

## Echocardiographic study of left ventricular diastolic dysfunction in normotensive asymptomatic type II diabetes mellitus

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### **Abstract**

**Aim:** To study the diastolic function of heart in Type 2 diabetes mellitus (T2DM) patients who are normotensives asymptomatic and correlate it with duration of diabetes, diabetic retinopathy and glycosylated haemoglobin (HbA1c).

**Method:** Enrollment of normotensive (Blood pressure <130/80) asymptomatic diabetic patients reporting in our hospital to evaluate the Presence of diastolic dysfunction through 2 dimensional transthoracic echocardiography and study the clinical history related biochemical investigation.

**Result:** On echocardiographic evaluation of 100 patients, 68 cases (68%) had diastolic dysfunction of which 54 cases had impaired relaxation, 9 cases had pseudonormal pattern and 5 cases had restricted filling. Diastolic dysfunction was highest in patients age 50- 60 years (84.7 %) compared to 59.3 % and 49.4 % in the age group 40 – 49 years and 25 – 39 years respectively. In patients who had HbA1c >7.5, 75.34 % developed diastolic dysfunction which was statistically significant. In the study population 29 % had retinopathy of which 93.01 % developed diastolic dysfunction, also significant association of diastolic dysfunction was seen with duration of diabetes >5years.

**Conclusion:** The incidence of left ventricular diastolic dysfunction is higher in T2DM who are free of clinically detectable heart disease. The diastolic dysfunction found statistically significant with age, duration of diabetes, diabetic complications especially retinopathy and in those with HbA1c level >7.5.

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### **I. Introduction**

Subclinical abnormalities of left ventricular function are recognized in both Type 1 and Type 2 diabetes mellitus. Studies using Doppler echocardiography have confirmed the findings of abnormal diastolic function as an early indicator of cardiac involvement in asymptomatic patients with Type 1 or Type 2 diabetes mellitus.<sup>1</sup> In Diastolic dysfunction the ventricles become relatively "stiff" Stiff ventricles cannot fully relax during diastole; as a result, the ventricles may not fill completely and blood can "dam up" in the body's organs (mainly the lungs). When diastolic dysfunction is sufficient to produce pulmonary congestion, diastolic heart failure is said to be present.

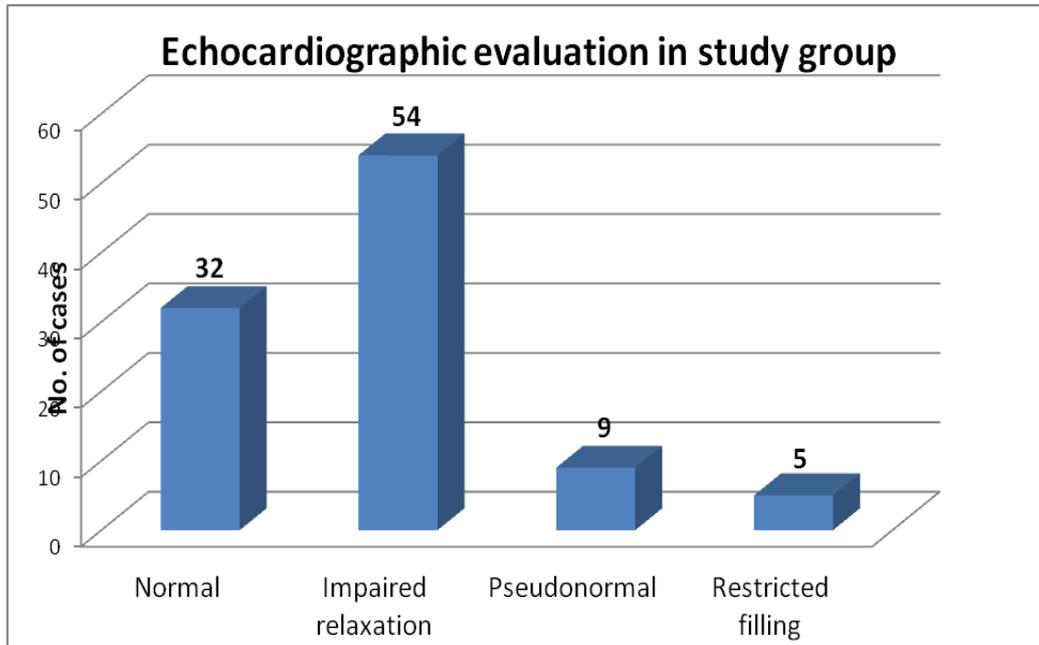
Diabetic subjects have been reported to develop congestive heart failure in the absence of coronary artery disease; hypertension or any known structural heart disease.<sup>2</sup> The term 'diabetic cardiomyopathy' has been introduced for this condition. It has been suggested that microangiopathic lesions of the myocardium, altered composition and fibrosis of myocardial interstitium and accumulation of lipids in myocardial cells are involved in pathogenesis of diabetic cardiomyopathy.<sup>3,4</sup> Thus, patients with diabetes are unusually prone to congestive heart failure. Several factors probably underlie diabetic cardiomyopathy: severe coronary atherosclerosis, prolonged hypertension, chronic hyperglycemia, microvascular disease, glycosylation of myocardial proteins, and autonomic neuropathy.<sup>5-6</sup> Improved glycemic control, better control of hypertension, and prevention of atherosclerosis with cholesterol-lowering therapy may prevent or mitigate diabetic cardiomyopathy. This diastolic dysfunction can be very easily and early detected by echocardiography.

### **II. Method**

This prospective single blind study done on 100 subjects was conducted in Jaya Arogya Hospital, Department of medicine, Gajra Raja Medical College, Gwalior over one year in June 2013- July 2014. Patients of age between 25-60 years with blood pressure <130/80 mm of Hg (at least 3 recordings with the highest recording taken into consideration) who diagnosed type 2 diabetes mellitus were included in the study. While the patients who had past history of acute coronary syndrome, Rheumatic heart diseases, Hypertension, documented overt renal disease like chronic renal failure and duration of diabetes over 10 years were excluded. All subjects underwent 2D transthoracic echocardiography for evaluation of left ventricular diastolic dysfunction. This diastolic dysfunction was detected by using variables such as ratio of E/A, IVRT (iso volumic relaxation time), DT (deceleration time), ratio of E/e' which are used for measuring diastolic functions of heart.

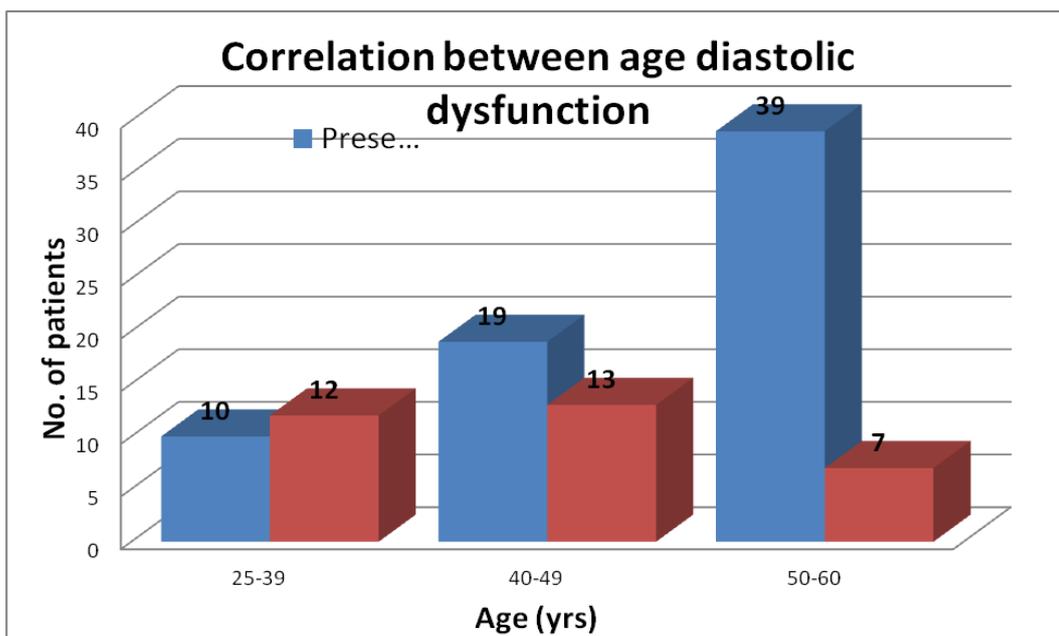
### III. Result

Out of the 100 normotensive asymptomatic diabetic cases, 68 cases (68%) had diastolic dysfunction of which 54 cases had impaired relaxation, 9 cases had pseudonormal and 5 cases had restricted filling shown in graph 1.



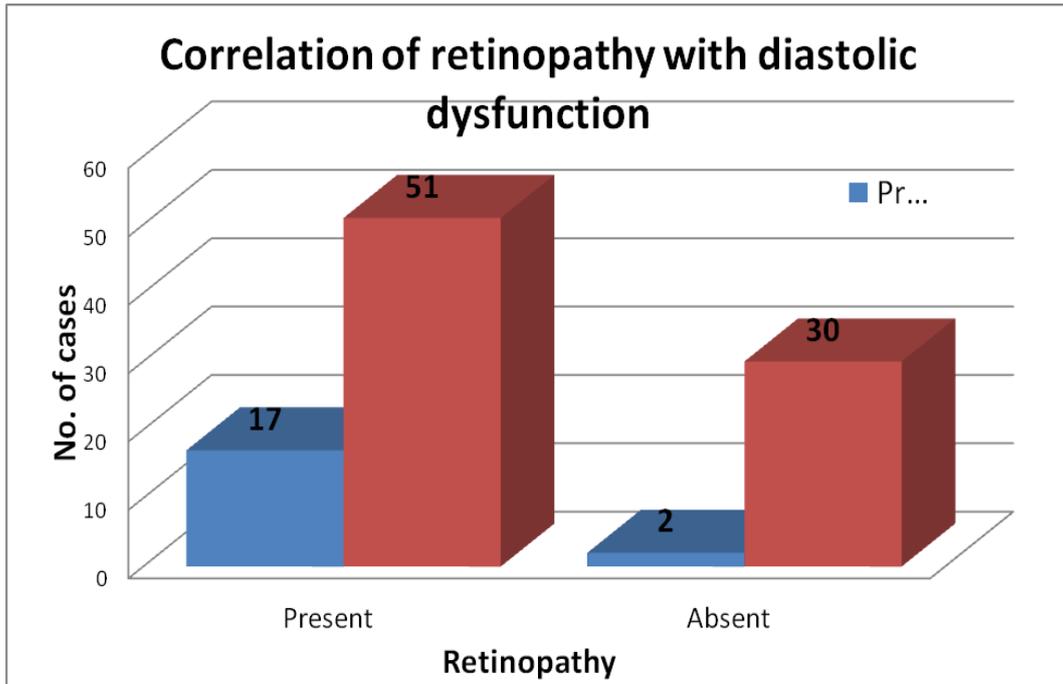
Graph 1: Echocardiographic evaluation in study group

22% of cases are in age group 25-39 and 32% cases are in the age group 40-49 and 46% of the cases are in the age group 50-60. The incidence of diastolic dysfunction is highest in the age group 50-60 years (Graph 2). This finding was statistically significant ( $\chi^2 = 12.18$  p value= 0.002).



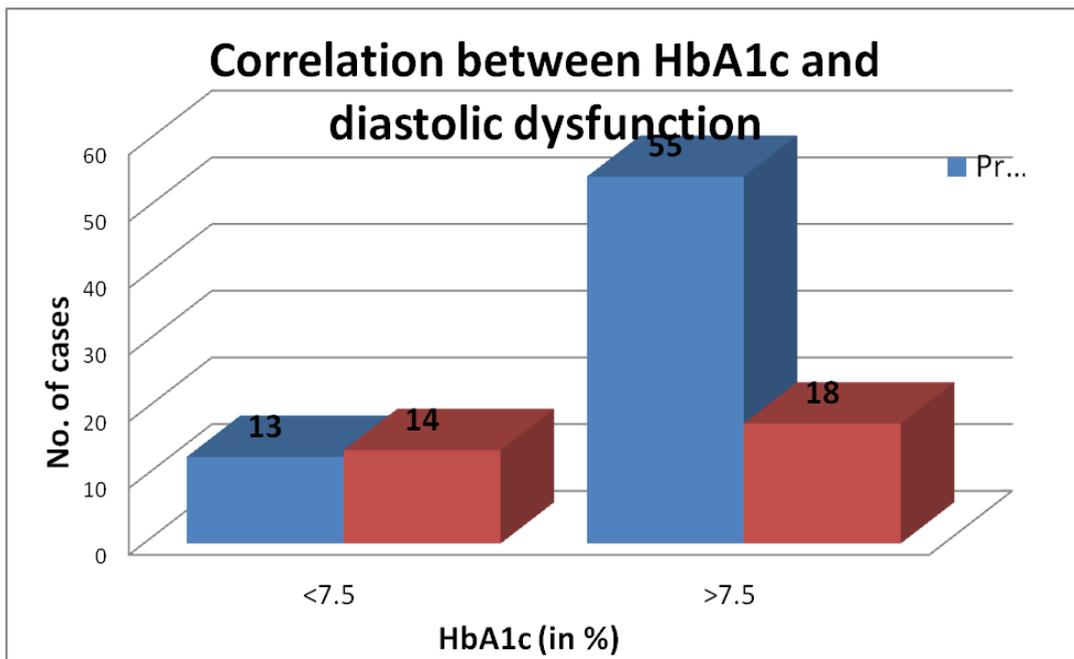
Graph 2: Correlation between Age and Diastolic dysfunction

In the study population 29% of the patient had retinopathy of which 27 patients (93.01%) had diastolic dysfunction and out of 71% of the patients who does not have retinopathy 41 patients (57.77%) found to have diastolic dysfunction (Graph 3). The data is statistically significant ( $\chi^2 = 11.8$  p value 0.0005).



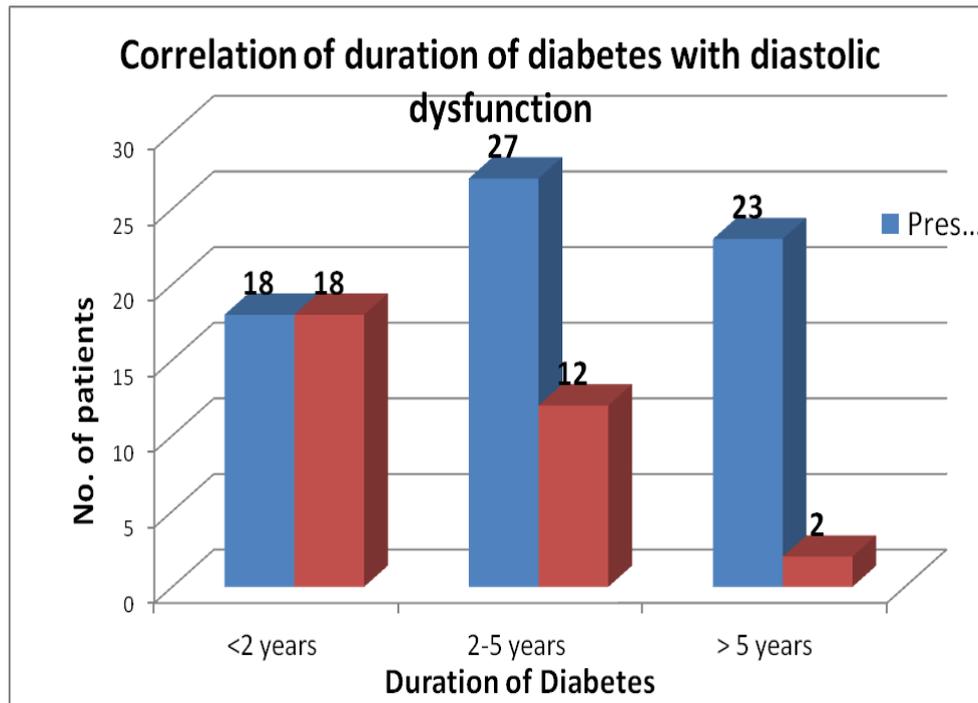
Graph 3: Correlation of retinopathy with diastolic dysfunction

The below mentioned graph shows that in the study population 73% of the patient had HbA1c levels greater than 7.5 of which 75.34 % of the cases developed diastolic dysfunction rest 27 % of the cases have their HbA1c <7.5 % of which 48.14 % developed diastolic dysfunction (Graph 4).The findings were statistically significant ( $\chi^2= 6.69$  p value 0.009).



Graph 4: Correlation between HbA1c and diastolic dysfunction

Among study population 36% had diabetic duration < 2 years, 39% had a diabetic duration of 2-5 years and 25% had a diabetic duration > 5 years (Graph 5).Maximum prevalence of diastolic dysfunction seen in patients who had duration of diabetes more than 5 years. It was found to be statistically significant ( $\chi^2= 12.005$  p value 0.0024).



Graph 5: Correlation of duration of diabetes with diastolic dysfunction

#### IV. Discussion

In present study 68 cases (68%) had diastolic dysfunction. In other studies **Paul poinier et al**<sup>7</sup> (2001) concluded that left ventricular diastolic dysfunction was found in 60% of whom 28% had a pseudonormal pattern of ventricular filling and 32% had impaired relaxation, while **S. Cosson et al**<sup>8</sup> (2003) found diastolic dysfunction was present in 69 % of the patients, study by **Gani**<sup>9</sup> (2005) reported diastolic dysfunction in 65.8% diabetic compared to 33.3 % in the control and **Rajput**<sup>10</sup> (2002) has reported an incidence of diastolic dysfunction in >60 % of the patients. In our study a total of 100 patients of T2DM were included with an age range of 25 to 60 years, 22% of cases are in age group 25-39 and 32% cases are in the age group 40-49 and 46% of the cases are in the age group 50-60. The incidence of diastolic dysfunction was highest in the age group 50-60 years. This finding was statistically significant (p value 0.002). Similar results were found in, **Patil et al**<sup>104</sup> (2011) who concluded that diastolic dysfunction was significantly higher in age >45 years compared to age <45 years (p value < .05), also **Gani et al** (2005)<sup>9</sup> concluded that the age of patients had significant correlation with E/A ratio of transmitral Doppler flow (p<0.01) i.e. patients with higher age group have more diastolic dysfunction.

In the present study 36% of the population had diabetic duration < 2 years, 39% had a diabetic duration of 2-5 years and 25% had a diabetic duration > 5 years. The same concluded by **Gani et al**<sup>9</sup> (2005), in their study in 114 NIDDM patients found that the duration of diabetes was independently associated with diastolic dysfunction. The duration of diabetes had significant correlation with EF (r = -0.26, p<0.01) and with E/A ratio (r= -0.295, p<0.01), also **Virendra c Patil**<sup>11</sup> (2011) in their study, found that out of 78 (61.41%) subjects with duration of diabetes between 6-10 years, 32 (41.02%) had diastolic dysfunction. Out of 49 (38.58%) subjects with duration of diabetes between 11-15 years, 37 (75.51%) had diastolic dysfunction.

In the study population 29% of the patient had retinopathy of which 27 patients (93.01%) shown diastolic dysfunction and out of 71% of the patients who does not have retinopathy 41 patients (57.77%) found to have diastolic dysfunction. The data is statistically significant (p 0.0005). **S.Cosson**<sup>8</sup> (2003) Diabetic Retinopathy Studies performed in diabetic patients free of coronary artery disease, have demonstrated that patients with mild to severe retinopathy exhibited left ventricle diastolic dysfunction (lower E/A values) compared to age-matched controls or patients without retinopathy. In the study population 73% of the patient had HbA1c levels greater than 7.5 of which 75.34 % of the cases developed diastolic dysfunction, the findings were statistically significant (p 0.009), in study of **Virendra C. Patil et al**<sup>11</sup> (2011) showed that subjects with HbA1c > 7.5% had diastolic dysfunction. Subjects with HbA1c > 7.5% had more prevalence of diastolic dysfunction, than subjects with HbA1c < 7.5% (P value < 0.02), also **Madhumathi R**<sup>12</sup> in 2014 found that prevalence of diastolic dysfunction increased gradually with the rise in HbA1c levels and it was statistically significant.

## V. Conclusion

The incidence of left ventricular diastolic dysfunction is higher in type II diabetes mellitus patients who are asymptomatic and non hypertensive. In the present series the incidence was more in patients with diabetic complications especially retinopathy, also in those with HbA1c level >7.5 and these findings were found statistically significant. It was also found that the incidence of diastolic dysfunction had a strong correlation with the age of the patient and duration of diabetes. The diastolic dysfunction is the earliest manifestation of diabetic cardiomyopathy and hence, detecting and treating it in early stages would prevent disease progression to symptomatic cardiac failure.

All the diabetic patients should undergo 2D Echocardiographic evaluation for identifying diastolic dysfunction. Patients should be advised strict control of diabetes in order to reduce the risk for developing diastolic dysfunction.

## Bibliography

- [1]. David SH Bell. Diabetes Care 2003 Oct; 26(10):2949-2951, 2791.
- [2]. Kannel WB, Hjortland M, Castelli WP. Role of diabetes in congestive heart failure. The Framingham Study. American Journal of Cardiology 1974; 34:29-34.
- [3]. Ramachandran A. High prevalence of diabetes in urban population in South India. BMJ 1988; 297:587-590.
- [4]. Ramachandran A. Prevalence of glucose intolerance in Asian Indians, urbanrural difference and significance of upper body adiposity. Diabetes Care; 1992.
- [5]. Regan TJ, Weisse AB. Diabetic cardiomyopathy. J Am Coll Cardiol, 1992, 19, 1165-6.
- [6]. Shehadeh A, Regan TJ. Cardiac consequences of diabetes mellitus. Clin Cardio, 1995, 18, 301-5.
- [7]. Poirier Paul, Peter Bogaty, Carline Garneall. Diastolic dysfunction in normotensive men with well controlled type 2 diabetes mellitus. Diabetes Care 2001; 24(1):5-10.
- [8]. Cosson S, Kevorkian JP. Left ventricular diastolic dysfunction; An early sign of diabetic cardiomyopathy. Diabetes Metab 2003; 29:455-466.
- [9]. Gani Bajraktari. Non-insulin dependent diabetes as an independent predictor of asymptomatic left ventricular diastolic dysfunction. Croat Med J 2005;46(5):225-231.
- [10]. Rajesh Rajput, Jagdish, Siwach SB, Rattan A. Echocardiographic and Doppler assessment of cardiac functions in patients of non-insulin dependent diabetes mellitus. JIACM 2002; 3(2):164-168.
- [11]. Patil VC, Patil HV, Shetty P. Diastolic dysfunction in asymptomatic type 2 diabetes mellitus with normal systolic function. J Cardiovasc Dis Res. 2011 Oct-Dec; 2(4): 213-222.
- [12]. Madhumathi R, Prakash Kikkeri Gowdaiah, Amogh Dudhwewala, Chaithra A. N, Tejaswini Dande, "Echocardiographic Evaluation of Diastolic Dysfunction in Asymptomatic Type 2 Diabetes Mellitus patients". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 01, January 06; Page: 200-209.