

The Effect of Music Therapy on Pain and Anxiety of Children Diagnosed with Leukemia during Bone Marrow Aspiration and Lumbar Puncture Procedures

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Abstract

Background: Pharmacological and non-pharmacological approaches can be mainly used to relieve children's pain and anxiety. Music therapy can be a part of patient care in nursing practices. It can be used as a non-invasive intervention for relieving pain and anxiety.

Methodology: This is a randomized clinical trial on 50 leukemia children who underwent bone marrow aspiration and lumbar puncture procedures in Children's Hospital of Kermanshah, Iran. Participants in this study were randomly assigned into two groups: One group listened to children's selective music by headphones half an hour before and during the invasive procedures and the other did not. The data were analyzed using SPSS17, independent t-test, paired t-test, Chi-square, Fisher exact, and U Mann-Whitney test.

Findings: No significant difference was found in terms of children's anxiety in pretest stage in intervention and control groups ($P=0.796$). In posttest stage, however, a significant decline was seen in anxiety in intervention group ($P=0.000$). The pretest pain score was not significant between two groups ($P=0.730$). The pain score, however, declined during ($P=0.000$) and after ($P=0.000$) intervention in the intervention group. **Conclusion:** Music therapy is one of the most widely-used methods in complementary and alternative medicine, which is readily accepted by patients. Therefore, music therapy is recommended to be used as a non-invasive, easy, inexpensive, and effective method for reducing pain and anxiety of leukemia children as well as other patients. More studies are advised in terms of different types of cancer in various hospitals.

Keywords: Music Therapy, Pain, Anxiety, Children, Leukemia.

Introduction

There are several procedures performed on cancer children, which cause pain and anxiety for children and stress for their families. This is particularly important when these procedures might be repeated during diagnosis and treatment of different types of cancer (1). Leukemia is the most common childhood cancer, accounting for 37.6% of cancer during this stage of life (2). The suspicion of leukemia is usually based on the patient's history, physical symptoms, and peripheral blood test which contain immature leukocytes, along with low number of blood cells. A definitive diagnosis is made based on the aspiration or bone marrow biopsy. Bone marrow specifically shows steady infiltration of blast cells. When the diagnosis is confirmed, lumbar puncture is performed to determine the central nervous system involvement (3). In fact, successful treatment of childhood cancer depends on a number of invasive procedures such as aspiration and bone marrow biopsy, spinal injections, and venipunctures to carry out and assess the effect of treatment (4). During these procedures, children might experience a great deal of fear and anxiety due to the real backache or pain forecast (5, 6, and 7). Studies on oncological patients point to the weak management of pain, More than 80% of cancer patients experience a significant pain during the treatment (8). Pain assessment is a substantial component of the nursing process, and the American Pain Society (2000) introduced pain as the fifth vital sign. It advises the forecast for stressful and painful processes for children and essential measures for meeting such processes (9). Careful management of pain during the course of the disease or injury can reduce or prevent the anxiety symptoms. Pain is remembered by children who experience repeated painful procedures as a result of cancer or other immune system problems. Child's memory of painful procedures early in the treatment course can lead to a fear and anxiety forecast prior to the next measures and anxiety disorders such as fear of blood or needle phobia, making the reception of next stages more difficult (10). While anxiety is quite common among children, Highly-prevalent anxiety is specifically reported among children with serious health problems, undergoing numerous medical procedures including cancer children (11). The study by Buchanan (2008) showed that almost 27% of children diagnosed by Acute Lymphoblastic Leukemia (ALL) are at increased risk of clinically significant anxiety. The study indicated that the numbers of leukemia children who experience anxiety are twice as many as the children's general population (12). Therefore, in order to reduce the physical and psychological effects of painful interventions and prevent the long-term consequences, nurses must be capable of managing painful procedures. To this end, a wide range of approaches are

advised including pharmacological and non-pharmacological methods (9). It has been found that pharmacological treatments are effective in reducing pain and anxiety related to medical procedures; however, they might be associated with alarming side effects (13). Also, despite using pain killers, some patients have stated the pain in painful procedures (14). Today, non-pharmacological relief methods have attracted the nursing systems (15). Complementary and Alternative Medicine is widely used to prevent the diseases and promote the public health (16). According to the advice by WHO in terms of complementary medicine, human beings are rightful to use the most effective and inexpensive global medical methods for treating different types of diseases (17). Music therapy, as one of complementary methods, traditionally plays a key role in improving human health and controlling pain. Music therapy is a supportive profession, which can be used by patients diagnosed with different types of physical and psychological problems or social-emotional disorders (18). The effect of music has been proven on human's physiological and emotional responses. According to the gate control theory of pain, pain receptors work with each other in order to send the pain messages to the brain. Therefore, a distracting factor such as music can block the specific ways of pain transfer and reduce the perceived pain (19). Nursing researchers have used the music therapy intervention for patients of all ages in different fields including intensive care, surgery, delivery, and palliative care. However, few considered the cancer children, It is essential to study the issue due to the need for repeated hospitalizations and multiple invasive procedures in children with leukemia and the fact that invasive procedures does not reduce children's pain and anxiety (5). According to the studies, controlling pain is the second important factor after right diagnosis for the patient and family (8). Therefore, this article aimed to study the effect of music therapy on pain and anxiety of children diagnosed with leukemia during bone marrow aspiration and lumbar puncture procedures.

Materials and Method

This is a randomized clinical trial performed in Kermanshah, Iran. A total of 50 children diagnosed with acute leukemia undergoing chemotherapy were enrolled as the sample. They visited the Chemotherapy Clinic of Children's Hospital of Kermanshah, Iran, from March to August 2016 for bone marrow aspiration and lumbar puncture procedures. The inclusion criteria were as follow:

- 6-12 year-old children
- Developing leukemia (lymphoblastic or myeloblastic)

- Lack of mental retardation , visual and aural problems
- No history of ear surgery
- Lack of ongoing intake of painkillers and anti-anxiety medications
- No history of relapse
- History of lumbar puncture and bone marrow aspiration for at least once

The subjects were excluded if the procedure was incomplete, the procedure was repeated for more than once, anti-anxiety or pain killer was prescribed by the physician, and the headphones was removed by the child.

Research Instrument

Data were collected using four questionnaires: Patient Medical - Personal History Questionnaire, Revised Children's Manifest Anxiety Scale (RCMAS), FLACC Behavioral Pain Assessment Scale, and self-reporting Wong-Baker Faces Pain Rating Scale (WBFPRS). The demographic characteristics included age, gender, order of birth, father's and mother's education, place of residence (city or village), and clinical background information including (disease duration, history of hospitalization, number of bone marrow aspiration and lumbar puncture procedures, and the length of invasive procedures).

RCMAS

The instrument was designed by Reynolds and Richmond (1978) to assess the symptoms of general anxiety of children and adolescents (up to 19 years old). The scale consists of 38 items. A total Anxiety score is computed based on 28 items, which are divided into three anxiety subscales: physiological anxiety, worry/oversensitivity, and concerns/concentration. The remaining nine items on the RCMAS constitute the Lie subscale. In this test, the children are asked to answer by "Yes" or "No". Each item is scored on a zero to one scale. The anxiety score can range from 0 to 28, The lie score from 0 to 9. A low score on the anxiety scale suggests lower levels of anxiety and lower scores on lie subscale suggests the honesty of subject for answering the questions. Multiple studies have been conducted for the validity of RCMAS. The construct and content validity has been verified in many studies. Reynolds and Richmond reported 0.56 to 0.80 for the internal consistency of three subscales. The total internal consistency was reported 0.80 (20). In Iran, Taghavi and Alishahi (2005) studied the validity and reliability of

RCMAS. The reliability was reported 0.67 and 0.66 using retest and bisection methods, respectively. Divergent validity and correlation were used for investigating RCMAS. According to this study, RCMAS was appropriate to be used in Iran (21). The study by Reihani (2014) verified the reliability (0.78) of RCMAS (22).

FLACC Behavioral Pain Assessment Scale

The scale consists of five sections (Face, Legs, Activity, Cry, and Consolability). Each item is scored on a 0-2 scale, with higher score representing more reaction to pain. The score of each item is recorded separately and the overall pain score is the total sum of the items. The scale is scored in a range of 0–10 with 0 representing no pain and 10 representing the maximum pain. The overall score is classified into three categories:

1-3: Mild pain

4-6: Moderate pain

7-10: Severe pain (23).

The scale was first designed by Merkel and Lewis (1997) in order to assess the postoperative pain of the children between the ages of 0 months and 7 years (24). Other studies have verified the scale to assess the pain severity in painful procedures such as peripheral venipuncture, lumbar puncture, and other invasive procedures among the children between the ages of 5 to 16 years. The study by Nilsson (2008) showed that a correlation was found between the observed behavior score of two researchers and the self-report through the Coloured Analogue Scale during the procedure ($r=0.59$, $P<0.05$). Interrater reliability during the procedure was supported by adequate Kappa statistics for all items and for the total FLACC score ($P<0.001$, $K=0.85$). Bagherian et al (2012) verified the validity using content validity by 10 nursing lecturers (9). The reliability was 0.74 and 0.85 in the studies by Tavasoli et al. (2008) (26) and Rostami et al. (2014) (27).

Wong-Baker Faces Pain Rating Scale (WBFPRS)

The scale was developed by Wong and Baker (1998) that consists of face and number. Prior to the procedure, full description is provided by the researcher proportional to age of the child in relation to the scale. The numerical section is explained for children older than 7 years, with zero representing No Pain, 1-2, Low Pain; 3-4, Hurts a Little Bit; 5-6, Hurts Much More; 7-8, Severe Pain; and 9-10, Hurts Worst. The second section, which is

above the numerical scale, shows a series of faces ranging from a happy face at 0, "No hurt" to a crying face at 10 "Hurts worst". The child must choose the face that best describes how they are feeling because they are not able to realize the meaning of numbers or cannot count. The scale used for individuals between the ages of 3 to 18 years (28). Wong and Hockenberry (2003) studied the validity and reliability of WBFPRS (3). Numerous other studies assessed the construct validity, concurrent validity, and test - retest this scale (3). The results showed that WBFPRS is valid and reliable to measure the procedure pain (29). Alhani et al. (2010) verified the validity and reliability of WBFPRS using content validity and test-retest ($r=1$) (30). The study by NikFarid (2008) showed that the reliability was 0.82 using the content validity method by nursing lecturers (31).

Method

The researcher selected the subjects among the children diagnosed with leukemia who visited the hospital for bone marrow aspiration and lumbar puncture. Oral and written consent was taken from the parents and subjects after briefing the subjects. Then, demographic characteristics were obtained using a questionnaire. The subjects were assigned into two groups: Intervention (25 members) and Control (25 members) using random block. The anxiety score was asked from both groups using RCMAS, then the subjects were asked to forecast their pain using WBFPRS. Next, for subjects in the intervention group the childish music, selected by the research consultant, was played 30 minutes prior to and during the invasive procedures (NIA headphones, made in China, were used) when the nurses and physician were preparing the chemotherapy procedure. Disposable covers were used to prevent the infection. The participants in the control group received the routine care. Note that anti-anxiety and pain killers are not routinely used in this center. During the invasive procedures, the pain was assessed using FLACC Pain Assessment Scale. Both groups rested for half an hour after the completion of procedure. Then, the anxiety and pain scores were recorded using RCMAS and WBFPRS. The data were analyzed using SPSS17, independent t-test, paired t-test, Chi-square, Fisher exact test, and U Mann- Whitney test. Kolmogorov Smirnov test was employed for verifying the normality of quantitative data, Qualitative data were investigated by Chi-Square. Significance level was considered 0.05.

Ethical considerations were taken into account including the permission of Ethics Committee provided by Tehran University of Social Welfare and Rehabilitation Sciences

(Ethics Code: IR.USWR.REC.1395.11), official letter from Kermanshah University of Medical Sciences, explanation of objectives and nature of the study for the parents and subjects, and written consents.

Findings

A total of 55 patients were enrolled in the study of which 5 were excluded (3 patients from control group; 2 patients received more than one invasive procedure and one had used EMLA ointment, 2 patients from the intervention group because they stopped using the headphones before finishing the procedure). As a result, 50 patients entered the study assigned in control and intervention groups. 20% of the subjects underwent lumbar puncture, 4% underwent bone marrow aspiration, and 76% experienced both procedures at the same time (Table 1). The results showed that both groups are matched in terms of age ($p=0.88$), gender ($p=1.000$), order to birth ($p=0.76$), father's education ($p=0.68$), mother's education ($p=0.84$), and place of residence ($p=0.73$) (Table 2). Clinical background variables indicated that were not different in terms of length of development ($p=0.76$), the frequency of procedures ($p=0.24$), and history of hospitalization ($p=0.20$). However, the length of invasive procedure was shorter in intervention group than the control ($p=0.003$) (Table 3).

Table 1: Comparing Control and Intervention Groups in Terms of Procedure							
Variable	Group	Intervention		Control		Total	
		No.	%	No.	%	No.	%
Type of Procedure	BMA	1	4	1	4	2	4
	LP	5	20	5	20	10	20
	Both	19	76	19	76	38	76
	Total	25	100	25	100	50	100

The mean duration of invasive procedures was 6.43 ± 1.73 minutes in intervention group, while it was 7.97 ± 1.69 minutes in control group

Table 2: Demographic Characteristics					
Variable		Intervention	Control	Test	P-Value

		Mean±SD			
Age (Year)		9.04±1.8	8.96±1.8	T=0.156	0.88
Gender (Number)	Female	11	11	X ² =0.000	1.000
	Male	14	14		
Order of Birth	First	17	18	X ² =0.095	0.76
	Second and After	8	7		
Place of Residence	City	19	20	X ² =0.117	0.73
	Village	6	5		
Father's Education	Illiterate	5	3	X ² =1.515	0.68
	Secondary School	5	7		
	Diploma	10	12		
	Academic Education	5	3		
Mother's Education	Illiterate	5	3	X ² =0.83	0.84
	Secondary School	5	7		
	Diploma	13	13		
	Academic Education	2	2		

The results of RCMAS before the start of procedure showed that no significant difference was found between the intervention and control groups in terms of the score of anxiety ($p=0.796$), while the score of anxiety after the procedure showed that the reported anxiety was less in intervention group than the control group ($p=0.000$) (Table 4).

Table 3: Background Clinical Variables

Variable	Intervention	Control	Test	P-Value
Length of Leukemia Development (Month)	19.7±11.2	17.4±10.8	T=0.45	0.76
Frequency of Procedure	11.08±5.27	9.44±4.53	T=1.17	0.24

(times)				
Frequency of Hospitalization (times)	8.9±5.3	7.1±4.2	T=1.31	0.20
Length of Procedure (Minute)	6.43±1.73	7.97±1.69	T=-3.16	0.003

Table 4: Comparing Anxiety between Intervention and Control before and after the procedure

Variable		Intervention	Control	Test	P-Value
		Mean±SD			
Anxiety	Before	21.04±1.38	21.24±2.42	T=0.260	0.796
	After	12.6±3.06	19.3±2.61	T=8.317	0.000

A review of pain scores before and after the procedure showed that no significant difference was found between the intervention and control groups in terms of the reported pain scores, and both groups forecasted equal pain ($p=0.730$), while, after the procedure, the reported pain score was significantly less in intervention group than the control group ($p=0.000$) (Table 5). The results of observing behavioral reactions during the procedure showed that the pain scores were significantly less in intervention group compared to control group ($p=0.000$) (Table 5).

Table 5: Comparing Pain in Intervention and Control Groups Before, During, and After the Procedures

Variable	Stage	Intervention	Control	Test	P-Value
		Mean±SD			
Pain	Before	8.56±1.583	8.40±1.633	U Mann-Whitney =0.345	0.730
	During	4.320±1.249	8.160±1.462	T=-9.982	0.000
	After	4.24±1.855	8.40±1.528	T=-8.657	0.000

In this article, the mean score of reported anxiety was 15.7 ± 4.04 among the girls and 16.1 ± 4.70 for boys. The mean score of experienced pain was 6.64 ± 2.67 among the boys and 5.91 ± 2.72 among the girls. The results of independent t-test showed that no significant difference was found between boys and girls in terms of the pain and anxiety scores.

Table 6: Comparing Pain and Anxiety between Boys and Girls Before and After the Procedure

Variable	Stage	Girls	Boys	Test	P-Value
		Mean±SD			
Anxiety	Before	20.95±2.55	21.28±2.83	T=0.428	0.67
	After	15.7±4.04	16.1±4.70	T=0.301	0.76
Pain	Before	8.27±1.66	8.64±1.54	T=0.812	0.42
	After	5.91±2.72	6.64±2.67	T=0.956	0.34

Discussion

This article aimed to determine the effect of music therapy on pain and anxiety of children diagnosed with leukemia undergoing bone marrow aspiration and lumbar puncture procedures. The results showed that music therapy can help reduce children's pain and anxiety during the invasive procedures. Distraction is the most commonly used method for painful procedures of short duration, but such distraction must be attractive for children (4). The commonly accepted hypothesis is that music, as a cognitive factor, causes distraction, directing the focus of child towards something enjoyable and encouraging (32). Music therapy has a number of merits with immediate effect, sometimes permanent effect on patients, family members, and care staff. Music penetrates physical and emotional obstacles, attracts people to each other, reduces isolation, and increases social interactions (33). People's perception of music is effective in its power of treatment. Certain music can create various effects in people with different perceptions (34). Therefore, moods, tastes, age, cultural traditions, geographical locations, and religious background need to be taken into account while selecting music. Music consultants were used in this regard, meaning that music was selected proportional to the

Iranian children. Findings showed that the hypothesis was verified (music was effective in reducing the children's anxiety and pain). The results are consistent with those of the study by Shabanloei (2010) on the effect of music on patient's pain and anxiety during bone marrow aspiration and biopsy. The result of this study showed that music group displayed lower pain and anxiety after intervention (22). The study by Nguyen (2010) on the effect of music on the anxiety and pain of leukemia children undergoing lumbar puncture showed that the pain and anxiety scores were lower in music group than control group (5). The study by ZamanZadeh (2013) showed that music was effective in reducing the anxiety of the patients undergoing cholecystectomy. The results are consistent with our study (35). The results of the study by Zhou (2014) on reducing the anxiety of patients undergoing radical mastectomy are consistent with ours (17). Zhou believed that music therapy sessions can reduce the women's anxiety undergoing mastectomy. The results of the study by Zengin (2012) on the effect of music on reducing the pain and anxiety of patients undergoing subclavian catheter port placement are consistent with ours (15). According to Zhou's study, the patients in music therapy group experienced less pain and anxiety compared to control group. Unlike our study, Danhauer (2010) studied the effect of music on the anxiety of patients during bone marrow biopsy. He stated that music was not effective on the pain and anxiety scores of the participants, and no significant difference was found in both groups before and after intervention in terms of the anxiety score (36). In Danhauer's study, the subjects in music group listened to music during the procedure, while no certain time was taken into account prior to the invasive procedure. Therefore, the length of intervention was not similar for the participants. On the other hand, no certain criterion was used for selecting the music appropriate with the age. These factors can be effective in the results. The study by Hooks (2014) on the effect of music on perceived pain of the patients undergoing knee surgery showed that the reported pain score was lower in music group than the control group; however, no significant difference was found between two groups in terms of the requested opium (16). Unlike our study through which music is the only intervention method for reducing pain, Hooks used opium along with music for reducing the pain.

no significant difference was found on the pain and anxiety scores of boys and girls in this study, while the study by Nilsson (2009) reported greater anxiety of female than male undergoing coronary angiography (37). it is advised to consider the effect of gender in future studies with more subjects at different ages.

Limitations

Lack of blinding in the control group was one of limitations. Since headphones were used in the intervention group and using headphones without music for blinding in the control group could create an unpleasant feeling, blinding was excluded, which is likely to be effective in results.

The subjects were selected in one center. Generalization of results might not be logical to other clinical situations due to few numbers of participants. Therefore, using music therapy is advised among more participants at different age and clinical situations.

Conclusion

The children diagnosed with chronic and serious diseases such as cancer are exposed to a number of examinations and treatment based on the complications and diagnostic measures. Tolerating these procedures is sometimes more difficult than the disease and can cause pain, stress, and anxiety among children. They can independently use the technique. Therefore, this technique is recommended to be used as non-invasive, inexpensive, and effective method in reducing the pain and anxiety of children diagnosed with leukemia and other patients.

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