Complementary Therapies in Medicine 32 (2017) 56–60

Contents lists available at ScienceDirect

Complementary Therapies in Medicine

journal homepage: www.elsevierhealth.com/journals/ctim

Effects of music listening on anxiety and physiological responses in patients undergoing awake craniotomy

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ARTICLE INFO

Article history:
Received 19 July 2016
Received in revised form 8 November 2016
Accepted 15 March 2017
Available online 31 March 2017

Keywords:
Music listening
Awake craniotomy
Anxiety
Physiological responses

ABSTRACT

Objective: The purpose of this study was to explore the effects of music listening on the level of anxiety and physiological responses for awake craniotomy.
Methods: An experimental design with randomization was applied in this study. Participants in experimental group (19 patients) selected and listened music at their preferences in the waiting room and throughout the entire surgical procedure in addition to usual care while control group (19 patients) only gave usual care. State-Trait Anxiety Inventory (STAI), heartbeat, breathing, and blood pressure were collected for analysis.
Results: The results of this study showed that after music listening, there was significant decrease in the level of anxiety ($p < .001$). The findings also showed that the music intervention significantly reduced heartbeat rate 84.5 ($p < .004$), systolic pressure 42 ($p < .001$), and diastolic pressure 38 ($p < .001$) over time. We concluded that music listening is associated with a decreased level of anxiety and distress after awake craniotomy patients.
Conclusion: The results of this study can provide perioperative nursing care in providing music listening when patients were in the waiting room and during surgery to reduce the anxiety so as to reach the goal of human care and improve perioperative nursing care.

1. Introduction

According to statistics, 5 people suffer from brain tumor per 100,000 populations in Taiwan. Brain tumor patients are more often between the ages of 45 to 75, with a gender ratio of male-to-female of 1.3:1. Most patients with brain tumors experience symptoms such as headache. However, these symptoms are nonspecific and difficult to detect. When a tumor is located in the left cerebral hemisphere, awake craniotomy surgery is performed to determine the cortical language location. During craniotomy, the patient undergoes local anesthesia and performs various language tests while conscious. This procedure is for determining the cortical language areas to avoid damages to these areas during tumor removal to prevent irreversible post-operative aphasia.[1] Because craniotomy is performed with an awake patient, where the procedure can last from 6 to 8 h, stressful patient with induced sympathetic nervous system can be prone to increased epinephrine secretion that can lead to increases in anxiety, heart rate, respiratory rate, and blood pressure.[2] If these abnormalities were not treated correctly, they could negatively affect the patient's post-operative prognosis and recovery.[3] In recent years, researches that focused on awake craniotomy have determined that pre-surgical patient fear can lead to postoperative dysfunctions such as emotional increase in unease feelings, and physiological increase in blood pressure and heart rate that can affect the patient's postoperative recovery,[4] and thus the surgeon should interact with the patient during the surgical procedure to reduce patient anxiety.[5] A study performed by Wang et al.[6] that investigated music intervention for women underwent hysterectomy determined that the intervention can significantly reduce patient's physiological responses such as blood pressure, heart rate, respiratory rate, and anxiety. Another research performed by Wong et al. also suggested that since respiratory rate and blood pressure are closely related to the respiratory and cardiovascular systems and these physiological responses are important indicators for assessing anxiety.[7]

Music intervention is one of the methods for alleviating anxiety.[8] It is a safe and non-medicated method for reducing patient anxiety and pain.[9,10] It can reduce the secretion of

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http://dx.doi.org/10.1016/j.ctim.2017.03.007

catecholamine to regulate autonomic functions and improve physiological responses such as respiratory rate, heart rate, blood pressure, body temperature, and muscle tension.[11] Music is also reported to have effects such as relaxation and reduction of anxiety, pain, and nausea.[12] These effects can reduce patient anxiety while receiving examination, where many patients reported to experience examination duration reductions.[13] Currently, there are many international studies that have demonstrated the effectiveness of music intervention for reducing pre-operative anxiety and post-operative pain.[14,15] Currently in Taiwan, there are very few literatures that have investigated patient anxiety during awake craniotomy. Therefore, this research was aimed to investigate the effectiveness of music intervention for improving patient anxiety and physiological responses before, during, and after awake craniotomy procedures. It is with high expectation that the study results can serve as reference for nursing personnel in improving health care quality.

2. Methods

2.1. Study design

This study was of an experimental design with randomization of the music experimental ($N = 19$) and control groups ($N = 19$). Data were collected between July 1st, 2014 and April 30th, 2015, from a medical institution in Taiwan. The selection criteria are: (1) brain tumor patients undergoing awake craniotomy; (2) of at least 20 years of age; (3) has no visual nor auditory impairment, conscious, and can communicate in Mandarin Chinese or Taiwanese; and (4) for the sake of consistency, for those who were unable to self-complete the questionnaire, the questions were read out carefully by the author and the patient's answer recorded. The exclusion criterion is: patients who underwent other anesthesia methods due to operation complications. A total of 38 patients were enrolled in this study. While holding in the waiting room, patients were asked to choose their preference of music from six types of soothing music (close to heartbeat) according to literature review and these six types of soothing music are: nature, piano, harp, orchestra, jazz, and synthesis music. During the procedure, the patient lies on the operating table, and their preference choice of music was provided for the patient through the air in the operating room. There were a total of four researchers participated in the data collection and reached internal consistency of 98% prior to the commencement of this study.

2.2. Study tools

The assessment tools used in this study include:

(1) Demographic information: Gender, age, education, religion, marital status, number of times undergone surgery, number of times received anesthesia, blood loss volume, operative time, and preference of music.
(2) State-Trait Anxiety Inventory (STAI): This is a self-reported inventory established by Spielberger,[16] translated and edited by Zong Ho-Long in 1984 into a Chinese version The Cronbach's α of this questionnaire was between 0.90 and 0.86. Each inventory consists of 20 emotional scenarios that are scored on a Likert 1–4 scale ranging from 20 to 80, where the higher the score corresponds to higher level of anxiety. The anxiety ranges were defined as: 0–19 is "no anxiety", 20–39 is "minor anxiety", 40–59 is "moderate anxiety", 60–79 is "high anxiety", and higher than 80 is panic.
(3) Physiological responses[17,18]: Blood pressure, respiratory rate and heart rate.

The study subjects were repeatedly measured for physiological response changes, especially in relationship to STAI fluctuations. The physiological response changes for two groups were compared at 60, 120, 180, 240, 300 and 360 min into the procedure.

2.3. Ethical considerations

This research was approved by the institute's ethics board (#102-3172A3). When a patient who fulfills the enrollment criteria in the waiting room he/she chose a preferred music for listening during the operation.

2.4. Data analysis

The SPSS 18.0 for Windows software package was used to analyze data. The descriptive statistical analysis included categorical variable analysis represented as frequency and percentage, and isometric variable analysis represented as mean and standard deviation. The inferential statistical analysis included independent t-test and Chi-square test to determine the presence of significant differences in demographic data among the patients. Paired t-test was used for evaluating whether there were differences between pre- and post-operation STAI scores or physiological indices within the experimental group and the control group.

3. Results

3.1. Demographic information

There were a total of 38 subjects that were enrolled in this study. The experimental and control groups consisted of 19 subjects each, with 25 male and 13 female subjects. The average age of the subjects is 40 years of age, with 29 subjects older than the average (76.3%). The demographic information including gender, age, education, religion, marital status, profession, number of times undergone surgery, the number of times received full anesthesia, blood loss volume, and operative time showed that there is not significant difference between the two groups ($p > .05$). In terms of preference of music, both of the groups preferred piano music (42.0%).

3.2. Effect of music toward anxiety level and physiological responses

The Mann–Whitney U test was utilized for determining the effect of music toward anxiety level and physiological responses. Both of the groups demonstrated a pre-operative STAI score of 145 ($p = .311$), indicating that there is no significant difference in pre-operative anxiety levels between the two groups. In terms of physiological responses, there was no difference in heart rate (168; $p = .072$) and respiratory rate (147.5; $p = .339$) prior to music intervention and no difference in pre-operative systolic blood pressure (SBP) (166; $p = .652$) and diastolic blood pressure (DBP) (164; $p = .664$) between the two groups.

The Mann–Whitney U test determined that, after music intervention, the two groups have a significant difference in anxiety levels (total value = 65.00; two-sided $p < .001$), with higher anxiety levels in the control group than the music experimental group. After music intervention, the heart rate (84.50; $p = .004$), SBP (42.00; $p < .001$), and DBP (38.00; $p < .001$) between the two groups exhibited statistical significant difference, with higher averages for each of the parameters in the control than the experimental group. However, in terms of respiratory rate (75.00; $p = .003$), there was no statistical difference between the two groups after music intervention (Table 1).

Table 1
Mann–Whitney *U* test analysis for the comparison of anxiety level and physiological responses between the two groups after music intervention ($N = 38$).

Variable	Group	Rank Average	Mann–Whitney *U* test	*p*
Anxiety level	Control	25.58	65.00	<.001***
	Music	13.42		
Heart rate	Control	24.55	84.50	.004*
	Music	14.45		
Respiratory rate	Control	23.11	75.00	.003*
	Music	13.21		
Systolic blood pressure	Control	26.79	42.00	<.001***
	Music	12.21		
Diastolic blood pressure	Control	27.00	38.00	<.001***
	Music	12.00		

Note: SBP, systolic blood pressure; DBP, diastolic blood pressure.
* Significant at the $p < .05$ level.
** Significant at the $p < .01$ level.
*** Significant at the $p < .001$ level[26] .

Table 2
Control group anxiety level and physiological marker improvements – Wilcoxon signed rank test ($N = 19$).

Variable	Average ± standard deviation		*Z* value	*p*
	Pre-operative	Post-operative		
Anxiety level	88.58 ± 6.64	92.63 ± 8.76	−1.658	.097
Hear rate	80.11 ± 12.15	81.84 ± 10.13	−0.284	.777
Respiratory rate	17.53 ± 2.12	17.42 ± 2.34	−0.577	.564
Systolic blood pressure	148.95 ± 14.89	146.53 ± 11.77	−0.524	.600
Diastolic blood pressure	81.74 ± 8.10	81.74 ± 7.53	0.002	1.000

To further understand the pre- and post-operative differences between the experimental and control groups, there is no significant difference in the anxiety level, heart rate, respiratory rate, SBP, and DBP, before and after the procedure for control group (Table 2). The results suggest that without music intervention, the patient's physiological responses were unaffected and showed no reduction in the subject anxiety experience after receiving awake craniotomy (Table 2).

Patients in the experimental group indicated that after 30 min of music intervention, the patient's anxiety level ($p < .001$), heart rate ($p < .001$), respiratory rate ($p < .035$), SBP ($p < .041$), and DBP ($p < .001$) were significantly different than that of the pre-operative levels. The patient's anxiety level, heart rate, SBP, and DBP were also significantly different while in the operation waiting room and during the procedure, where respiratory rate exhibited no significant difference (Table 3).

The aforementioned results determined that patients without music intervention exhibited no significant difference in pre- and post-operative anxiety and physiological responses. Patients who received music intervention exhibited statistical significantly lower averages of heart rate, respiratory rate, SBP, DBP, and subjective anxiety after 30 min of music intervention. These results confirmed that music intervention can effectively reduce pre- and post-operative anxiety for patients who underwent awake craniotomy.

4. Discussion

In this research, the subjects consisted of primarily males. This is consistent with a study performed by Chen et al.[25] that brain tumors are commonly found in males of age 45–75. Without music intervention, there was no observable difference in the subjects' pre- and post-operative anxiety level, heart rate, respiratory rate, SBP, and DBP. The patients' pre- and post-operative anxiety level, respiratory rate, heart rate, SBP, and DBP exhibited significant difference after receiving music intervention. Therefore, the results indicated that music intervention can be used to effectively reduce heart rate, respiratory rate, SBP, DBP, and subjective anxiety of patients undergoing awake craniotomy. These results are similar to that performed by Lee et al.,[19,20] where the effect of music intervention for 70 patients who underwent spinal surgeries was investigated. The study determined that music intervention can be used to significantly reduce heart rates, and thus in turn reduce patient's pre-operative anxiety levels. Hu et al.[21] investigated the effect of music intervention for 60 myocardial infarction patients determined that music can effectively reduce patient heart rate, respiratory rate, SBP, DBP, and anxiety. A study performed by Lin et al.[22] for investigating the effect of music intervention to pain and physiological responses for 60 patients who underwent spinal surgery. The result indicated that music can effectively reduce post-operative pain and anxiety, and can significantly reduce blood pressure at 1 h after surgery. Buffum et al.[23] analyzed the effect music intervention for 170 patients undergoing cardiovascular imaging, and determined that music intervention can effectively reduce patient heart rate and anxiety level. Mok and Wong[24] investigated the effect of music intervention for 80 patients undergoing local surgeries and determined that it can effectively reduce patient heart rate, respiratory rate, SBP, DBP, and anxiety level.

Patients receiving awake craniotomy indicated that the major sources of anxiety are due to the uncertainty of surgical success, the risk of surgical anesthesia, and unease toward surgical procedures. This result is similar to that determined by Mok and Wong,[24] that patient was unfamiliar to local anesthesia and surgeries. The unfamiliarity will manifest as unease for awake patients, and the patient can further become anxious when the post-operative outcome is poor. In the music experimental group, patients can select preferable music for diverting their attentions during surgery, which in turn can result in reduced anxiety and nervousness. When undergoing music intervention, patient's heart rate and blood pressure continue to reduce, within normal boundaries, with the progression of the intervention. It is possible that the slow rhythms of the music can reduce the secretion of catecholamines and the activity

Table 3
Experimental group anxiety level and physiological marker improvements – Wilcoxon signed rank test ($N = 19$).

Variable	Average ± standard deviation		Z value	p
	Pre-operative	Post-operative		
Anxiety level	92.47 ± 9.34	81.05 ± 10.17	−3.180	<.001***
Heart rate	77.79 ± 10.83	62.84 ± 7.33	−3.772	<.001***
Respiratory rate	16.58 ± 2.91	12.11 ± 2.77	−2.065	<.035*
Systolic blood pressure	131.79 ± 13.54	124.37 ± 12.76	−2.048	<.041*
Diastolic blood	80.00 ± 6.47	69.63 ± 7.07	−3.639	<.001***

Note: SBP, systolic blood pressure; DBP, diastolic blood pressure.
* Significant at the $p < .05$ level.
**Significant at the $p < .01$ level[27].
*** Significant at the $p < .001$ level.

of autonomic nervous system to result in the reduction of heart rates. Therefore, music is an alternative non-invasive intervention that is both safe and inexpensive. It is suggested that this intervention can be included in the perioperative nursing care for improving the quality of operating room health care.

5. Research limitations

The subject enrollment in this study is difficult, due to time and clinical limitations. The subjects consisted of patients undergoing awake craniotomy, and the study was not designed to include Parkinson's disease patients undergoing hypothalamic nucleus deep brain stimulation (DBS) surgeries. Because these surgeries are also performed with awake craniotomy, it is suggested that these patients can be included in future investigations to demonstrate the effectiveness of music intervention. Also, it is recommended that future operating room fulltime nursing care can provide music for waiting room patients for reducing anxiety and improve care quality. During the study, many patients indicated that listening to music can indeed reduce their anxieties. Therefore, we recommend that music intervention service can also be provided in the inpatient wards for reducing patient anxiety and improving health care qualities.

6. Relevance to clinical practice

Awake craniotomy is a surgical procedure in which the patient undergoes local anesthesia and performs various language tests while conscious. Since patients stay awake during surgery, it is a serious source of stress for the patients where the fear of the unknown is a major source of anxiety for the patients. Nurses taking care of these patients have to face patients' anxiety. Therefore, it is important to provide good care such as music listen to sooth their anxiety so as to promote best quality of care.

7. Conclusion

In conclusion, patients who did not receive music intervention during awake craniotomy showed no difference in physiological and STAI scores, suggesting that to just lay down was insufficient to relieve anxiety. Instead, receiving music intervention was sufficient to reduce the anxiety for patients during awake craniotomy as indicated by the reduced heart rate, respiration rate, systolic blood pressure, diastolic blood pressure, and STAI score.

Conflict of interest

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

Acknowledgements

We are thankful to the Chang Gung Medical Foundation Research Subsidies, Project Number CMRPG3D1151 for the successful completion of this study. We would also like to thank Dr. Lee Shi-Zeng and Dr. Wei Guo-Zhen, from the Neurosurgery Department in Linkou Chang Gung Memorial Hospital for assistance in research planning and subject enrollment. Finally, we would like to thank all study participants.

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