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Scientific Research

Effect of Music on State of Ischaemia in Stable Angina; a Randomized Controlled Trial

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Abstract

Introduction: Ischaemic heart disease is the number one cause of deaths in the world. As these patients experience severe distress due to a number of associated reasons, it is important to focus on both physiological and psychological needs of the patients in the management. Beyond the standard medical and surgical treatments, relaxation therapies such as relaxing music have been identified as having impact in reducing morbidity in ischaemic heart disease. Even though several studies have been conducted to find out the impact of music on pain, anxiety, heart rate and stress associated with myocardial ischaemia, it is hard to find literature on the long-term effects of music on ischaemia. Therefore the effort of this study was to determine the long-term effects of Indian classical music on state of ischaemia in stable angina. Methodology: A single blind randomized clinical trial was conducted on 60 patients of 45 to 65 years of age with stable angina. Intervention group (n = 30) listened to a music based on Indian classical system at home twice a day complementary to their regular treatment for a period of one month. Control group (n = 30) was only on their usual treatment. Both groups were assessed before and one month after the study period for state of ischaemia based on exercise ECG results. Results: Significant improvement in state of ischaemia ($p < 0.01$) was observed in the intervention group (increase in mean exercise duration by 123 s, the stage at which the test was terminated, maximum metabolic equivalents level

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achieved by 2.1, the time until 1 mm ST depression by 127.3 s and the time until maximum ST segment depression by 85.9 s and significant reduction in mean maximal ST segment depression by 0.55 mm). But no significant improvement was observed in the control group ($p > 0.05$). Conclusion: Systematic, regular listening of music based on Indian classical system significantly improved the severity of the state of ischaemia associated with stable angina. Hence music therapy has a potential benefit in considering for use as complementary to angina treatment in reducing morbidity.

Keywords

Music, Indian Classical, Stable Angina, Ischaemia, Exercise ECG

1. Introduction

World Health Organization (WHO) indicates that cardio vascular disease (CVD) was the leading cause of death in the world during the past decade [1]. People with coronary heart disease (CHD) often suffer from severe distress due to various reasons such as their diagnosis, hospitalization, surgical procedures, uncertainty of outcome, fear of dying, doubts about progress in recovery and helplessness [2]-[4]. As a consequence, this disease is associated with stress triggering the release of stress hormones leading to increase heart rate, respiratory rate, arterial blood pressure and myocardial oxygen demand. Such stress-related adverse effects put the patient at greater risk for complications, including sudden cardiac death [5]. Therefore it is important to focus on both physiological and psychological needs of the patients in the management of ischaemic heart disease (IHD). In addition to the standard treatment which includes lifestyle modification, drug treatment and surgical interventions such as revascularization [6], relaxation techniques such as music therapy and meditation aimed at reducing stress and anxiety are also considered [5].

Ischaemic Heart Disease and Music Therapy

Music therapy is a complementary therapy that is used along with other treatments to help patients cope mentally and physically with their condition [7].

Effect of relaxing music has been thought to be due to complex neurophysiological phenomenon. It affects entire nervous system and the stress hormones [8]. With theses mechanisms, it reduces the rate of formation of the atheromatous plaque, the metabolic rate, heart rate, blood pressure, free fatty acids and oxygen consumption and hence reduces the severity of the disease [9] [10]. Additionally, by acting on different parts of the brain and relieving pain through endorphins secreted from the pituitary gland it may enhance the quality of life [9].

Practicing music therapy is easy; prior preparations are not necessarily needed and can be practiced at any given time. In general, it is relatively inexpensive [11] and considered safe [12].

Though the effect of Indian and western relaxation music on physical health has been identified since the ancient period [8] [9] [13], most of the studies conducted in patients with myocardial infarction (MI), have focussed on determining short-term effects of music such as on stress, anxiety, blood pressure and heart rate at different setups [4] [5] [14]-[16]. These studies consisted only one 20 - 30 minutes music listening session and assessed the outcome immediately following music intervention. The results varied from study to study. While some were able to show a significant effect of music on heart rate variability, blood pressure, pain, anxiety and rapid recovery [4] [5] [16], some were not able to show a significant impact of music [14] [16].

The effect of frequent listening to music for a longer period on state of ischaemia has not been studied. Assessing the effects of music on state of ischaemia is important as it indirectly assesses the severity as well as the progression of the disease and the underlying pathophysiology. Additionally, assessing the state of ischaemia objectively rather than subjectively is vital as it gives excellent scientific evidence to consider music as a complementary therapy to the standard management.

Therefore, the aim of this study was to determine the long-term effects of frequent listening to Indian classical music on state of ischaemia in chronic stable angina (SA) patients.

2. Methodology (Figure 1)

This study was an extension of a study conducted to find out the effect of on symptoms of stable angina [17]. The study was conducted at the Coronary Care Unit, National Hospital, Sri Lanka from May 2007 to June 2008. This was a single blind randomised intervention study. Those who assessed and analysed the outcome were blinded to patient treatment status. The approval of ethics review committee of University of Sri Jayawardhanapura, Sri Lanka was obtained before commencing the study.

The estimated sample size was 60 calculated for the effect size of 20% from the base line of the time taken to 1 mm ST segment depression in exercise ECG at $\alpha = 0.05$ and power at 0.8 (80%).

Both male and female patients between of 45 to 65 years of age with clinically diagnosed chronic stable angina confirmed by exercise ECG using Bruce protocol were selected as the sample. Patients who had any other heart diseases or any other chronic medical or psychological illness and whose clinical condition was not stable which would require frequent change of the treatment were excluded. After assessing the eligibility of 412 patients of 45 - 65 years of age with positive exercise ECG, 60 patients were selected for the study (352 patients were excluded—349 did not meet the selection criteria and 3 refused participation). Thirty patients were allocated to each intervention (study) and control (treatment only) groups by restricted randomisation technique with the allocation ratio of 1:1 after obtaining the informed written consent.

2.1. Data Collection

The intervention period was one month. Data was obtained from the participants at the time of recruitment for the study (pre test) and after the completion of intervention period (post test). State of ischaemia was assessed according to the details of exercise ECG results using Bruce protocol.

Therefore, exercise duration (s), stage at which the test was terminated, maximum metabolic equivalents (MET) level achieved, maximum heart rate during exercise (beats·min^{-1}), time until 1 mm ST segment depression, maximal ST segment depression and time until maximum ST segment depression were considered in the assessment.

2.2. Intervention

The intervention group was provided an audio compact disc (CD) with a music based on Indian classical Rag

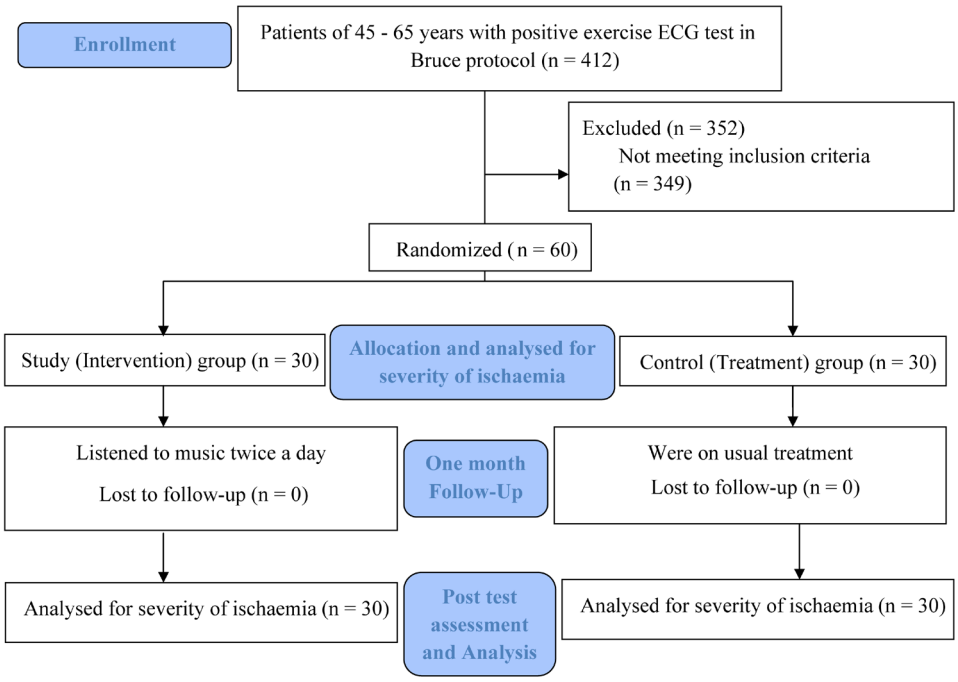

Figure 1. Methodology.

Darbari Kanada which lasts for about 22 minutes to listen till the end of the track complementary to their usual medicines for a period of one month. According to the empirical studies, this Rag has shown a positive effective on cardio vascular system [18]. Patients were instructed to listen to music twice a day preferably early in the morning and in the evening using either ear or head phones. Special measures were taken to ensure the compliance of the study individuals. During the whole period of one month, the control group was kept only on their usual medicines.

The significant level of a statistical test was considered as 0.01 and 0.05. Significance obtained from the statistical tests ≤0.01 were all considered as 0.01. To analyse the data, independent or paired t tests and Wilcoxon signed ranks test were used where relevant.

3. Results

All the patients who had been selected for the study attended for the post test assessment with 0% loss to follow up.

3.1. Baseline Data

As this was an extension of a previous study published, except the evaluation methods used, the base line data was same as mentioned in the **Table 1** of the previous research [17]. Both groups were approximately similar in the measured socio demographic variables. Female to male ratio in intervention and control groups were 1:5 and 1:3.3 respectively. About 63% were between 45 to 55 years and almost all were Sinhalese. Majority were Buddhist in religion. Almost all were married except 1 in the study group. Each participant had either primary or secondary level education. Though majority indicated that they were neither current smokers nor current alcohol drinkers, about 40% and 30% were social drinkers of alcohol in study and control group respectively.

12 participants from each group were on treatment for less than 1 year while rest were on treatment for more than 1 year. Both groups were almost similar in current drug treatment for the heart disease.

3.2. Influence of Intervention on State of Ischaemia

There was no statistically significant differences between the study and control groups for exercise duration (389.7 vs 383.9 s), maximum MET level achieved (8 vs 8), maximal heart rate during exercise (133.6 vs 131.5 bpm), time until 1 mm ST segment depression (166.8 vs 161.5 s), maximal ST segment depression (3.2 vs 2.8 mm) and duration for maximum ST depression (415.4 vs 369.6 s) and also for the stage at which the test was terminated prior the commencement of the intervention ($p > 0.05$).

However, except for maximum heart rate achieved during exercise (bpm) and maximal ST segment depression ($p > 0.05$), there was a significant difference observed in all the other parameters measured ($p < 0.01$) in the post test results between the study and control groups after the intervention. After the intervention a statistically significant increase ($p < 0.01$) in exercise duration by 123 s (389.7 vs 512.7 s), maximum MET level achieved by 2.1 (8 vs 10.1), time until 1 mm ST segment depression by 127.3 s (166.8 vs 294.1 s) and duration for maximum ST depression by 85.9 s (415.4 vs 501.3 s) and a significant drop in maximal ST segment depression by 0.6 mm (3.2 vs 2.6 mm) ($p < 0.01$) were observed in the intervention group. However, the 10.6 bpm drop in maximal heart rate during exercise (133.6 vs 123 bpm) was not significant ($p > 0.05$). Compared to before the intervention, after the intervention the stage at which the exercise ECG test was terminated was also increased significantly ($p < 0.01$).Conversely the changes observed in the control group; increase in exercise duration by 18.6 s (383.9 vs 402.5 s), maximum MET level achieved by 0.1 (8 vs 8.1), time until 1 mm ST segment depression by 3 s (161.5 vs 164.5 s) and duration for maximum ST depression by 16.1 s (369.6 vs 385.7 s) and drop in maximal heart rate during exercise by 5.6 bpm (131.5 vs 125.9 bpm) and maximal ST segment depression by 0.1 mm (2.8 vs 2.7 mm) were not significant ($p > 0.05$). At the same time, there was no significant change in the stage at which the exercise ECG test was terminated in the treatment only group ($p > 0.05$) after one month period (**Table 1** and **Table 2**).

4. Discussion

Our study results clearly show that regular, systematic listening to music complementary to usual medical management for considerable period increasedexercise duration, maximum MET level achieved, time until 1 mm ST

Table 1. Effect of intervention in state of ischaemia.

Variable	Study group (n = 30)			Control group (n = 30)		
	Pre test	Post test	p*	Pre test	Post test	p*
Mean exercise duration (SD) (s)	389.7 (93.2)	512.7 (119.8)	<0.01	383.9 (163.83)	402.5 (155.29)	>0.05
Mean maximum MET level achieved (SD)	8.0 (1.2)	10.1 (2.2)	<0.01	8.0 (2.6)	8.1 (2.3)	>0.05
Mean maximal heart rate during exercise (SD) (bpm)	133.6 (25.2)	123.0 (27.9)	>0.05	131.5 (24.0)	125.9 (18.3)	>0.05
Mean time until 1 mm ST segment depression (SD) (s)	166.8 (123.7)	294.1 (165.4)	<0.01	161.5 (127.1)	164.5 (126.9)	>0.05
Mean maximal ST segment depression (SD) (mm)	3.2 (1.0)	2.6 (0.8)	<0.01	2.8 (0.9)	2.7 (0.8)	>0.05
Mean duration for maximum ST depression (SD) (s)	415.4 (90.2)	501.3 (118.5)	<0.01	369.6 (151.1)	385.7 (124.9)	>0.05

*Paired t test.

Table 2. Effect of intervention instage of exercise ECG at which the test was terminated.

	Study group (n = 30) Exercise ECG stage terminated					Control group (n = 30) Exercise ECG stage terminated				
	I	II	III	IV	Completed	I	II	III	IV	Completed
Pre test	0	10	17	3	0	2	14	4	10	0
Post test	0	2	12	14	2	2	9	11	8	0
p*			<0.01					>0.05		

*Wilcoxon signed rank test.

segment depression and duration for maximum ST depression and also reduced significantly the maximal ST segment depression. These are considered as better indicators in favour of better prognosis. Additionally, since significant number of patients in the study group terminated the exercise ECG test either at higher stages or fully completed, time taken to achieve stopping criteria of treadmill test (**Table 3**) was also prolonged by listening to music. This also supported the better effects of music in heart diseases.

Even though no similar study found to have conducted earlier, observed results of our study support the results obtained by previous studies conducted to find out the effect of music on heart rate, anxiety and pain in heart disease patients at various settings such as acute care setting, during cardiac catheterization and coronary angiogram [4] [5] [16]. However, the effect observed in the current study was more prolonged and persistent. Moreover, our study did not show any adverse effect due to listening of music for a prolonged period. This also confirms the current evidence of safety of relaxation music in therapeutic use [12]. Furthermore, this study also showed similar improvement in angina symptoms which has been observed with anti anginal treatment [19] [20].

In addition, it shows the implications of music on state of ischaemia which indirectly indicates its effect on the underlying pathophysiology of myocardial ischaemia. The dramatic improvement observed would further help to understand the pathophysiological phenomenon of the effect of relaxing music. Furthermore, it would help to presume newer theories for explaining the effect of music such as metabolic shifting which is postulated by scientists in order to find out newer therapies for the treatment of IHD [21] [22].

Similar to most studies conducted elsewhere in the world, our study also observed the effect of music in a smaller sample. Additionally, due to the lack of previous evidence, the intervention period was also restricted to one month. Moreover, a study if able to be conducted for a longer time in a larger cohort will show feasibility and acceptability of music as complementary treatment and the effect of it on cardiac morbidity. Furthermore, if it could be coupled with invasive coronary angiography which remains the gold standard for detecting and assessing CAD [23], would be more suitable for an exact interpretation of the test findings. Therefore, our study warrants further investigation in definitive, large-scale, randomized clinical trials.

Table 3. Reasons for stopping an exercise ECG (treadmill) test.

Electrocardiographic criteria	
	• Severe ST segment depression (>3 mm)
	• ST segment elevation > 1 mm in non-Q wave lead
	• Frequent ventricular extrasystoles (unless the test is to assessment ventricular arrhythmia)
	• Onset of ventricular tachycardia
	• New atrial fibrillation or supraventricular tachycardia
	• Development of new bundle branch block (if the test is primarily to detect underlying coronary disease)
	• New second or third degree heart block
	• Cardiac arrest
Symptoms and signs	
	• Severe fatigue
	• Severe chest pain, dyspnoea or dizziness
	• Fall in systolic blood pressure (>20 mmHg)
	• Rise in blood pressure (systolic > 300 mmHg, diastolic > 130 mmHg)
	• Ataxia

5. Conclusion

Complementary listening to the music based on Indian classical system twice a day for a one month period significantly improved the state of ischaemia of stable angina patients aged between 45 and 65 years measured according to exercise ECG test results. A similar improvement was not observed in the control groups who were only on prescribed medicines. Therefore, listening to music could be considered as a complementary to regular treatment for SA. Additionally, as listening to relaxing music would be easier, cost effective and has no side effects, it would help to minimise cost to the state by reducing morbidity as well as the quality of life in SA patients.

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Competing Interests

The authors declare that they have no competing interests.

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List of Abbreviations

CAD: Coronary Artery Disease
CD: Compact Disc
CVD: Cardio Vascular Disease
IHD: Ischaemic Heart Disease
MET: Metabolic Equivalents
MI: Myocardial Infarction
SA: Stable Angina
WHO: World Health Organization