

Recently diagnosed diabetes mellitus type 2 and hypertensive patients and their correlation with cardiac dysfunction: A prospective study

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Abstract

Background: The incidence of diabetes mellitus and hypertension is increasing worldwide and rapidly assuming epidemic proportions. Over the last three decades, a number of epidemiological, clinical and autopsy studies have proposed the presence of diabetic heart disease and hypertension as a distinct clinical entity. This study is to determine the correlation of recently diagnosed diabetes and hypertension with cardiac function and the magnitude of cardiac manifestation in recently diagnosed diabetic and hypertensive patients.

Materials and methods: The present study was carried out in the Department of Medicine of in-patient basis for the period of 18 months. A total number of 100 cases of recently diagnosed diabetic and hypertensive cases included.

Result: Sex wise distribution of cases and their correlation with cardiac dysfunction to be found higher in male and age group 36-45. The incidence was maximum

in those patients who smoke >10 cigarette for > 10 year. BMR findings was maximum in diabetic patients.

Conclusion: The incidence of cardiac dysfunction was higher in diabetes mellitus and hypertensive patients who are free of clinically detectable heart disease. The incidence was more in patients with diabetic and hypertensive. The incidence of diastolic dysfunction had a strong correlation with the age of the patient and duration of diabetes. Patients should be advised strict control of diabetes and hypertension in order to reduce the risk for developing cardiac dysfunction.

Keyword: Diabetes mellitus, cardiac dysfunction, hypertension

Introduction

The incidence of diabetes mellitus (DM) and hypertension is increasing worldwide and rapidly assuming epidemic proportions. Over the last three decades, a number of epidemiological, clinical and autopsy studies have proposed the presence of diabetic heart disease and

hypertension as a distinct clinical entity.¹ Many studies have reported that the incidence of heart failure in diabetic subjects is high even in the absence of hypertension and coronary artery disease.² Studies have reported a high prevalence of pre-clinical diastolic dysfunction among subjects with DM and hypertension.³ The evidence indicates that myocardial damage in diabetic subjects affects diastolic function before the systolic function. The pathogenesis of this left ventricular (LV) dysfunction in diabetic and hypertensive subjects is not clearly understood. Diabetic cardiomyopathy has been proposed as an independent cardiovascular disease, and many mechanisms, such as microvascular disease, autonomic dysfunction, metabolic disorders, and interstitial fibrosis, have been suggested as causative factors. However, the exact etio-pathogenesis of diabetic cardiomyopathy still remains unclear. 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. So, our study is to determine the correlation of recently diagnosed diabetes and hypertension with cardiac function and the magnitude of cardiac manifestation in recently diagnosed diabetic and hypertensive patients.

Materials and methods

Result

Table 1: Showing sex wise distribution of cases and their correlation with cardiac dysfunction

Sex	Total Number	Normal cardiac function	Cardiac dysfunction
Male	63	33	30
Female	37	25	12
Total	100	58	42

Observation was statistically insignificant in relation with gender and cardiac dysfunction.

The present study was carried out in the Department of Medicine, J.A. Group of Hospitals, Gajra Raja Medical College, Gwalior on an inpatient basis from January 2019 to June 2020 after getting institutional ethical committee approval. A total number of 100 cases of recently diagnosed diabetic and hypertensive cases included in this study.

Inclusion criteria

Age more than 18 years, hypertensive patients those who are diagnosed with stage I and stage II within or equal to 5 years, patients those who are diagnosed with diabetes mellitus within or equal to 5 years and those who are diagnosed with both of above within or equal to 5 years.

Exclusion criteria

Age below 18 years, cases those who are suffering/ diagnosed with diabetes and / or hypertension < 5 years, documented or detected cases of acute and chronic kidney disease, Coronary Artery Disease, Ischemic Heart Disease, LV dysfunction (moderate and severe) and Chronic inflammatory conditions and subjects who do not give consent for the study.

Statistical Analysis

Used SPSS 2.0 and graphs shall be generated by Microsoft Excel and Word. A p value of less than 0.05 shall be considered significant.

Table 2: Showing age wise distribution of cases and their correlation with cardiac dysfunction

Age Group (years)	Male	Female	Percentage	
18-25	03	0	03%	
26-35	12	08	20%	
36-45	23	15	38%	
46-55	16	08	24%	
>56	09	06	15%	
Total	63	37		
Particulars	Normal cardiac function	Cardiac dysfunction		
		26-35year age	36-45year age	>45year age
Total diabetes patients – 47	30	2	5	10
Total hypertensive patients- 18	13	1	1	3
diabetes and HTN patients-35	15	2	5	13

Data is statically insignificant in correlation patients with diabetes and hypertension with cardiac dysfunction and their association with age.

Table 3: Showing Smoking & hypertension correlation with cardiac dysfunction

Parameter		Total patients	Cardiac dysfunction	Normal cardiac function
Smoking	Cigarette >10 for > 5 year	10	09 (90%)	01
	Cigarette < 10 for >5 year	08	04 (50%)	04
	Cigarette >10 for < 5 year	10	08 (80%)	02
	Cigarette < 10 for < 5 year	12	04 (67%)	08
Non smoker		60	17 (30%)	43

Data is statically significant in correlation with no of cigarette and duration of smoking with cardiac dysfunction. Incidence is maximum (90%) in those patients who smoke >10 cigarette for > 10 year, it signifies leaner relationship between toxic component of cigarette and cardiac dysfunction because cigarette smoking affects all phases of atherosclerosis.

Table 4: Showing distribution of BMI findings

BMI	Diabetic (47)		Hypertensive (18)		Diabetic + hypertensive (35)		Percentage
	Male	Female	Male	Female	Male	Female	
BMI 18.5- 24.9	12	14	04	05	12	8	55%
BMI 25-29.9	08	10	03	04	06	07	38%
BMI >30	01	02	01	01	01	01	7%
Total	47		18		35		

Table 5: Showing correlation of distribution of cardiac dysfunction patients with BMI >25

Parameter		Total no of patients with BMI > 25	Total no of patients with diastolic dysfunction	Total no of patients with HF rEF	Total no of cardiac dysfunction patients with abnormal lipid profile and BMI > 25
Diabetic Total patients-47	Diabetic with abnormal lipid profile (20)	14	08	04	08(5 DDF,03 HF rEF)
	Diabetic with normal lipid profile (27)	04	04	01	00
Hypertensive Total patients-18	Hypertensive with abnormal lipid profile (06)	05	02	02	03(02 DDF,01 HF rEF)
	Hypertensive with normal lipid profile (12)	02	00	00	00
Diabetic and hypertensive Total patients- 35	Diabetic and hypertensive with abnormal lipid profile (15)	09	10	05	09(05 DDF,04HF rEF)
	Diabetic and hypertensive with normal lipid profile (20)	04	04	03	00

Abnormal lipid profile included – total cholesterol >200mg/dl, Triglyceride >150 mg/dl, HDL cholesterol <40 mg/dl, LDL cholesterol >100 mg/dl.

This finding with association of BMI and abnormal lipid profile with cardiac dysfunction is statistically significant.

Patients with abnormal lipid profile enhanced foam cell

formation and an increase in formation of low-density lipoprotein cholesterol which increase the susceptibility of LDL for oxidation and predispose for atherosclerosis, similarly hyperglycemia induce a state of oxidative stress which in turn promote LDL oxidation and decrease in availability of nitric oxide.

Table 6: Showing distribution of HbA1C findings and their correlation with cardiac dysfunction

	Diabetes patients (47)		Diabetes and hypertensive patients (35)	
	With normal cardiac function (30)	Cardiac dysfunction (17)	With normal cardiac function(15)	Cardiac dysfunction (20)
HbA1 C 7- 9	15	03	09	03
HbA1C >9-10	10	04	04	05
HbA1C > 10	05	10	02	12

Data is statically significant in patients with high HbA1C having increase incidence of cardiac dysfunction.

Table7: Showing distribution of diabetes patients and their correlation with family history and cardiac dysfunction

Parameter	Positive family history of Diabetes		Negative family history of diabetes		Diabetes patients with cardiac dysfunction with positive family history
	Male	Female	Male	Female	
Total no of diabetic patients- 47	10	06	20	11	10

Table showing data is statically significant in diabetes patients with positive family history and their correlation with cardiac dysfunction.

Table 8: Showing distribution of Sympatientsomatology and their correlation with cardiac dysfunction

Presenting Sympatientsom	Total patients of diabetes- 47		Total patients of hypertension -18		Total patients of diabetes and hypertension-35	
	Diabetic patients without cardiac dysfunction	Diabetic patients with cardiac dysfunction	hypertensive patients without cardiac dysfunction	hypertensive patients with cardiac dysfunction	Diabetic and hypertensive patients without cardiac dysfunction	Diabetic and hypertensive patients with cardiac dysfunction
Ghabrahat Total patients 60	18	05	02	03	03	12
Breathlessness Total patients 20	10	02	08	01	10	06
Chest pain Total patients 20	02	10	03	01	02	02

The data is statistically significant for diabetic patients with cardiac dysfunction presented with complain of chest pain, which is statistically insignificant for hypertensive patients with cardiac dysfunction presented with complain

of ghabrahat and statistically significant for hypertensive and diabetic patients with cardiac dysfunction presented with complain of ghabrahat.

Table 9: Showing distribution of socioeconomic status and their correlation with cardiac dysfunction

	Lower class (42 patients)		Lower Middle class (20 patients)		Upper Middle class (12 patients)		upper class (26 patients)		Total no of cardiac dysfunction patients (42)
	Normal function	Cardiac dysfunction	Normal function	Cardiac dysfunction	Normal function	Cardiac dysfunction	Normal function	Cardiac dysfunction	
Total diabetes patients (47)	12	08	04	05	04	02	10	02	17
Total no of HTN patients (18)	04	03	03	01	01	0	04	01	05
Total no of diabetes and HTN (35)	06	09	03	04	01	04	06	03	20
Total Patients (100)	22	20	10	10	06	06	20	06	

Data is statically significant in patients of diabetes with low socioeconomic status (lower class and middle class) and their correlation with cardiac dysfunction.

Table 10: Showing distribution of echocardiography finding in diabetic patients

Echocardiography finding		Total no of diabetic patients (47)
Sepatientsal e' >8 Normal cardiac function		27
Lateral e' >10 Normal cardiac function		27
Sepatientsal e' <8 and lateral e' <10 Cardiac dysfunction		20
E/A	E/A < 0.8 (normal/DDF 1)	33
	E/A 0.8-1.5 (normal/DDF 2)	11
	E/A > 2 DDF 3	03
E/e'	E/e' < 8 (normal/DDF 1)	44
	E/e' > 8 (DDF 2/ DDF 3)	03
IVRT	IVRT > 100 (DDF1)	09
	IVRT 70-100 (normal/DDF 2)	36
	IVRT < 70 (DDF 3)	02
DT	DT > 200 (DDF 1)	09
	DT (160-200) (normal/DDF 2)	36
	DT < 160 (DDF 3)	02

Table 11: Showing distribution of echocardiography finding and their correlation with cardiac dysfunction in diabetic patients

Echocardiography finding	Out of total diabetic cardiac dysfunction patients
E/A < 0.8, IVRT >100 and DT >200 and E/e' <8 DDF 1	09
E/A 0.8-1.5, IVRT 70-100 DT 160-200 (DDF 2), E/e' >8	01
E/A >2 , IVRT <70 , DT <160 (DDF3), E/e' >8	02
Total no of diastolic dysfunction in diabetic patients	12

Data is statically significant in relation with when E/A < 0.8, IVRT > 100, DT >200, E/e' <8 with DDF 1, similarly when E/A between 0.8-1.5 , IVRT 70-100, DT 160-200 and E/e' >8 with DDF 2 and when E/A >2, IVRT <70 DT <160 and E/e' >8 with DDF 3.

Table 12: Showing distribution of echocardiography finding in hypertensive patients

Echocardiography Finding		Total No of hypertensive patients (18)
Septentials e' >8 Normal cardiac function		12
Lateral e' >10 Normal cardiac function		12
Septentials e' <8 and lateral e' <10 Cardiac dysfunction		06
E/A	E/A < 0.8 (normal/DDF 1)	10
	E/A 0.8-1.5 (normal/DDF 2)	08
	E/A >2 DDF 3	00
E/e'	E/e' <8 (normal/DDF 1)	16
	E/e' >8 (DDF 2/ DDF 3)	02
IVRT	IVRT >100 (DDF1)	02
	IVRT 70-100 (normal/DDF 2)	16
	IVRT <70 (DDF 3)	00
DT	DT > 200 (DDF 1)	02
	DT (160-200) (normal/DDF 2)	16
	DT <160 (DDF 3)	00

Table 13: Showing distribution of echocardiography finding and their correlation with cardiac dysfunction in hypertensive patients

Echocardiography finding	Out of total hypertensive cardiac dysfunction patients
E/A < 0.8 ,IVRT >100 and DT >200 and E/e' <8 DDF 1	02
E/A 0.8-1.5 , IVRT 70-100 DT 160-200 (DDF 2),E/e' >8	00
E/A >2 , IVRT <70 , DT <160 (DDF 3),E/e' >8	00
Total no of diastolic dysfunction in hypertensive patients	02

Data is statically significant in relation with when E/A <0.8, IVRT > 100, DT>200, E/e' <8 with DDF 1.

Table 14: Showing distribution of echocardiography finding in diabetic and hypertensive patients

Echocardiographic Finding	Total No of diabetic and hypertensive patients (35)	
Septentials e' >8 Normal cardiac function	15	
Lateral e' >10 Normal cardiac function	15	
Septatl e' <8 and lateral e' <10 Cardiac dysfunction	20	
E/A	E/A <0.8 (normal/DDF 1)	16
	E/A 0.8-1.5 (normal/ DDF 2)	14
	E/A >2 DDF 3	05
E/e'	E/e' <8 (normal/DDF 1)	29
	E/e' >8 (DDF 2/ DDF 3)	06
IVRT	IVRT >100 (DDF1)	08
	IVRT 70-100 (normal/DDF 2)	22
	IVRT <70 (DDF 3)	05
DT	DT > 200 (DDF 1)	08
	DT (160-200)(normal/DDF2)	22
	DT <160 (DDF 3)	05

Table 15: Showing distribution of echocardiography finding and their correlation with cardiac dysfunction in diabetic and hypertensive patients

Echocardiography finding	Out of total hypertensive and diabetic cardiac dysfunction patients
E/A < 0.8, IVRT >100 and DT >200 and E/e' <8DDF 1	08
E/A 0.8-1.5, IVRT 70-100 DT 160-200 (DDF 2), E/e' >8	01
E/A >2, IVRT <70, DT <160 (DDF 3), E/e' >8	05
Total no of diastolic dysfunction in hypertensive and diabetic patients	14

Data is statically significant in relation with when E/A <0.8, IVRT > 100, DT>200, E/e' <8 with DDF 1, similarly when E/A between 0.8-1.5, IVRT 70-100, DT 160-200 and E/e' >8 with DDF 2 and when E/A>2, IVRT<70 DT<160 and E/e'>8 with DDF 3.

Table 16: Showing distribution of echocardiography finding in diabetic patients and their correlation with cardiac dysfunction

Echocardiography finding		Total no of diabetic patients (47)
LVEDd (38.9-56.1mm)	> 56.1 mm(raised)	08
	38.9-56.1mm(normal)	39
LVESd (21.4-37mm)	>37 mm(raised)	10
	21.4-37mm(normal)	37
Ejection fraction	>50%(normal)	25
	40-50(borderline)	12
	<40%(HFrEF)	10
Fractional shortening	>25%(normal)	42
	<25(HFrEF)	05
Total no of diabetic patients are full filling criteria of HFrEF		05 patients

Data is statically significant in relation with raised LVESd, LVEDd, reduced EF, reduced FS with HFrEF (p value < 0.05)

Table 17 : Showing distribution of echocardiography finding in hypertensive patients and their correlation with cardiac dysfunction

Echocardiography finding		Total no of hypertensive patients (18)
LVEDd (38.9-56.1mm)	> 56.1 mm(raised)	06
	38.9-56.1mm(normal)	12
LVESd (21.4-37mm)	>37 mm(raised)	05
	21.4-37mm(normal)	13
Ejection fraction	>50%(normal)	08
	40-50(borderline)	04
	<40%(HFrEF)	06
Fractional shortening	>25%(normal)	15
	<25(HFrEF)	03
Total no of hypertensive patients are full filling criteria of HFrEF		03 patients

Data is statically significant in relation with raised LVESd, LVEDd, reduced EF, reduced FS with HFrEF.

Table 18: Showing distribution of echocardiography finding in diabetic and hypertensive patients and their correlation with cardiac dysfunction

Echocardiography finding		Total no of diabetic and hypertensive patients (35)
LVEDd (38.9-56.1mm)	> 56.1 mm(raised)	15
	38.9-56.1mm(normal)	20
LVESd (21.4-37mm)	>37 mm(raised)	12
	21.4-37mm(normal)	23
Ejection fraction	>50%(normal)	18
	40-50(borderline)	05
	<40%(HFrEF)	12
Fractional shortening	>25%(normal)	29
	<25 (HFrEF)	06
Total no of diabetic and hypertensive patients are full filling criteria of HFrEF		06 patients

Data is statically significant in relation with raised LVESd, LVEDd, reduced EF, reduced FS with HFrEF.

Discussion

Cardiac dysfunction may be the earliest marker of diabetes induced heart muscle disease which leads to the progressive development of cardiac failure. The importance of detecting diastolic dysfunction is for early intervention which can prevent progression of disease to failure.

The increasing prevalence of diabetes mellitus is reaching epidemic proportions. Most complications in diabetes mellitus, cardiac failure particularly left ventricular diastolic dysfunction may occur without evidence of CAD and may present early in the disease process unlike the long-term complications Cardiovascular complications are the most common cause of morbidity and mortality in diabetes.⁴ Patients with

NIDDM have three to four fold higher rate of cardiovascular mortality than non diabetes.⁵

Myocardial damage in patients with diabetes affects diastolic function before systolic function. Other than diabetes, ischemic heart disease, systemic hypertension, thyroid disease, cardiomyopathy, valvular heart disease can also cause LV dysfunction. In our study subjects with the above conditions which affect Lv diastolic function were excluded.

In this study electrocardiography and echocardiography was done in 100 newly diagnosed diabetes mellitus and hypertensive patients and their correlation with cardiac dysfunction.

Comparison of present study with other previous study Cardiac Dysfunction

In present study 42 cases (42%) had cardiac dysfunction of which 23 cases (23%) had diastolic dysfunction in which 19% patients had impaired relaxation pattern, 2%

had pseudonormal pattern and 7% had reversible restrictive pattern 14 cases (14%) had HFrEF.

Mamatha B Patil, diastolic dysfunction was present in 40% of the patients and HFrEF was present in 23% of the patients and Paul poinier et al (2001) LVDD was found in 60% of whom 28% had a pseudonormal pattern of ventricular filling and 32% had impaired relaxation. S. Cosson et al diastolic dysfunction was present in 69% of the patients.^{6,7}

Our study was found some similarity in result with Mamatha B Patil study as both study determine cardiac dysfunction in diabetes and HTN patients, sample size was almost equal in both study and cardiac dysfunction was found more in diabetes and HTN patients in both study.

Age Distribution

In the present study a total of 100 patients of diabetic/HTN/diabetic and hypertensive patients were included with age >18 year. A total of 20 cases are in age group of 26-35 year and 38 cases are in the age group 36-45 year and 24 cases are in the age group 46-55 year and 15 cases were in age more than 56 year and 1 case was in between age group of 18-25 years. Incidence of diabetes/HTN/ diabetes and HTN maximum in age group of more than 45 year of age. Among total diabetic patients (47 patients) cardiac dysfunction was found in 17 patients, among them most of patients of age more than 45 year. Among total hypertensive patients (18 patients) cardiac dysfunction was found in 05 patients and most of patients lies in age more than 45 year. Among total diabetic and HTN patients (35 patients) cardiac dysfunction was found in 20 patients and most of them lies in age group more than 45, Patil et al cardiac dysfunction was significantly higher in age >35 years compared to age <35 years whereas Mamatha B patil et al there was linear increase in

the prevalence of cardiac dysfunction with increasing age group. Gani et al, 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 cardiac dysfunction.⁸ Our study finding are correlating with Patil et al study as in both study, most of patients of cardiac dysfunction lies in study group are in age group of 36-45 year of age.

Sex Distribution

In the present study among the patients with the cardiac dysfunction 63% of the population were males and 37% were females. The cardiac dysfunction was seen to be higher among the males (30 cases) compare to females (12 cases) but this observation was statistically insignificant. Whereas Sohail Ashraf et al found cardiac dysfunction in 17.5 % of males compared to 12.2 % of females.⁹ Rajput studied LVDD in 30 diabetics which included 15 males and 15 female which indicate equal incidence in type 2 diabetic patients.¹⁰ Mamatha B Patil et al found cardiac dysfunction was more common among female sex (68.18%) compared to male (60.17%).⁷ Our study is correlating with study of Sahail ashraf as in both study cardiac dysfunction is more among male as compare to female because in both study number of studying patients was more male patients as compare to female patients.⁹

Socioeconomic status

In a study group of 100 most of patient's lies in lower class (47%) as per modified kuppaswamy scale follow by lower middle class (38 %) follow by upper middle class (14%) and 14% cases lies in upper class group. Among total 47 patient's incidence of diabetes were found almost equal in both upper, middle and lower class respectively but no of cases of cardiac dysfunction was found more in lower class group (08 cases out of 17 cases- 47% cases) and middle class (07 cases/ 41%) as compared to upper

class group (2 cases / 11%). A total 17 patients have cardiac dysfunction with diabetes out of total 47 patients of diabetes in which 08 cases is in lower class (47%). This finding is statistically significant in patients with diabetes with middle or low socioeconomic status has more incidence of cardiac dysfunction. Paul poinier et al found most of diabetes patients from upper (50%) and middle class (30%) and among them diastolic dysfunction was more in upper class group patients (60%).¹¹ Similarly total 35 patients with diabetes and hypertension incidence were found almost equal in both middle and lower class as compare to higher class respectively. There was no of cases of cardiac dysfunction was found more in middle (08 cases) and lower class group (09 cases) as compared to higher class group (03 cases). A total 20 patients have cardiac dysfunction out of total 35 patients of diabetic and hypertension 09 cases (45%) is in lower class. S. Cosson et al found most of diabetes and hypertension patients from lower class (40%) and middle (36%) and among them cardiac dysfunction was more in lower class 4 (46%) as compare to middle class (30%).¹² This finding is statistically insignificant in patients with diabetes and hypertension with middle or low socioeconomic status have more incidence of cardiac dysfunction (p value 0.8685). Similarly total 18 patients with hypertension incidence were found almost equal in both higher class and middle class respectively Patients with HTN and cardiac dysfunction are almost equally distributed in lower/ middle and hyper class. A total of 5 patients with HTN have cardiac dysfunction out of total 18 patients of HTN (3 cases were found in lower class and 1 case was found in lower middle class and 1 case was in upper class with cardiac dysfunction). This finding is statistically insignificant in patients with hypertension with middle or

low socioeconomic status have more incidence of cardiac dysfunction.

Our study finding is similar to S Cosson et al study because in both study most of diabetes and hypertension patients presented in hospital was lower and middle socioeconomic status as compare to paul poinier et al study in which most of patients were upper- and middle-class socioeconomic status.

Personal habits (smoking)

In a study group of 100 patients history of smoking was present in 40 patients 25 patients were found cardiac dysfunction with history of smoking out of which patients those who smoke > 10 cigarette for >5 year (10 patients), cardiac dysfunction was found in 10 patients who smoke > 10 cigarette for < 5 year, cardiac dysfunction was found in 08 patients And patients who smoke < 10 cigarette for < 5 year, cardiac dysfunction was found in 04 patients. This finding is statistically significant with more no of cigarette smoke for more year risk of cardiac dysfunction will be increase further. Rajpoot et al found strong association of smoking > 10 cigarette for >10 year in patients of diabetes with diastolic dysfunction.¹⁰ Paul poinier et al found association of >5 cigarette for > 15 year in patients of diabetes with cardiac dysfunction.¹¹

Our study has similar result as of rajpoot study because total sample size of both study was 100 and no of total patients who smoke were almost similar.

Basal Metabolic Rate (BMR)

In the present study 55 cases had a BMI between 18.5-24.9, 38 cases had BMI of 25-29.9 and 07 cases had a BMI >30. The incidence of cardiac dysfunction was highest in BMI 25-30 followed by BMI of >30 while lowest in BMI 18.5-24.9. Among diabetic cardiac dysfunction patients - 17 patients out of total 47 patients

of diabetes 4 patients have BMI between 18.5-24.9, 12 cases have BMI between 25-29.9 and 01 case has BMI more than 30. This finding is statistically significant in relation to as BMI is increased from normal incidence of cardiac dysfunction raises in diabetes patients. Among hypertensive cardiac dysfunction patients 05 patients out of total 18 patients of HTN 1 patients had BMI between 18.5-24.9, 3 cases have BMI between 25-29.9 and 01 case has BMI more than 30. This finding is statistically significant in relation to as BMI is increased from normal chances of cardiac dysfunction raised in HTN patients. Among diabetic and hypertensive cardiac dysfunction patients 20 patients out of total 35 patients of diabetes and HTN 3 patients has BMI between 18.5-24.9, 12 patients have BMI between 25-29.9 and 05 patients has BMI more than 30. This finding is statistically significant in correlation with raised BMI and cardiac dysfunction in patients of diabetes and HTN. Most of patients with BMI > 25 has also significant association with abnormal lipid profile. Among total diabetic patients with cardiac dysfunction (17 patients), found abnormal lipid profile in 12 patients out of which 08 patients have BMI >25. Similarly in hypertension patients with cardiac dysfunction (03 patients), found abnormal lipid profile was in 02 patients in which all two patients have BMI >25. Patients with both hypertension and diabetes with cardiac dysfunction (22 patients) have abnormal lipid profile in 15 patients in which 09 patients have BMI >25. This finding in correlation of BMI >25 and abnormal lipid profile with cardiac dysfunction is statistically significant (p value 0.004637). Virendra et al in their study Total 23 (33.33%) male and 13 (24.41%) female patients had high BMI; and, out of them 16 (69.56%) male and 8 (61.53%) female had cardiac dysfunction. Their finding was statistically significant.¹³

HBA1C

In the study population of 100, 30 patient had HbA1C levels between 7-8% and 23 patients have their HbA1c 9-10 % and 29 patients had HbA1C > 10. Among total cardiac dysfunction patients with diabetes (17 patients), 10 patients have HbA1C > 10 (58.8 %). Similarly among total cardiac dysfunction patients with diabetes and HTN (20 patients), 12 patients with HbA1C > 10 have cardiac dysfunction (60 %). This finding is statistically significant, patients with high HbA1C (specially >10) have more risk to developing cardiac dysfunction. Virendra C. Patil et al found, 89 subjects with HbA1c < 9%, 39 (42.82%) had cardiac dysfunction; and, out of 38 subjects with HbA1c > 9%, 31 (81.57%) had cardiac dysfunction. Subjects with HbA1c >9% had more prevalence of cardiac dysfunction, than subjects with HbA1c < 9 %.¹³

Mamatha B Patil et al we co-related the cardiac dysfunction with glycemic study the prevalence of cardiac dysfunction increased gradually with the rise in HbA1C levels.⁷ This was in accordance with Fiorina who demonstrated that glycemic levels had an impact on cardiac dysfunction.²³ There was one study done by Ann m. Grandi et al, showed a close relationship between glycemic control and cardiac dysfunction in 36 type 1 diabetic patients which improved with glycemic control. Our study has similar result as of virendra c patil et al study as in both study no of diabetes patients studied was almost similar in number as compare to other study where less no of diabetes patients was studied.

Association of Sympatientsom

In study population based on sympatientsomatology, ghabrahat, breathlessness and chest pain were most common finding among the patients. A total patient with diabetes (47) ghabrahat was in 23 patients, breathlessness

was in 12 patients and chest pain was in 12 patients association of ghabrahat with cardiac dysfunction in diabetic patients was found in 05 patients, association of breathlessness with cardiac dysfunction in 2 patients and 10 patients have chest pain association with cardiac dysfunction. C Halley et al study found breathlessness and chest pain as a main presenting symptoms in most of diabetes patients and most of patients with breathlessness was associate with diastolic dysfunction in their study the data is statistically significant for diabetic patients with cardiac dysfunction presented with complain of chest pain.^{14,15}

ECG abnormality associate with cardiac dysfunction

In a study population based on ECG finding ST-T segment changes, finding s/o LVH are most common ECG abnormality. Among total diabetic patients with cardiac dysfunction 17 patients. ECG changes with abnormal ST-T segment changes were found in 13 patients ,1 patients has finding of LVH,1 patients has normal ECG and 1 patients has other nonspecific ECG changes the data is statistically significant for diabetic patients with cardiac dysfunction with abnormal ST-T segment changes in ECG.

Cardiac dysfunction variables (Echocardiographic)

The cardiac dysfunction variables which had been used in our study are septal e' Lateral e', E/A , IVRT , DT , E/e', \uparrow LVEDd and LVESd, EF, FS and Septal e' - Maximum number of the cases (diabetic/ hypertensive/ diabetic and hypertensive) 54 cases have septal e' > 8 and most of cases have no diastolic dysfunction only 6 cases have HFrEF followed by 46 cases of the cases have septal e' value <8 in which 28 cases have diastolic dysfunction which is 60% of total diastolic dysfunction followed by 3 cases of HFrEF

Isovolumetric relaxation time (IVRT)

In the study population maximum number of the cases 74 cases have IVRT between 70-100 of which 2 cases have diastolic dysfunction followed by 19 cases having IVRT >100, all 19 patients have diastolic dysfunction followed by 07 cases have IVRT <70, 07 cases have diastolic dysfunction. Out of total 47 diabetes patients, IVRT was > 100 in 09 patients, IVRT between 70-100 was in 36 patients and IVRT < 100 in 2 patients this signify relationship of IVRT >100 with DDF 1 IVRT between 70-100 for DDF2 and IVRT <70 with DDF 3. Similarly, Out of total 18 HTN patients, IVRT was > 100 in 02 patients (DDF 1 was in 02 patients), IVRT between 70-100 was in 16 patients, this signify relationship of IVRT >100 with DDF 1. Similarly Out of total 35 diabetes and HTN patients, IVRT was > 100 in 08 patients, IVRT between 70-100 was in 22 patients and IVRT < 100 in 05 patients. This signify relationship of IVRT >100 with DDF 1 IVRT between 70-100 for DDF2 and IVRT <70 with DDF 3, which is statistically significant.

Deceleration time (DT)

In the study population maximum number of the cases 74 cases have DT between 160-200 of which 2 cases have diastolic dysfunction followed by 19 cases having DT >200 of which all 19 cases developed diastolic dysfunction followed by 07 cases have their DT < 160 of which all 07 cases developed diastolic dysfunction. The data is statistically significant in correlation with patients of diastolic dysfunction grade 2 / pseudo normal type of diastolic dysfunction will have E/A- 0.8-1.5, E/e'->8, IVRT-70 to 100, DT-160 to 200ms.

Fractional shortening (FS)

In the study population maximum number of the cases 71 cases having FS >25%. Most of cases of diabetes have FS > 25% (average normal rang according to AHA), total 5

cases of diabetes among 47 cases have FS < 25% in which all 5 patients have HFrEF this signifies relationship of reduced FS with HFrEF. Similarly, most of cases of hypertension have FS > 25%, total 3 cases of hypertension among 18 cases have FS < 25% in which all 3 patients have HFrEF. Maximum cases were found in patients with both diabetes and hypertension with FS > 25%, total 6 cases have FS < 25% out of them all 06 cases have HFrEF, this further signify relationship of reduced FS with HFrEF, which is statistically significant in correlation of FS < 25% with patients of HFrEF.

Ejection fraction (EF)

In the study population maximum number of the cases 58 cases having EF > 50%. Out of them all case has normal cardiac function in remaining cases of 9 cases have with EF 40-50%, and 33 cases have EF < 40%. Similarly, among total patients with HFrEF (14 patients) 12 patients have EF < 40%, which is statistically significant in correlation of EF < 40% with patients of cardiac dysfunction.

Left ventricular end diastolic diameter (LVEDd)

Most of cases of diabetes have LVEDd is in range of 38.9 – 56.1 mm, total 8 cases of diabetes among 47 cases have LVEDd > 56.1 in which 5 patients have HFrEF which is a 36 % of total HFrEF, this signifies relationship of increased LVEDd with HFrEF. Similarly, most of cases of hypertension have LVEDd is in range of 38.9 – 56.1 mm, total 6 cases of hypertension among 18 cases have LVEDd > 56.1 in which 3 patients have HFrEF which is a 21 % of total HFrEF, this signifies relationship of increased LVEDd with HFrEF, which is statistically significant in correlation with increased in LVEDd with patients of HFrEF.

Left ventricular end systolic diameter (LVESd)

Most of cases of diabetes have LVESd is in range of 21.4 – 37 mm. A total 10 cases of diabetes among 47 cases have LVESd > 37 mm in which 5 patients have HFrEF which is a 36 % of total HFrE, this signify relationship of increased LVESd with HFrEF. Similarly, most of cases of hypertension have LVESd is in range of 21.4 – 37 mm, total 5 cases of hypertension among 18 cases have LVESd > 37mm in which 3 patients have HFrEF which is a 21 % of total HFrEF, which is statistically significant in correlation with increased in LVESd with patients of HFrEF.

Conclusion

It can be concluded that the incidence of cardiac dysfunction (both diastolic and HFrEF) is higher in diabetes mellitus and hypertensive patients who are free of clinically detectable heart disease. The incidence was more in patients with diabetic and hypertensive those with HbA1c level >10 than isolated diabetes and Hypertension incidence of diastolic dysfunction is more among diabetes patients and incidence of systolic dysfunction is more among hypertensive patients but overall incidence of cardiac dysfunction were significantly raises when both diabetes and hypertension present simultaneously. The incidence of diastolic dysfunction had a strong correlation with the age of the patient and duration of diabetes and the incidence of cardiac dysfunction did not show any correlation with age, gender but high BMI with abnormal lipid profile, low socioeconomic status has significant correlation in patient with cardiac dysfunction. All the diabetic and hypertensive patients should undergo 2D Echocardiography evaluation for identifying diastolic dysfunction and systolic dysfunction. Patients should be advised strict control of diabetes and hypertension in order to reduce the risk for developing cardiac dysfunction.

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