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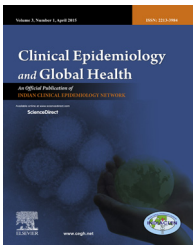

Original Article

Association and pattern of diastolic dysfunction in metabolic syndrome: Potential for diagnosis and prognosis

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ABSTRACT

Background: There is need to assess left ventricular diastolic dysfunction (LVDD) in metabolic syndrome to effectively implicate and strengthen population-based prevention strategies.
Objectives: To assess the prevalence of LVDD in metabolic syndrome.
Methods: This study was conducted in the Department of Medicine, Guru Gobind Singh Medical College and Hospital, Faridkot on 100 cases (with metabolic syndrome diagnosed on International Diabetic Federation criteria) and 100 age- and sex-matched controls (without metabolic syndrome) between 30 and 60 years of age by echocardiography to assess LVDD.
Results: Overall prevalence of diastolic dysfunction was 73% in the cases and 14% in controls with an increasing trend with increasing age in both groups showing age an important determinant of diastolic dysfunction; gender-wise difference was not significant in any group. However, increasing trend with increasing body mass index, elevated blood pressure, elevated fasting blood sugar, elevated serum triglyceride, and deceased serum high density lipoprotein was noted showing their risk correlation in the outcome of diastolic dysfunction; participants without metabolic syndrome had lesser diastolic dysfunction (14%).
Conclusions: The diastolic dysfunction in metabolic syndrome was found to be higher that supports the assumption that metabolic syndrome could be correlated to risk of development of LVDD. Holistic prevention of metabolic syndrome has an important role to prevent development of diastolic dysfunction.

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1. Introduction

Globally increased prevalence of diastolic dysfunction has been shown in the metabolic syndrome that results from abnormality in active relaxation of myocardium and an increase in passive stiffness due to metabolic derangements and structural remodeling.[1,2] Diastolic dysfunction is the key pathophysiologic mechanism responsible for hemodynamic perturbations and symptoms in patients of heart failure with normal ejection fraction also called as diastolic heart failure. Patients with diastolic dysfunction have impaired quality of life because of the deterioration in exercise capacity that limits activities of daily living. Left ventricular diastolic dysfunction (LVDD) with a normal left ventricular ejection fraction is clinically very important because it is responsible for half of all hospital admissions for acute heart failure.[1,3–5] Researchers working in different parts of the world have noted that metabolic syndrome comprises of a constellation of metabolic abnormalities that confer increased risk of hyperglycemia and dyslipidemia leading to a spectrum of cardiovascular diseases including heart failure with normal ejection fraction.[1,6–9] National Cholesterol Education Program's Adult Treatment Panel III report identified the metabolic syndrome as a multiplex risk factor for cardiovascular disease that deserves more clinical attention.[10] Asian Indians have double the risk of coronary artery disease characterized by high serum levels of apolipoprotein B, lipoprotein and triglycerides (TGs) and low levels of apolipoprotein A1, and high-density lipoprotein cholesterol leading to metabolic syndrome cases of high prevalence of LVDD.[11,12] In the above scenario, this study was undertaken to assess the prevalence of LVDD in metabolic syndrome by echocardiography so that we can effectively implicate and strengthen the population-based prevention strategies for prevention of epidemic of obesity and metabolic syndrome.

2. Methods

This study was conducted on consenting participants aged between 30 and 60 years (both genders) among 100 cases [50 males and 50 females fulfilling the criteria of metabolic syndrome of International Diabetic Federation (IDF)] and 100 controls [50 males and 50 females without metabolic syndrome].[10,12] Patients with known cases of valvular heart diseases, coronary heart disease, cor pulmonale, pulmonary hypertension, primary volume overload, atrial fibrillation, left ventricular ejection fraction less than 55%, left ventricular hypertrophy (LVH), pericardial effusion, and poor transthoracic window were excluded from the study. The parameters of diastolic dysfunction were *E*/*A* index [ratio of transmitral flow during early (*E*) ventricular filling to flow during atrial (*A*) contraction] <1 or >2, DT <150 or >220 ms, IVRT <60 or >100 ms, $E/e' < 15$, $e'/a' < 1.0$.[13,14]

Ethical approval from the Institutional Ethics Committee was taken. Each participant was individually counseled following Helsinki declaration and asked to provide informed consent. Detailed history, clinical, and anthropometric evaluation were carried out including body mass index (BMI), blood pressure, and fundus assessment. Laboratory investigations included complete blood count, liver function test, renal function test, serum electrolytes, and complete urinalysis using standard operating procedures. Pulsed Doppler evaluation of transmitral inflow and Tissue Doppler Imaging, M mode echocardiography, and 2D echocardiography was performed to minimize the errors in assessing the diastolic dysfunction. Pulsed-wave Doppler-derived transmitral inflow velocities were obtained in the apical 4-chamber view with the sample volume placed at the mitral valve leaflet tips. Measurements included the transmitral early diastolic and atrial wave velocities to calculate *E*/*A* ratio, IVRT, and deceleration time. For tissue Doppler imaging, mitral annulus velocity was done with a 2 mm sample volume placed at the septal side of the mitral annulus. Data were analyzed to find relations between metabolic syndrome and its various components with diastolic dysfunction.

3. Results

Among the cases (i.e. with metabolic syndrome), 73 out of 100 (73%) had diastolic dysfunction and in the control group (i.e. without metabolic syndrome), 14 out of 100 (14%) had diastolic dysfunction which was statistically significant ($p < 0.0001$) (Table 1).

Diastolic dysfunction was found in 21 cases (60%) in 30–40 years of age group, 24 (70.59%) in 41–50 years of age group, and 28 (90.32%) persons in 51–60 years of age group which was statistically significant ($p = 0.02$). Among controls, diastolic dysfunction was 2.86% in 30–40 years of age group, 3 (9.09%) in 41–50 years, and 10 (31.25%) persons in 51–60 years which was statistically significant ($p = 0.002$) (Table 1).

In the cases, 38 males (76%) and 35 females (70%) were found to have diastolic dysfunction. On the other hand, diastolic dysfunctions were noted more in males (76%) than females (70%). Controls had less diastolic dysfunction which was statistically insignificant (Table 1).

3 out of 4 (75%) participants with overweight category, 23 out of 35 (65.71%) with obesity class I category, 25 out of 37 (67.57%) with obesity class II category, and 22 out of 23 (95.65%) with obesity class III category, had diastolic dysfunction in the study group; diastolic dysfunction increased as BMI increased. It was statistically significant with p value of 0.03.

Among cases with hypertension according to IDF criteria of metabolic syndrome, 82.5% had diastolic dysfunction that was statistically significant ($p < 0.0001$) (Table 1).

In our study, in persons who have fasting blood sugar (FBS) according to IDF criteria of metabolic syndrome, 65 out of 84 (78.57%) were found to have diastolic dysfunction in the study group. It was statistically significant with p value of 0.024 (Table 1).

In participants with high serum TG according to IDF criteria of metabolic syndrome, 69 (75.82%) were found to have significantly higher diastolic dysfunction ($p = 0.043$) (Table 1).

In participants with high serum high density lipoprotein (HDL) according to IDF criteria of metabolic syndrome, 56 (78.87%) had diastolic dysfunction that was statistically significant ($p = 0.038$) (Table 1).