

## ORIGINAL ARTICLE

**Music therapy for patients receiving spine surgery**

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**Aims and objectives.** The aim of this study was to evaluate the effects of music therapy on anxiety, postoperative pain and physiological reactions to emotional and physical distress in patients undergoing spinal surgery.

**Background.** Surgery-related anxiety and pain are the greatest concern of surgical patients, especially for those undergoing major procedures.

**Design.** A quasi-experimental study design was conducted in a medical centre in Taiwan from April–July 2006.

**Methods.** Sixty patients were recruited. The study group listened to selected music from the evening before surgery to the second day after surgery. The control group did not listen to music. Patients' levels of anxiety and pain were measured with visual analogue scales (VAS). Physiological measures, including heart rate, blood pressure and 24-hour urinalysis, were performed.

**Results.** The average age of the 60 patients was 62.18 (SD 18.76) years. The mean VAS score for degree of anxiety in the study group was 0.8–2.0, compared with 2.1–5.1 in the control group. The mean VAS score for degree of pain in the study group was 1.7–3.0, compared with 4.4–6.0 in the control group. The differences between the two groups in VAS scores for both anxiety ( $p = 0.018$ – $0.001$ ) and pain ( $p = 0.001$ ) were statistically significant. One hour after surgery, the mean blood pressure was significantly lower in the study group than in the control group ( $p = 0.014$ ), but no significant differences were found between the two groups in urine cortisol ( $p = 0.145$ – $0.495$ ), norepinephrine ( $p = 0.228$ – $0.626$ ) or epinephrine values ( $p = 0.074$ – $0.619$ ).

**Conclusions.** Music therapy has some positive effects on levels of anxiety and pain in patients undergoing spinal surgery.

**Relevance to clinical practice.** Complementary music therapy can alleviate pain and anxiety in patients before and after spinal surgery.

**Key words:** anxiety, music therapy, nurses, nursing, pain, spinal surgery

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**Introduction**

Postoperative pain is the greatest concern of surgical patients, especially for those undergoing major procedures such as spinal surgery (Lin *et al.* 2001). Failure to ease pain can increase the burden on many organs of the body, negatively influencing postoperative rehabilitation and possibly contributing to chronic pain (Brown *et al.* 2004, Cheng & Lu 2007). Pain also interferes with patients' emotions, activities, quality

of sleep and appetite and may prolong hospitalisation and increase medical expenses (Chung & Lui 2003). Proper pain management is both a demand and a right of patients, as well as a responsibility of nursing personnel (Acute Pain Management Guideline Panel 1992). Orthopaedic often have high levels of anxiety, especially those undergoing a complicated procedure such as spinal surgery (Huang *et al.* 2004, Starkweather *et al.* 2006). They have concerns about wound pain after surgery and possible complications such as paralysis, so

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their anxiety and fear is natural (Bridwell & DeWald 1997). If patients' levels of anxiety before and after surgery can be reduced, they will require less anaesthesia and analgesia after surgery and anxiety-related complications may be reduced (Lepage *et al.* 2001, Zhang *et al.* 2005).

Music as a therapeutic intervention is a development largely of the mid-20th century but it has existed in various forms in most cultures for many centuries (Evans 2002). It involves the use of music under controlled conditions to restore, maintain and improve patients' physiological, psychological and emotional health (Joanna Briggs Institute 2009). In clinical practice, it is regarded as a complementary therapy (Avers *et al.* 2007). It has been described as an effective non-invasive technology that can shift patients' attention, promote relaxation, alleviate anxiety about surgery, improve emotional health and relieve pain (Evans 2002, Lee *et al.* 2005). Peng *et al.* (2009) found that listening to soft music increased the level of relaxation, as indicated by a shift of the autonomic balance towards parasympathetic activity in young healthy individuals. In a review of music therapy research, this intervention was found to have positive effects on patients' anxiety and pain in approximately half of the studies (Nilsson 2008). Few studies have been performed using music therapy for patients undergoing spinal surgery, and no such research has been conducted in Taiwan. This study was conducted to evaluate the effects of music therapy on anxiety, pain and physiological reactions of patients with spondylopathy before and after surgery.

## Background

### Pain and anxiety in patients undergoing spinal surgery

As the population ages, an increasing number of individuals are undergoing surgery for degenerative spondylosis. The prospect of such a major surgery usually causes considerable fear and apprehension in the patient (Bridwell & DeWald 1997). Patients worry about whether the surgery will result in spinal nerve injury, possibly leading to hemiplegia or incontinence, as well as possible complications of anaesthesia and even death during the procedure (Mitchell 2000, Walker 2002). This anxiety may be associated with physiological symptoms, including elevated body temperature, urgency of urination, thirst, mydriasis, increased pulse and respiration rates, elevated blood pressure, constriction of peripheral vessels, loss of appetite, nausea and diaphoresis (Mitchell 2000, Walker 2002). Patients with no prior experience with surgery have especially high levels of anxiety (Kindler *et al.* 2000). Patients with high anxiety before surgery usually have more pain after surgery (Kain *et al.* 2000), a longer period of

physical recovery and a need for more anaesthesia (Buffum *et al.* 2006).

Lee (2004) reported that approximately 77–98% of patients have pain after surgery; of this group, 40–80% have moderate-to-severe pain. Approximately 40–50% of these patients have less than ideal pain management. The incision from spinal surgery is on the patient's back and bed rest after surgery may involve direct pressure on the wound; therefore, postoperative pain tends to be greater than that of other surgical procedures (Lin *et al.* 2001). Postoperative pain has a significant impact on the patient's psychological and physical health and well-being. In terms of psychological health, the pain causes anxiety, fear and even depression, often leading to tense relations between patients and nurses (Brunges & Avigne 2003). Physiologically, pain affects the functions of different systems and can cause insomnia and poor appetite (Brunges & Avigne 2003). Alleviating patients' postoperative pain and anxiety is a primary responsibility of nursing personnel.

### Music therapy

According to the National Association for Music Therapy, music therapy is the use of music to restore, maintain and improve an individual's physical and mental health and to bring about positive behavioural change. Lai (2002) defines music therapy as 'the use of a special sonic wave, which contains cheerful beats and melodies, to help individuals to enter a peaceful state; its purpose is to alleviate patients' discomfort, maintain and improve physical and mental health.' Music therapy can prompt physical and mental reactions, mainly because melodies and rhythms affect the perimeter system of the brain and hypothalamus, which can alter the functions of the neuroendocrine system, reduce the secretion of catecholamine, affect the regulative function of autonomic nerves and thereby influence physiological reactions (Joanna Briggs Institute 2009). At a wave frequency of 8–13 Hz, musical melodies stimulate the production of regular, coordinated alpha ( $\alpha$ ) brain waves, leading to the relaxation of consciousness to a steady state and thus helping to alleviate pain and discomfort (Shi 2003).

Music therapy was initially provided to psychiatric patients; subsequently, it was gradually expanded to patients in surgery, dentistry, obstetrics, paediatrics, rehabilitation and hospice care (Brunges & Avigne 2003, Chang & Chen 2005, Sendelbach *et al.* 2006). The provision of music therapy to clinical patients has been found to reduce anxiety, elevate mood, relax muscles and lower pulse rate, blood pressure and respiration rate (Evans 2002, Wu & Chou 2008). As early as 1989, Kaempf and Amodei found that

patients who listened to music before surgery had lower levels of anxiety. Several scholars have found that listening to music after surgery reduces the level of postoperative pain (Good *et al.* 2002) and the amount of analgesia used by patients who have listened to music is less than that of patients who have not listened to music (Cepeda *et al.* 2006). But two studies reported that there were no effects of music therapy on reduction in opioid usage for patients undergoing cardiac surgery or on the dosage of sedative medications for patients undergoing colonoscopy or cardiac surgery (Sendelbach *et al.* 2006, Bechtold *et al.* 2009). Wang *et al.* (2002) studied patients undergoing anaesthesia and surgery who listened to a 30-minute patient-selected music session and found that there were no group differences on electrodermal activity, blood pressure, heart rate, cortisol and catecholamine data. Buffum *et al.* (2006) found that patients who were scheduled for vascular angiography and who listened to music significantly reduced their anxiety level and pulse rate, compared to a group that did not listen to music before the procedure. This study was conducted to evaluate the effects of music therapy on anxiety, postoperative pain and physiological reactions to emotional and physical distress, such as increased blood pressure, respiration rate and secretion of cortisol and epinephrine in patients undergoing spinal surgery.

## Methods

### Study participants and setting

This study was conducted using a quasi-experimental pretest and post-test design involving a study group and a control group. The study participants were selected from patients who underwent spinal surgery at a 2900-bed medical centre in Taipei City, Taiwan, from April–July 2006. All patients scheduled for non-emergency spine surgery were eligible to participate in the study. Patients were assigned to the study group or to a control group, depending on the day of their surgery. The surgery schedule was arranged by doctors unaware of the recruitment process and all patients received the identical anaesthetic regimen and postoperative analgesia. A coin toss decided the assignment sequence. All patients scheduled for surgery on Tuesdays and Thursdays were assigned to the study group, while those scheduled for surgery on Wednesdays and Fridays were assigned to the control group. Monday was excluded because it was not available for spine surgery. Sixty patients were enrolled in the study; 30 per group. Inclusion criteria were as follows: age > 18 years, no mental or cognitive impairment, ability to communicate and willingness to participate in the study.

### Instruments

The primary outcomes were anxiety and pain, as examined by self-reported psychological instruments, the State-Trait Anxiety Inventory (STAI), visual analogue scales (VAS) and physiological measures.

*Basic information:* Basic information about the study participants was collected, including sex, age, educational status, occupation, religion, marital status, medical illnesses and history of any previous surgeries.

*STAI:* The STAI was compiled by Spielberger *et al.* in 1970 and translated into Chinese by Chung and Long (1984). 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 music intervention on a patient's state anxiety and not the impact of the stable personality trait of anxiety. The state inventory includes 20 items, each with a scoring range of 1–4; the total possible score is 20–80, with higher scores indicating higher levels of anxiety. This instrument has been widely used to measure patients' anxiety before surgery and has been found to have good reliability and validity (Lee *et al.* 2004). In this study, the Cronbach  $\alpha$ -value was 0.93.

*VAS:* This study used two VAS to measure anxiety and pain, respectively; this scale has been widely used to evaluate subjective phenomena, such as sensations, perceptions and reactions. Subjects indicated their degree of anxiety or pain on a scale of 0–10, with 0 indicating the least amount and 10 the greatest amount. This scale has been found to be reliable as well as easy and convenient to use (Wewers & Lowe 1990).

*Blood pressure and pulse monitor* (Philip A1 2-in-1 blood pressure monitor; Philips Healthcare, Andover, MA, USA): A blood pressure monitor was used for automatic measurement of heart rate and systolic, diastolic and mean blood pressure.

*Urine cortisol, norepinephrine and epinephrine concentrations:* Cortisol excretion in 24-hour urine samples has been demonstrated to correlate reliably with daily secretion of the hormone from the adrenal glands. Another advantage of collecting urine samples is that the procedure is non-invasive and is not in itself a stressor that might increase stress hormone production in the patient as is, for instance, venipuncture (Doering *et al.* 2000).

Twenty-four-hour urine specimens were collected from subjects, with a 15 ml sample thoroughly stirred and used for measurement. High-performance liquid chromatography and an electrochemistry detector (ECD) were used to simultaneously separate and acidify urine for testing.

*Validity:* The VAS and music therapy effects evaluation form were checked by five specialists for validity and were

given scores of 1–4 points according to the fitness of content. The content validity index (CVI) was between 0.8–1.0, mean score = 3.2–3.8.

### Music therapy

**Music:** The songs used in this study had 60–72 beats per minute and were mid- to low-pitch, soft melodies in Chinese, the native language of Taiwan, including pop music, classical music, sounds found in nature and sacred music. Researchers stored a large number of examples of these four genres of music in a personal computer and then each patient selected his or her favourite songs. The researchers copied this favourite music onto an MP3 player for each patient's use.

**MP3 player** (Topfox Digital MP3 player; Topfox Technology Co., Ltd., Taipei, Taiwan): Each patient listened to music through ear-canal-type earphones, a method of listening found to reduce ambient noise, which may influence the curative effect (Joanna Briggs Institute 2009).

**Environment:** A sign was placed outside the patient's door, the ceiling light turned off and the curtain pulled around the twin bed to keep the patient's area quiet and undisturbed. A comfortable position was encouraged while listening to music and researchers remained to ensure that the patient was not interrupted. For patients in the control group, the environment was kept quiet and the patient was undisturbed while resting in bed.

### Data collection

Two orthopaedic nurses involved in the protocol screened patients undergoing spine surgery from patient lists in the nursing station in an effort to identify potential candidates. The researcher then approached the potential candidates to explain the study and to offer them an opportunity to sign the informed consent form. Patients who consented to participate were then assigned to either group depending on the day of surgery. Patients in the study group selected their favourite music and the researchers prepared the music and MP3 players for the patient's use and demonstrated how to use the machine. The researchers helped the patients listen to their selected music for 30 minutes at a time at 7 PM the day before the surgery, one hour before surgery and at 3 PM on the first and second day after surgery. In addition, the patients were encouraged to listen to music at any other times they wanted. Measurements of the patients' pulse rate, blood pressure and VAS scores were recorded before and after the scheduled listening times. On the evening before surgery and on the second day after surgery, the STAI instrument was completed by the patient. Patients' urine was collected from 7 PM the

day before the surgery to 7 AM the third day after surgery, for a total of 84 hours, with testing of cortisol, norepinephrine and epinephrine concentrations performed at 7 AM each day.

For patients in the control group, data collection was the same as that in the study group, except that these patients did not listen to music but rested in bed for 30 minutes before measurement of their levels of pain and anxiety. Measurements of the patients' pulse rate, blood pressure and VAS scores were recorded at 7 PM the day before the surgery, one hour before surgery and at 3 PM on the first and second day after surgery. On the evening before surgery and on the second day after surgery, the STAI instrument was completed by the patient. Patients' urine was collected from 7 PM the day before the surgery to 7 AM the third day after surgery, for a total of 84 hours, with testing of cortisol, norepinephrine and epinephrine concentrations performed at 7 AM each day.

### Ethical considerations

This study was approved by the institutional review board of a hospital in Taipei, where we proceeded the study. The researchers explained the purpose and process of the research to all patients. All patients provided written informed consent to participate in the study and were informed about their rights in the research process. Patients were assigned an identification number and treated anonymously in all analyses.

### Statistical analysis

Mean and standard deviation (SD) were given to continuous variables; number and percentage were calculated and shown for categorical variables. To compare the differences between two groups, an independent *t*-test was used. In addition, repeated analysis of variance (ANOVA) was implemented to examine the differences among various time-points. All statistics were two-sided and analysed with SPSS statistical software (version 14.0, SPSS Inc., Chicago, IL, USA).

## Results

### Demographic data

A total of 60 spinal surgery patients were recruited and assigned to the study (30 patients) and control (30 patients) groups. The mean age of the patients was 62.2 (SD 18.8) years, with 36 patients older than 65 years (60%). The participants included 31 male patients (51.7%), 12 employed patients (20%), 54 married patients (90%) and 19 patients with a primary-school educational background

**Table 1** Characteristics of 60 patients

Variables	Number (%)
Age (years) [mean $\pm$ SD]	62.2 $\pm$ 18.8
$\leq 65$	24 (40.0)
$> 65$	36 (60.0)
Male gender	31 (51.7)
Education	
Illiterate	8 (13.3)
Elementary school	19 (31.7)
Junior high school	7 (11.7)
Senior high school	11 (18.3)
College or above	15 (25.0)
Married	54 (90.0)
Employed	12 (20.0)
Other disease	45 (75.0)
History of operation	
None	21 (35.0)
Spinal surgery	9 (15.0)
Other surgery	30 (50.0)
Main caregiver*	
Spouse	28 (47.5)
Children	23 (39.0)
Parents	6 (10.2)
Nurse aid	2 (3.4)

SD, standard deviation.

\*One patient did not have a primary caregiver.

(31.7%). Fifty-nine patients had caregivers (98.3%), of which 28 patients were cared for by spouses (47.5%), 45 patients had other medical illnesses (75%), nine patients had undergone previous spinal surgery (15%) and 30 patients had undergone other surgical procedures (50%, Table 1).

### Effects of music therapy on patients' anxiety

According to the results of the VAS instrument, the average anxiety scores of the study group after music therapy were from 0.8 (SD 1.3) to 2.0 (SD 2.1). In the control group, the mean anxiety scores after bed rest were from 2.1 (SD 1.9)–5.1

(SD 2.7); the highest score was recorded in the evening before surgery, and the lowest score was recorded on the second day after surgery. Comparison by *t*-test showed statistically a significant difference in anxiety score between the two groups regardless of time ( $p = 0.018$ – $0.001$ , Table 2).

The results of the STAI instrument showed that for the study group, the mean pretest score (the evening before surgery) was 38.1 (SD 11.5) and the mean post-test score (the second day after surgery) was 38.2 (SD 8.9). For the control group, the mean pretest score was 43.4 (SD 11.2) and the mean post-test score was 40.6 (SD 8.2). Two groups had similar STAI scores presurgery and postsurgery; also, the STAI score was not significantly changed after the surgery in both groups ( $p = 0.074$ – $0.286$ ).

### Effects of music therapy on patients' pain

According to the results of the VAS instrument, the average pain scores of the study group after music therapy ranged from 1.7 (SD 1.5)–3.0 (SD 2.3); the worst pain was on the first day after surgery and the least pain was on the second day after surgery. In the control group, the mean pain scores after bed rest were from 4.4 (SD 1.9)–6.0 (SD 2.5); the worst pain was in the evening before surgery and the least pain was on the second day after surgery. Comparison by *t*-test showed statistically significant differences between the two groups throughout the entire observation period, with the lower pain level of the study group after music therapy (all:  $p = 0.001$ , Table 2).

### Physiological measures of anxiety and pain

Comparison of systolic, diastolic and mean blood pressure values and pulse rates between the two groups from data collected one hour after surgery revealed significantly lower systolic levels ( $p = 0.007$ ) and mean blood pressure levels ( $p = 0.014$ ) in the study group than in the control group. Moreover, in both groups, the highest systolic and mean

**Table 2** Mean anxiety and pain score of VAS (0–10 score) of 60 patients<sup>†</sup>

	Mean anxiety ( $\pm$ SD)			Mean pain score ( $\pm$ SD)			Mean STAI ( $\pm$ SD)		
	Study ( $n = 30$ )	Control ( $n = 30$ )	<i>p</i> -value	Study ( $n = 30$ )	Control ( $n = 30$ )	<i>p</i> -value	Study ( $n = 30$ )	Control ( $n = 30$ )	<i>p</i> -value
Before surgery	1.3 $\pm$ 2.1	5.1 $\pm$ 2.7	$< 0.001^*$	2.3 $\pm$ 2.3	6.0 $\pm$ 2.5	$< 0.001^*$	38.1 $\pm$ 11.5	43.4 $\pm$ 11.2	0.074
Day of surgery	2.0 $\pm$ 2.1	4.9 $\pm$ 2.8	$< 0.001^*$	1.8 $\pm$ 2.2	4.7 $\pm$ 2.1	$< 0.001^*$	–	–	–
Post op day 1	1.4 $\pm$ 1.6	2.7 $\pm$ 2.4	0.018*	3.0 $\pm$ 2.3	5.2 $\pm$ 1.7	$< 0.001^*$	–	–	–
Post op day 2	0.8 $\pm$ 1.3	2.1 $\pm$ 1.9	0.002*	1.7 $\pm$ 1.5	4.4 $\pm$ 1.9	$< 0.001^*$	38.2 $\pm$ 8.9	40.6 $\pm$ 8.2	0.286

VAS, visual analogue scales; SD, standard deviation; STAI, State-Trait Anxiety Inventory; op, operation; –, no measurement.

\*Statistically significant difference between the two groups,  $p < 0.05$ .<sup>†</sup>Independent *t*-test was used.



blood pressure levels were ascertained at one hour before surgery and the lowest measurements were recorded at the second day after the surgery. By the results of repeated ANOVA, the highest and lowest systolic and mean blood pressure levels of the study group were 133.2 mmHg and 111.2 mmHg for systolic blood pressure and 95.8 mmHg and 78.9 mmHg for the mean blood pressure ( $p = 0.032$  for the former and  $p = 0.007$  for the latter). In the control group, the highest and lowest systolic and mean blood pressure levels were 136.2 mmHg and 120.8 mmHg for systolic blood pressure ( $p = 0.018$ ) and 95.2 mmHg and 83.2 mmHg for the mean blood pressure ( $p = 0.002$ , Table 3). Comparison by  $t$ -test of cortisol ( $p = 0.145$ – $0.495$ ), norepinephrine ( $p = 0.228$ – $0.626$ ) and epinephrine concentrations ( $p = 0.074$ – $0.619$ ) in 24-hour urinalysis revealed no statistically significant differences between the two groups (Table 4).

## Discussion

### Effects of music therapy on patients' anxiety and pain

The results of this study as indicated by VAS scores from before surgery to two days after surgery show that the level of anxiety was lower in the study group than in the control group. This is in agreement with the results of previous research (Evans 2002, Chang & Chen 2005). Evans (2002) reviewed 19 studies to investigate the effectiveness of music as an intervention for hospital or procedure patients. The results showed that music reduced the anxiety (as measured by STAI or VAS) of hospital patients during normal care delivery, but it had no impact on the anxiety of patients undergoing procedure such as bronchoscopy, sigmoidoscopy or surgery with a spinal anaesthetic. Chang and Chen (2005) also found that women scheduled for caesarean section who received music therapy had significantly lower anxiety (VAS) compared with those receiving routine care only.

Although our study group exhibited a trend towards a lower STAI score, no statistically significant differences were found in the groups' pretest and post-test results. This finding differs from previous studies (Wang *et al.* 2002, Lee *et al.* 2004, Sendelbach *et al.* 2006). Sendelbach *et al.* found that music therapy reduced anxiety (as measured by STAI) significantly for patients undergoing cardiac surgery on postoperative days (POD) 1–3. Lee *et al.* (2004) also found that patients who listened to music preprocedure had significantly lower self-reported anxiety levels compared with those who were provided with space and opportunity for other relaxing activities in the waiting area, such as reading or watching television. Wang *et al.* (2002) reported that

Table 3 Comparison of blood pressure and pulse in 60 patients†

	Mean DBP ( $\pm$ SD)			Mean SBP ( $\pm$ SD)			Mean MBP ( $\pm$ SD)			Mean pulse ( $\pm$ SD)			$p$ -value
	Study ( $n = 30$ )	Control ( $n = 30$ )	$p$ -value	Study ( $n = 30$ )	Control ( $n = 30$ )	$p$ -value	Study ( $n = 30$ )	Control ( $n = 30$ )	$p$ -value	Study ( $n = 30$ )	Control ( $n = 30$ )	$p$ -value	
The evening before surgery	76.6 $\pm$ 14.3	73.7 $\pm$ 13.7	0.426	128 $\pm$ 19.3	135 $\pm$ 22.9	0.210	94.2 $\pm$ 16.1	93.2 $\pm$ 14.9	0.804	70.6 $\pm$ 8	69.8 $\pm$ 11.6	0.767	
1 hour before surgery	77.7 $\pm$ 13.2	76.3 $\pm$ 10	0.661	133.2 $\pm$ 23	136.2 $\pm$ 21	0.596	95.8 $\pm$ 16.4	95.2 $\pm$ 12	0.886	66.7 $\pm$ 10.7	70.3 $\pm$ 12.9	0.253	
1 hour after surgery	64.7 $\pm$ 12.4	67.4 $\pm$ 7.8	0.305	111.2 $\pm$ 15	123 $\pm$ 17.4	0.007*	78.9 $\pm$ 12.8	86.4 $\pm$ 9.8	0.014*	76.6 $\pm$ 16.3	77.1 $\pm$ 13.7	0.885	
1 day after surgery	65.1 $\pm$ 11.2	67.0 $\pm$ 12.3	0.548	119.4 $\pm$ 21.1	122.6 $\pm$ 16.5	0.520	83.0 $\pm$ 12.8	85.5 $\pm$ 13	0.456	88 $\pm$ 16.4	84.7 $\pm$ 14.5	0.412	
2 days after surgery	66.9 $\pm$ 9.9	65.0 $\pm$ 8.5	0.430	118.0 $\pm$ 18.5	120.8 $\pm$ 15.1	0.534	83.3 $\pm$ 10.7	83.2 $\pm$ 9.9	0.970	83.1 $\pm$ 13.1	82.2 $\pm$ 12	0.782	

SD, standard deviation; DBP, diastolic blood pressure; SBP, systolic blood pressure; MBP, mean blood pressure.

\*Statistically significant difference between the two groups,  $p < 0.05$ .

†Independent  $t$ -test was used.

**Table 4** Comparison of cortisol, norepinephrine and epinephrine values between the two groups<sup>†</sup>

	Mean cortisol ( $\pm$ SD)			Mean norepinephrine ( $\pm$ SD)			Mean epinephrine ( $\pm$ SD)		
	Study ( <i>n</i> = 30)	Control ( <i>n</i> = 30)	<i>p</i> -value	Study ( <i>n</i> = 30)	Control ( <i>n</i> = 30)	<i>p</i> -value	Study ( <i>n</i> = 30)	Control ( <i>n</i> = 30)	<i>p</i> -value
The evening before surgery	21.0 $\pm$ 12.4	28.5 $\pm$ 24.9	0.145	12.7 $\pm$ 12.0	9.6 $\pm$ 7.2	0.228	6.2 $\pm$ 5.7	4.5 $\pm$ 4.7	0.194
Day of surgery	211.8 $\pm$ 228.3	323.0 $\pm$ 421.1	0.209	41.0 $\pm$ 53.8	35.7 $\pm$ 25.1	0.626	22.0 $\pm$ 18.6	14.0 $\pm$ 16.2	0.082
1 day after surgery	178.4 $\pm$ 125.7	157.4 $\pm$ 110.4	0.495	71.9 $\pm$ 128.3	51.5 $\pm$ 59.7	0.433	25.4 $\pm$ 23.1	21.8 $\pm$ 31.6	0.619
2 days after surgery	182.2 $\pm$ 201.4	132.1 $\pm$ 104	0.230	167.3 $\pm$ 352.6	95.6 $\pm$ 214.2	0.345	22.9 $\pm$ 23.4	13.1 $\pm$ 18.1	0.074

SD, standard deviation.

<sup>†</sup>Independent *t*-test was used.

preoperative patients participating in music therapy had lower anxiety levels (STAI).

In our study, subjects in the music group had a 16% decrease in anxiety when compared with the pre-intervention level, while the anxiety level of the control group did not change significantly. This difference may result from the older age of participants in the present study (Chinese population had a mean age of 62.18 years vs. approximately 50 years in the study of Lee *et al.* 2004), participants' limited educational backgrounds, unfamiliarity with the terms of the STAI and the fact that, traditionally, older Chinese people do not readily express their emotions. This may imply that the VAS scale is more suitable than the STAI for older Chinese, because of its ease of use. This is indicated by the fact that the participants in the present study showed moderate anxiety both before and after surgery, while other researchers have found high levels of anxiety among patients undergoing spinal surgery (Starkweather *et al.* 2006). The levels of anxiety among the subjects in the current study are also lower than those reported by Lee *et al.* (2004).

In this study, in the comparison of pain in the study group after music therapy with that in the control group, a statistically significant difference was found in the VAS pain score. The findings of previous studies evaluating the impact of music on patients' assessment of pain are contradictory (Evans 2002, Good *et al.* 2002, Sendelbach *et al.* 2006). The results in this study were in accordance with the results of the studies of Good *et al.* and Sendelbach *et al.* Good *et al.* (2002) found that gynaecologic surgery patients receiving music therapy had significantly less pain than did the control group on POD 1 and 2, indicating that music therapy can reduce patients' level of postoperative pain; however, Evans (2002) did a meta-analysis of two studies evaluating the impact of music on procedure patients' assessment of pain using VAS and found no difference in pain scores between groups.

In our study, the results showed that one hour after surgery, systolic and mean blood pressure in the study group

were significantly lower than in the control group; no significant differences were observed in other physiological indices between the two groups. No significant differences were found between the two groups in cortisol, norepinephrine and epinephrine concentrations in 24-hour urine testing, echoing the results of previous research (Wang *et al.* 2002, Chang & Chen 2005, Sendelbach *et al.* 2006). Sendelbach *et al.* compared the effects of music therapy vs. a quiet, uninterrupted rest period for cardiac surgery patients on blood pressure and heart rate and found there were no differences between two groups. Wang *et al.* (2002) also found no differences in pulse rate, blood pressure, cortisol, norepinephrine or epinephrine values between music and control groups of elective outpatients preoperatively. A study by Chang and Chen (2005) involving women who had undergone caesarean section also showed that music therapy had no prominent effects on physiological indices (saturation pulsation oxygenation [SpO<sub>2</sub>], finger temperature, respiration rate, pulse rate, blood pressure) compared with a control group. The explanation may be that cortisol, norepinephrine and epinephrine values are hormonal and related to stress. From the day before surgery to the second day after surgery during data collection, the patients experience stress related to the surgery, which results in the physiological changes. The patient is at the peak of stress, therefore, there is no significant difference in blood pressure or cortisol, norepinephrine or epinephrine values between the two groups. The study group displayed a trend towards lower physiological values related to stress, although the difference did not reach statistical significance. The small sample size in the present study may have also affected the findings.

### Study limitations and recommendations

The research was conducted at a Veterans hospital. The low number of female patients and the advanced age of most of

the patients may have affected the results; for example, the traditionally limited expression of emotions displayed by older Chinese people may have affected the anxiety level exhibited by the patients in this study. The VAS scale may be more useful than the STAI for these older Chinese. This study also was limited by the constraints of human resources and time, as well as by the relatively small sample size from which the results were extrapolated. There is still a need to replicate this study in different institution and with a larger sample; as well, the frequency of listening to music should be explored to determine whether it affects physiological indices between study and control groups.

## Relevance to clinical practice

Alleviating patient pain and anxiety is a central component of surgical nursing. It is important in offering strategies for a possible reduction in anxiety and pain. The results of this study indicate that patients undergoing spinal surgery have significantly lower subjective indices of anxiety and pain after receiving music therapy and that music therapy also has an effect on patients' mean blood pressure immediately after surgery. The findings suggest that the provision of self-

selected music to patients could enhance patient well-being during the postoperative period. Therefore, music therapy could be incorporated into clinical practice as a routine nursing intervention before and after spinal surgery.

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## Contributions

Study design: PCL, MLL, LCH, HCH, CCL; data collection and analysis: PCL, MLL, LCH, HCH, CCL and manuscript preparation: PCL.

## Conflict of interest

The authors declare that they have no conflict of interests.

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