

Frequency of Diastolic Dysfunction in Normotensive Type 2 Diabetes Mellitus Patients with Preserved Systolic Function in an Asian Tertiary Care Hospital

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Authors' contributions

This work was carried out in collaboration among all authors. Author BM conducted the study and wrote the article. Author SK helped in review and proof reading of the article. Author IAK did analysis of the data and its interpretation. Author MAA did proof reading of the article and made corrections. Author AA Re-arranged the data and author MSM helped in making tables and figures. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Type 2 Diabetes mellitus (DM2) is a chronic metabolic disorder [1] The occurrence of the heart failure in among diabetics is very high, even when there is no history of hypertension or coronary heart disease [2] The literature indicated that the myocardial injuries that occurred in diabetics may affect the diastolic function before effecting the systolic function.

Aims: To assess the frequency of diastolic dysfunction in normotensive type 2 diabetes mellitus patients presenting with preserved systolic function.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Cardiology, Mayo hospital, Lahore for Six months i.e. from 01-03-2018 to 31-08-2018.

Methodology: 200 patents who fulfilled the selection criteria were enrolled in the study. Then all

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patients underwent echocardiography to detect the presence of diastolic dysfunction. Reports were assessed and diastolic dysfunction was labelled as Grade I, II, III or IV. Performa was used to gather the data. The gathered data was entered and analysed in SPSS 21.

Results: The mean age of patients was 56.62 ± 10.38 years. There were 131 (65.5%) males while 69 (34.5%) females. The mean BMI of patients was $28.43 \pm 6.34 \text{ kg/m}^2$. The mean duration of DM2 was 10.55 ± 5.86 years. There were 94 (47%) patients who had diastolic dysfunction.

Conclusion: The frequency of diastolic dysfunction was high (47%) in type 2 diabetes mellitus patients even in the absence of hypertension with preserved systolic function.

Keywords: Type 2 diabetes mellitus; Diastolic dysfunction; normotensive; preserved systolic function.

1. INTRODUCTION

Diabetes mellitus type 2 (DM2) is a long-term metabolic condition marked by elevated blood sugar, insulin tolerance and relative insulin deficiency [3] Except in the absence of hypertension and coronary artery disease, the occurrence of heart failure in diabetic subjects is large [4] DM2 has multi-system complications and is a disorder [5] The end result of cardiovascular problems is congestive heart failure, heralded by the presence of diabetic cardiomyopathy, suggested by left ventricular diastolic dysfunction, which can be easily measured by echocardiography [6].

Echocardiography is the highly sensitive tool to detect and diagnose the diastolic dysfunction [7] Previous literature reported that the prevalence of diastolic dysfunction is high in patients of DM2 [8] Diastolic dysfunction can be an early marker for development of diabetic cardiomyopathy [6] Some studies indicate that both men and women with DM2 have similarly high prevalence of diastolic dysfunction [9]. The previous data also indicated that the damage or injuries to myocardial lining in DM2 patients may affect the diastolic function before any changes occur to the systolic functions. The development of this diastolic or left ventricular dysfunction among diabetics is not yet clear [4,10].

One study reported that the frequency of diastolic dysfunction was 48% among DM2 patients who were normotensive.10 Another study has also showed that the frequency of diastolic dysfunction was 52% among DM2 patients who were normotensive [4].

Previous literature also showed more prevalence of diastolic dysfunction in diabetic patients as compared to control group (62.3% versus 12.8%, $p < 0.05$) [11]

Rationale of this study is to assess the frequency of diastolic dysfunction in normotensive DM2 patients presenting with preserved systolic function in an Asian Tertiary Care Hospital [12]. Literature has showed that in DM2 patients who seem to be normotensive and asymptomatic have risk of developing diastolic dysfunction which may cause cardiovascular death and increase chances of mortality among DM2 patients. But not much studies have been done in this regard in our population. So we want to conduct this study to get the local evidence to get the extent of problem in local population and make it practice to screen diabetic patients for diastolic dysfunction on regular intervals. So that DM2 patients can be screened and diagnosed early and can be prevented or managed on time [13]

2. OBJECTIVE

To assess the frequency of diastolic dysfunction in normotensive type 2 diabetes mellitus patients presenting with preserved systolic function

3. MATERIALS AND METHODS

- **Study Design:** Cross-sectional study.
- **Setting:** Department of Cardiology, Mayo hospital, Lahore, Pakistan.
- **Study Duration:** Six months i.e. from 01-03-2018 to 31-08-2018.
- **Sample Size:** $n = 200$ cases was estimated by using 95% confidence level, 7% margin of error and anticipated percentage of diastolic dysfunction i.e. 48% in normotensive DM2 patients with preserved systolic function.
- **Sampling Technique:** Non-probability, consecutive sampling.

3.1 Sample Selection

Inclusion Criteria: Patients of age 40-75 years of either gender presenting as normotensive DM2 (as per operational definition) with preserved systolic function.

Exclusion Criteria: Patients with segmental wall motion defects, taking anti-hypertensive medicines, serum creatinine >1.8 mg/dl, who had previous angiography, PCI or CABG, valvular, congenital heart disease, and cardiomyopathy.

3.2 Data Collection Procedure

200 patients who fulfilled the selection criteria were enrolled in the study through medical OPD. Demographic details were also obtained. Then all patients underwent echocardiography to detect the presence of diastolic dysfunction. All echocardiography were performed by a single senior cardiologist. Reports were assessed and diastolic dysfunction was labelled.

Normotensive DM2: BSR>186mg/dl for >1year and patient taking anti-glycaemic medication and have normal blood pressure i.e. SBP: 110-130mmHg and DBP: 70-90mmHg with preserved systolic function i.e.EF>50% on echocardiography.

Diastolic Dysfunction: As assessed in mitral inflow on echocardiography:

Grade I (Impaired relaxation): If E/A<1 and DT>200ms

Grade II (Pseudonormal): If E/A=0.8-1.5 and DT=160-200ms

Grade III (Reversible restricted): If E/A>2.0 and DT<160ms

Grade IV (Fixed restricted): If E/A>2.0 and DT<160ms

Grade I= Mild; Grade II= Moderate; Grade III, IV= Severe

3.3 Data Analysis

All the data was analysed using SPSS version 21. Numerical variables like age, BMI and duration of DM2 were presented as mean \pm Standard Deviation. Categorical variables like sex and diastolic dysfunction were presented as frequency and percentage.

4. RESULTS

The mean age of patients was 56.62 ± 10.38 years. There were 131 (65.5%) males while 69 (34.5%) females. The mean BMI of patients was 28.43 ± 6.34 kg/m². The mean duration of DM2 was 10.55 ± 5.86 years (Table 1).

There were 94 (47%) patients who had diastolic dysfunction while 106 (53%) had normal diastolic function (Fig 1). Out of 94 patients with diastolic dysfunction, 67 (71.28%) had mild, 23 (24.47%) had moderate and 4 (4.25%) had severe diastolic dysfunction.

Data was stratified for age of patients. In patients aged 40-60 years, 49 (39.2%) had diastolic dysfunction. In patients aged 61-75 years, 45 (60%) had diastolic dysfunction.

The difference was significant (p-value<0.05). Data was stratified for gender of patients. In male patients, 66 (50.4%) had diastolic dysfunction. In female patients, 28 (40.6%) had diastolic dysfunction. The difference was insignificant (p-value>0.05). Data was stratified for BMI of patients. In normal weighted patients, 26 (34.7%) had diastolic dysfunction. In overweight patients, 21 (48.8%) had diastolic dysfunction. In obese patients, 22 (55%) had diastolic dysfunction. In morbidly obese patients, 25 (59.5%) had diastolic dysfunction. The difference was significant (p-value<0.05). Data was stratified for duration of DM2. In patients having DM2 from 1-10 years, 34 (34.3%) had diastolic dysfunction. In patients having DM2 from 11-20 years, 60 (59.4%) had diastolic dysfunction. The difference was significant (p-value<0.05) (Table 2).

5. DISCUSSION

The rate of DM2 is rising alarmingly all around the world and promptly assuming as epidemic proportion. During the last thirty years, several epidemiological, clinical and autopsies researches have been done which proposed the presence of diabetic cardiac disease as the separate clinical object. Diastolic cardiac failure is also known as the heart failure, with normal functioning of the left ventricular systolic function [14]

Several researches have showed that the rate of failure among diabetics is very high, even when the history of high blood pressure and coronary heart disease are negative. Literature have shown the high prevalence of diastolic dysfunction among diabetic [8,15]

The data indicated that the injury to the myocardium in patients with DM2, may lead to the significant diastolic dysfunction before the development of systolic dysfunction.[10]

Table 1. Demographics of patients

N	200
Age (years)	56.62±10.38
Male	131(65.50%)
Female	69(34.50%)
BMI (kg/m ²)	28.43±6.34
Duration (years)	10.55±5.86

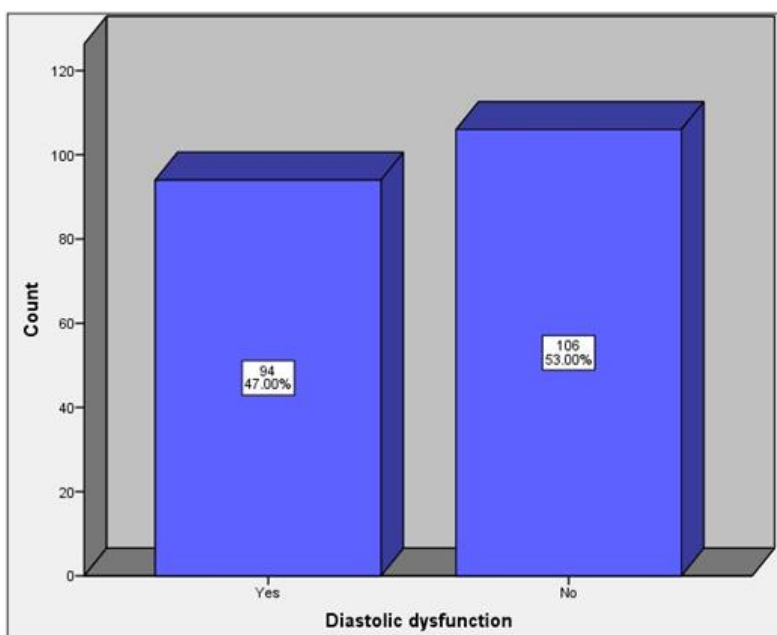


Fig.1. Distribution of diastolic dysfunction

Table 2. Comparison of diastolic dysfunction in stratified groups

		Diastolic dysfunction		Total n=200	P-value
		Yes (n=94)	No (n=106)		
Age	40-60years	49 (39.2%)	76(60.80%)	125	0.004
	61-75years	45 (60%)	30(40%)	75	
Gender	Male	66(50.4%)	65(49.6%)	131	0.187
	Female	28(40.6)	41(59.4%)	69	
BMI	Normal	26(34.7%)	49(65.3%)	75	0.040
	Overweight	21(48.8%)	22(51.2%)	43	
	Obese	22(55%)	18(45%)	40	
	Morbidly obese	25(59.5%)	17(40.5%)	42	
Duration	1-10years	34(34.3%)	65(65.7%)	99	0.000
	11-20years	60(59.4%)	41(40.6%)	101	

The occurrence of this left ventricular dysfunction among diabetics is still under process of research.[16] One study reported that the frequency of diastolic dysfunction was 48% among DM2 patients who were normotensive. Diastolic dysfunction is significantly associated with DM2, whether other risk factors are present or not that also cause diastolic dysfunction. [17] Patil et al., conducted a study and found that percentage of diastolic dysfunction was noted as 52% among diabetic patients who had normal blood pressure levels. This study revealed the higher frequency of diastolic dysfunction in asymptomatic diabetic patients; and these findings were associated with the duration of DM2, HbA1c level, obesity as well as diabetic micro-angiopathies. It had been concluded that the early detection and early initiation of treatment for diastolic dysfunction can help to reduce the complications as well as improve the sequel, and can also help to prevent the heart failure in future [4]

Soldatos et al., conducted a case control study on 55 diabetic patients and observed that the diastolic dysfunction was present in significant number of diabetic patients [18]

Van Heerebeek et al., conducted a study on 36 diabetic patients and reported that the cardiomyocyte resting tension has more important role when the fraction of left ventricular ejection is normal [19] Unnecessary left ventricular diastolic stiffness is a very significant factor that leads to heart failure in diabetic patients [20] DM2 is supposed to cause the rise in the stiffness via myocardial deposition of the collagens and progressive glycation end products.[21]

Masugata et al., conducted a case control study on 77 candidates of DM2 who were normotensive. It was observed that the diastolic dysfunction without left ventricular systolic dysfunction among patients who had well controlled glycaemic level did not have hypertension as well as no left ventricular hypertrophy, but age and duration of diabetes have mildly significant impact [22]

In our study, there were 94 (47%) patients out of 200 who had diastolic dysfunction while 106 (53%) had normal diastolic function. The mean age of patients was 56.62±10.38years. Data was stratified for age of patients. In patients aged 40-60years,

49 (39.2%) had diastolic dysfunction. In patients aged 61-75years, 45 (60%) had diastolic dysfunction. The difference was significant (p-value<0.05).

There were 131 (65.5%) males while 69 (34.5%) females. Data was stratified for gender of patients. In male patients, 66 (50.4%) had diastolic dysfunction. In female patients, 28 (40.6%) had diastolic dysfunction. The difference was insignificant (p - value>0.05). The mean BMI of patients was 28.43±6.34kg/m². Data was stratified for BMI of patients. In normal weighted patients, 26 (34.7%) had diastolic dysfunction. In overweight patients, 21 (48.8%) had diastolic dysfunction. In obese patients, 22 (55%) had diastolic dysfunction. In morbidly obese patients, 25 (59.5%) had diastolic dysfunction. The difference was calculated as significant (p-value<0.05).

The mean duration of DM2 was 10.55±5.86years. Data was stratified for duration of DM2. In patients having DM2 from 1-10years, 34 (34.3%) had diastolic dysfunction. In patients having DM2 from 11-20years, 60 (59.4%) had diastolic dysfunction. The difference was calculated as significant (p-value<0.05).

Mild diastolic dysfunction was the most common (71.28%) among diabetic patients who had diastolic dysfunction. Moderate (24.47%) and severe (4.25%) diastolic dysfunction were relatively less common.

6. CONCLUSION

The frequency of diastolic dysfunction was high (47%) even in the absence of hypertension with preserved systolic function. Now in future, we will recommend to screen diabetic patients for diastolic dysfunction on regular intervals. So that DM2 patients can be screened and diagnosed early and can be prevented or managed on time.

CONSENT

Informed consent was obtained from patients.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore

been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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