ECHOCARDIOGRAPHIC EVALUATION OF DIASTOLIC FUNCTION IN ASYMPTOMATIC TYPE 2 DIABETES AND RELATION WITH DURATION OF DM

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ABSTRACT

INTRODUCTION

Congestive heart failure is the final result of cardiovascular complications in diabetes mellitus, in which the diastolic dysfunction is impaired earlier than the systolic function. Diastolic dysfunction may be asymptomatic without signs of overt heart failure.

METHODS

A cross-sectional hospital based study was done which included 50 asymptomatic patients with type 2 diabetes without evidence of coronary artery disease, congestive heart failure or thyroid disease. LV diastolic dysfunction was evaluated by Doppler echocardiography, which included the Valsalva manoeuvre to unmask the pseudonormal pattern of left ventricular filling. The prevalence of diastolic dysfunction and the associated risk factors were assessed.

RESULTS

LVDD was found in 35 subjects (71%), of whom 30 had impaired relaxation and 5 had a pseudonormal pattern of ventricular filling. Systolic function was normal in all subjects, and there was no correlation between LVDD and indexes of metabolic control. It was also found that age ≥46 years was associated with an almost three times higher risk for the development of diastolic dysfunction in type 2 diabetes. Especially females were at two times higher risk of developing diastolic dysfunction than when compared to men. Duration of diabetes ≥ two and half years was associated with a two times higher risk for developing diastolic dysfunction.

CONCLUSIONS

LV Diastolic dysfunction is much more common than previously assumed in subjects with well-controlled type 2 diabetes who are without any clinically detectable cardiac disease. The high prevalence of this phenomenon in this high-risk population suggests that screening for LVDD in type 2 diabetes should be routinely done & must include procedures such as the Valsalva manoeuvre to unmask a pseudonormal pattern of ventricular filling.

KEYWORDS

Diabetes Mellitus, Echocardiography, Diastolic dysfunction, Heart failure.

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INTRODUCTION: The incidence of diabetes mellitus (DM) is increasing worldwide from last 2 decades. Diabetes mellitus is now a common risk factor for heart failure. Studies have reported a high prevalence of pre-clinical diastolic dysfunction among subjects with DM.[1]

Prevalence of diabetes in heart failure ranges from 10 to more than 30%.[2,3] The Framingham Heart Study has shown that the incidence of congestive cardiac failure in diabetic patients occurs irrespective of coronary artery disease or hypertension. Left ventricular diastolic function (LVDF) is affected earlier than systolic function in the development of congestive cardiac failure.[4] Therefore, left ventricular diastolic dysfunction may represent the first stage of diabetic cardiomyopathy, thus an early examination of left ventricular diastolic function may help detect this condition in patients with diabetes, thereby allowing early intervention for a more favourable outcome.[5]

This study was done to find out the left ventricular diastolic dysfunction (LVDD) in patients with type 2 diabetes and to assess the risk factors for the development of diastolic dysfunction in such patients.

METHODS: A cross-sectional study that was conducted in the Department of Medicine, Saptagiri Institute of Medical Sciences, Bangalore over a period of one year from February 2015 to January 2016. This study was approved by the Ethical Committee of Saptagiri Institute of Medical Sciences, Bangalore. Patients with type 2 diabetes attending the outpatients clinic who were asymptomatic were enrolled in the study.

Fifty diabetic patients who were on lifestyle intervention and treatment (oral medications or insulin) with an ejection fraction of more than 54% on echocardiogram and no

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clinical evidence of cardiorespiratory illness were included in the study.

Patients were excluded if they had prior history of angina or myocardial infarction, other co-existing cardiac illnesses like valvular heart disease, regional wall motion abnormalities, hypertrophic cardiomyopathy, any pericardial disease or thyroid disease.

Informed consent was obtained from the subjects and the Hospital Ethical Board Committee approved the study.

All subjects had their fasting blood glucose levels (enzymatic glucose oxidase/peroxidase method), creatinine and lipid profiles estimated. ECG was done in all subjects. Physical examination included routine general examination, systemic examination and anthropometric evaluation including height (metre) and weight in kilograms.

They also had an echocardiogram done to assess the presence of diastolic dysfunction and if present it was graded as impaired relaxation, pseudonormal pattern or restrictive physiology. Echocardiograms were done using the commercially available Hewlett Packard Sonos 1800. Echocardiography to detect diastolic dysfunction was done by assessing the E/A ratio, the deceleration time (DT) and IVRT isovolumetric relaxation time (IVRT) in pulsed wave Doppler. Impaired relaxation (grade I diastolic dysfunction) was detected when the E/A ratio was less than 1, IVRT more than 240 msec, DT more than 90 msec. Pseudonormal pattern (grade II diastolic dysfunction) was diagnosed when the E/A ratio was less than 1 after Valsalva manoeuvre (E/A more than 1 prior to Valsalva) and restrictive physiology (grade III diastolic dysfunction) when E/A ratio of more than 1.5, DT less than 150 msec. and IVRT less than 70 msec.

The subjects were divided into two groups, those with normal diastolic function and those with diastolic dysfunction. All data were analysed by using statistical package for social sciences (SPSS) version 10 for windows. Comparisons between proportions were carried out using the χ^2 test, and a P value less than 0.05 was considered as statistically significant. Binary logistic regression analysis was applied to compute odds ratio (95% CI) and variables showing a statistical significance were simultaneously considered in the multivariate logistic regression analysis to determine the significant independent risk factors of diastolic dysfunction.

RESULTS: Of the 50 patients that were included in the study, diastolic dysfunction was detected in 35 patients while 5 of them had normal echocardiographic findings. Among the 35 patients who had diastolic dysfunction, impaired relaxation was detected in 30 (60%) and pseudonormal pattern was detected in 5 (10%) which was unmasked by the Valsalva manoeuvre. Restrictive physiology was not noted in any patients (Figure 1).

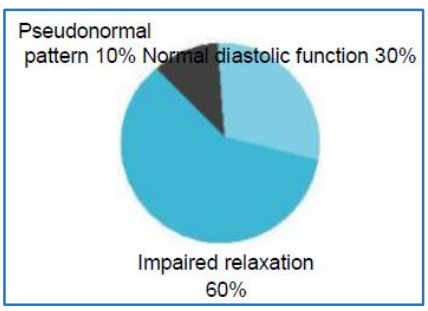

Fig. 1: Echocardiographic assessment of left ventricular function

The potential risk factors for the development of diastolic dysfunction in type 2 diabetics that were determined were; (a) age ≥46 years was associated with an almost three times higher risk for the development of diastolic dysfunction, (b) females had almost two times a higher risk for the development of diastolic dysfunction as compared with men, and (c) patients with diabetes of more than two and half years duration had a two times higher risk of developing diastolic dysfunction (Table 1).

Variables	Normal (n =15)	Diastolic Dysfunction (n=35)	P value	Odds ratio	(95% CI)
Age (years)	46.9±10.2	52.3±9.9	0.015	3.62	1.4 - 8.9
Male: female	11:4	19:16	0.15	1.92	0.7 - 4.8
Duration of diabetes (years)	1.8±0.8	5.3±1.1	0.003	3.2	1.2 - 8.1
Systolic blood pressure (mm Hg)	126.2±14.4	130.1±16.1	0.26	1.3	0.5 - 3.5
Diastolic blood pressure (mm Hg)	81.3±9.3	82.9± 8.4	0.41	1.2	0.2 - 6.5
Smokers	12	26	0.65	0.8	0.3 - 1.9
BMI (kg/m^2)	23.6±2.4	23.8± 3.1	0.73	1.3	0.6 - 1.7
Waist: Hip ratio	0.96±0.40	0.97±0.63	0.53	1.2	0.5 - 2.8
Fasting plasma glucose (mg/dL)	164.8±49.8	161.7±56.1	0.79	0.8	0.4 - 2.2
Serum creatinine (mg/dL)	0.81±0.21	0.84±0.26	0.58	0.8	0.7 - 2.4
Total cholesterol (mg/dL)	173.1±25.5	176.1±42.9	0.65	2.9	0.8 - 10.9
HDL cholesterol (mg/dL)	42.4±9.1	42.4± 8.2	0.96	1.5	0.6 - 3.8
Triglycerides (mg/dL)	164.4±90.8	143.9±63.8	0.21	0.9	0.4 - 2.3
LDL cholesterol (mg/dL)	98.5±26.9	105.7±37.8	0.35	1.3	0.5 - 3.1
24 hour urinary protein excretion (g/24 hours)	0.71±0.22	0.75±.35	0.86	0.9	0.6 - 1.9
LVH on ECG	1	13	0.05		

Table 1: Comparison of characteristics between subjects with normal and those with diastolic dysfunction

Echocardiographic parameters	Normal (n=29)	Impaired relaxation (n=60)	Pseudonormal pattern (n=11)
Ejection fraction (%)	61.3±7.6	61.7±8.2	57.7±5.5
E wave (cm/s)	781±131	425±101	816±79
			561±86*
A wave (cm/s)	620±105	733±148	673±82
			680±89*
E/A ratio	1.26±0.16	0.71±0.05	1.22±0.18
	173±34	246±55	0.76±0.11*
DT (ms)			179±24
IVRT (ms)	88.8±14	120.7±13	90.1±12
*after Valsalva			

Table 2: Comparison of echocardiographic parameters between subjects with normal and those with diastolic dysfunction

DISCUSSION: Epidemiological data indicate a greater risk of cardiovascular morbidity and mortality, particularly congestive cardiac failure, in diabetic subjects as compared with those without diabetes.[6] The prevalence of diabetes mellitus in heart failure population is close to 20% as compared with 4 to 6% in control populations.[7]

This study showed that the overall prevalence of diastolic dysfunction in type 2 diabetic patients was 70% and among them impaired relaxation was detected in 60% and pseudonormal pattern of left ventricular filling was noted in 10%.

Bajraktari et al in 2004 in Kosovo demonstrated that left ventricular diastolic dysfunction was present in 68.8% of asymptomatic type 2 diabetic patients as compared to 34.9% in the control group without diabetes which was due to the presence of asymptomatic diabetic cardiomyopathy which was present in the diabetic population.[8]

Soldatos et al.[9] in their case control study of 55 individuals with type -2 DM found that diastolic dysfunction, present in a significant proportion of population with type 2 DM.

Sohail et al.[10] in their study of 212 diabetic population found that 30.76% patients with type 2 DM had diastolic dysfunction.

Poirier et al in 2001 in Canada attempted to determine the prevalence of left ventricular diastolic dysfunction in middle-aged asymptomatic subjects with type 2 diabetes in a study, which included 46 men who has no evidence of diabetic complications, hypertension, coronary artery disease, congestive cardiac failure, thyroid or renal disease. Left ventricular dysfunction was found in 28(60%) subjects, of whom 13(28%) had a pseudonormal pattern of ventricular filling and 15(32%) had impaired relaxation.[11]

It was also observed that diastolic dysfunction was more common among diabetic women and they also had a more advanced form of diastolic dysfunction as compared to men, i.e. pseudonormal pattern of left ventricular filling (21.2% vs. 10.5%). The Strong Heart Study by Devereuex and colleagues in 2000 also demonstrated that diastolic dysfunction is more prevalent in women than in men.[12]

Patients with diastolic dysfunction were older than those without diastolic dysfunction and the duration of diabetes in these group of patients was also more.

Further our study did not find any relationship between diastolic dysfunction and fasting blood glucose levels. It was noted that among those with diastolic dysfunction the use of oral hypoglycaemic agents and/or insulin was higher as compared to those without diastolic dysfunction (80.2% vs. 68.9%), thus this could have resulted in the blood glucose levels being similar despite the presence of asymptomatic diastolic dysfunction. Poirier and colleagues also did not find any difference in the glycaemic indices and concluded that fasting blood glucose levels did not correlate with the presence of diastolic dysfunction in type 2 diabetes.[13]

However, Holzmann and colleagues demonstrated that the presence of diastolic dysfunction is related to the concentrations of fasting blood glucose.[13]

It was also noted that in both the study groups the body mass index was normal and the difference between the two groups were not significant. This normal body mass index could be due to the racial and dietary factors, which is different between the South East Asian population and the Caucasian and the Black population.

CONCLUSIONS: Our study demonstrates that the incidence of pre-clinical diastolic dysfunction is high in type 2 DM subjects. Overall prevalence of diastolic dysfunction was 71% in asymptomatic type 2 DM subjects in the present study. Asymptomatic type 2 DM had significantly high prevalence of diastolic dysfunction as compared to healthy subjects with DM type 2, should be screened for subclinical diastolic dysfunction by echocardiography and should include procedures such as the Valsalva manoeuvre to unmask the pseudonormal pattern of left ventricular filling. Diastolic dysfunction increases as the duration of diabetes increases.

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