



Pre-Clinical Diastolic Dysfunction in Diabetes Mellitus

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Abstract

Background: *Studies have reported a high prevalence of pre-clinical diastolic dysfunction among patients with DM. Diabetic patients are often complicated by subsequent development of heart failure, maybe primary or secondary to hypertension / CAD. Abnormalities of both systolic and diastolic performance in diabetic subjects have been demonstrated in various human studies. However, diastolic dysfunction precedes systolic dysfunction. Studies in the West have demonstrated a direct correlation between duration of diabetes and diastolic dysfunction. Hence we attempted to identify the correlation between duration of diabetes mellitus and subsequent LV diastolic dysfunction (E/e' ratio) by conventional and tissue doppler imaging in our local population.*

Methods: *We retrospectively identified all diabetic patients with a Doppler mitral valve imaging (both transmitral and tissue doppler) assessment of diastolic dysfunction at Sri Ramachandra Medical College, Chennai from January – May 2015. Overall, 112 diabetic patients were identified and subjected to a tissue Doppler echocardiographic assessment of diastolic dysfunction after obtaining informed consent. Diastolic dysfunction was defined as Ratio of a passive transmitral left ventricular (LV) inflow velocity to tissue Doppler imaging velocity of the medial mitral annulus during passive filling (E/e') ratio >15. Patients with coronary disease, hypertension, high body mass index, heart failure, mitral valve or aortic valve regurgitation or stenosis were excluded.*

Results: *Of the 112 patients identified, no patient withdrew his/her consent. 69 male patients and 43 female patients were identified with a mean age of 55 years. Of these 51 patients had an average duration of diabetes for more than 4 years. 42 (38.4%) patients among this group had diastolic dysfunction (i.e.) E/e' ratio of > 15. Patients with diabetes of less than 4 years' duration had either normal or intermediate level of diastolic dysfunction. Using Chi-square test, we determined that there is a significant association between duration of diabetes and development of diastolic dysfunction (E/e') ($\chi^2 = 107.974$, $Df = 4$, $0.000 < 0.05$ significant) in the patients with diabetes for more than 4 years.*

Conclusion: *Our current study demonstrates that pre-clinical diastolic dysfunction is high in DM patients and there is a direct correlation between duration of DM and diastolic dysfunction. Significant diastolic dysfunction occurs 4 years after the onset of DM independent of coronary disease or hypertension. Such patients must be advised regarding strict glycaemic control and followed up for development of frank diastolic dysfunction.*

Aims and Objectives

To determine whether there is correlation between duration of diabetes and pre-clinical diastolic dysfunction in Diabetes Mellitus (DM) patients.

Background

Studies have reported a high prevalence of pre-clinical diastolic dysfunction among patients with DM. Diabetic patients are often complicated by

subsequent development of heart failure, maybe primary or secondary to hypertension / CAD. Abnormalities of both systolic and diastolic performance in diabetic subjects have been demonstrated in various human studies. However, diastolic dysfunction precedes systolic dysfunction. Studies in the West have demonstrated a direct correlation between duration of diabetes and diastolic dysfunction. Hence we attempted to identify the correlation between duration of diabetes mellitus and subsequent LV diastolic dysfunction (E/e' ratio) by conventional and tissue doppler imaging in our local population.

Methods

We retrospectively identified all diabetic patients with a Doppler mitral valve imaging (both transmitral and tissue doppler) assessment of diastolic dysfunction at Sri Ramachandra Medical College, Chennai from January – May 2015.

Overall, 112 diabetic patients were identified and subjected to a tissue Doppler echocardiographic assessment of diastolic dysfunction after obtaining informed consent.

Diastolic dysfunction was defined as Ratio of a passive transmitral left ventricular (LV) inflow velocity to tissue Doppler imaging velocity of the medial mitral annulus during passive filling (E/e') ratio >15.

Exclusion criteria

- Patients with
- Coronary disease
- Hypertension
- High body mass index,
- Heart failure,
- Mitral valve or aortic valve regurgitation or stenosis

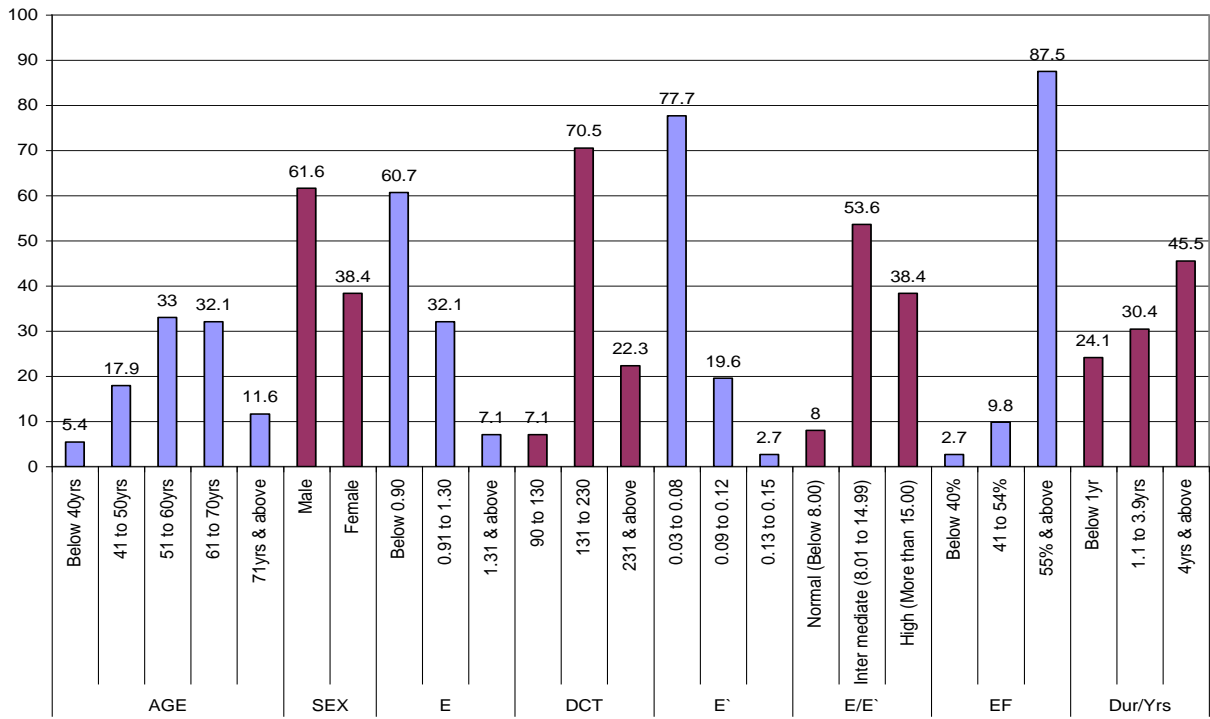
Patient Demographics

Personal profile	No.of respondents (n=112)	Percentage (100%)
AGE		

Below 40yrs	6	5.4
41 to 50yrs	20	17.9
51 to 60yrs	37	33.0
61 to 70yrs	36	32.1
71yrs & above	13	11.6
SEX		
Male	69	61.6
Female	43	38.4
E		
Below 0.90	68	60.7
0.91 to 1.30	36	32.1
1.31 & above	8	7.1
DCT		
90 to 130	8	7.1
131 to 230	79	70.5
231 & above	25	22.3

Personal profile	No.of respondents (n=112)	Percentage (100%)
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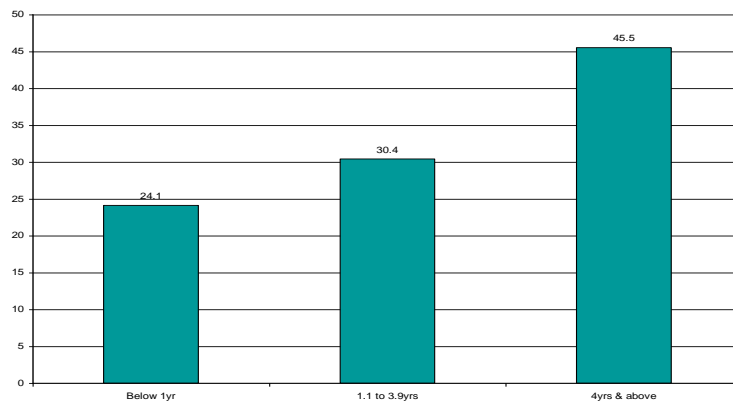
E'		
0.03 to 0.08	87	77.7
0.09 to 0.12	22	19.6
0.13 to 0.15	3	2.7
E/E'		
Normal (Below 8.00)	9	8.0
Inter mediate (8.01 to 14.99)	60	53.6
High (More than 15.00)	43	38.4
EF		
Below 40%	3	2.7
41 to 54%	11	9.8
55% & above	98	87.5
Dur/Yrs		
Below 1yr	27	24.1
1.1 to 3.9yrs	34	30.4
4yrs & above	51	45.5



DCT -Deceleration time, EF – Ejection Fraction

Item	N	Min	Max	Median	S.D	Mean
AGE	112	35	83	59.50	10.849	58.88
E	112	.48	1.51	.8450	.22995	.8929
DCT	112	90.00	325.00	191.0000	53.70537	196.5625
E`	112	.03	.15	.0700	.02278	.0698
E/E`	112	6.80	38.20	12.6350	5.01134	13.6871
EF	112	27	90	69.00	11.487	67.06
Duration (in.yrs)	112	.3	15.0	3.000	2.9514	3.893

Duration



51 patients (45.5%) had diabetes for 4 years and above.

AGE	Dur/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
Below 40yrs	4	1	1	6	X ² =21.497 Df=8 .006<0.05 Significant
41 to 50yrs	7	7	6	20	
51 to 60yrs	12	11	14	37	
61 to 70yrs	4	13	19	36	
71yrs & above	0	2	11	13	

SEX	Dur/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
Male	22	23	24	69	X ² =9.597 Df=2 .008<0.05 Significant
Female	5	11	27	43	

E	Dur/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
Below 0.90	22	25	21	68	X ² =19.430 Df=4 .001<0.05 Significant
0.91 to 1.30	5	9	22	36	
1.31 & above	0	0	8	8	

There is statistically significant association between E value and duration of diabetes.

DCT	Dur/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
90 to 130	1	4	3	8	X ² =6.529 Df=4 .163>0.05 Not Significant
131 to 230	23	19	37	79	
231 & above	3	11	11	25	

There is no statistically significant association between DCT and duration of diabetes.

E/E` * Duration/Yrs -Association

E/E`	Dur/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
Normal (Below 8.00)	9	0	0	9	X ² =107.974 Df=4 .000<0.05 Significant
Inter mediate (8.01 to 14.99)	18	34	8	60	
High (More than 15.00)	0	0	43	43	

Out of 51 patients who had diabetes for 4 years and above, 43 patients had a E/e' ratio of > 15.

Using Chisquare test, we determined that there is a significant association between duration of diabetes and development of diastolic dysfunction (E/e')

EF * Duration/Yrs - Association

EF	Duration/Yrs				Statistical inference
	Below 1yr (n=27)	1.1 to 3.9yrs (n=34)	4yrs & above (n=51)	Total (n=112)	
Below 40%	0	0	3	3	X ² =4.266 Df=4 371>0.05 Not Significant
41 to 54%	2	3	6	11	
55% & above	25	31	42	98	

There is no statistically significant association between EF and duration of diabetes

Difference (E/E' vs Duration) Oneway ANOVA

E/E'	Mean	S.D	SS	Df	MS	Statistical inference
Between Groups			1693.579	2	846.790	
<i>Below 1yr (n=27)</i>	8.7870	1.36953				
<i>1.1 to 3.9yrs (n=34)</i>	11.3950	1.44482				
<i>4yrs & above (n=51)</i>	17.8094	4.41898				
Within Groups			1094.024	109	10.037	

As the duration of diabetes increases, E/e' ratio (subclinical diastolic dysfunction) also increases. This increase is statistically significant.

Results

Of the 112 patients identified, no patient withdrew his/her consent. 69 male patients and 43 female patients were identified with a mean age of 55 years.

Of these 51 patients had an average duration of diabetes for more than 4 years.42 (38.4%) patients among this group had diastolic dysfunction (i.e.) E/e' ratio of > 15.

Patients with diabetes of less than 4 years' duration had either normal or intermediate level of diastolic dysfunction.

Using Chi-square test, we determined that there is a significant association between duration of diabetes and development of diastolic dysfunction (E/e') (x2 = 107.974, Df = 4, 0.000<0.05 significant) in the patients with diabetes for more than 4 years.

Discussion

Cardiac dysfunction is one of the common complication of uncontrolled diabetes mellitus.

The high prevalence of diastolic dysfunction is due to myocardial fibrosis, and in the Strong Heart Study, the extent and frequency of diastolic dysfunction was directly proportional to the HbA_{1c} level¹. Since diastolic dysfunction is silent in the early stages its is prudent to diagnose it early by echocardiography. Doppler pattern of impaired LV relaxation, characterized by reduced early and increased late diastolic flow, is an early sign of diastolic dysfunction ⁴. According to strong heart study, there is increased CV risk in individuals with abnormal glucose regulation⁶.

Hence our study correlated the duration of diabetes and glycemic control and early echo cardiac marker of early diastolic dysfunction . this data helps to identify the high risk group individuals and aggressive management of

diabetes can halt the progression of frank diabetic cardiomyopathy

Conclusion

Our current study demonstrates that pre-clinical diastolic dysfunction is high in DM patients and there is a direct correlation between duration of DM and diastolic dysfunction.

Significant diastolic dysfunction occurs 4 years after the onset of DM independent of coronary disease or hypertension.

Such patients must be advised regarding strict glycaemic control and followed up for development of frank diastolic dysfunction.

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