Original Research Article

The Effect of Binaural Beats on Preoperative Anxiety among Coronary Artery Bypass Grafting Patients

Abstract

Background: Every surgery is associated with different levels of risks and complications. Cardiac surgeries would definitely cause moderate to severe anxiety because cardiac surgeries are associated with high vital risk.

Objective: To determine the effectiveness of binaural beats on pre-operative anxiety among patients undergoing for CABG surgery.

Methodology: This quasi-experimental study was conducted at Tabba Heart Institute. In this study, total 56 patients were included who were undergoing for CABG surgeries. The patients were divided into two groups; interventional group and control group. Blood pressure, heart rate and respiratory rate were measured before intervention and 30 minutes after the intervention. State-Trait Anxiety Inventory (STAI) questionnaire was used to determine the pre-operative anxiety level among CABG patients.

Results: Both groups; binaural beats (BB) and counseling technique groups comprised 28 patients. Patients in BB group and counseling technique showed significant reduction of STAI state scores after the intervention. Among two groups, a significant difference was seen in mean post STAI-S scores, with mean score of 52.9±5.5 in control and 48.2±6.7 in intervention group and it was statistically significant (p-value=0.006). There was no significant difference in mean values of other demographic variables between two groups. A significant reduction in systolic

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blood pressure and heart rate recorded only in the BB group, whereas, no significant difference of vital signs found in counseling technique group.

Conclusion: Both, BB and counseling technique proved as factor to decrease anxiety level. Physiologic indicators of anxiety, systolic blood pressure and heart rate were also significantly lower in the BB group over counseling technique.

Keywords: Binaural beats, CABG, pre-operative anxiety

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Background

Coronary artery bypass graft surgery (CABG) is generally considered as the most useful and effective treatment for patients who have coronary arteries blocked at multiple areas but it is also one of the most stressful events that can occur in the lifetime of a person[1]. Patients with CABG can experience psychological problems such as fear, worry, depression and anxiety. These problems start as soon as CABG is chosen as a therapeutic solution and continue till discharge from the hospital[2]. Symptoms such as exhaustion, headache, chest pain, palpitation, muscle weakness, vomiting and sweating are negative effects of anxiety[3]. Evidences suggest that surgical candidates are often concerned about the procedure and fear the outcome[4]. Possible surgical discomfort, loss of control during surgery, changes in body image, adverse diagnosis, concern about lack of recovery, and concern for family members and profession are among the causes of preoperative anxiety[3]. These findings are consistent with recent studies which shown a 60–80 percent prevalence of preoperative anxiety[5]. Moreover, 62 percent of preoperative anxiety prevalence reported in Pakistan[6], 76.7 percent in Sri Lanka[7], and 70.3 percent in Jimma, Ethiopia[8]. Heart surgery causes anxiety with its dangers outcomes, complications and poor

prognosis on a wider scale and sometimes it causes patients to be defeated even before the operation[9]. Preoperative anxiety should be reduced since excessive worry might make it difficult for patients to understand and recall crucial postoperative home care instructions[10]. Music is one of several strategies for reducing preoperative anxiety, including the use of medicine or other adjuvant treatments[11]. Preoperative music intervention is a low-cost, easy-to-use technique with minimal adverse effects that has been shown to reduce patient anxiety in a variety of surgical populations[12]. Musical intervention is an excellent way for promoting relaxation and spiritual peace that is increasingly being employed as a supplemental therapy[13]. Watching humor films has been demonstrated to reduce preoperative anxiety and blood pressure in individuals in studies[14]. One recent research study provides evidence of using music as an anxiolytic treatment. The benefits of preventing physiological anxiety reactions were demonstrated, in particular those patients who had received mechanical ventilation and stayed in an ICU[15]. To reduce preoperative anxiety, BB may be valuable tool[16]. In the 19th century, BB were first reported and described in detail in 1973 by Oster[17]. Therefore, this study was conducted to determine the effectiveness of binaural beats on pre-operative anxiety among patients undergoing for CABG surgery in a private tertiary care hospital of Karachi, Pakistan.

Methods

This quasi-experimental study was conducted in five months of duration from April to August 2020. All the patients advised for CABG with stable hemodynamic and clinical conditions were included, while the patients with neurological diseases or any condition that interfere with the study procedures were excluded from the study. The sample size was calculated by taken pre-intervention mean and standard deviation (35.9± 10.9) and after intervention mean and standard

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deviation (28.7 ± 7.8) 33. 95% confidence interval and 80% power of the test. Calculated sample size was 56 comprised of 28 in each group.

State-Trait Anxiety Inventory (STAI) was used to determine the pre-operative anxiety level among CABG patients. STAI has 2 parts such as STAI-State and STAI-Trait, 20 questions in each part. STAI-State indicates how much anxiety level is available at present time in an individual. While, STAI-Trait reveals how much the anxiety level is sustain in personality of an individual. All 40 items rated on a 4-point likert scale e.g. “almost never” to “almost always”. Higher scores indicate more anxiety.

Ethical clearance was obtained from Ethical Review Committee (ERC) of Ziauddin University and Institutional Review Board (IRB) of Tabba Heart Institute was also obtained. Study subjects were approached by using non-probability convenient sampling technique. The participant’s confidentiality was assured and written informed consent was obtained for voluntary participation. For statistical analysis, SPSS version 22.0 was used. Descriptive statistics were shown in frequency and percentage. While, mean and SD calculated for the continuous data like blood pressure, heart rate, respiratory rate and anxiety score. Chi square test, independent t-test and paired t-test and was performed for the inferential statistics with $p<0.005$ was considered the level of significance.

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Results

Table 1 describes the baseline characteristics of the study participants both groups. Among patients enrolled in intervention group majority 53.6% individuals were in age group >55 years, 28.6% in age group in >45-55 years and 17.9% were aged < 45years. While in control group, majority 46.4% patients were in age group between >45-55 years, 42.9% were in age group >55 years and 10% were in <45 years age group. In both groups, majority participants were male. Most of enrolled participants, 89.3% and 85.7% in both group intervention and control respectively were married. In control group, 96.4% patients had disease for <1 year duration while in intervention group 78.6% had disease for < 1 year that was significant with p-value 0.043. The monthly income of majority participants 46.4% in both groups was less than 40 thousand per month. Of participants included in intervention group 35.7% had history of traumatic event in between 4-6 years, 32.1% had traumatic event within 1-3 years and other 32.1% had traumatic event less than a year ago while in control group 57.1% had some traumatic event amid 4-6 years, 28.6% had in between 1-3 years and 14.3% had traumatic event less than 1 year ago. Majority patients in both groups were not habitual of any substance usage, 25% in control group while 32.1% among intervention group were smokers. In intervention group 13 (46.4%) had intermediate educational level, 39.3% had graduation/post-graduation and only 4 (14.3%) had educational qualification of primary/secondary. While, in control group 13 (46.4%) had graduation/post-graduation educational qualification, 42.9% had intermediate and 3 (10.7%) had educational qualification of primary/secondary school

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Table1. Baseline characteristics of patients in different groups

Baseline characteristics	**Control (n=28)**		**Intervention (n=28)**		**P-value**
Age	N	%	n	%	0.364
< 45 Years	3	10.7%	5	17.9%	
>45-55 Years	13	46.4%	8	28.6%	
>55 Years	12	42.9%	15	53.6%	
Gender					0.515
Male	21	75.0%	23	82.1%	
Female	7	25.0%	5	17.9%	
Marital Status					0.686
Married	24	85.7%	25	89.3%	
Un married	4	14.3%	3	10.7%	
Duration					0.043
<1 Year	27	96.4%	22	78.6%	
> 1 Years	1	3.6%	6	21.4%	
Substance Usage					0.822
Smoking	7	25.0%	9	32.1%	
Other Substance using	6	21.4%	6	21.4%	
None	15	53.6%	13	46.4%	
Qualification					0.840
Primary/ Secondary	3	10.7%	4	14.3%	
Intermediate	12	42.9%	13	46.4%	
Graduation/ Post Graduation	13	46.4%	11	39.3%	

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Table 2 shows the comparison of STAI scores, blood pressure, heart rate and respiratory rate between control and intervention groups before participants were exposed to interventional BB. Data revealed that before interventional therapy mean STAI-S and SAI-T score were not significantly different between control and intervention groups with p-value of 0.626 and 0.493 respectively. Also there was no significant difference observed in mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings, no significant variation noticed in mean heart rate (HR) and respiratory rate (RR) as well among both groups.

Table 2 Comparison of STAI scores, blood pressure, heart rate and respiratory rate between the groups before intervention

	Control (n=28)	**Intervention (n=28)**	**P-value**
Vital sign	**Mean± S.D**	**Mean± S.D**	
STAI Score			
STAT-S	55.57±3.77	55.03±4.37	0.626
STAI-T	54.96±4.03	54.17±4.48	0.493
Systolic	118.53±12.16	121.07±12.32	0.442
Diastolic	68.64±5.49	69.10±7.17	0.787
Heart rate	78.96±12.27	75.53±8.28	0.226
Respiratory rate	19.00±1.33	18.53±0.88	0.130

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Table 3 reveals the comparison of STAI scores, blood pressure, heart rate and respiratory rate between control and intervention groups after participants were exposed to interventional BB. Among two groups, the significant difference was seen in mean post STAI-S scores, with mean score of 52.9±5.5 in control and 48.2±6.7 in intervention group. This was statistically significant with p-value 0.006. There was no significant difference in mean values of other variables such as SBP, DBP, RR and RR between the two groups.

Table 3 Comparison of change in blood pressure, heart rate and respiratory rate after intervention between groups

Vital sign	**Control (n=28)**	**Intervention (n=28)**	**P-value**
	Mean± S.D	**Mean± S.D**	
STAI Score			
Post STAI-S	52.92±5.50	48.25±6.74	0.006
Systolic	118.85±12.06	123.35±12.49	0.176
Diastolic	69.03±5.02	70.10±6.629	0.498
Heart rate	78.25±13.32	78.32±10.18	0.982
Respiratory rate	19.03±1.77	19.03±1.42	1.000

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Table 4 describes the comparison between mean STAI-S scores, SBP and DBP readings along with mean HR and RR, in patients of control group before and after interventional BB therapy. Data demonstrated that there was significant difference in mean pre STAI-S score and post STAI-S score, 55.5±3.7 and 52.9±5.5 respectively, which was statistically significant with p-value 0.024. However there was no significant difference observed in mean SBP and DBP, HR and RR before and after intervention in control group with p-values 0.43, 0.47, 0.29 and 0.83 respectively.

Table 4. Mean pre and post intervention difference STAI-S scores compared in control groups

Control	**Pre**	**Post**	**Mean**	**P-value**
	Mean± S.D	**Mean± S.D**	**Difference**	
STAI-S Score	55.5±3.775	52.92±5.503	2.642	0.024
SBP	118.8±12.06	118.5±12.16	0.321	0.431
DBP	69.03±5.022	68.64±5.492	0.392	0.479
HR	78.25±13.32	78.96±12.27	00.71	0.292
RR	19.0±1.773	19.00±1.333	0.035	0.832

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Table 5 highlights the difference between pre and post BB intervention, STAI-S scores, mean systolic and diastolic blood pressure readings, heart and respiratory rates among participants enrolled in intervention group. The results showed that statistically significant difference between pre and post STAI-S score among participants of intervention group with p-value <0.001. There is also significant difference observed between pre and post SBP readings and HR with p-value 0.024 and 0.040 respectively.

Table 5. Mean pre and post intervention difference STAI-S scores compared in intervention groups

Intervention	**Pre**	**Post**	**Mean Difference**	**P-value**
	Mean± S.D	**Mean± S.D**		
STAI-S Score	55.03±4.375	48.25±6.74	6.785	<0.001
SBP	123.3±12.49	121.0±12.32	2.285	0.024
DBP	70.10±6.629	69.10±7.176	1.00	0.199
HR	78.32±10.18	75.53±8.28	2.785	0.040
RR	19.03±1.426	18.53±0.881	0.500	0.055

Discussion

The use of analgesic and sedative drugs are the most effective method for reducing anxiety[18].The current trend highlights use non-pharmacological interventions to reduce anxiety. It has been observed in several research studies that music has been found to be beneficial to patients who were undergoing for various types of surgeries[19, 20].Anxiety relief is one among these benefits. Music therapy (as practiced by certified music therapists) is increasingly gaining acceptability

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among healthcare professionals as a non-pharmacological anxiolytic strategy[21].According to recent research study, BB has a positive effect on anxiety[22]. BB can help to reduce acute pre-operative anxiety before having general anesthesia[23]. Hence, such types of studies are mandatory to initiate and reduce anxiety; this is first research in Pakistani context that investigated the effects of BB on pre-operative anxiety in CABG patients. In order to demonstrate additional benefit of BB, present study also evaluated the effects of BB embedded on SBP, DBP, HR and RR. The Spielberger's STAI, one of the most widely used subjective self-measuring tests, was utilized to determine anxiety levels in thisstudy[24]. The STAI has become the gold standard for assessing preoperative anxiety[7].

Research study investigated the use of BB tones for the treatment of mild anxiety among patients. Although no physiologic test of anxiety reduction was performed, their results demonstrated a significant drop in post-treatment STAI scores after 4 weeks of routinely listening to cassettes implanted with BB music tones[20]. Research study compared the effects of various original sound compositions (electro acoustic music, audio field recordings from natural and constructed settings, and audio field recordings with embedded BB) on anxiety reduction in emergency department patients with reconstructed ambient noise simulating an emergency department environment and headphones only without music. They found that musical interventions with BB embedded compositions lowered anxiety (as measured by STAI scores) much more than headphones alone or simulated emergency room noise[25]. In current study, it was found that all participants (between 45-80) were with high pre-operative anxiety levels whereas, studies conducted in Pakistan[26], Thailand[27], Turkey[28] and Italy[29] showed most of their participants (between 35 to 80) were with moderate to high anxiety levels. In this study, it was found that most of the patients belong to age group between the 30 to 70 years, which is

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supported by a studies conducted in Thailand[27, 30], and Iran[31].In this study, both binaural beats and counseling techniques showed a statistically significant reduction in pre-operative anxiety levels among CABG patients but binaural beat music reduced more effectively then the counseling technique. Similar type of findings of binaural beats on pre- operative anxiety were found in the studies conducted in Thailand[27, 30], Turkey[28 ,32] and Italy[29]. In present study, the physiologic outcome measurement of anxiety included SBP, DBP, HR and RR. Patients in control group had no significant difference in SBP, DBP, HR and RR with p-values 0.43, 0.47, 0.29 and 0.83 respectively. However, significant difference was observed between pre and post SBP readings and HR with p-value 0.024 and 0.040 in interventional group. Additionally, binaural beats group showed a significant decrease in SBP and HR, whereas significant decrease found only in SBP among patients undergoing fiberoptic bronchoscopy[30]. BB is a low-cost, safe, and side-effect-free way to help patients to be relaxed. Therefore, it is suggested that BB have a stronger anxiolytic effect than the other traditional method such as counseling technique before the surgery.

Conclusion

In conclusion, the finding of this study supports the evidence that binaural beats decreased the level of pre-operative anxiety of CABG patients more effectively than the counseling technique method, measured by STAI questionnaire. Physiologic indicators of anxiety such as DBP and HR were also significantly lower in the binaural beat group over counseling technique. These findings may potentially contribute to inexpensive and safe treatment options to make patient pre-operative experience smooth.

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-- MeSH Terms --

Humans

Heart Rate

Blood Pressure

Control Groups

Respiratory Rate

Anxiety

Surveys and Questionnaires

Counseling

Demography

Coronary Artery Bypass

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