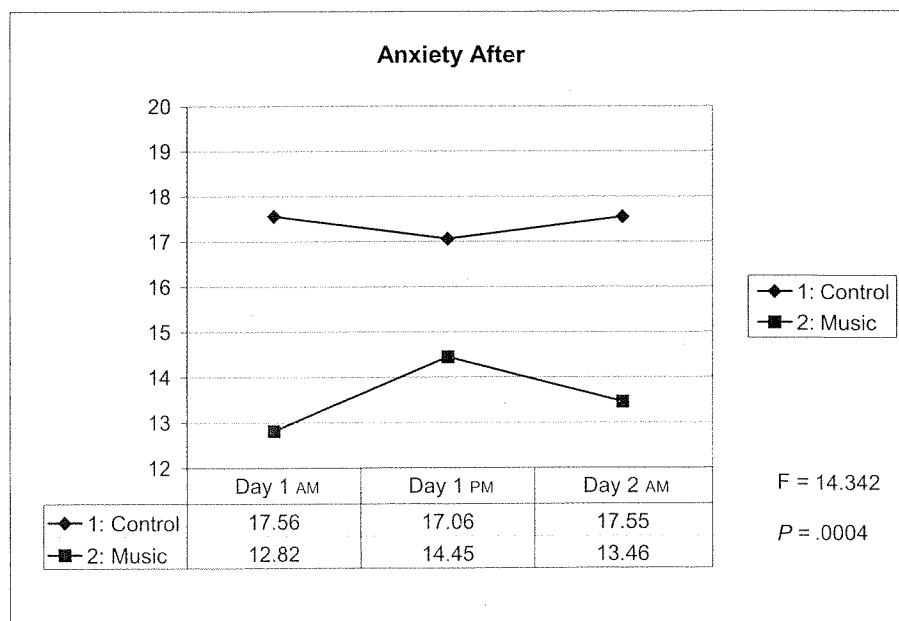


FIGURE 1. Postoperative day 1 (AM and PM) and day 2 (AM) anxiety after 20 minutes of music therapy (intervention group) or usual care (control group).

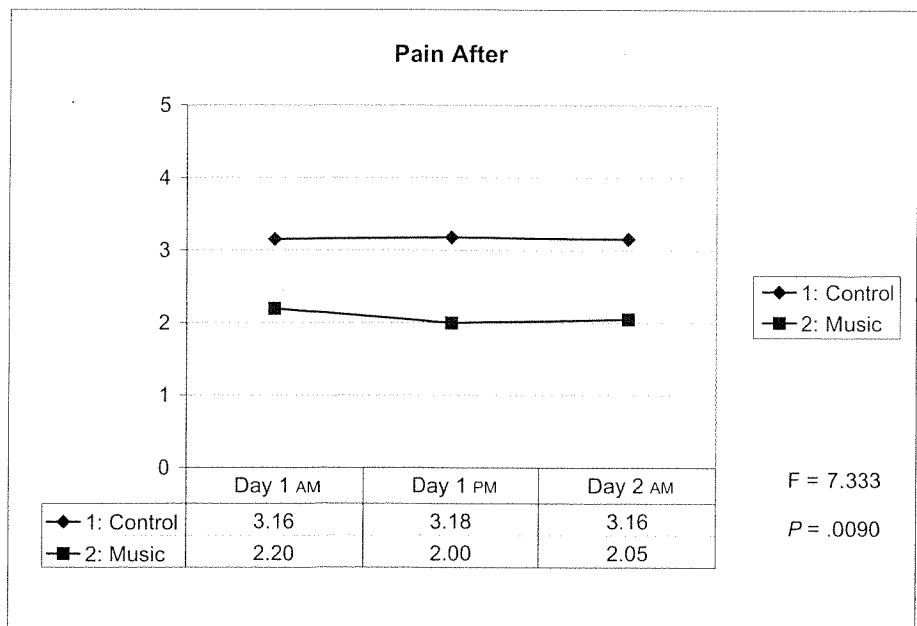


FIGURE 2. Postoperative day 1 (AM and PM) and day 2 (AM) pain after 20 minutes of music therapy (intervention group) or usual care (control group).

with a mean of 66 mg for the other patients. Consequently, this patient outlier was removed from all analysis. There were no differences in opioid use between groups on any of the days, and therefore, music therapy did not decrease the amount of pain medication used.

Discussion

In this study, there was a significant reduction in pain and anxiety as a result of music therapy. This pattern is consistent with other studies that examined the effects of music on anxiety in hospitalized patients.^{7,9,10,17-23}

Valdix and Puntillo⁵ reported that the worst pain intensity, 7.2 on a 0 to 10 scale, was experienced 36 hours after cardiac surgery. Overall, pain intensity in our study was low, the mean ranging between 3 before intervention and 2 afterward. These low ratings may be the result of well-managed pain including the implementation of the Agency for

Healthcare Research and Quality Acute and Pain guidelines.⁶ Given the low ratings, the significant effects music therapy had on pain level are noteworthy. It would be of interest to investigate whether these effects would increase in populations with higher pain levels. Given the mixed results in the literature and between our study and the literature, more attention is needed regarding differences in evidence-based pain management. The findings of this study point to the potential importance of using music therapy for pain management postcardiac surgery. Other investigators have identified similar results of music therapy in controlling pain with surgical patient populations.²⁰⁻²³

The value of assisting patients to manage pain is supported in the literature. Unrelieved pain may precipitate a generalized sympathetic response, including increased HR, peripheral resistance, BP, cardiac output, and depth and respiratory rate, as well as interfere with appetite and sleep and contribute to gastrointestinal and urinary tract complications.³³⁻³⁵

TABLE 2 Mean Scores of HR, Systolic and Diastolic BP, and Pain and State Anxiety Before and After Music (Intervention) or Usual Care (Control) for Both Groups

Variable	Day 1								Day 2			
	AM Session				PM Session				AM Session			
	Control Group		Music Group		Control Group		Music Group		Control Group		Music Group	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
HR	82	81	83	82	81	81	82	81	83	83	82	81
Systolic BP	115	115	116	115	118	117	113	111	118	118	115	110
Diastolic BP	62	62	58	56	58	59	58	56	60	61	58	57
Pain rating	3.2	3.2	3.1	2.2	3.2	3.2	2.9	2.0	3.2	3.2	3.2	2.1
State anxiety	18.44	17.56	18.16	12.82	17.59	17.06	17.95	14.45	17.47	17.55	17.63	13.46

TABLE 3 Comparison of the Mean Milligrams of Parenteral Morphine Equivalents for Opioids Administered POD 1 to 3 in the Control Group and Intervention Group

POD	Control Group (Rest in Bed) (n = 36)	Intervention Group (Music Therapy) (n = 49)*	p
Day 1			.68
Mean	33	35	
SD	20	21	
Range	6-84	4-97	
Day 2			.14
Mean	20	25	
SD	13	16	
Range	2-48	0-62	
Day 3			.62
Mean	9	9	
SD	6	8	
Range	0-30	0-27	
Days 1-3			.34
Mean	61	69	
SD	33	36	
Range	12-149	11-147	

*One patient outlier was removed from analysis.

Research on pain management has suggested that early treatment to relieve or minimize acute pain may actually prevent long-term pain.³⁵ Because opioids or nonsteroidal anti-inflammatory agents do not always provide sufficient relief and may be associated with undesired side effects, interventions such as music therapy should be encouraged as an adjuvant for more complete relief of postoperative pain in the cardiac surgery population.

Systolic BP, diastolic BP, and HR were not statistically different between the 2 groups. The physiological effects of beta-blockers and other cardiac medications such as digitalis and antihypertensive agents could be a factor, which affected HR and BP results after relaxation/music therapy. Specific types and doses of cardiac medications administered during the study were not collected. However, many patients are given prophylactic beta-blockers after cardiac surgery, unless contraindicated, in an attempt to prevent the development of atrial fibrillation or to control the ventricular rate of atrial fibrillation.³⁶ Perhaps, future studies with patients having cardiac surgery who usually receive cardiac medications which affect HR and BP should control for cardiac medications or physiologic factors.

The difference between the groups on anxiety scores was the most noteworthy in this study. As a nursing diagnosis, anxiety has been defined as a "vague uneasy feeling of discomfort or dread accompanied by an autonomic response; the source is often nonspecific or unknown to the individual...It is an altering signal that warns of impending danger and

enables the individual to take measures to deal with threat"^{37(p467)} In addition, the use of music to reduce anxiety of patients is an independent nursing function.^{32,37} Music is an inexpensive intervention with no known side effects. If music were to become a part of the regimen for the postoperative care of cardiac surgery patients, there may be positive effects on anxiety and stress reduction. Many nursing outcomes are available to evaluate the effectiveness of music in reducing anxiety. The important effect of music on psychological outcomes of patient's after cardiac surgery may well be the greatest benefit of music therapy.

Limitations

Several limitations accompany this study. Data collectors mentioned that patients were occasionally disrupted during the intervention despite efforts to maintain a quiet environment. Also, a pain initiative at the study hospitals had implemented around-the-clock dosing as a nursing standard. It is unknown how much influence patient disturbance and consistent (and thereby higher) opioid dosing had on study results. The lack of reliability testing on the BP measurements is another limitation. Oscillometric indirect BP readings were not correlated with the BP bedside monitor readings in this study. Another limitation was that the persons delivering the music were also the same persons who collected the physiological measures.

Missing values were also prevalent for the afternoon session of POD 2 and both POD 3 sessions. As a result, the repeated-measures analysis was only completed for the first 3 study time points on POD 1 and POD 2. Missing values occurred because the patient either refused a specific intervention or data collection points, reflecting, the researchers think, the burden of the recovery period. In addition, the cardiac monitor was used to collect HR data in this study. In some patients, the cardiac monitor had been discontinued according to protocol on POD 2, an occurrence which accounted for additional missing data points.

Recommendations for Future Research

Several recommendations for further study are offered. First, the frequency of music should be explored. Listening to music for 20 minutes has been substantiated in the literature; however, frequency of this intervention has not been established through research. Another consideration for future research is to study the use of music preoperatively and intraoperatively and to offer a wider array of selections for cultural appropriateness. The researchers also recommend replicating this study with other surgical populations.

Although the control group in this study did not receive music as an intervention, they did receive the 20-minute rest in bed. The intent was that they would not be walking or doing other activities that may have precipitated pain, anxiety, or altered HR and/or BP that would, consequently, not have been a comparative group. In future research, it may be beneficial to add a third group that would not have any restrictions placed on them to be able to compare a "usual care" group to a music group in a quiet, restful environment to a group who spent the 20-minute rest in bed.

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