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Original Article

Effect of Meditation on Heart Rate, Blood Pressure and Exercise Performance in Coronary Artery Disease Patients

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Abstract

Introduction: Coronary artery disease (CAD) is the leading cause of morbidity and mortality worldwide. This study is to evaluate the role of Meditation in improving physiological parameters like heart rate (HR) and systolic (SBP) and diastolic blood pressure (DBP) and exercise performance in known CAD patients.

Method: Sixty CAD patients are divided into two groups of which one group did Meditation and other did not. HR, SBP, DBP and Metabolic Equivalents (METs) were measured before and at end of 6 months of study in both the groups.

Result: At the end of study significant decrease in HR, SBP and DBP was seen in patients who practiced Meditation as compared to other group but there was no significant improvement in exercise performance in Meditation group.

Discussion: Meditation may modulate the physiological response to stress via neurohumoral activation, which may be a novel therapeutic target for the treatment of CAD but has no statically significant effect on exercise performance.

Introduction

Coronary artery disease (CAD) is epidemic in world and the leading cause of death worldwide (1). Previously thought to affect primarily high-income countries, CAD now leads to more death and disability in low- and middle-income countries (2), with rates that are increasing disproportionately compared to high-income countries. CAD affects people at younger ages in our country thereby having a greater economic impact (3). Advances in therapy like angioplasty, stenting and by-pass surgery address effectively the problem of individual patients. However, they are very expensive and beyond the

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reach of the majority of patients in our country. Besides, these procedures are focused upon treating the manifestations of disease and not on the underlying cause of disease.

With increasing understanding of various risk factors as causative agents of CAD, lot of interest is generated in prevention of modifiable risk factors like tobacco smoking (4), high blood cholesterol (5), hypertension (6), physical inactivity (7), obesity (8) and diabetes mellitus (6). It has been also recognized that stress, anxiety and depression are also important in aetiology and progression of CAD (9) Cumulative exposure to chronic stressors may be a risk factor for CAD (10). Individuals who are exposed to high levels of demands and low levels of control at work, to distressing marriages, and to low social support are more likely to have incident CAD than their less stressed counterparts (10–12). Dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis is one of the pathways through which chronic stress may affect CAD risk. In healthy individuals, cortisol has a distinct diurnal pattern with the peak cortisol occurring in the early morning, declining throughout the day, and reaching a nadir around 2 or 3 AM (13). Cortisol also exhibits sizable, short-term increases during the first hour after awakening and in response to a lunch meal or a threat-provoking stressor. Dysregulation can take the form of altered overall levels of cortisol or a smaller decline in cortisol throughout the day and evening, i.e., flatter slope.

The physiological underpinning of this link may involve excessive sympathetic nervous system activation (14). Ornish et al (15) were the first to document the beneficial effects of lifestyle changes in reversing the coronary heart disease. Manchanda et al (16) in their study similarly showed encouraging results with their yoga lifestyle intervention. However, both these studies included only a small number of patients.

“Meditation” is a set of attentional practices leading to an altered state or trait of consciousness characterized by expanded awareness, greater presence, and a more integrated sense of self. Practice of concentrating focus on an imaginary point on forehead (between eyebrows), sound or object increase awareness of the present moment, reduce stress, promote relaxation, and enhance personal and spiritual growth. Meditation practice self-regulates the body and mind, thereby affecting mental events by engaging into a specific attentional set. These practices are a subset of other practices used to induce relaxation or altered states such as hypnosis, progressive relaxation and trance-induction techniques (17). Meditation is a simple mental technique which has well documented benefits for health and wellbeing (18, 19). It can be learned easily by anyone regardless of age, educational background, or culture. The technique is effortless and requires no belief or any change in lifestyle or diet.

During Meditation mental activity settles down in a natural way, while alertness is maintained and even enhanced. Meditation produces a specific physiological response pattern that involves various biological systems. Mechanism most frequently suggested that meditation produces effects including metabolic, autonomic, endocrine, neurological, cardiovascular and psychological responses on a multidimensional interactive basis.

Mental states can markedly alter physiologic function. For example, stressful situations result in a hypermetabolic state, with increased oxygen consumption, heart rate and blood pressure. In contrast, the majority of scientific studies show meditation to be a wakeful state accompanied by a decreased metabolism resulting in decreased breathing pattern, decreased heart rate, and decreased blood pressure (16). There is also marked decreased in the level of oxygen utilization and carbon dioxide elimination by muscles verified by innumerable studies (20).

Methods

The study was conducted in Department of Physiology and Cardiology, Maulana Azad Medical College and associated G. B. Pant Hospital from June 2011 to January 2012. The study group comprise of sixty angiographically proven (criteria: 50% or more obstruction in any coronary artery) coronary artery disease patients. These patients were

randomly selected and were equally divided into two groups, Meditation and Control group, each group consisting of thirty patients. Out of sixty patients, fifty six (93.3%) were males and four (6.7%) were females.

Group I : Meditation group contains CAD patients with medication and on prescribed meditation (concentrative meditation) and dietary modifications

Group II : Control group contains CAD patients with medication and dietary modifications.

Inclusion criteria were 1) Age group 30-70 years of either sex, 2) Angiographically proven coronary artery disease, 3) non-smokers. Exclusion criteria were 1) Patients with a history of acute myocardial infarction in recent past (two months), 2) Patients with unstable angina pectoris, 3) Patients with clinical cardiac failure, those with ejection fraction of below 30% by echocardiography, 4) Patients who had undergone coronary angioplasty or by-pass surgery, 5)Patients with heart ailments other than CAD such as congenital heart disease, cardiac myopathies, etc., 6) Patients with endocrine disorders like thyrotoxicosis, 7) Patients with neurological or psychiatric disorders, 8) Patients who had participated in athletics/sports activity or routinely following yogic exercises.

A complete general physical and detailed systemic examination was done on each patient to rule out any other major systemic illness. Heart rate was recorded with the help of a stethoscope placed on anterior left chest wall (precordium) to count heart beats for complete one minute and blood pressure were recorded with the help of a mercury sphygmomanometer using palpatory and auscultatory method.

The TMT was done in Department of Cardiology, G. B. Pant Hospital, New Delhi. The test was done using a computerized machine (manufacturer: Mortara Xscribe) with built-in Bruce protocols. The tests were done by a medical officer in collaboration with a cardiologist. Male patients were instructed to come chest clean shaven and female patients were instructed to come with proper inner wears. All of them were asked to accompany a relative to take care in case of any unforeseen problem. Graded metabolic workloads were administered for fixed intervals of 3 minutes. Continuous ECG recordings were made throughout the test. Blood pressure was recorded at the end of each stage through automatic blood pressure recording machine. Patients following the conventional Bruce treadmill protocol started the test at the speed of 1.7 mph, with an elevation of 10% grade (for 3 min) and continued in 3-minute intervals (i.e., at 2.5 mph, 12% grade; at 3.4 mph, 14% grade; at 4.2 mph, 16% grade; 5.0 mph, 18% grade; and 5.5 mph, 20% grade, respectively). The test was discontinued in the event of limiting symptoms like pain in leg, breathlessness, fatigue, angina, abnormalities of rhythm or blood pressure, or marked and progressive ST-segment deviation (more than 1mm from the baseline) or when the target heart rate (THR) was achieved. THR was calculated by subtracting the patients age from 220, 85% of this value was THR. Metabolic equivalents (METs), a measure of energy expenditure, were automatically calculated by the testing device during the exercise testing (1 MET equals approximately 3.5 mL of oxygen consumed per minute per kilogram of body weight). After the test, patients were allowed to recover for about 3 to 5 minutes till his/her heart rate reached the baseline value. Continuous ECG recording was taken till the patient recovers.

Protocol for Meditation in Meditation group: Patients were called in group of 10 twice a week (Monday and Thursday) at 9 AM in the Department of Cardiology, G. B. Pant Hospital. They were instructed to come empty stomach, wearing clean, simple and loose clothing. They were made to sit comfortably on the floor and allowed to relax for about five minutes. This was to allay any apprehension associated with the class. To ensure free and fresh ventilation all the windows of the room were opened. The room's ambient temperature was maintained on all days between 16ºC-20ºC. The room was clean, noise-free and dim lighted. Meditation technique was demonstrated each day for first few days until they had learned the technique perfectly; subsequently they followed the procedure themselves. Special emphasis was laid on breathing technique practiced

by each patient individually and the same was checked on each subsequent visit.

Meditation technique

Concentration on body : Sitting relaxed on the floor, patients were asked to focus attention on their body. Asked to put their attention at the area of forehead, and just sweep the body, feeling every part of body sensations, tensions. If they felt any tensions in their body, they were asked to just be aware of those tensions; don't try to resist or control those tensions and continue sweeping the body.

Concentration on breathing : Patients were taught to allow their body to breathe naturally, and focus their attention wherever they feel the sensation of the breath in the body. While inhaling, be aware, be conscious of inhaling; when exhaling, be aware, and be conscious of exhaling. Be with this movement of the breath; just come back to it as an anchor.

Distress to de-stress : Patients were taught that whenever they experience tension, stress or anxiety, try to focus their attention on other things: perhaps the sounds they hear, the sensations in their body, the touch of their clothing, movements in their body, their heart beating, or the rise and fall of the abdomen during breathing. They were made to learn to be aware of other things that are happening while they are experiencing stress.

Forgiveness

Patients were taught to gently soften their thought towards themselves, accept themselves as they are, without any notion of what they should become. Making friends with whom they are - and really feel that friendship, that kindness. Then only they can extend that friendship, gentleness, softness even to those who have hurt, disappointed or frustrated them. Letting go of the hurts and wounds they have been carrying by learning to forgive, by learning to accept the common humanness.

To ensure whether patients were doing meditation properly or not heart rate and blood pressure were recorded before (after 5 minutes of rest) and after doing meditation. Patients in meditation group were asked to maintain a Record Diary in which they entered days on which they did meditation and for how long. To ensure their compliance to program at home, they were subjected to stress management intake questionnaire. Any patient found not following instructions properly or doing meditation for less than 5 times in a week was not included in the study.

Follow-up: 1) All the patients were directed to fill up the requisite information with respect to the medication prescribed routinely as per performa given, 2) In the meditation group of patient they were instructed to routinely follow up the meditation process and to make the entries in the record diary, 3) Each patient in control group was instructed to report for follow up regularly at an interval of 15 days, 4) Each patient was instructed to immediately contact the investigator in case of any problem, 5) At the end of 6 months physiological parameters were studied in both the group of patient.

Results

Name of the software used for statistical analysis is IBM SPSS Statistics Data Editor. The data was normally distributed. Name of the test used is student's t-test. Physical characteristics of two groups of patients are shown in Table I. It can be seen that the physical characteristics in the two groups of the patients showed no statistical difference in the age, height, weight and body surface area. Hence the two groups are statistically comparable

TABLE I: Mean±SD of baseline value of anthropometry in the two groups of patients.

		Mean	*Std. Deviation*	*p value (Gr. I compared with Gr. II)*
Age (years)	Group I	53.9	9.8	0.328 (NS)
	Group II	56.2	7.2	
Height (cms)	Group I	165.5	4.9	0.690 (NS)
	Group II	166.1	5.9	
Weight (kgs)	Group I	69.5	6.2	0.173 (NS)
	Group II	67.2	6.3	
BSA (m^2)	Group I	1.8	0.1	0.345 (NS)
	Group II	1.7	0.1	

to assess the effect of meditation on CAD patients.

A thorough clinical examination was done in each of the two groups of patients. The data obtained from them is presented in Table II. Mean±SD value of HR, SBP and DBP were obtained and the data suggested that the patients in the two groups can be presumed to be normally distributed.

Intra-group comparison of physiological parameters before and after study in the two groups of patients

Mean±SD value of physiological parameters viz. heart rate and blood pressure were measured in the two groups of patients before and after study and the values are given in Table II and III. Mean±SD of heart rate, systolic and diastolic blood pressure in group I patients were found to be higher before the study as compared to that of after the study and the difference was statistically highly significant.

On the other hand Mean±SD of heart rate, systolic and diastolic blood pressure in group II patients showed minor differences before and after the study and were statistically insignificant (Table IV).

Metabolic equivalents (METs) were automatically calculated by the Treadmill during the exercise testing in both the groups of patients before and after study. Mean±SD value of METs in group I patients before and after study was 10.1±1.8 and 10.0±2.0 respectively. Mean±SD value of METs in group II patients before and after study was 9.7±1.7 and 9.6±2.0 respectively (Table V). Although the value of METs decreased in both the group of the patients at the end of the study but its statistical significance was not established (p>0.05).

TABLE II : Mean±SD of baseline physiological parameters in the two groups of the patients. (n=30 for each group).

		Mean	*Std. Deviation*	*p value (Gr. I compared with Gr. II)*
Heart rate at rest (bpm)	Group I	72.2	4.6	0.600 (NS)
	Group II	71.6	4.2	
SBP (mmHg)	Group I	139.9	12.4	0.729 (NS)
	Group II	140.9	11.3	
DBP (mmHg)	Group I	81.9	9.4	0.390 (NS)
	Group II	83.9	7.8	

p value: >0.05 not significant (NS); <0.05 significant (S); <0.01 highly significant (HS); SBP=systolic blood pressure; DBP=diastolic blood pressure; bpm=beats per minute; mmHg=millimetre of mercury.

TABLE III : Mean±SD values of physiological parameters in group I patients before and after study (n=30).

Parameters	*Before study*	*After study*	*p value*
Heart rate (bpm)	72.2±4.6	68.0±4.4	0.000 (HS)
SBP (mmHg)	139.8±12.4	130.5±10.2	0.000 (HS)
DBP (mmHg)	81.9±9.4	76.4±9.2	0.000 (HS)

p value: >0.05 not significant (NS); <0.05 significant (S); <0.01 highly significant (HS); SBP=systolic blood pressure; DBP=diastolic blood pressure; bpm=beats per minute; mmHg=millimetre of mercury.

TABLE IV : Mean±SD values of physiological parameters in group II patients before and after study (n=30).

Parameters	*Before study*	*After study*	*p value*
Heart rate (bpm)	71.6±4.2	72.9±3.9	0.018 (S)
SBP (mmHg)	140.9±11.3	138.9±9.9	0.077
DBP (mmHg)	83.8±7.8	84.5±6.7	0.460

p value: >0.05 not significant (NS); <0.05 significant (S); <0.01 highly significant (HS); SBP=systolic blood pressure; DBP=diastolic blood pressure; bpm=beats per minute; mmHg=millimetre of mercury.

TABLE V : Mean±SD value of METs in both the group of patients before and after study (n=30 for each group).

Parameter	*Group*	*Before study*	*After study*	*p value*
METs	I	10.1±1.8	10.0±2.0	0.099 (NS)
METs	II	9.7±1.7	9.6±2.0	0.127 (NS)

p value: >0.05 not significant (NS); <0.05 significant (S); <0.01 highly significant (HS); METs=Metabolic equivalents.

Discussion

Coronary artery disease (CAD) remains one of the major causes of morbidity and mortality in India. A number of risk factors have been identified to be strongly associated with CAD, stress and behaviour patterns are one of them. Hence the present study was chosen to study the effect of stress relieving technique i.e., meditation on physiological parameters

on coronary artery disease patients.

Meditation has a number of positive effects on the physiology of the human body. It has been shown to reduce the heart rate, blood pressure (21, 22, 23) and thus, the practice of meditation significantly helps in the management and the prevention of CAD by reducing the risk factors which are associated with the same.

In our study, we found that resting heart rate in the patients practicing meditation for a period of 6 months was decreased significantly as compared to those in the non-meditating subjects. The statistical analysis showed that the differences were highly significant ($p<0.01$). In a study which was conducted in 1984 on 25 rajyogis, both males and females, by the medical wing of Rajyoga Education and Research Foundation, an overall decrease in the mean values of the heart rate, systolic and diastolic blood pressure was observed (21). Meditation is associated with a blunted sympathetic activity as is shown by a reduction in the heart rate after regular meditation for a period of 6 months. Similar trends in the heart rate were noted in other studies (22, 23). The Mean±SD value for systolic blood pressure in the meditators was 130.5±10.2 and in the non-meditators, it was 138.9±9.9. Similarly, the Mean±SD value for diastolic blood pressure in the meditator subjects was 76.4±9.2 and in the non-meditator subjects, it was 84.5±6.8. Statistically, these results were found to be significant ($p<0.001$).

In other studies, there was a significant reduction in the systolic and diastolic blood pressure, serum cholesterol and the incidence of ischaemic heart disease in the meditators (24, 25). It was reported that not only in hypertensive individuals, but in normotensive individuals also, the regular practice of meditation could reduce the ambulatory blood pressure levels and hence, it could give significant protection from cardiovascular diseases (26).

Improvements in the cardiovascular parameters in the present study were similar to those which were found in other studies on meditation (27-30). The decrease in the diastolic and systolic blood pressure and the heart rate may be because of the activation of the parasympathetic state (31). Meditation, by modifying the state of anxiety, reduces the stress induced sympathetic over-activity, resulting in lowering of the diastolic blood pressure and the heart rate. It makes the person relaxed and thus decreases the arterial tone and the peripheral resistance (21, 32). This could be another reason for the fall in the diastolic blood pressure. Environmental conditions and a variety of behavioral factors such as stress, anxiety and the affective and attitudinal disposition of the individual influences the cardiovascular responses. Meditation affects the hypothalamus and brings about a decrease in the diastolic and systolic blood pressures through its influence on the vasomotor centre, which reduces the sympathetic tone and the peripheral resistance (32).

Prior studies of meditation and blood pressure have been criticized because of the quality of the trials (33, 34), potential side effects of meditation (34), and potential bias of investigators (33, 34). Different studies stated that the benefits of meditation and relaxation could only be maintained by the regular practice and integration of these techniques in the day to day life (35). Also, the amount of the practice of meditation does not correlate with the amount of blood pressure reduction after the training. Regular meditation is required to maintain positive effects on the blood pressure and the heart rate (36) for at least 60 minutes/day.

Conclusion

In the present study, it was concluded that there is significant decrease in the heart rate and systolic and diastolic blood pressure in CAD patients practicing meditation for a period of 6 months. Our findings are also in compliance with the study conducted by Lang et al. (37) and Wenneberg et al. (38) on the effect of Meditation on heart rate and blood pressure by regulating sympathetic activity. The results of the present study demonstrate that practicing meditation reduces heart rate and blood pressuren in CAD patients and that change were more marked in yoga group. It can be concluded from the present study that meditation helps in improving health status of an individual including heart rate and blood pressure. Furthermore, the practice should be adopted and continued for a long duration.

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