Left Ventricular Diastolic Dysfunction in Primary Hypertension and its Relation with Leisure Time Physical Activity

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Abstract

Objective: Left ventricular diastolic dysfunction with preserved ejection fraction is associated with an increased risk of morbidity and mortality. Population-based survey studied the associations between diastolic dysfunction in primary hypertension and its association with lifestyle—once of risk factors. Exercise prevents and prolongs the degenerative changes but whether leisure time physical activity (LTPA) is associated with similar effects is being studied here.

Methods: Total 301 patients of age 30-60 year old with essential hypertension were included in prospective observational study. Patients were classified according to their leisure time physical activity and subjected for echocardiography and color Doppler.

Results: Out of 301 patients, 149 (49.66%) were sedentary during leisure time, out of which 114 (76.5%) were having diastolic dysfunction and 35 (23.5%) were normal, while 104 (34.66%) were having moderate physical activity in which 66 (63%) were normal. Twenty-nine (60%) of 48 vigorously active were found to be normal. By using Fisher’s exact test p-value was < 0.05.

Conclusion: In this study, a sedentary lifestyle is found to be associated with a rapid decline of ventricular compliance. Physical activity in any form has definite protective role in prevention of degenerative changes occurring inside the body.

Introduction

In the natural habitat of our ancestors, physical activity was not a preventive intervention but a matter of survival. In that hostile environment with scarce food and ubiquitous dangers, human genes were selected to optimize aerobic metabolic pathways and conserve energy for potential future famines.¹

Cardiac and vascular functions were continuously challenged by intermittent bouts of high-intensity physical activity and adapted to meet the metabolic demands of the working skeletal muscle under these conditions.²

The scenario has completely changed from physically active to almost inactive lifestyle. Average physical activity in our society is much below the levels normal for our genetic background.³

The sedentary lifestyle in combination with excess food intake has surpassed all other preventable causes of death in all over the world.⁴

Physical activity i.e. exercise has been shown to have beneficial effects on glucose metabolism, skeletal muscle function, ventilator muscle strength, bone stability, locomotor coordination, psychological well-being, and other organ functions.⁵

The hypertension and cardiovascular disease burden is ever increasing globally. The World Health Organization attributes hypertension, as the third leading cause of cardiovascular morbidity and mortality.⁶ As estimated 17.3 million people i.e. 30% of all global deaths are attributed to cardiovascular disease in 2008.⁷ In Indian scenario it is 29 % of all deaths.

Nearly one billion people are affected by hypertension

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worldwide; and this figure is predicted to increase to 1.5 billion by 2025.

The epidemiological studies show that hypertension is present in 25% urban and 10% rural subjects in India.8

Uncontrolled hypertension leads to a number of structural changes in the heart which eventually cumulates into interstitial fibrosis, myocardial wall thickness and functional alteration such as diastolic dysfunction.

We in our study focused our attention on diastolic heart failure which develops in two-thirds of patients of hypertension and its correlation with leisure time physical activity which indirectly indicates the relation of diastolic dysfunction and exercise.

Leisure time physical activity (LTPA) is a form of slow exercise, and it is nothing but the lifestyle of the person. The importance of this preventive role of LTPA can be conveyed to the persons so that they may change their lifestyle and that will in turn help them to decrease the burden of hypertensive heart disease.

Material and Methods

A Prospective observational study, in which patients from age group 30 to 60 years were included in study. Detected or newly diagnosed essential hypertensive patients presenting to OPD/IPD were included in the study.

Patients were considered eligible for entry to the study if they fulfilled the following clinical criteria.

Inclusion criteria was patients with primary hypertension.

Exclusion criteria were renal disease, diabetes mellitus, ischemic heart disease, acute myocardial ischemia, chronic coronary heart disease, cardiomyopathy (hypertrophic, infiltrative, restrictive), valvular heart disease (acute aortic or mitral regurgitation, mitral stenosis, aortic stenosis), pericardial disease, tamponade, circulatory congestive states, rapid fluid administration, arterio-venous fistula, severe anemia, thyrotoxicosis, patients with congenital heart disease and patients with LVEF < 40%.

All cases with secondary hypertension and pregnancy-induced hypertension were excluded.

All patients on drugs and toxins were excluded.

The study was approved by the ethical committee of the institution.

Methodology

A written informed consent was taken from all patients, complete history and clinical examination was done according to a proforma.

Blood pressure was measured as a mean of two readings recorded on the right arm, measured under standardized conditions with the participant seated (after 5 min rest).

In all the patients of essential hypertension information regarding the leisure time physical activity was gathered.

Then patients were subjected to detailed clinical examination routine hematological and biochemical examination and ECG to rule out secondary hypertension and IHD.

Patients who were detected or diagnosed as essential hypertension as per JNC VII criteria were included.

Definitions

Essential Hypertension

Essential hypertension is the form of hypertension that has no identifiable cause.

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<th>SBP/DBP</th>
<th>JNC 7</th>
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<tr>
<td>&lt;120/80</td>
<td>Normal</td>
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<tr>
<td>120 – 139/80 - 89</td>
<td>Prehypertension</td>
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<tr>
<td>140 – 149/90 - 99</td>
<td>Hypertension</td>
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<td>&gt;160/100</td>
<td>Stage 1</td>
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Diastole9

Diastole is the time period during which the myocardium loses its ability to generate force and shortens and returns to an unstressed length and force.

Diastolic Dysfunction

Diastolic dysfunction occurs when these processes are prolonged, slowed, or incomplete.

It depends on the onset, rate, and extent of ventricular pressure decline and filling and the relationship between pressure and volume or stress and strain during diastole.

Leisure Time Physical Activity10

Leisure is: free time, i.e.: non-work, non-obligated or non-constrained.

The amount of time people spend away from work whatever they do.

This data was computed based on three questions11

- Does your [recreation, sport or leisure time] involve mostly sitting, reclining, or standing, with no physical activity lasting more than 10 minutes at a time? [if yes, the person was graded as sedentary during leisure].
- In your leisure time do you do any moderate intensity activities like brisk walking (cycling or swimming) for at least 10 minutes at a time? [if yes, the person was coded as moderately active during leisure].
- In your leisure time do you do any vigorous activities like (running or strenuous sports, weight lifting) for at least 10 minutes at a time? [if yes, the person was graded vigorously active during leisure].
- If an individual said yes for all the three, he / she was graded as vigorously active during leisure.
- If an individual said yes for both moderate and sedentary, he / she was graded as moderately active during leisure.
active during leisure.

If the individual did not do any physical activity he was labeled as sedentary.

If an individual said yes for all the three, he / she was graded as vigorously active at work.

If an individual said yes for both moderate and sedentary, he / she were graded as moderately active at work.

All those included for study were subjected for echocardiography and colour Doppler.

Analysis was performed by using PHILIPS HD 7 and following parameters were measured.

Assessment of Diastolic Function Using Doppler

Fundamental information viz. chamber size, wall thickness and motion, systolic function, the valves, and the pericardium was noted on two dimensional echocardiography.

The diastolic filling wave known as ‘E’ wave which is due to rapid filling of LV due to atrio-ventricular gradient in early diastole was noted. (Almost 80 % of the LV filling occurs during this phase.)

‘A’ wave. During the late diastolic phase the LA acts as a ‘booster pump’ with a late diastolic filling of LV was noted. (Contributes to almost 20 % of LV filling in normal subjects).

Tissue Doppler imaging (TDI) is not dependent on imaging quality and tracings are easily obtainable. It is taken at mitral annulus either medial or lateral. The contraction and relaxation produces a wave form or that is recorded.

Early diastolic wave E’ i.e. E prime or Em wave and late diastolic wave A at the time of atrial contraction we recorded and E/A and E/E’ ratio were calculated.

Results

Out of 301 hypertensive patients 171 (55.70%) were having diastolic dysfunction and 130 (44.30%) were normal.

Distribution of patients with respect to age (years) and occurrence of diastolic dysfunction is shown in Table 1.

By using chi-square test p-value <0.05 showing association between the occurrence of diastolic dysfunction and age (years).

Majority i.e. 137 (74%) of the patients of diastolic dysfunction were from the age group of 51–60 years.

Distribution of patients with respect to gender and occurrence of diastolic dysfunction is shown in Figure 2.

Among 171 males 98 (57.3%) were having diastolic dysfunction, out of 136 females 73 (53.6 %) were found to have diastolic dysfunction. There was no association between the occurrence of diastolic dysfunction and gender (p>0.05).

Majority of patients, 177 (59.8%) were from urban areas where 118 (66.6%) were having diastolic dysfunction. One hundred twenty-six (41.85%) were from rural areas where 73 (58.01%) were found to be normal. There was association between the diastolic dysfunction and area of population (P<0.05).

Distribution of patients with respect to leisure time physical activity and occurrence of diastolic dysfunction is shown in Table 1.

Majority of patients 149 (48.5%) were having sedentary lifestyle 114 (76.5%) having diastolic dysfunction. There was association between the occurrence of diastolic dysfunction and leisure time physical activity (P<0.05).

Discussion

The study included 301 cases fulfilling inclusion criteria, found 171 (55.70%) were having abnormal diastolic function.

Slama et al demonstrated that diastolic dysfunction preceded the left ventricular hypertrophy. Also Ike et al in a study found that prevalence of diastolic dysfunction in the hypertensive group to be 82.86%.

In our study the majority i.e. 137 (74%) of patients out of 301 were from the age group of 51 – 60 years. As the age advances the leisure time activity decreases.

Similar to this Redfield et al in cross-sectional survey found diastolic dysfunction common above 65 years.

Among 167 males 98 (58.68%) were having diastolic dysfunction, out of 134 females 73 (54.47 %) were found to having diastolic dysfunction. It seems that females have more sedentary lifestyle than males. Similar to this Masoudi, et al in a cross-sectional study using data from retrospective medical chart abstraction of a national
Identification of a sedentary lifestyle in females increases the probability of diagnosing diastolic dysfunction.22

Similarly, Arbab-Zadeh et al in twelve healthy sedentary seniors and 12 masters athlete found that sedentary lifestyle during healthy aging is associated with decreased left ventricular compliance, leading to diminished diastolic performance.23

Prolonged, sustained endurance training preserves ventricular compliance with aging and may help to prevent heart failure in the elderly.

Kitzman et al reported the first single-center, single-blind RCT on exercise training in older patients with diastolic dysfunction. The benefits of exercise training in patients with heart failure include an improvement in exercise tolerance as assessed not only by exercise duration but more importantly by peak V’O2.24

Leisure-time physical activity is associated with longer life-expectancy, even at relatively low levels of activity and regardless of body weight, according to a study by a team of researchers led by the National Cancer Institute (NCI), part of the National Institutes of Health. The study, which found that people who engaged in leisure-time physical activity had life-expectancy gains of as much as 4.5 years.25

In conclusions, our study suggests that urban population is more susceptible for diastolic dysfunction as compared to rural population. This is definitely linked with leisure time physical activity.

It is shown that there is definite cardioprotection with a leisure time physical activity which is feasible, safe, and effective in patients with diastolic dysfunction.

Leisure time physical activity delays the development of ventricular diastolic dysfunction. A sedentary lifestyle is definitely associated with a decline of ventricular compliance.

Leisure time physical activity may therefore be considered as having potential role in preventing diastolic dysfunction in addition to regular exercise.

References

25. Dr Moore, NCI Press officer, NIH study Nov 6,2012