

CLINICAL STUDY OF CARDIAC INVOLVEMENT IN GERIATRIC TYPE 2 DIABETES MELLITUS WITH REFERENCE TO ELECTROCARDIOGRAPHY AND 2D ECHOCARDIOGRAPHY

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ABSTRACT

Introduction: Cardiovascular problems brought on by ageing and the premature atherosclerosis unique to DM are the most common consequences. Thus Geriatric Diabetic patients have a high prevalence of cardiovascular disease (CVD). Coronary Artery diseases, Heart failure, Diabetic Autonomic cardiomyopathy causing arrhythmias are more common type of cardiovascular diseases in these group of patients.

Materials and Methods: The present prospective cross sectional hospital based observational study was conducted among 150 Geriatric patients with Type 2 diabetes Mellitus. A detailed clinical history was taken from all the patients regarding symptoms of Diabetes Mellitus Type 2. The data was collected and entered into a spread sheet application (Microsoft9 Excel).

Results: Majority of the study participants were among 60-70 years (89.33%) and least being >80 years(0.67%) .Majority of the study participants were females with 50.67% and 49.33% were males.

considering BMI, 47.61% cases were Overweight (25-30) and 15.65% cases were Obese (>30). Major duration of DM among study population was 10-20 years(50.67%) followed by <10 years (27.33%). Major symptoms suggestive of cardiovascular involvement was palpitation 44% followed by 37.33% fatigue. Major signs suggestive

of cardiovascular involvement was crepitations 13.33%, followed by 10% pedal edema. Major chest x-ray finding was cardiomegaly 12%, followed by 6.67% Pleural effusion. Major ECG changes considering infarction was NSTEMI 15.33% followed by 12% STEMI. Major ECG changes considering arrhythmias was sinus tachycardia 18% followed by 6.67% sinus bradycardia, 0.67% atrial fibrillation, 1.33% VPC, 19.33% LVH and 0.67% BBB. Major 2D Echo findings was 36.67% LVDD followed by 32.67% had Hypokinesia, 31% akinesia, 27.33% LVSD. It was observed that Around 62% had no cardiovascular involvement, 31.33% had Myocardial infarction, 20.67% arrhythmia, 12.67% heart failure and 12% Diabetic cardiomyopathy (HCM+DCM).

Conclusion: Geriatric Diabetics are at significantly increased risk for cardiovascular disease. Myocardial Infarction is commonest cardiovascular abnormality detected. ECG and Echocardiography are basic yet most sensitive diagnostic procedure to detect CVD at an early stage .

Keywords: Cardiovascular disease, diabetes mellitus, Geriatric, Coronary Artery diseases, Heart failure, Diabetic Autonomic cardiomyopathy

INTRODUCTION

In January 1999, the Government of India adopted the "National Policy on Older Persons," which defines a "elderly" person as one who is 60 years of age or older.¹ Diabetes is a heterogeneous complex metabolic disorder characterized by elevated blood glucose concentration secondary to either resistance to the action of insulin, insufficient insulin secretion, or both.²

ETIOLOGIC CLASSIFICATION OF DIABETES MELLITUS³

- I. Type 1 diabetes
- II. Type 2 diabetes
- III. Gestational Diabetes mellitus (GDM)
- IV. Other specific Types (Genetic defects of beta cell function, Endocrinopathies, Drug or chemical induced, Infections)

CRITERIA FOR THE DIAGNOSIS OF DIABETES MELLITUS AND IMPAIRED GLUCOSE HOMEOSTASIS⁴

Diabetes mellitus—positive findings from any two of the following tests on different days:
Symptoms of diabetes mellitus plus random plasma glucose concentration ≥ 200 mg per dL (11.1 mmol/L) Or FPG ≥ 126 mg per dL (7.0 mmol/L) Or 2hrPPG ≥ 200 mg per dL (11.1 mmol/L) after a 75-g glucose load
Impaired glucose homeostasis
Impaired fasting glucose: FPG from 110 to <126 (6.1 to 7.0 mmol/L) Impaired glucose tolerance: 2hrPPG from 140 to <200 (7.75 to <11.1)

mmol/L)	
Normal.	FPG <110 mg per dL (6.1 mmol per L) 2hrPPG <140 mg per dL (7.75 mmol per L)
HbA1C	<5.7%-Normal 5.7-6.4% Pre-diabetic >6.5% Diabetes

Diabetes mellitus is a major independent risk factor for cardiovascular disease (CVD) . The acceleration of coronary atherosclerosis, which develops at an earlier age and advances more quickly to clinical cardiovascular events in people with diabetes than in those without diabetes, has been attributed in large part to the increase prevalence of CVD in the population. Patients with diabetes are also prone to arterial thrombosis due to persistently activated thrombogenic pathways and impaired fibrinolysis. One of the main underlying causes of acute ischemic coronary heart disease is this combination of increased arterial disease and a prothrombotic environment in diabetes ⁵.

The increased risk of cardiovascular disease in individuals with diabetes is appears to relate to the synergism of risk factors, including dyslipidemia, hypertension, hyperglycemia, hyperinsulinemia, and prothrombotic factors⁶. The ACCORD trial and VADT trial results, showed that strict glucose management had no impact on cardiovascular outcomes in people with established cardiovascular disease, due to the significance of insulin resistance and dyslipidemia.⁵

COMMON CARDIOVASCULAR DISEASES IN GERIATRIC DIABETES

A. CORONARY ARTERY DISEASE.

B. CARDIOMYOPATHIES

C. DIABETIC CARDIOVASCULAR AUTONOMIC NEUROPATHY

A. CORONARY ARTERY DISEASE

Ischemic heart disease (IHD) is a condition in which there is an inadequate supply of blood and oxygen to a portion of the myocardium; it typically occurs when there is an imbalance between myocardial oxygen supply and demand.⁷

Stable angina typically presents as substernal chest pain or pressure that worsens with exertion or emotional stress and gets relieved with rest or nitroglycerin ⁸

Patients with acute coronary syndrome (ACS) are commonly classified into two groups to facilitate evaluation and management, namely patients with acute myocardial infarction (MI) with ST-segment elevation (STEMI) on their presenting electrocardiogram (ECG) and those with non-ST-segment elevation acute coronary syndrome (NSTEMI-ACS).⁹

Diabetes mellitus is a risk factor for new coronary events in elderly men and women. In the Cardiovascular Health Study, an elevated fasting glucose level (>130 mg/ dL) increased 5-year mortality 1.9 times. At 40-month follow-up of 664 elderly men and at 48-month follow-up of 1488 elderly women, diabetes mellitus increased the relative risk of new coronary events 1.9 times in men and 1.8 times in women.¹⁰

B. CARDIOMYOPATHY IN DIABETES

Diabetic cardiomyopathy is defined by the existence of abnormal myocardial structure and performance in the absence of other cardiac risk factors, such as coronary artery disease, hypertension, and significant valvular disease, in individuals with diabetes mellitus.¹¹ In 2013, the American College of Cardiology Foundation, the American Heart Association, and the European Society of Cardiology in collaboration with the European Association for the Study of Diabetes defined diabetic cardiomyopathy as a clinical condition of ventricular dysfunction that occurs in the absence of coronary atherosclerosis and hypertension in patients with diabetes mellitus¹¹.

Diabetic Cardiomyopathy A Population Based Study in Olmsted County, MN. This study is the first to determine a population-based prevalence of diabetic cardiomyopathy as defined by left ventricular dysfunction in diabetic patients in the absence of coronary, valvular or hypertensive disease. Study from Olmsted County, MN, results showed prevalence of DCM in diabetic patients is 16.9% and the prevalence of diastolic dysfunction in diabetic patients is 54%.¹² Paralleling the incidence of CAD in patients with diabetes is the incidence of heart failure. Heart failure is a frequent clinical manifestation of the end stage of cardiovascular complications that afflicts patients with diabetes.¹³ Dilated cardiomyopathy develops insidiously, and may not initially cause symptoms significant enough to impact on quality of life. Nevertheless, many people experience significant symptoms. These might include: fatigue, leg swelling, and shortness of breath, Syncope, palpitations.¹⁴ No specific electrocardiographic (ECG) pattern is diagnostic of HF. Rather, the ECG may provide important information regarding presence of underlying cardiac disease. When left bundle-branch block (LBBB) is accompanied by right axis deviation (RAD), the rare combination is considered to be highly suggestive of dilated cardiomyopathy¹⁵. Echocardiography shows left ventricular dilatation and thinning of walls with reduced ejection fraction¹⁶.

C. DIABETIC CARDIOVASCULAR AUTONOMIC NEUROPATHY

Autonomic neuropathy is a common complication of both type 1 and 2 diabetes. Common clinical manifestations of diabetic autonomic neuropathy (DAN) include orthostatic hypotension, gastroparesis, and Cardiac arrhythmias¹⁷.

Study by Gaurav Agarwal et al. Done study on the prevalence of different types of arrhythmias in 100 patients of Type 2 Diabetes Mellitus presented with cardiac arrhythmias, particularly in association with Cardiac Autonomic Neuropathy (CAN). Study results showed, Sinus Tachycardia (ST) was the commonest arrhythmia, found in 32% of patients. 20% had Complete Heart Block (CHB), 15% had Sinus Bradycardia (SB), and 15% had Atrial Fibrillation (AF). Ventricular Premature Complex (VPC) was found in 10%. Poorly controlled diabetes and co-morbidities was associated with higher incidence of arrhythmias.¹⁸

In old age (≥ 60 –65 years old), DM is becoming an alarming public health problem in world. DM complications and co-morbidities are more frequent in old diabetics

compared to their young counterparts. The most frequent are cardiovascular diseases due to old age and to precocious atherosclerosis specific to DM.¹⁹

The ECG and Echocardiography are basic yet most sensitive diagnostic modalities to detect CVD early. Researchers from all around the world have worked hard to identify the underlying pathology and assist patients with CVD. Understanding the mechanism of cardiovascular illnesses will allow us for early detection, treatment and prevention of this devastating disease. Hence, the current study was carried out with a aim of studying the occurrence of cardiac abnormalities in Geriatric patients with Type 2 Diabetes Mellitus.

MATERIALS AND METHODS:

Source of Data:The present prospective cross sectional hospital based observational study was conducted among 150 Geriatric patients with Type 2 diabetes Mellitus from October 2020 to September 2022.

METHODOLOGY

The study was conducted after taking permission from institutional ethics committee. Geriatric type 2 diabetic patients were taken up for the study. A detailed clinical history was taken from all the patients regarding symptoms of Diabetes Mellitus Type-2. Patients were examined for signs and symptoms of Diabetes mellitus.

Investigations

The Patient were subjected for detailed investigations : Complete blood count, Renal function test, Serum electrolytes, Liver function test, Urine R/M, ECG, Chest X-Ray AP view, USG Abdomen, 2D echo, FLP, BSL-R, HbA1c.

Inclusion criteria

- All geriatric patients (age ≥ 60 years) previously diagnosed as Type 2 Diabetes Mellitus.
- Newly diagnosed cases of Type 2 Diabetes Mellitus aged 60 years or more.

Exclusion criteria

- Diabetic patients aged less than 60 years.
- Patients with cardiovascular diseases with no known causal relation to Diabetes Mellitus.
- Patients having Diabetes with Hypertension.

Analysis

The data was collected and entered into a spreadsheet application (Microsoft Excel) prior to being exported to the SPSS version 20 data editor page (SPSS Inc., Chicago, Illinois, USA). Independent sample chi-square test were used as statistical tests in this study. The confidence interval and p-value were set at 95% and 5%, respectively.

Results:

Table 1. Age wise distribution of study population

Age (years)	Frequency	Percentage
60-70	134	89.33
70-80	15	10.00
> 80	1	0.67
Mean \pm SD	64.98 \pm 3.73	

The above table shows the age distribution of cases. Mean age of the study participants were around 64.98 \pm 3.73 years.

Majority of the study participants were among 60-70 years 89.33%, followed by 70-80 years 10% and least being 0.67% >80 years.

Table 2. Gender wise distribution of study population

Gender	Frequency	Percentage
Male	74	49.33
Female	76	50.67
Total	150	100.00

The above table displays cases according to gender distribution. Majority of the study participants were females with 50.67% and 49.33% were males.

Table 3. Distribution of study population according to BMI (kg/m²)

BMI (kg/m ²)	Frequency	Percentage
18.5-22.9	26	17.69
23-24.9	28	19.05
25-30	70	47.61
> 30	23	15.65
Total	147	100.00

The above table shows distribution of cases according to BMI categories. It was observed that 17.69% (18.5-22.9), 19.05% (23-24.9) that makes total of 36.74% cases in Normal BMI range (18.5-24.9), 47.61% cases were Overweight (25-30) and 15.65% cases were Obese (>30).

Table 4. Distribution of study population according to duration of DM-II (years)

Duration of Diabetes mellitus	Frequency	Percentage
<10	41	27.33
10 -20	76	50.67
>20	33	22.00
Mean \pm SD	14.96 \pm 8.31	

The above table displays distribution of cases according to duration of diabetes mellitus. It was observed that 27.33% cases were <10 years, 50.67% cases were 10-20 years and 22% cases were >20 years.

Table 5. Distribution of symptoms suggestive of cardiovascular involvement in the study population

Symptoms	Frequency	Percentage
Dyspnea	50	33.33
Orthopnea	14	9.33
PND	15	10.00
Fatigue	56	37.33
Chest Pain	33	22.00
Palpitation	66	44.00
Sweating	50	33.33

The table above displays distribution of cases according to symptoms suggestive of cardiovascular involvement. It was observed that Around 33.33% had dyspnoea, 9.33% orthopnoea, 10% PND, 37.33% fatigue, 22% chest pain, 44% palpitation and 33.33% sweating.

Table 6. Distribution of signs suggestive of cardiovascular involvement in the study population

Signs	Frequency	Percentage
JVP	14	9.33
Pedal oedema	15	10.00
Added sound, S3+	7	4.67
Added sound, S4+	3	2.00
Crepitations	20	13.33
Hepatomegaly	1	0.67

The table above displays distribution of cases according to signs suggestive of cardiovascular involvement. It was observed that Around 9.33% had raised JVP, 10% pedal edema, 4.67% added sound, S3+, 2% added sound S4+, 13.33% crepitations and 0.67% hepatomegaly.

Table 7. Distribution of Blood Sugar profile in the study population

Indicators	Category	Frequency	Percentage
Fasting BSL (mg/dl)	<126	44	29.33
	126-200	42	28.00
	>200	64	42.67
PP BSL (mg/dl)	<200	45	30.00
	200-300	34	22.67
	>300	71	47.33
HBA1c (%)	<6.5	16	10.67
	6.5-7.5	54	36.00
	7.5-8.5	51	34.00
	>8.5	29	19.33

The above table shows distribution of cases according to Blood sugar profile. It was observed that Around 29.33% had Fasting BSL of 29.33% <126 mg/dl, 28% with 126-200 mg/dl, 42.67% with >200 mg/dl. With respect to Post prandial blood sugar levels 30% had <200 gm/dl, 22.67% 200-300 gm/dl and 47.33% >300 gm/dl. With

respect to HBA1c 10.67% in <6.5, 36% 6.5-7.5, 34% 7.5-8.5 and 19.33 >8.5.

Table 8. Distribution of Lipid profile in study population

Parameter	Category	Frequency	Percentage
TC (mg/dl)	<200	87	58.00
	200-300	48	32.00
	>300	15	10.00
TG (mg/dl)	<150	90	60.00
	150-200	60	40.00
	>200	0	0
LDL (mg/dl)	≤100	97	64.67
	>100	53	35.33
HDL (mg/dl)	≤30	75	50.00
	>30	75	50.00

The above table shows distribution of cases according to Lipid profile. It was observed that Around 58% had TC<200 mg/dl, 32% 200-300 mg/dl and 10% >300 mg/dl. Around 60% had <150 mg/dl, 40% 150-200 mg/dl. Around 64.67% had ≤100 mg/dl and 35.33% >100 mg/dl. Around 50% had ≤30 mg/dl and 50% >30 mg/dl.

Table 9. Distribution of Pro BNP level and Trop I level in the study population

Parameter	Category	Frequency	Percentage
PRO BNP	Raised	19	12.67
Trop I	>10	49	32.67

The above table shows distribution of cases according to cardiac biomarkers. It was observed that Around 12.67% had raised PRO BNP and 32.67% had increased Trop I levels.

Table 10. Distribution of key X-ray findings in the study population

Chest X ray findings	Frequency	Percentage
Normal	124	82.67
Kerley B line	1	0.67
Plural effusion	10	6.67
Pulmonary oedema	8	5.33
Cardiomegaly	18	12.00

The above table shows distribution of cases according to chest x ray. It was observed that Around 82.67% had normal X-ray, 0.67% Kerley B lines, 6.67% Pleural effusion, 5.33% pulmonary edema and 12% cardiomegaly.

Table 11. Distribution of ECG findings in the study population

ECG findings	Frequency	Percentage
Normal	50	33.33
STEMI	18	12.00
NSTEMI	23	15.33
q wave	5	3.33
Sinus Tachy	27	18.00

Sinus Brady	10	6.67
Atrial fibrillation	1	0.67
VPC	2	1.33
LVH	29	19.33
BBB	1	0.67

The above table shows distribution of cases according to ECG. It was observed that around 33% had normal ECG findings, 12% STEMI, 15.33% NSTEMI, 3.33% q wave, 18% sinus tachycardia, 6.67% sinus bradycardia, 0.67% atrial fibrillation, 1.33% VPC, 19.33% LVH and 0.67% BBB.

Table 12. Distribution of Electrocardiography findings in study population

ECG findings	Category	Frequency	Percentage
Hypokinesia	Positive	49	32.67
Akinesia	Positive	47	31
LVSD	Positive	41	27.33
LVDD	Positive	55	36.67
EF	<40	15	10
	40-50	8	5.33
	≥50	127	84.67

The above table shows distribution of cases according to 2D Echo findings . It was observed that Around 32.67% had Hypokinesia, 31% akinesia, 27.33% LVSD, 36.67% LVDD. Considering Ejection fraction, 10% of cases had EF of <40%, 5.33% had EF between 40%-50% and 84.67% had EF of ≥50%.

Table 13. Distribution of diagnosis of Cardiovascular disease involvements in study population

Diagnosis	Frequency	Percent
Normal	93	62.00
MI	47	31.33
Arrhythmia	31	20.67
HF	19	12.67
Diabetic cardiomyopathy (HCM+DCM)	18	12.00

The above table shows distribution of cases according to CVD involvement. It was observed that Around 62% had no cardiovascular involvement, 31.33% had Myocardial infarction, 20.67% arrhythmia, 12.67% heart failure and 12% Diabetic cardiomyopathy (HCM+DCM).

Table 14. Correlation of Blood sugar profile and CVD in the study population

Diagnosed cases	HBA1c f (%)		Chi square value	p Value	PP BSL (mg/dl) f (%)		Chi square value	p Value
	<6.5	≥6.5			<200	≥200		
MI (N=47)	0	47 (100)	8.173	0.004	0	47 (100)	29.334	<0.001

Arrhythmia (N=31)	0	31 (100)	4.666	0.031	0	31 (100)	16.747	<0.001
HF (N=19)	0	19 (100)	2.598	0.107	0	19 (100)	9.324	0.002
Diabetic cardiomyopathy (HCM+DCM) (N=18)	0	18 (100)	2.442	0.118	0	18 (100)	8.766	0.003

f(%) Frequency (percentage), N; Number, Test applied: Chi-square test

The above table shows Correlation of Blood sugar profile with CVD . It was observed that All Cardiovascular disease cases including Myocardial infarction, Arrhythmia , Heart failure and Diabetic cardiomyopathy patients had HbA1C \geq 6.5 and post prandial blood sugar levels \geq 200 mg/dl. Statistically significant correlation exist between HbA1c and cardiovascular diseases among study population only with Myocardial Infarction(p=0.004) and Cardiac arrhythmias (p=0.031). Statistically significant correlation exist between post-prandial BSL and all cardiovascular diseases among study population, with Myocardial Infarction(p= $<$ 0.001), Cardiac arrhythmias (p= $<$ 0.001), heart failure(p=0.002) and diabetic cardiomyopathy(p= 0.003).

Table 15. Correlation of BMI and CVD in the study population

Cases	BMI (kg/m ²) f (%)		Chi square Value	p Value
	<25	>25		
MI (N=46)	2 (4.25)	45 (95.65)	33.082	<0.001
Arrhythmia (N=31)	22 (71.00)	9 (29.00)	18.026	<0.001
HF (N=19)	2 (10.52)	17 (89.48)	6.97	0.008
Diabetic cardiomyopathy (HCM+DCM) (N=18)	3 (16.67)	15 (83.33)	3.951	0.47

f(%) Frequency (percentage), N; Number, Test applied: Chi-square test

The Above table shows Correlation of BMI and CVD .It was observed that Among myocardial infarction patients 95.65%(p= $<$ 0.001) had BMI of >25. Among arrhythmia patients 29%(p= $<$ 0.001) had BMI of >25. Among heart failure patients 89.48%(p=0.008) BMI of >25. Among diabetic cardiomyopathy 83.33%(p=0.47) BMI of >25. Statistically significant correlation exist between BMI and Myocardial Infarction, Cardiac arrhythmias and heart failure.

Table 16. Correlation of Lipid profile and CVD across the study population

Cases	TC (mg/dl) f (%)		Chi square Value	p Value	LDL (mg/dl) f (%)		Chi square Value	p Value
	\leq 200	>200			\leq 100	>100		
	MI (N=46)	4			43	75.60		

	(8.51)	(91.49)	9	1	(17.02)	(89.98)	0	1
))))		
Arrhythmia (N=31)	29 (93.55)	2 (6.45)	18.32 5	<0.00 1	29 (93.55)	2 (6.45)	14.26 6	<0.00 1
HF (N=19)	4 (21.05)	15 (78.95)	13.75 1	<0.00 1	8 (42.11)	11 (57.89)	4.847	0.028
Diabetic cardiomyopath y (HCM+DCM) (N=18)	15 (83.33)	3 (16.67)	4.640	0.031	15 (83.33)	3 (16.67)	3.119	0.077

f(%) Frequency (percentage), N; Number, Test applied: Chi-square test

The above table shows Correlation of Lipid profile and CVD .It was observed that ,Among myocardial infarction patients 91.49% (p=<0.001) had >200 mg/dl of TC. Among arrhythmia patients 6.45%(p=<0.001) had >200 mg/dl of TC. Among heart failure patients 78.95%(p=<0.001) had >200 mg/dl of TC. Among diabetic cardiomyopathy patients 16.67%(p=0.031) had >200 mg/dl of TC. Statistically significant correlation exist between total cholesterol and all cardiovascular diseases.

Considering LDL, Among myocardial infarction patients 89.98% (p=<0.001) had >100 mg/dl LDL, Among arrhythmia patients 6.45%(p=<0.001) had >100 mg/dl LDL ,Among heart failure patients 57.89%(p=0.028) had >100 mg/dl LDL and Among diabetic cardiomyopathy patients 16.67%(p=0.077) had >100 mg/dl LDL. Statistically significant correlation exist between LDL and Myocardial Infarction, Cardiac arrhythmias and heart failure.

DISCUSSION

Age wise distribution of cases

In the present study Mean age of the participants were around 64.98 ± 3.73 years. Sardesai et al²⁰ the mean age of patients was 56.3 ± 8.60 .

In a study by Einarson et al²¹ 47.0% aged 63.6 ± 6.9 years old.

Sex wise distribution of study subjects

In our study around 49.33% were males and 50.67% were females. In a study by Sardesai et al²⁰ males were 58.5%, whereas females were 41.5%.

Distribution of study subjects according to BMI and Duration of diabetes

In our study among BMI of 18.5-22.9 (17.69%), 23-24.9 (19.05%), 25-30 (47.61%) and more than 30 (15.65%). In a study by Patil et al²² mean BMI 27.6 ± 2.2 kg/m².

In present study among Duration of diabetes <10 years were 27.33%, 10-20 years 50.67% and >20 years were 22%. In a study by Einarson et al²¹ 47.0% subjects were with T2DM duration of 10.4 ± 3.7 years. In a study by Sardesai et al²⁰ patients with duration of diabetes more than 5 years were 39.2%. In a study by Patil et al²² total 78 (61.41%) subjects were with the duration of diabetes between 6-10 years, and 49 (38.58%) were between 11-15 years.

Distribution of cases according to Symptoms and signs Suggestive of cardiovascular involvement

In our study around considering symptoms 33.33% had dyspnoea, 9.33% orthopnoea, 10% PND, 37.33% fatigue, 22% chest pain, 44% palpitation and 33.33% sweating. In a study by Pattoneri et al²³ majority had palpitations and sweating.

In our study considering signs among 9.33% had raised JVP, 10% pedal edema, 13.33% crepitations and 0.67% hepatomegaly. In a study by Pattoneri et al²³ 5% had pedal edema, 6% had heptomegaly.

Distribution of cases according to laboratory Profile

In our study 70.67% had Fasting BSL of >126 mg/dl, 70% had >200 gm/dl of PP BSL and 53.33% had HBA1c >6.5. In our study among 42% had >200-300 mg/dl of Total Cholesterol, 40% had >150 mg/dl of Triglycerides, 35.33% had >100 mg/dl of LDL. In a study by Pattoneri et al²³ around 14% had hypercholesterolemia. In present study Around 12.67% had raised PRO BNP and 32.67% had increased Trop I levels.

Distribution of cases according to ECG findings

In our study among 33% had normal ECG findings, 12% STEMI, 15.33% NSTEMI, 3.33% q wave, 19.33% LVH and 0.67% BBB. In a study by Sardesai et al²⁰ study showed, Among patients with abnormal ECG (53.1%), 17.7% of cases had ST-T changes/T-Inversion, 8.5% of cases had bundle branch block, 3.8% of cases had q waves. In a study by Muddu et al²⁴ prevalence of LVH was up to 19.3% of the patients, same prevalence we got in our study.

In our study among the other arrhythmic ECG findings most common being 18% sinus tachycardia, 6.67% sinus bradycardia, 0.67% atrial fibrillation, 1.33% VPC. In a study by Agarwal et al²⁴ Sinus Tachycardia was the commonest arrhythmia, found in 32% of patients. 15% had Sinus Bradycardia, and 15% had Atrial Fibrillation. Ventricular Premature Complex (VPC) was found in 10%. In a study by Sardesai et al²⁰ out of 53.1% of total cases of abnormal ECG findings 20% had resting sinus tachycardia.

Distribution of cases according to 2D Echocardiography Findings

In our study Around 32.67% had Hypokinesia, 31% akinesia, 27.33% LVSD, 36.67% LVDD, 10% EF <40%, 5.33% 40%-50% and 84.67% ≥50%. In a study by Sardesai et al²⁰ study showed, Among the 53.8% of total cases having abnormal findings on 2D Echo, 48.5% of cases had diastolic dysfunction, 11.5% systolic dysfunction. In a study by Dandamudi et al²⁵ Among diabetic patients the prevalence of diastolic dysfunction was 54%.

Distribution of cases according to Cardiovascular involvement

Around 38% of cases of cardiovascular involvements, 31.33% had Myocardial infarction, 20.67% arrhythmia, 12.67% heart failure and 12% Diabetic cardiomyopathy. In a study by Einarson et al²¹ CVD affected 32.2% overall study population, 31.2% had coronary heart disease (including myocardial infarction), 14.9% heart failure. In a study by Dandamudi et al²⁵ Among diabetic patients the prevalence of Diabetic cardiomyopathy is 16.9%

Correlation between Diabetes and other risk factors with cardiovascular diseases.

In the present study Among the study population All cases having cardiovascular involvement had post prandial blood sugar levels ≥200 mg/dl and HbA1c

value $\geq 6.5\%$.

Statistically significant correlation exist between post-prandial BSL and cardiovascular diseases among study population with Myocardial Infarction($p < 0.001$), Cardiac arrhythmias ($p < 0.001$), heart failure($p = 0.002$) and diabetic cardiomyopathy($p = 0.003$).

Statistically significant correlation exist between HbA1c and cardiovascular diseases among study population only with Myocardial Infarction($p = 0.004$) and Cardiac arrhythmias ($p = 0.031$).

In a study by Esteghamati et al²⁶ suggested Diabetics patients with MI had significantly higher BS (274.7 ± 130.8 mg/dl, $p < 0.005$) and HbA1c (10 ± 2.4 , $p < 0.05$), same significance was found in present study too.

In a study by Patil et al²² out of 38 subjects with HbA1c $> 7.5\%$, 31 (81.57%) had diastolic dysfunction. Subjects with HbA1c $> 7.5\%$ had more prevalence of diastolic dysfunction, than subjects with HbA1c $< 7.5\%$.

In a study by Roy et al²⁷ poor glycemic status, that is high FBS ($p = 0.007$) and PPBS ($p = 0.001$), was associated with left ventricular systolic dysfunction on 2D echocardiography. Results showed among 226 patients, 29.2% patients had left ventricular systolic dysfunction, but in our study it was only 11.5%.

In the present study, Among myocardial infarction patients 95.65% ($p < 0.001$) had BMI of > 25 . Among arrhythmia patients 29% ($p < 0.001$) had BMI of > 25 . Among heart failure patients 89.48% ($p = 0.008$) BMI of > 25 . Among diabetic cardiomyopathy 83.33% ($p = 0.47$) BMI of > 25 . Statistically significant correlation exist between BMI and Myocardial Infarction, Cardiac arrhythmias and heart failure.

In the present study, among myocardial infarction patients 91.49% ($p < 0.001$) had > 200 mg/dl of TC (total cholesterol). Among arrhythmia patients 6.45% ($p < 0.001$) had > 200 mg/dl TC. Among heart failure patients 78.95% ($p < 0.001$) had > 200 mg/dl TC. Among diabetic cardiomyopathy patients 16.67% ($p < 0.031$) had > 200 mg/dl TC. Statistically significant correlation exist between total cholesterol and all cardiovascular diseases.

CONCLUSION

The current study came to the conclusion that Geriatric Diabetics are at significantly increased risk for cardiovascular disease. Myocardial Infarction is commonest cardiovascular abnormality detected. Statistically significant correlation exist between cardiovascular diseases and Blood sugar profile, BMI, Lipid profile. ECG and Echocardiography are basic yet most sensitive diagnostic procedure to detect CVD at an early stage. Given the large burden that CVD exerts on healthcare systems, early attention, proper control and treatment directed to all cardiovascular risk factors is central to curbing this growing problem.

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