

Prevalence of Left Ventricular Diastolic Dysfunction in Metabolic Syndrome as Assessed by Echocardiography

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ABSTRACT

Introduction: Metabolic syndrome is a complex disorder with high socio-economic cost that is considered a worldwide epidemic. It is very common condition Consisting hyperglycemia, central obesity, hypertension and dyslipidemia (low levels of high density lipoprotein cholesterol(HDL-C) and high levels of triglycerides). Current study was done to assess Left Ventricular Diastolic Dysfunction in patients of Metabolic Syndrome by 2d- Echocardiography.

Material and methods: In this study my aim is to find out the prevalence of left ventricular diastolic dysfunction in metabolic syndrome and to highlight the importance of primary prevention in metabolic syndrome. The Present study is cross-sectional observational study carried out at CSS Hospital Subharti medical college Meerut UP, consisting of 50 patients having metabolic syndrome according to the criteria of International Diabetic Federation and to look for there LVDD via 2d- Echocardiography.

Results: The left ventricular diastolic dysfunction grade is associated with the number of characteristics of metabolic syndrome. Waist circumference, FBS, E/A, IVRT, Deceleration time, E/e' showed a statistically significant association (p value <0.01) with the degree of diastolic dysfunction.

Conclusion: The current study showed that, metabolic syndrome group have an associated abnormal left ventricle diastolic performance So the patients with metabolic syndrome should receive aggressive therapy to avoid occurrence of heart failure in the future.

Keywords: Left Ventricular Diastolic Dysfunction, Metabolic Syndrome, Echocardiography

with MetS.⁶

Diastolic heart failure (HF) is a progressive disorder characterized by impaired left ventricular (LV) relaxation, increased LV stiffness, increased interstitial deposition of collagen, and modified extracellular matrix protein. 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.

Impaired left ventricular (LV) diastolic dysfunction is highly prevalent and plays an important role in the development of heart failure syndrome, particularly heart failure with preserved ejection fraction (HFpEF).⁷ Diastolic dysfunction is also associated with cardiovascular mortality in the general population and patients with various cardiac conditions.⁸ LV diastolic dysfunction usually precedes clinical presentation of overt cardiac disease, and thus, its early recognition and proper management are important. Fortunately, this cardiac preclinical change in diastolic dysfunction can be detected by Doppler echocardiography.⁹ As the importance of the prognostic value of LV diastolic function and related heart failure has been increasingly recognized¹⁰, assessment of LV diastolic function becomes a routine process during echocardiographic examination.⁹ the metabolic syndrome driving the twin global epidemics of type 2 diabetes and CVD there is an overwhelming moral, medical and economic imperative to identify those individuals with metabolic syndrome early, so that lifestyle interventions and treatment may prevent the development of diabetes and/or cardiovascular disease.⁵

Study aimed to find out the prevalence of left ventricular diastolic dysfunction in metabolic syndrome and to highlight

INTRODUCTION

The term metabolic syndrome was defined by Haller in 1977.¹ The main features of this syndrome are central obesity, hypertriglyceridemia, low HDL cholesterol, hyperglycaemia and hypertension.² Metabolic syndrome is also known as carido-metabolic syndrome, syndrome X, and insulin resistance syndrome.³ In most people with glucose intolerance or type 2 diabetes, there is a multiple set of risk factors that commonly appear together, forming what is now known as the 'Metabolic Syndrome'. The underlying cause of the metabolic syndrome continues to challenge the experts but both insulin resistance and central obesity are considered significant factors. The clustering of cardiovascular disease (CVD) risk factors that typifies the metabolic syndrome is now considered to be the driving force for a new CVD epidemic⁴ Many studies have reported that impaired Left Ventricular (LV) diastolic function is prevalent in patients

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the importance of primary prevention of metabolic syndrome.

MATERIAL AND METHODS

The present cross-sectional, observational study was conducted for 2 years in the department of Medicine at Chatrapati Shivaji Subharti Hospital, Meerut from August 2017 to July 2019. The study group comprised of 50 patients, suffering from metabolic syndrome. Patients were enrolled in the study after obtaining written informed consent and approval from Institutional Ethical Committee.

Inclusion criteria

1. Subjects of both genders with age between 30 years to 60 years with normal left ventricular systolic function.
2. Metabolic syndrome, according to International Diabetic Federation, patients having: a. Central obesity (waist circumference) more than equal to 90 cm in South Asian male and more than equal to 80 cm in South Asian female. With any two of the following:
 - i. Serum triglyceride >150mg/dl or specific treatment for lipid abnormality.
 - ii. Serum HDL cholesterol <40 mg/dl in males and <50 mg/dl in female or specific treatment for lipid abnormality.
 - iii. Blood pressure (BP) in supine position after 10 minute rest systolic BP more than or equal 130 mm Hg or diastolic BP more than or equal 85 mm of hg or on treatment of previously diagnosed hypertension.
 - iv. Fasting plasma glucose more than equal 100 mg/dl or a preciously diagnosed type 2 diabetes mellitus.

Exclusion criteria: It excludes patients with following characteristics i.e.:

1. Subjects with age <30 years or >60 years.
2. With known case of valvular heart diseases, coronary artery diseases, cor pulmonale, pulmonary hypertension, primary volume overload.
3. Atrial fibrillation
4. Left ventricular ejection fraction <55%
5. Left ventricular hypertrophy
6. Pericardial effusion

Case selection

The data was collected by a preformed structured interviewer-administered questionnaire that was pretested with modifications made prior to its use in the study. The patients were interviewed for the demographic, socioeconomic status, medical history and previous history of taking any medications and supplements.

Ethical clearance: The study protocol for all procedures was approved by the Institutional Review Board for Ethical Clearance of Chatrapati Shivaji Subharti Hospital and was performed in accordance with the Code of Ethics of the World Medical Association according to the Declaration of Helsinki of 1975, as revised in 2000. All patients were asked to sign a written consent form prior to commencement of the study.

Investigations

1. Anthropometric measurements
2. Fasting blood sugar
3. Fasting lipid profile
4. Echocardiography
5. Routine tests:
 - a. CBC
 - b. Kidney function test
 - c. Liver function test
 - d. HbA1C
 - e. X ray chest

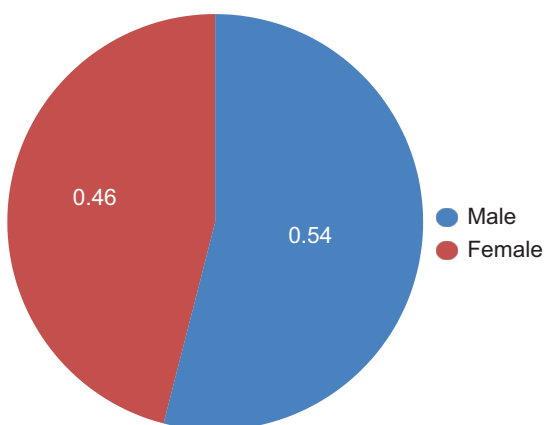
Echocardiographic examination was performed on the ultrasound system by using a 2-to-4 MHz transducer. The values of all echocardiographic parameters were obtained as the average value of 5 consecutive cardiac cycles. The left ventricle end-systolic (LVESD) and end-diastolic diameters (LVEDD), the left ventricle free wall (PWT), septum thickness (IVS) and the left atrium (LA) diameter were determined according to the recommendations of the American Society of Echocardiography⁹³. End-systolic and end-diastolic volumes and parameters of systolic function (ejection fraction – EF, and fractional shortening – FS) were estimated by using the Teicholz formula. Relative wall thickness (RWT) was calculated as $(2 \times \text{PWT}) / \text{LVEDD}$. The left ventricular mass (LVmass) was calculated by using the Penn formula: $\text{LV mass} = 1.04 \times [(\text{LVEDD} + \text{PWT} + \text{IVS})^3 - (\text{LVEDD})^3] - 13.6 \text{g}$ ⁹⁴. The left ventricular mass index (LVmass/Ht^{2.7}) was calculated as the ratio of the left ventricular mass and height^{2.7}. The left ventricular hypertrophy was defined as $\text{LVmass}/\text{Ht}^{2.7} \geq 51 \text{ g}/\text{m}^{2.7}$ for men and $\geq 49.5 \text{ g}/\text{m}^{2.7}$ for women. The analysis of transmitral inflow velocities was obtained by pulsed-wave Doppler in the apical 4-chamber view with the sample volume placed at the mitral valve leaflet tips. Measurements included transmitral early diastolic (E-wave) and atrial (A-wave) velocities which were used to calculate E/A ratio and E-wave deceleration time (DT). Criteria used for diastolic dysfunction of heart: That would be any of the following;

- a. E/A ratio <1 or >2
- b. DT <150 OR >220ms
- c. VRT <60 or >95 ms
- d. d.E/e' >10

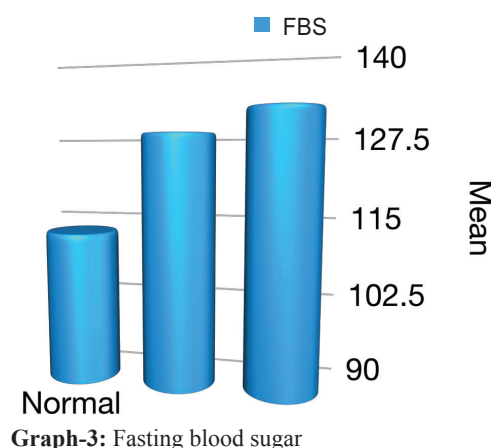
RESULT

The study group comprised of 50 patients, suffering from metabolic syndrome. Out of 50 patients 27 were male (54%) and 23 were females (46%) as shown in As shown graph 2, out of 50 subjects, 23 (46%) had normal diastolic function, 18 (36%) had impaired relaxation, 9 (18%) had pseudonormal pattern. Thus 27 (54%) subjects had diastolic dysfunction. As shown in graph 3 - fasting blood sugar in the normal group was 113.19 mg/ dl, in impaired relaxation group it was 128.24 mg/dl and in the pseudonormal group, the same was 132.96 mg/dl. Mean fasting blood sugar values were higher in pseudonormal group, with statistically significant difference as $p < 0.05$

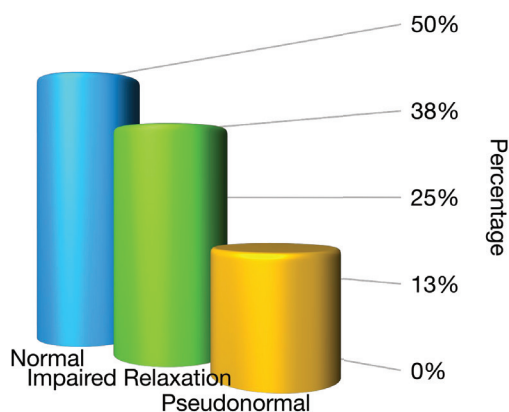
As shown in graph 4 - mean waist measurement in the



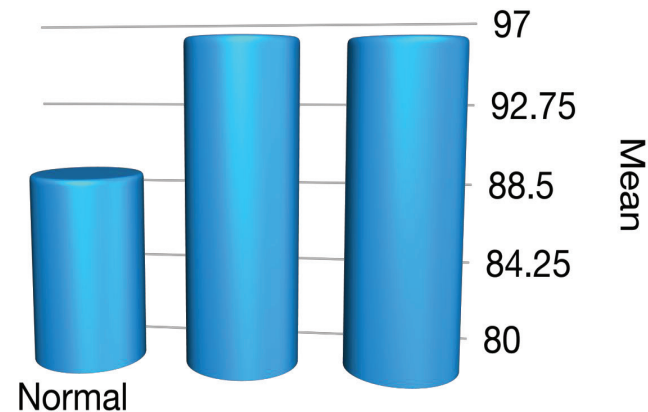
Graph-1: Gender distribution among the study subjects



Graph-3: Fasting blood sugar



Graph-2: Left ventricular diastolic dysfunction in study subjects



Graph-4: Mean waist measurement

ECHO Parameters	Left Ventricular Diastolic Dysfunction					
	Normal		Impaired Relaxation		Pseudonormal	
	Mean	SD	Mean	SD	Mean	SD
E/A ratio	1.10	0.14	0.81	0.10	1.15	0.16
Anova test	3.41					
p value	0.04*					
DT	185.09	13.32	225.21	11.79	169.91	12.20
Anova test	11.34					
p value	<0.01*					
IVRT	85.19	13.71	87.81	15.62	95.99	16.04
Anova test	5.67					
p value	0.02*					
E/e'	7.94	0.88	7.67	0.72	11.78	0.93
Anova test	8.41					
p value	<0.01*					
*statistically significant						

Table-1: ECHO Parameters

normal group was 89.41 cms, in impaired relaxation group it was 96.10 cms and in the pseudonormal group was 95.04 cms. The mean waist measurement values were higher in impaired relaxation group, with statistically significant difference as p<0.05.

E/A ratio was 1.10 in the normal group, 0.81 is the reading in the impaired relaxation group while pseudonormal group has a value of 1.15. When E/A ratio was compared statistically among the normal, impaired relaxation and pseudonormal group, it was found to be statistically significant difference

as p<0.05 (table-1).

Deceleration time in the normal group is 185.09 msec, in the impaired relaxation group it was 225.21 msec whereas 169.91msec was the value in the Pseudonormal group with. When DT was compared statistically among the normal, impaired relaxation and pseudonormal group, it was found to be statistically significant difference as p<0.05.

Isovolumetric relaxation time was 85.19 msec in the normal group. The value in the impaired relaxation group was 87.81 msec while in the Pseudonormal group the value was 95.99

msec (. When IVRT was compared statistically among the normal, impaired relaxation and pseudonormal group, it was found to be statistically significant difference as $p < 0.05$.

DISCUSSION

Metabolic syndrome is described by a combination of underlying risk factors such as central obesity, glucose intolerance, low level of high-density lipoproteins (HDL), high triglyceride (TG) level, and hypertension, that when occurring together culminate in adverse outcomes, including cardiovascular disease (CVD). Cardiovascular diseases associated with metabolic syndrome comprise vascular and myocardial abnormalities that are usually manifested as impaired relaxation of the left ventricle. This myocardial dysfunction is characterized predominantly by diastolic dysfunction consisting of relaxation abnormalities that are prevalent and have prognostic importance. The correlation between the intensity of metabolic syndrome and the presence of diastolic dysfunction is well documented, as well as the fact that the grade of diastolic dysfunction is associated with the intensity of metabolic syndrome.¹ Left ventricular diastolic dysfunction may be the earliest marker of metabolic syndrome induced heart disease, which leads to progressive development of cardiac failure. Thus it is important to detect left ventricular diastolic dysfunction at an early stage. This will prevent progression of disease to failure. The present study was designed to evaluate the association between left-ventricular diastolic dysfunction and metabolic syndrome. So far there is minimal literature in our institute regarding the study of diastolic dysfunction in subjects with metabolic syndrome.

Previous studies like Tarumi et al¹¹ reported LVDD 36% and Antonio Nicolino A et al¹² reported LVDD from 32-40%. But in our study we reported a prevalence of 54%. When compared to the above mentioned studies, we had studied the pseudo normal pattern. Hence the reason for high prevalence levels of LVDD in our study. The recognition of pseudo normal pattern is important because it is an intermediate stage impaired relaxation and restrictive filling which is a more advanced stage of LVDD. Dinh W et al¹³ in year 2011 conducted a study on 166 subjects with normal ejection fraction in which metabolic syndrome was found in 97 persons and the prevalence of LVDD was 68% in subjects with metabolic syndrome vs 19% in patients without metabolic syndrome ($p < 0.001$).

CONCLUSION

In conclusion, the current study showed that, metabolic syndrome group have an associated abnormal left ventricle diastolic performance. The left ventricular diastolic dysfunction grade is associated with the number of characteristics of metabolic syndrome. Waist circumference, FBS, E/A, IVRT, Deceleration time, E/e' showed a statistically significant association with the degree of diastolic dysfunction. So, patients with metabolic syndrome should receive aggressive therapy to avoid occurrence of

heart failure in the future.

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