

Cardiovascular Diseases and Yoga: *Non-Pharmacological Intervention*

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Abstract—Cardiovascular diseases (CVDs) are the disorders of the heart and blood vessels and include coronary heart disease, cerebrovascular disease, rheumatic heart disease and other conditions. It is a major cause of death globally and is also a leading cause of deaths in India. The most common type of heart disease is coronary heart disease and collectively these CVDs have a huge impact on our country's economy. CVDs occur primarily due to poor lifestyle choices like inactivity, overeating leading to obesity and substance abuse. Chronic stress also contributes to cardiovascular diseases by increasing blood pressure and causing plaque formation. Various pharmacological agents utilized for remedy have been shown to cause undesirable side-effects. Therefore it becomes essential to explore options of non-pharmacological interventions such as yoga. Respiratory and cardiovascular systems have similar control mechanisms; therefore, yogic breathing techniques like pranayama are beneficiary in preventing and managing CVDs. Relaxation methods based on Yoga help lower mental stress and lead to the reduction of sympathetic activity which in turn lower heart rate and increase breath volume. Yoga is an economic and effective agent with no side effects and has the potential to reduce cardiovascular diseases; they are an attractive alternative to pharmacological options for the prevention and treatment of diseases related to the heart. Psychoneuroimmunology is an emerging field exploring the mind body connection and its relation to cardiovascular diseases. With the aid of further studies the underlying mechanism by which Yoga appears to alleviate maladies such as CVDs, obesity and diabetes can be better understood.

1. INTRODUCTION

Cardiovascular Diseases (CVDs) comprise a group of disorders of the heart and blood vessels that include: coronary heart disease; cerebrovascular disease; peripheral arterial disease; rheumatic heart disease; congenital heart disease; deep vein thrombosis and pulmonary embolism. CVDs are the biggest cause of death globally. According to the world health Organization, an estimated 17.5 million people were reported to have died from CVDs in 2012, representing 31% of all global deaths. Of these deaths, 7.4 million were estimated to be caused by coronary heart disease and 6.7 million due to stroke [1-2]

In India, the rise of burden due to cardiovascular diseases has increased dramatically over the past few decades. As a consequence, CVD has emerged as the leading cause of death,

with coronary heart disease (CHD) estimated to affect Indians at least 5-6 years earlier than their western counterparts [3-4]. Current estimates from disparate cross-sectional studies indicate the prevalence of CHD to be between 7-13 per cent in urban and 2-7 per cent in rural India³. The spiraling rates of modifiable risk factors for CHD across the spectrum of rural to urban segments of our population have been demonstrated by several studies across India [5-6]. In addition, urbanization has resulted in an increase in the prevalence of risk factors such as diabetes, obesity and hypertension. The economic impact of these transformations was estimated at 9 billion dollars in national income from premature deaths due to heart disease, stroke and diabetes in 2005 alone, the economic impact of these transformations is estimated to be ~237 billion dollars by the end of this decade [7].

Coronary heart disease lead to heart attacks and occur when the flow of oxygen-rich blood to the heart is blocked or reduced by a build-up of fatty material (atheroma) in the coronary arteries. A stroke is a serious medical condition that occurs when the blood supply to part of the brain is cut off leading to brain damage and eventual death. Heart attacks and strokes are usually caused by the presence of a combination of risk factors, such as substance abuse, sedentary lifestyle, obesity, hypertension, diabetes and hyperlipidemia. Most deaths caused by cardiovascular disease are premature and could easily be prevented by making subtle lifestyle changes. In addition, drug treatment of diabetes, hypertension and high blood lipids may be necessary to reduce cardiovascular risk and prevent heart attacks and strokes [8-9].

The fast pace of modern living has introduced stress as a byproduct into our lives. The generation of stress leads to the release of stress hormones like epinephrine from the sympathetic nerves. This leads to an increase in the heart rate by influencing the Sinu Atrial (SA) node which is the pacemaker of the heart. Epinephrine also causes the constriction of heart muscles by binding to the receptors present on the heart. Prolonged activity of sympathetic nerves leads to accumulation of plaques in the arteries, a situation called atherosclerosis which causes an increase in the blood

pressure, hypertension and eventually cardiovascular diseases [10-11].

The benefits of yoga - an unconventional form of physical exercise originating from ancient Indian practices, have been shown in various diseases of the human body [12]. It has been implicated in the modification of cardiovascular risk factors and in the rehabilitation of the post-myocardial infarction patients. Stresses of urban and modern lifestyle have since long been thought to be the major contributors of many an illness including heart disease. Yoga has been shown to be responsible in reducing anxiety, which is brought about by increased cardiac vagal modulation. Activity in the parasympathetic (Vagus) nerve causes the heart rate to decrease; whereas the activity in the sympathetic nerve causes an increase. Pranayama increases the parasympathetic activity and checks the sympathetic over-activity by influencing the anxiety level by decreasing the secretion of stress hormones and thus controls the heart rate and blood pressure and lowers the risk of cardiovascular diseases. Mindfulness-based stress reduction (MBSR) techniques such as yoga have been shown to lead to a decrease in the average number of visits to medical professionals in certain parts in the USA [13]. This observation suggests that yoga may play a major role towards improvement of health in general and cardiac health in particular amongst the populations that are subject to significant mental stress. The advantage of Yoga as a non-pharmacological method of preventing/treating cardiovascular diseases is that while being highly effective, it is also inexpensive and easy to practice, without the need for any facility or equipments [14].

2. FACTORS AFFECTING CARDIOVASCULAR SYSTEM

The cardiovascular system comprises of the heart, blood, blood vessels, and the arteries and the veins. The contraction and the relaxation of the heart and the blood vessels are under the control of the nervous and endocrine system. The autonomic part of the nervous system plays a major role in this control of the cardiovascular system, and is composed of the sympathetic and parasympathetic nervous system. A large number of parasympathetic and sympathetic nerve fibers end on the S.A node of heart, which controls the heart rate. Vagal nerve stimulation activates the parasympathetic nervous system which is responsible for rest, digestion, reproductive functions and decrease in heart rate. The sympathetic nervous system controls the flight or fight response.

When sympathetic nervous system is active, then stress hormones flood our system and create a state of disease. Therefore it is important to activate vagus nerve as it is the key to activation of the parasympathetic nervous system, leading to decrease in stress level. Elevated stress levels also lead to the release of stress hormones like epinephrine by the endocrine system. Prolonged stimulus of stress hormones lead to the accumulation of plaques in the arteries (atherosclerosis)

which causes increase in blood pressure and cardiovascular diseases. These stress hormones also lead to the constriction of blood vessels thus leading to the increase in total peripheral resistance of blood flow (Fig. 1) [12-15].

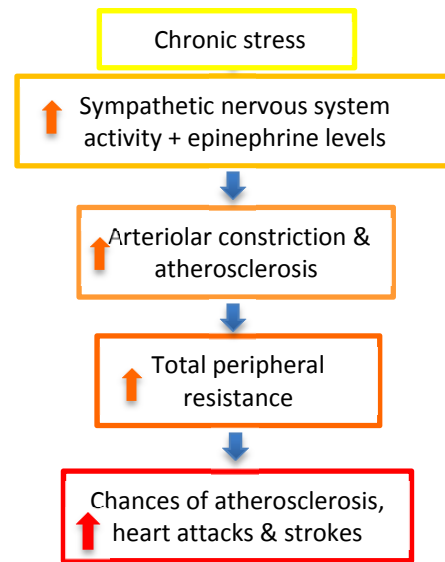


Fig. 1 Effects of stress on the Cardiovascular System

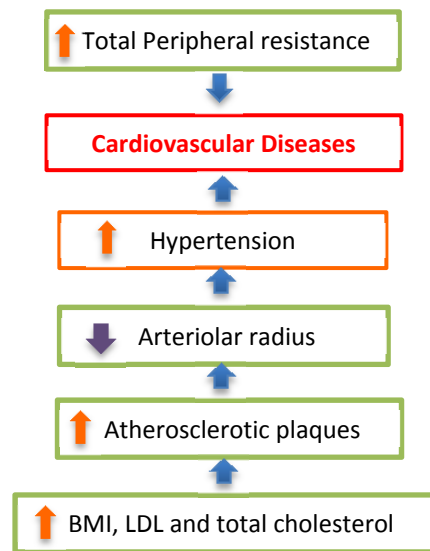


Fig. 2: Effect of poor lifestyle on cardiovascular system

During inspiration the diaphragm which is an important muscle present between the thorax and abdomen, contracts and it moves downward into the abdominal cavity, enlarging the thoracic cavity. The intercostal muscles present between the ribs are also activated during inspiration and this leads to their contraction leading to outward and upward movement of ribs causing further increase in thoracic dimension. Therefore

inspiration or deep breathing causes enlargement of the lungs due to increase in thoracic cavity and there is bulk flow of air from the atmosphere into the lungs. The movement of the dome shaped diaphragm downward and of intercostal muscles outward leads to decrease in thoracic pressure and increase in abdominal pressure. This increases the pressure on veins due to compression of abdominal cavity. The net effect of difference in pressure in thorax and abdomen increases venous return i.e. the flow of blood from the veins into the heart. This increased flow of blood into the heart causes an increase in the stretching of cardiac muscles and increased end diastolic volume. The greater the end-diastolic volume, greater is the contraction of cardiac muscles, increasing the cardiac output. Heart rate and stroke volume determine the cardiac output. Thus, the increase in blood flow to the heart decreases the risk of cardiovascular diseases [16-17] (Fig. 2).

3. YOGA: NON-PHARMACOLOGICAL REMEDY FOR CARDIOVASCULAR DISEASES.

Yoga is an unconventional form of physical exercise that has been practiced in the Indian sub-continent since times immemorial and has been subsequently adopted all over the world. The recorded history of the yogic techniques begins with the Yoga Sutra, which is the definitive text on the philosophy of classical yoga. Its origins can be dated back to the period between 200 BC and 300 AD and is believed to be written by the sage Patanjali. Yoga gained entry into the Western mainstream through the works of Swami Vivekananda who is accredited with the popularization of the Eastern Hindu philosophy. A number of studies have been carried out stressing on the importance of adopting Yoga as a way of life. The clinical outcome of practicing regular yoga has also been shown to be highly beneficial for both heart patients as well as healthy individuals [14-15, 18-19].

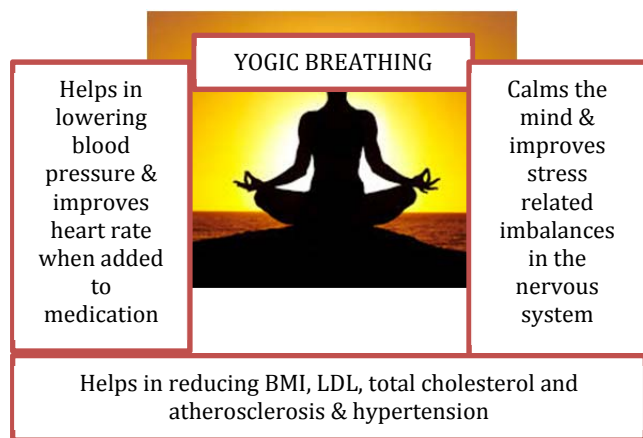


Fig. 3: Role of Yoga in prevention & management of cardiovascular diseases

4. YOGA AND HYPERTENSION

The management of hypertension primarily involves pharmacotherapy and many of the antihypertensive agents

currently used have been associated with undesirable side effects. Although it has been shown that regular aerobic exercise can also have a beneficial effect on high blood pressure, however, this effect is significantly inferior to that generated by pharmacotherapy. It has been demonstrated in a randomized controlled study that even a short period of regular practice of yoga (11 weeks, 1 h/day) is almost as effective as medical therapy for hypertension subjects [20-21]. The mechanism of this yoga-induced reduction in blood pressure may be attributed to its beneficial effects on the autonomic neurological function [22]. Yoga has also proven its mettle in managing other complications arising from chronic hypertension. It has been shown Sarvangasana (head-down-body-up postural exercise) appears to be beneficial in preventing and treating hypertension-associated problems [23].

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6. INTRINSIC ADVERSE NEUROHORMONAL ACTIVITY

The general stress in life contributes increase in intrinsic neuro-hormonal activity which in turn is known to lead to increased risk of myocardial disease. Level of stress-induced neuro-hormonal generation can be quantitated by the measurement of specific markers in the body fluids of subjects. Regular practitioners of yoga asanas have showed a significant reduction in the markers of stress. The stress related hormones like epinephrine have also been shown to be produced in a less prolific manner. Yoga based guided relaxation techniques like *pranayama* have been implicated in the reduction of sympathetic nervous system activity leading to the reduction in heart rate along with an increase in the breath volume [14, 24-26].

7. DISCUSSION

Cardiovascular diseases have become a global challenge that need to be addressed on an urgent basis. The heartening aspect of this disease is that it can be prevented by taking a few basic measures. Yoga is recognized as a form of mind-body exercise that integrates an individual's physical, mental and spiritual components to improve health and wellbeing. Deep breathing and pranayama has become increasingly widespread as a therapy used to maintain wellness. Relaxation by yoga training is associated with increase in cardiac vagal modulation which stimulates the parasympathetic activity.

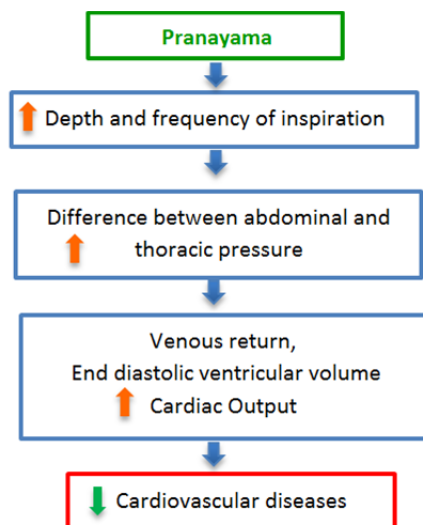


Fig. 4 Effect of guided deep breathing or Pranayama on cardiovascular diseases

Pranayama is a yogic technique that systematically encourages deep breathing. As previously discussed, deep inspiration increases the difference in pressure between thoracic and abdominal cavity. This in turn leads to higher venous return of blood into the heart and increase in cardiac output. Yogic techniques also increase the activity of the parasympathetic system, causing a decrease in stress levels and hence lower release of stress hormones. This consequentially decreases heart rate and keeps the heart healthy. Thus, Yoga is not only a form of physical exercise but also has a scientific and systematic approach to stimulate the parasympathetic activity of the nervous system, thereby enabling better management of the stress generated in daily lives. In addition to general wellbeing, it is also shown to aid in keeping cardiovascular diseases at bay.

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