ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

Incidence and Quantification of Left Venticular Diastolic Dysfunction In Relation To Hba1c Levels in Newly Diagnosed Type 2 Diabetics

Dr Baljit Kaur Seehra1, Dr Kapil Yadav2, Dr Kutubuddin1

1MBBS, DNB, Assistant professor, IIMSR, Integral University, Lucknow, India
2MBBS, DNB, Registrar, MICU, Narayana Multispeciality Hospital Jaipur, India

(Corresponding) Dr Baljit Kaur Seehra,

Abstract:
Background: Hyperglycaemia in poorly controlled diabetes leads to production of advanced glycation end products and free radicals. Both can cause elevated collagen deposition in myocardium leading to myocardial fibrosis and thus effecting contractility and relaxation of heart. Hence a poor glycemic control can be associated with high chances of having left ventricular hypertrophy and left ventricular diastolic dysfunction (LVDD). So far, very few population-based studies have been carried out in India, to demonstrate the prevalence of diastolic dysfunction in diabetic subjects in the Indian patients. Thus, this cross-sectional study will be conducted with the aim of determining the incidence of asymptomatic LV diastolic dysfunction and its quantification on the basis of echocardiographic findings in newly diagnosed cases of type 2 DM subjects and its relation to HbA1c levels.
Material and methods: A hospital based single centre prospective observational cross sectional study done on 84 newly diagnosed asymptomatic type 2 diabetic patients; attending in-patient or out-patient department in General Medicine, Government Multispecialty Hospital, sector16, Chandigarh during a period of six months. All newly diagnosed Type 2 diabetes mellitus patients, who clinically have no cardiovascular symptoms and blood pressure of < 130/80 mmHg, with normal ECG were included in the study. Reduction in E velocity increase over A velocity with E/A ratio of <0.8 and increase in left atrial (LA) size with preserved ejection fraction (EF) are considered as the evidence of left ventricular diastolic dysfunction. Statistical analysis was done using SPSS version 24.0.
Results: In the present study, Mean±SD echocardiography parameters of patients without LVDD are summarized as follows: LA volume (ml) 35.05±5.945, E wave (m/s) 0.6376±0.08919, A wave (m/s) 0.6529±0.1494, E/A ratio 1.011±0.2061, E'm (m/s) 0.06933±0.009860, E'l (m/s) 0.09914±0.01681, E'avg (m/s) 0.08423±0.01200, E/E'avg 7.697±1.380, $A_1(cm^2)$ 14.14±1.449, $A_2(cm^2)$13.08±1.542, L (cm) 4.514±0.3995, BSA (m^2) 1.801±0.2018, LAVI(ml/m^2) 19.52±3.035& TR velocity(m/s) 0.7000±0.8252 and Mean ±SD echocardiography parameters of patients with LVDD are LA volume (ml) 43.07±12.61, E wave (m/s) 0.8610±0.2291, A wave (m/s) 0.8100±0.1215, E/A ratio 1.087±0.3523, E'm (m/s) 0.07631±0.01608, E'l (m/s)0.09346±0.02111, E'avg (m/s)0.08489±0.01765, E/E'avg 10.77±4.088, $A_1(cm^2)$ 16.82±2.587, $A_2(cm^2)$ 13.55±2.352, L (cm) 4.574±0.3799, BSA (m^2) 1.770±0.1898, LAVI(ml/m^2) 24.34±6.562& TR velocity (m/s) 1.793±1.066.
Conclusion: Our Study demonstrated a very significant positive correlation between level of glycosylated hemoglobin (HbA1c) and LVDD in the newly diagnosed cases of type 2 diabetes mellitus. It is suggested that all patients of diabetes should be routinely and repeatedly subjected to 2-D color Doppler echocardiographic assessment of cardiac functions in the long-term management of this metabolic disease. This has important therapeutic implications and helps physicians planning early intervention strategies. Thus, diastolic dysfunction can be used as an early indicator, as it is a precursor to increased LV hypertrophy and clinical.

Keywords: Diabetes mellites type 2, LVDD, ECHO, HbA1c etc

Introduction:

Diabetes mellitus is a major health problem, affecting millions of people all over the world affecting developing and developed regions equally. Overall, diabetes and complications caused by it have become a challenging health issue to tackle with.[1]

Worldwide, there are approximately 194 million adult cases of type 2 diabetes and this number is expected to increase to 333 million by 2025. There are approximately 33 million diabetics in India presently and this number is expected to reach 79.4 million in 2030.[2] Based on current trends, the IDF projects that 642 million individuals will have diabetes by year 2040.[3] The Indian Council of Medical Research-Indian Diabetes Study (ICMR-INDIAB), a national DM study, estimates that currently India has 62.4 million people with DM.[4] The majority (>90%) of them have Type 2 DM (T2DM).

Diabetes and cardiovascular diseases are rapidly gaining pandemic proportions in South East Asian subcontinent, and India is leading the race of numbers. One of the important factors contributing to increased prevalence of type 2 diabetes in Asian Indians is the fact that they have a greater degree of insulin resistance compared to Caucasians.[5,6] The

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

Framingham study pointed out a previously unknown factor in diabetic patients that causes much higher incidence of cardiovascular complications.[7] Diabetic individuals have higher serum concentrations of lipids and more hypertension, obesity, and thus the pathogenesis of advanced atherosclerosis. Type-2 diabetics are also prone to silent myocardial ischemia even before the development of overt coronary artery disease.[8] This is a reflection of accelerated coronary atherosclerosis, though autonomic neuropathy has also been implicated in its causation.[9]

Cardiovascular diseases like congestive heart failure, coronary artery disease, myocardial infarction which are commonly associated with diabetes are the leading cause of mortality in diabetic patients.[10,11] Diabetes, itself can lead to the development of heart failure (HFnEF) referred to as diabetic cardiomyopathy.[12]

Diabetes is usually irreversible and, although patients can have a reasonably normal lifestyle, its late complications result in reduced life expectancy and major health costs. These include macro vascular disease, leading to an increased prevalence of coronary artery disease, peripheral vascular disease and stroke, and micro vascular damage causing diabetic retinopathy and nephropathy.[13] The American Heart Association has designated DM as a "CHD risk equivalent," and type 2 DM patients without a prior MI have a similar risk for coronary artery–related events as non- diabetic individuals who have had a prior MI. The absence of chest pain ("silent ischemia") is common in individuals with diabetes, and a thorough cardiac evaluation should be considered prior to major surgical procedures. The increase in cardiovascular morbidity and mortality rates in diabetes appears to relate to the synergism of hyperglycemia with other cardiovascular risk factors. In the UKPDS , the number of cardiovascular events in patients with type 2diabetes were not different between the standard and intensively treated groups during the trial but were reduced at follow-up 17 years later (legacy effect) or (metabolic memory).[13]

A number of studies have reported a high prevalence of pre-clinical diastolic dysfunction among subjects with DM.[14] Diabetes mellitus is one of the major risk factors for diastolic heart failure (DHF). The mortality rates among the patients with DHF ranges from 5-8% annually as compared with 10-15% among patients with systolic heart failure.[15] The evidence suggests that myocardial damage in diabetic patients affects diastolic function before the systolic function. The pathogenesis of this left ventricular (LV) dysfunction in diabetic patients is not clearly understood. It has been proposed that diabetic cardiomyopathy is an independent cardiovascular disease and many underlying mechanisms, such as microvascular disease, autonomic dysfunction, metabolic disorders, and interstitial fibrosis, have been suggested as aetiological factors.[16] Left ventricular diastolic dysfunction (LVDD) represents the first stage of diabetic cardiomyopathy preceding changes in systolic function, reinforcing the importance of early evaluation of ventricular function in individuals with diabetes.[17,18] The diastolic abnormalities are present in diabetic patients in absence of diabetic complications of cardiovascular system.[19-21]

Hyperglycaemia in poorly controlled diabetes leads to production of advanced glycation end products and free radicals. Both can cause elevated collagen deposition in myocardium leading to myocardial fibrosis and thus effecting contractility and relaxation of heart.[22] Hence a poor glycemic control can be associated with high chances of having left ventricular hypertrophy and left ventricular diastolic dysfunction (LVDD). So far, very few population-based studies have been carried out in India, to demonstrate the prevalence of diastolic dysfunction in diabetic subjects in the Indian patients. Thus, this cross-sectional study will be conducted with the aim of determining the incidence of asymptomatic LV diastolic dysfunction and its quantification on the basis of echocardiographic findings in newly diagnosed cases of type 2 DM subjects and its relation to HbA1c levels.

Material & Methods:

A hospital based single centre prospective observational cross sectional study done on 84 newly diagnosed asymptomatic type 2 diabetic patients; attending in-patient or out-patient department in General Medicine, Government Multispecialty Hospital, sector16, Chandigarh during a period of six months from 19-04-2019 to 19-10-2019 based on following inclusion and exclusion criteria:

Inclusion criteria:

All newly diagnosed Type 2 diabetes mellitus patients, who clinically have no cardiovascular symptoms and blood pressure of < 130/80 mmHg, with normal ECG.

Exclusion criteria:

- Known diabetic patients on insulin and OHA
- Ischemic heart disease
- Hypertensive heart disease
- Congestive heart failure,
- Valvular heart disease
- Cardiomyopathy

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

- Connective tissue diseases
- Renal failure
- Thyroid dysfunction
- Severe anaemia.

Methods:

A blood sample was taken in EDTA vial and HbA1c will be processed on fully automated biochemistry analyser.
Lab parameter quality assurance work:

A. Internal: Quality assurance of haematological parameters by quality control.
B. External: external quality assurance is through EQAS programme by CMC vellore.

Echocardiography

All the subjects underwent resting transthoracic 2-dimensional echocardiography and Doppler imaging, to assess left ventricular diastolic function. Echocardiographer was not aware of this study to avoid bias in the interpretation. A transthoracic 2-dimentionsional echocardiogram (TTE) with pulsed Doppler evaluation of transmitral inflow and Tissue Doppler Imaging (TDI) and 2D echocardiography was performed to minimize the errors in assessing the diastolic dysfunction. Echocardiography was performed by harmonic imaging mode by Acuson-Siemens-X 300 echocardiography machine (5-1 MHz multi-frequency probe) according to the standard protocol. Pulsed-wave Doppler (PWD)-derived transmitral inflow velocities was obtained in the apical 4-chamber view, with the sample volume placed at the mitral valve leaflet tips.[23]

Measurements included the transmitral early diastolic rapid filling (E-wave) and atrial contraction late filling (A-wave) velocities to calculate E/A ratio, E'm and E'l , Left atrial volume (LAV) and Left atrial volume index (LAVI). For tissue Doppler imaging, the negative deflection of mitral annulus velocity was obtained with a 2 mm sample volume placed at the lateral side and septal side of the mitral annulus(E'm and E'l) and average (E'avg) was calculated according to Nagueh formula. Diastolic dysfunction was labelled according to the standard guidelines. Left ventricular overall ejection fraction (systolic function) was calculated by modified Simpson's method; and, LVEF ≥ 50% was considered as normal.[23,24] All echocardiographic measurements were averaged over three consecutive cardiac cycles, measured by a single investigator blinded to all other variables.

Reduction in E velocity increase over A velocity with E/A ratio of <0.8 and increase in left atrial (LA) size with preserved ejection fraction (EF) are considered as the evidence of left ventricular diastolic dysfunction.

LV relaxation, filling pressures and 2D and Doppler findings according to LV diastolic function

	Normal	Grade I	Grade II	Grade III
LV relaxation	Normal	Impaired	Impaired	Impaired
LAP	Normal	Low or Normal	Elevated	Elevated
Mitral E/A ratio	≥0.8	≤0.8	0.9-1.9	>2
Average E/e' ratio	<10	<10	10-14	>14
Peak TR velocity (m/sec)	<2.8	<2.8	>2.8	>2.8
LA volume index	Normal	Normal or Increased	Increased	Increased

Assessment of LA size

LA is not a symmetrically shaped three-dimensional (3D) structure. Furthermore, LA enlargement may not occur in a uniform fashion. Therefore anteroposterior measurement of LA by M-mode echocardiography is likely to be an insensitive assessment of any change in LA size. In contrast, LA volume by two-dimensional (2D) or 3D echocardiography provides a more accurate and reproducible estimate of LA size as compared to magnetic resonance imaging (MRI) and cine-computerised tomography (CT). The LA size is measured at the ventricular end-systole when the LA chamber is at its greatest dimension. It is imperative to avoid foreshortening of the LA for computing LA volume. The confluence of the pulmonary veins and LA appendage should be excluded, when performing planimetry. For assessment of left atrial 'reservoir', 'conduit' and 'contractile' function, LA volumes should be measured at specified phases of the cardiac cycle. They are a) end-systolic frame just before mitral valve opening ; b) end-diastolic frame just before mitral valve closure; c) last frame just before mitral valve reopening i.e. pre-atrial contraction. Echocardiographic assessment of LA volume is done by Biplane area –length method.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

LA Volume & LA Volume Index (Biplane Area-Length Method)[25]

When left atrial (LA) size is measured clinically, LA volume determinations are preferred over linear measurements since they allow more accurate assessment of the asymmetric remodeling of the LA chamber. Moreover, the strength of the relationship between cardiovascular diseases is stronger for LA volume than for LA linear dimensions.

LA size should be measured at the end-ventricular systole (maximum LA size). Foreshortening should be avoided. When planimetry is performed, LA confluences of the pulmonary veins and the LA appendage should be excluded. The length, L, remains the LA long-axis length determined as the distance of the perpendicular line measured from the middle of the plane of the mitral annulus to the superior aspect of the LA. In the area-length formula the length is measured in both the 4-chamber (A_1) and 2-chamber (A_2)views and the shortest of these 2 length measurements is used in the formula.

Although there are gender differences in LA size, these are completely accounted for once indexed to body size, such as body surface area (BSA).

$$\text{LA Volume} = \frac{8}{3\pi} * \frac{A_1 * A_2}{L} = (0.85) * \frac{A_1 * A_2}{L}$$

$$\text{LAVI} = \frac{\text{LA Volume}}{\text{BSA}}$$

Reference Ranges & Partition Values for LA Volume Index (mL/m2)

	LAVI (mL/m^2)
Reference Range	16-28
Mildly Abnormal	29-33
Moderately Abnormal	34-39
Severely Abnormal	≥40

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

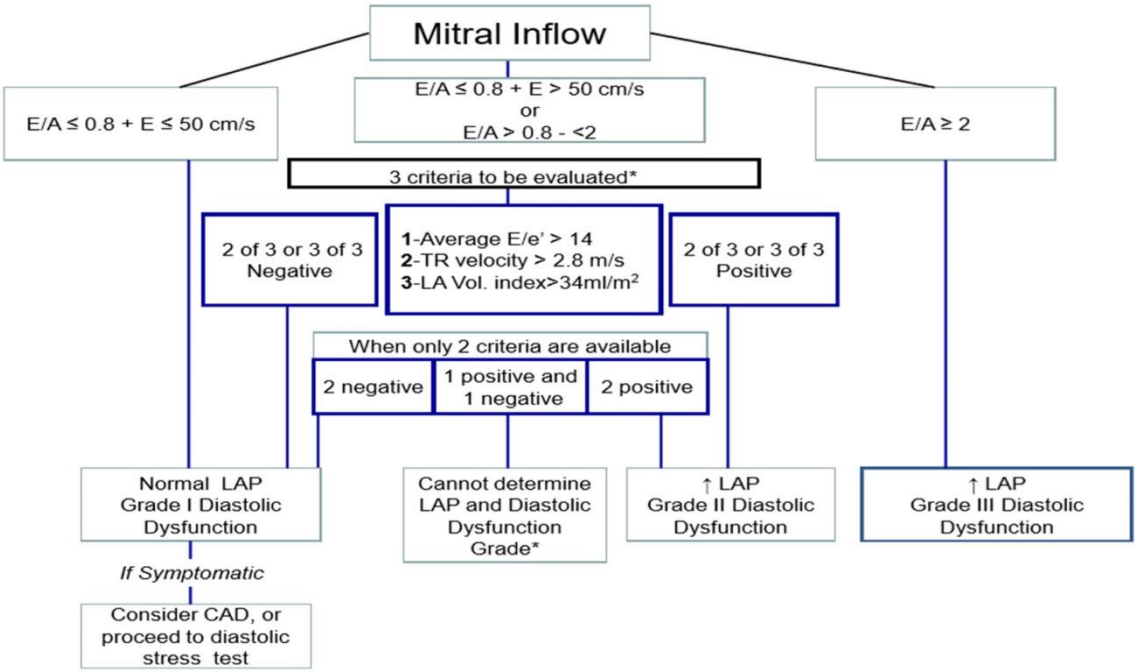

Figure5 :Assessment of filling pressures and LVDD grade

STATISTICAL ANALYSIS

For categorical data comparisons will be made by Pearson Chi-square test or Fisher's exact test as appropriate.(%). All the statistical tests were two-sided and was performed at a significance level of α=.05 . Analysis will be conducted using IBM SPSS Statistics (version 22.0).

Results:

Our study showed that the mean HbA1c of subjects with LVDD was 10.34±1.219 as compare to subjects without LVDD 8.926±0.8578 the Correlation was found significant using unpaired t test (p value <0.0001***).This signifies that higher the value of HbA1c at the time of diagnosis , higher will be the incidence of LVDD. Mean age of subjects with LVDD was 49.32±6.413 yrs and that of population without LVDD was 42.93±5.966 yrs. Age is positively associated with the incidence of diabetic LVDD in population as mean of age of population with LVDD was higher as compare to population without LVDD and correlation was found very significant (p<0.0001***) mean body mass index of subjects with LVDD was 24.15±2.432 kg/m² and that of population without LVDD was 25.01±3.228 kg/m².BMI is not positively associated with the incidence of diabetic LVDD in population as mean of BMI of population and correlation was not significant (p=0.1752) (table 1).

Table 1: Shows the characteristics of patients with and without LVDD

Parameters		With LVDD (N=41)	Without LVDD (N=43)	P-value
Age (yrs)		49.32±6.413	42.93±5.966	<0.0001***
Gender	Male	23	22	0.6503 NS
	Female	18	21	
HbA1c%		10.34±1.219	8.926±0.8578	<0.0001***
BMI (kg/m^2)		24.15±2.432	25.01±3.228	0.1752 NS

Table 2: Echocardiography parameters of patients

Parameters	With LVDD (N=41)	Without LVDD (N=43)	P-value
E wave (m/s)	0.8610±0.2291	0.6376±0.08919	<0.0001***
A wave (m/s)	0.8100±0.1215	0.6529±0.1494	<0.0001***

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

E/A ratio	1.087±0.3523	1.011±0.2061	0.2248 NS
E'm (m/s)	0.07631±0.01608	0.06933±0.009860	0.0181*
E'L (m/s)	0.09346±0.02111	0.09914±0.01681	0.1755NS
E' avg	0.08489±0.01765	0.08423±0.01200	0.8424 NS
E/E'avg	10.77±4.088	7.697±1.380	<0.0001***
$A_1(cm^2)$	16.82±2.587	14.14±1.449	<0.0001***
$A_2(cm^2)$	13.55±2.352	13.08±1.542	0.2866NS
L (cm)	4.574±0.3799	4.514±0.3995	0.4834 NS
LA Volume (ml)	43.07±12.61	35.05±5.945	0.0003***
BSA (m^2)	1.770±0.1898	1.801±0.2018	0.4707 NS
LAVI (ml/m^2)	24.34±6.562	19.52±3.035	<0.0001***
TR velocity (m/s)	1.793±1.066	0.7000±0.8252	<0.0001***

In the present study, Mean±SD echocardiography parameters of patients without LVDD are summarized as follows: LA volume (ml) 35.05±5.945, E wave (m/s) 0.6376±0.08919, A wave (m/s) 0.6529±0.1494, E/A ratio 1.011±0.2061, E'm (m/s) 0.06933±0.009860, E'l (m/s) 0.09914±0.01681, E'avg (m/s) 0.08423±0.01200, E/E'avg 7.697±1.380, $A_1(cm^2)$ 14.14±1.449, $A_2(cm^2)$13.08±1.542, L (cm) 4.514±0.3995, BSA (m^2) 1.801±0.2018, LAVI(ml/m^2) 19.52±3.035& TR velocity(m/s) 0.7000±0.8252 and Mean ±SD echocardiography parameters of patients with LVDD are LA volume (ml) 43.07±12.61, E wave (m/s) 0.8610±0.2291, A wave (m/s) 0.8100±0.1215, E/A ratio 1.087±0.3523, E'm (m/s) 0.07631±0.01608, E'l (m/s)0.09346±0.02111, E'avg (m/s)0.08489±0.01765, E/E'avg 10.77±4.088, $A_1(cm^2)$ 16.82±2.587, $A_2(cm^2)$ 13.55±2.352, L (cm) 4.574±0.3799, BSA (m^2) 1.770±0.1898, LAVI(ml/m^2) 24.34±6.562& TR velocity (m/s) 1.793±1.066.

Discussion:

Diabetes Mellitus is a metabolic disease, associated with a number of complications including nephropathy, neuropathy, ischemic heart disease, cerebrovascular disease and peripheral vascular diseases. Our study showed that the majority of cases (50%) were seen in 41-50 years of age groups followed by other 50% cases were seen in30-40 yrs and 51-60 years of age groups. The mean age of patients was 46.05±6.938 years. Srinivasa S. V. *et al* (2018)[26] found age of the patients was between 42 to 58 yrs, with mean age being 52 years. Another study done by O.Suneetha, G.Kamala Rajeswari (2019)[13] found that most of the participants belonged to >50 years age group, which was compatible with our results.

Our study showed that the most patients (60.72%) had HbA1c8.1-10.0% followed by more than 10.0% HbA1c was seen in 25 (29.76%) patients and only 8 (9.52%) patients had HbA1c6.5-8.0%. The mean value of HbA1c was 9.617±1.263%. A study done by Jain K *et al*. (2018)[27] found mean value of HbA1c was 8.01±1.23%.

The mean HbA1c of subjects with LVDD was 10.34±1.219 as compare to subjects without LVDD 8.926±0.8578 the Correlation was found significant using unpaired t test (p value <0.0001***).This signifies that higher the value of HbA1c at the time of diagnosis, higher will be the incidence of LVDD. Mean age of subjects with LVDD was 49.32±6.413 yrs and that of population without LVDD was 42.93±5.966 yrs. Age is positively associated with the incidence of diabetic LVDD in population as mean of age of population with LVDD was higher as compare to population without LVDD and correlation was found very significant (p<0.0001***) mean body mass index of subjects with LVDD was 24.15±2.432 kg/m² and that of population without LVDD was 25.01±3.228 kg/m².BMI is not positively associated with the incidence of diabetic LVDD in population as mean of BMI of population and correlation was not significant (p=0.1752).

Srinivasa S. V. *et al* (2018)[26] found that mean age of subjects with LVDD was 52.68± 5.69 years and that of population without LVDD was 46.38±5.15 years. The mean HbA1c of subjects with LVDD was 7.95±1.09 and of subjects without LVDD was 7.21±1.22. HbA1c level is positively associated with the incidence of LVDD in diabetic population as mean HbA1c of population.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

Russo C *et al* (2011)[28] in a community-based study in an elderly cohort on effect of obesity and overweight on left ventricular diastolic function reported a strong association between obesity and left ventricular diastolic dysfunction. Another study done by Dikshit NM *et al* (2013)[29] found Mean BMI (kg/m2) 24.06±2.53 in diabetic patients & 22.65±1.92 in control group which was statistical significant (p value<0.05).

In a study performed on Diastolic Dysfunction in Newly Diagnosed Type 2 Diabetes Mellitus and its Correlation with Glycosylated Haemoglobin (HbA1c) by Chaudhary AK *et al* (2015)[30] the observations of HbA1c were directly proportional to the incidence of diastolic dysfunction. Senthil N *et al* (2015)[31] observed in their study 60 patients had HbA1c <7, 30 patients with 7-8 and 10 had >8.

Hameedullah *et al* (2009)[32] in their study population of 60 patients with type 2 DM found that there was strong correlation between HbA1c level and diastolic indices (P< 0.05). Diastolic dysfunction was more frequent in poorly controlled diabetic patients, and its severity is correlated with glycemic control. Prior studies have shown that the prevalence of diastolic dysfunction in asymptomatic newly diagnosed Type 2 diabetics as 42%. Mean of HbA1c (%) was found higher in group with as compared to group without LVDD. S Kumar *et al* (2014) suggesting that glycemic control may be an important determinant of diastolic function.[33]

Our results suggested with various study such as Dikshit NM *et al* (2013)[29] in a prospective study found that all subjects showed normal systolic function. Interventricular septum thickness, left ventricular dimensions (both end-systolic and end-diastolic) and left ventricular posterior wall thickness was greater in the diabetic group (p < 0.01). Left ventricular mass was increased by ~ 20% in the patient group (223.4±54.44 vs 187±29.84, p<0.01). In regard to the pattern of left ventricular diastolic filling, diabetic patients showed a higher atrial peak filling velocity (p<0.01) and, consequently, a reduced E/A ratio (p<0.01). The diabetic patients also showed prolonged isovolumic relaxation and deceleration times (p< 0.01).

In a study done by Senthil N *et al* (2015) LVDD was found in 30 (30%) patients.[31] All patients had impaired relaxation by ECHO. None of the patients had pseudonormal pattern or restrictive pattern. Senthil N *et al* (2015)[31] observed Echocardiography parameters of normal subjects as follows: IVRT (ms) 106±17, E wave (cm/s) 69±11, A wave (cm/s) 52±9, E/A 1.34±0.17, DT (ms) 189±42, A wave duration (cm/s) 129±16 and Impaired relaxation subjects found Number of IVRT (ms) 109±11, E wave (cm/s) 56±10, A wave (cm/s) 71±3, E/A 0.79+0.07, DT (ms) 224±51, A wave duration (ms) 128±25 respectively.

Sharavanan TKV *et al* (2016) observed that echocardiography is of immense help to diagnose diastolic dysfunction in diabetic subjects who are normotensive and with no known cardiac disease.[34] Schiller NB *et al* (1989)[35] observed clinical use of 2D echo in detecting the cardiac derangements in type 2 diabetes mellitus has been justified. Cosson S *et al* (2003)[17]and Zarich SW *et al* (2001)[18] suggested left ventricular diastolic dysfunction represents the earliest first stage indicator of diabetic cardiomyopathy and thus evaluation of cardiac status is mandatory in all diabetic patients.

Jain K *et al* (2018)[27] found echocardiography parameters of patients without LVDD was mean±SD of LA volume index (ml/m2) 26.26±2.75, Relative wall thickness 0.34±0.05, LV mass (g) 149.02±6.74, LV mass index (g/m2) 84.37±6.67, LV hypertrophy (%) 13.1±2.33, LV ejection fraction (%) 65.17±3.24, E wave (cm/s) 0.69±0.18, A wave (cm/s) 0.62±0.14, E/A ratio 1.16±0.48, DT (msec) 195.14±11.60, AT (msec) 82.45±10.77 IVRT (msec) 71.65±7.43 and Mean ±SD echocardiography parameters of patients with LVDD are LA volume index (ml/m2) 26.78±0.66, Relative wall thickness 0.39±0.12, LV mass (g) 158.20±4.01, LV mass index (g/m2) 91.27±4.74, LV hypertrophy (%) 18.8±1.36, LV ejection fraction (%) 64.07±2.74, E wave (cm/s) 0.56±0.12, A wave (cm/s) 0.71±0.19, E/A ratio 0.83±0.26, DT (msec) 224.73±16.02, AT (msec) 86.67±7.59 and IVRT (msec)76.87±13.29.

Conclusion:

Our Study demonstrated a very significant positive correlation between level of glycosylated hemoglobin (HbA1c) and LVDD in the newly diagnosed cases of type 2 diabetes mellitus. It is suggested that all patients of diabetes should be routinely and repeatedly subjected to 2-D color Doppler echocardiographic assessment of cardiac functions in the long-term management of this metabolic disease. This has important therapeutic implications and helps physicians planning early intervention strategies. Thus, diastolic dysfunction can be used as an early indicator, as it is a precursor to increased LV hypertrophy and clinical.

References:

1. Yuankai S, Hu Frank B. The global implications of diabetes and cancer. The Lancet 2014;383(9933):1947–8.
2. World Health Organisation. Addressing health inequalities in Indonesia, 2017. Available from http://www.who.int.
3. Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. Diabetes Res Clin Pract 2011; 94(3):311-21.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

4. R. M. Anjana, R. Pradeepa, M. Deepa, M. Datta, V. Sudha, R. Unnikrishnan *et al*. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research–INDIA DIABETES (ICMR–INDIAB) study. Diabetologia 2011;54:3022-7.
5. Misra A, Vikram NK. Insulin resistance syndrome (metabolic syndrome) and Asian Indians. Current Science 2002;83:1483-96.
6. Mohan V, Sharp PS, Cloke HR, Burrin JM, Schumer B, Kohner EM. Serum immunoreactive insulin responses to a glucose load in Asian Indian and European type 2 (non-insulin-dependent) diabetic patients and control subjects. Diabetologia 1986;29(4):235-7.
7. Garcia MJ, McNamara PM, Gordon T, Kannell WB. Morbidity and mortality in diabetics in the Framingham population: sixteen-year follow-up study. Diabetes 1974;23(2):105-11.
8. Weiner DA, Ryan TJ, McCabe CH, Luk S, Chaitman BR, Sheffield LT, Tristani F, Fisher LD. Significance of silent myocardial ischemia during exercise testing in patients with coronary artery disease. Am J Cardiol 1987;59(8):725-9.
9. Airaksiran K E J. Silent coronary artery disease in diabetics-A feature of autonomic neuropathy or accelerated atherosclerosis. Diabetologia 2001;44:256-66.
10. Najarian RM, Sullivan LM, Kannel WB, Wilson PWF, DAgostino RB, Wolf PA. Metabolic Syndrome Compared With Type 2 Diabetes Mellitus as a Risk Factor for Stroke: The Framingham Offspring Study. *Arch Intern Med*2006;166(1):106-11.
11. Saunders J, Mathewkutty S, Drazner MH, McGuire DK. Cardiomyopathy in type 2 diabetes: update on pathophysiological mechanisms. Herz 2008; 33(3):184-90.
12. Isaaz K, Thompson A, Ethevenot G, Cloez JL, Brembilla B, Pernot C. Doppler echocardiographic measurement of low velocity motion of the left ventricular posterior wall. The American Jornal of cardiology 1989; 64(1): 66-75.
13. O. Suneetha, G. Kamala Rajeswari. A Study of Relation of Hba1c to Left Ventricular Diastolic Dysfunction in Patients with Type 2 Diabetes Mellitus and Without Overt Heart Disease.IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 2019;18:19-23.
14. Anna Kazik, Krzysztof Wilczek, Lech Poloński. Management of diastolic heart failure. Cardiology Journal 2010;17(6):558–65.
15. Piccini JP, Klein L, Gheorghiade M, Bonow RO. New insights into diastolic heart failure: role of diabetes mellitus. The American Journal Of Medicine 2004;116 Suppl 5A:64s-75s.
16. From AM, Scott CG, Chen HH. Changes in diastolic dysfunction in diabetes mellitus over time. Am J Cardiol 2009;103:1463–66.
17. Cosson S, Kevorkian JP. Left ventricular diastolic dysfunction: an early sign of diabetic cardiomyopathy. Diabetes Metab 2003;29:455–66.
18. Zarich SW, Nesto RW. Diabetic cardiomyopathy. Am Heart J 2001;35:166–8.
19. Sujino T, Kawasaki D, Bonow RO. New insights into diastolic heart Failure. role of diabetes mellitus. Am J Med 2005;116(suppl6):34S–45S.
20. Patil MB, Burji Nishkal Prabhu A. Echocardiographic Evaluation of Diastolic Dysfunction in Asymptomatic Type 2 Diabetes Mellitus. JAPI 2012;60:23–6.
21. Vanninen E, Pitale SU. LV Function and dimensions in newly diagnosed non- insulin- dependent mellitus. Am J Cardiol 1992;70:371–8.
22. H von Bibra1, A Hansen 1, V Dounis, T Bystedt, K Malmberg 1, L Rydén *et al*. Augmented metabolic control improves myocardial diastolic function and perfusion in patients with non-insulin dependent diabetes. Heart 2004;90:1483-4.
23. Ommen SR, Nishimura RA, Appleton CP, Miller FA, Oh JK, Redfield MM *et al.* Clinical utility of Doppler echocardiography and tissue Doppler imaging in the estimation of left ventricular filling pressures: A comparative simultaneous Doppler-catheterization study. Circulation 2000;102:1788-94.
24. OH JK, Seward JB, Tajik AJ. Assessment of diastolic dysfunction and diastolic heart failure. In: Oh JK, editor. The Echo Manual. 3rd ed. New Dehli: Wolters Kluwer; 2006. p. 120-41.
25. Biswajit Paul. Left Atrial Volume - A New Index in Echocardiography. JAPI 2009;57:463-5.
26. Srinivasa S. V., Modugula S. Naga Swetha, Abhishek Kumar Verma, Prabhakar K. HbA1C as a Predictor of Left Ventricular Diastolic Dysfunction (LVDD) in Type 2 Diabetic Patients. International Journal of Internal Medicine 2018;7(1): 4-7.
27. Jain K, Palange AA, LalKakrani A, Dhanorkar AS. Left ventricular diastolic dysfunction in asymptomatic type 2 diabetes mellitus patients. Int J Res Med Sci 2018;6:240-6.
28. Russo C, Jin Z, Homma S, Rundek T, Elkind MS, Sacco RL *et al*. Effect of obesity and overweight on left ventricular diastolic function: a community-based study in an elderly cohort. J Am Coll Cardiol 2011;57:1368-74.
29. Dikshit NM, Wadia PZ, Shukla DK. Diastolic Dysfunction in Diabetes Mellitus. National Journal of Medical Research 2013;3(3).

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 8, 2023

30. Abhay Kumar Chaudhary, Girish Kumar Aneja, Shubhra Shukla, and Syed Mohd Razi. Study on Diastolic Dysfunction in Newly Diagnosed Type 2 Diabetes Mellitus and its Correlation with Glycosylated Haemoglobin (HbA1C). Journal of clinical and diagnostic research 2015;9(8); 20-22.
31. Senthil N, Vengadakrishnan K, Vankineni SS, Sujatha S. Diastolic Dysfunction in Young Asymptomatic Diabetics Patients. Int J Sci Stud. 2015;3(7):226-9.
32. Hameedullah, Faheem M, Bahadar S, Hafizullah M, Najeeb S. Effect of glycaemic status on left ventricular diastolic function in normotensive type 2 diabetic patients. J Ayub Med Coll Abbottabad 2009;21:139-44.
33. Kumar S, G K Aneja, Arvind Trivedi, V Atam, Abhishek Singh, Neetu Verma, *et al*. Glycosylated haemoglobin (HbA1c) is a reliable predictor of left ventricular hypertrophy (LVH) and left ventricular diastolic dysfunction (LVDD) in newly diagnosed type 2 diabetic patients of western Uttar Pradesh. International Journal of Scientific and Research Publications 2014;4(12):1-7.
34. Sharavanan TKV, Prasanna KB, Ekanthalingam S, Sundaram A, Premalatha E, Arumugam B. A study on the prevalence of diastolic dysfunction in type 2 diabetes mellitus in a tertiary care hospital. IAIM 2016;3(7):216-21.
35. Schiller NB, Shah PM, Crawford M, DeMaria A, Devereux R, Feigenbaum H, *et al*. Recommendations for quantitation of the left ventricle by two-dimensional echocardiography. American Society of Echocardiography Committee on Standards, Subcommittee on Quantitation of Two-Dimensional Echocardiograms. J Am Soc Echocardiogr 1989;2(5):358-67.