Cardiac Complications of Diabetes Mellitus: A Prospective Study

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Abstract

Background: The purpose of this study is to assess the various cardiac manifestations in diabetes mellitus (DM) like coronary artery disease and non-coronary artery disease. To evaluate the associated risk factors in patients with DM and cardiac diseases. Correlation between cardiac disease and duration of DM.

Methods: A total of 100 patients admitted or attending outpatient clinics and fulfilling the inclusion criteria were evaluated clinically. A baseline electrocardiogram (ECG) was taken in all cases irrespective of cardiac involvement. Patients with normal ECG pattern were further evaluated with a stress test for latent coronary artery disease. All the patients were subjected to routine investigations.

Results: The mean age of the study group was 55.54 years. The mean duration of DM was 9 years. 40 out of 100 patients had ischemic heart disease. Out of 18 patients of angina pectoris, only 4 had symptoms correlating with angina and had resting ECG abnormalities. Rest 14 patients (17.94%) had latent coronary artery disease detected by the stress test. Out of 22 patients with myocardial infarction (MI) eight patients (36.36%) had atypical or silent MI, which was detected by routine ECG recording.

Conclusion: With the present study, it can be concluded that there is a high occurrence of coronary artery disease with coronary risk factors in patients with DM. Every patient with DM should be screened for latent coronary artery disease. Furthermore, all patients with prolonged history of DM should be screened clinically with simple tests for the presence of cardiac autonomic neuropathy and managed accordingly.

Key words: Angina pectoris, Blood sugar levels, Cardiomyopathy, Coronary artery disease, Diabetes, Dyslipidemia, Glycosylated hemoglobin, Smoking

INTRODUCTION

Diabetes with cardiac complications is a well-known global problem. The prevalence of diabetes mellitus (DM) in Urban South India (as reported by Ramachandran *et al.*) is 5%. Diabetes is present in 21% of people aged 40 and above. The peak incidence of 41% is in age group 55-64. The incidence, prevalence, and the pattern of occurrence of coronary artery disease are increasing in India and South Asian countries.[1] Coronary artery disease is more prevalent and more severe and occurs early in diabetics than non-diabetics. The higher incidence of angina pectoris, myocardial infarction (MI) (including silent MI), and congestive cardiac failure has been reported in DM. Early recognition of coronary artery disease in DM patients may, therefore, be important for management and prognostic purpose.[2]

Objectives of the Study

I. To study the various cardiac manifestations in DM like:
    Coronary artery disease: (1) Ischemic heart disease (IHD), (2) Acute MI, and (3) Silent MI
    Non-coronary artery disease: (1) Cardiac autonomic neuropathy and (2) Diabetic cardiomyopathy.
II. To evaluate the associated risk factors in patients with DM and cardiac diseases.
III. Correlation between cardiac disease and duration of DM.

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MATERIALS AND METHODS

The protocol was approved by the local ethics committee and written informed consent was obtained from each patient. 100 patients admitted or attending outpatient clinics and fulfilling the inclusion criteria (mentioned below) were evaluated clinically. A baseline electrocardiogram (ECG) was taken in all cases irrespective of cardiac involvement. Patients with normal ECG pattern are further evaluated with the stress test for latent coronary artery disease. All the patients subjected to the following investigations.
1. Fasting blood sugar (FBS) level
2. Postprandial blood sugar level
3. Blood urea
4. Serum creatinine
5. Lipid profile
6. Cardiac enzymes (is necessary)
7. Echocardiography (if necessary)
8. Glycosylated hemoglobin.

Inclusion Criteria
I. Patients above the age of 18 years
II. Patients with type 1 DM
III. Patients with type 2 DM.

Exclusion Criteria
I. Patients with hypertensive heart diseases
II. Patients with corpulmonale
III. Patients with rheumatic heart disease and congenital heart disease
IV. Patients with gestational diabetes mel1itus.

RESULTS AND OBSERVATIONS

About 100 patients of DM type 1 and type 2 attending the outpatient clinics and admitted in ICCU and medical wards that satisfied the inclusion criteria were studied, and the following observations were made (Tables 1-13).

The maximum numbers of patients were found to be in the age group of 41-60 years (73% of patients) (Table 1).

46% of patients had FBS between 120 and 180 mg% (Table 3).

65% of patients had blood sugar level between 200 and 400 mg% (Table 4).

In this study, 40% of patients had evidence of IHD. 36% of patients had cardiac autonomic neuropathy. 10% of patients developed congestive cardiac failure and 4% of patients had dilated cardiomyopathy (Table 6).

Table 1: Sex preponderance

Age (years)	Male	Female	Total (%)
20-40	1	1	2 (2)
41-50	28	15	43 (43)
51-60	17	13	30 (30)
61-70	8	4	12 (12)
71 and above	10	3	13 (13)
Total	64	36	100 (100)

Table 2: Duration of diabetes mellitus

Age (years)	Male	Female
0-5	21	8
5-10	25	18
11-15	12	7
16 and above	16	3
Total	64	36

Table 3: The fasting blood glucose value at the time of presentation

Range (mg%)	Male	Female	Total (%)
<120	4	4	8 (8)
120-180	33	13	46 (46)
181-250	19	11	30 (30)
>250	8	6	14 (14)

Table 4: Post prandial blood sugar level at the time of presentation

Range (mg%)	Male	Female	Total (%)
<200	7	9	16 (16)
200-300	35	9	44 (44)
301-400	12	9	21 (21)
>400	-	2	2 (2)

Table 5: The presenting symptoms of the patients in present study

Symptoms	Male	Female	Total (%)
Chest pain	8	10	18 (18)
Swelling of feet	4	6	10 (10)
Palpitation	10	8	18 (18)
Dizziness	5	3	8 (8)
Breathlessness	6	8	14 (14)
Other symptoms	26	12	38 (38)

Table 6: The varied clinical manifestations in the present study

Patten	Males	Females	Total (%)
Angina	9	9	18 (18)
Myocardial infarction	10	12	22 (22)
Cardiac autonomic neuropathy	20	16	36 (36)
Congestive cardiac failure	4	6	10 (10)
Dilated cardiomyopathy	2	2	4 (4)
Sudden cardiac death	0	0	-

Table 7: Pattern of IHD

Pattern	Males	Female	Total (%)
Angina	9	9	18 (18)
Myocardial infarction	10	12	22 (22)

IHD: Ischemic heart disease

Table 8: Pattern of myocardial infarction

Pattern	Male	Female	Total (%)
Symptomatic MI	6	8	14 (63.63)
Atypical symptoms or silent MI	4	4	8 (36.36)

N=22, male=10, female=12. MI: Myocardial infarction

Table 9: Symptoms associated with atypical manifestations of myocardial infarction

Symptoms	Number of cases
Chest pain	1
Angina	-
Atypical	1
Epigastric pain	2
Dyspnea	1
Only	-
With pulmonary edema	1
With congestive cardiac failure	-

N=8, male=4, female=4

Table 10: The pattern of MI (*N*=22)

Pattern of infarction	Number of patients (%)
Anterior or anterolateral infarction	12 (55.54)
Inferior wall infarction	4 (18.18)
Inferior wall infarction with right ventricular extension	2 (9.09)
Non-Q wave MI	4 (18.18)

MI: Myocardial infarction

Among 40 patients of IHD 18 patients had angina and 22 patients had MI. Out of 18 patients of angina, only 4 had typical ischemic changes on resting ECG, rest of the 14 patients had latent coronary artery disease, which was detected by stress test (Table 7).

36.36% of patients in this study presented with atypical symptoms or silent MI, which was detected on routine ECG recording (Table 8).

4 patients out of 22 patients presenting with MI had atypical presentations. 4 out of 22 (18.20 %) patients with MI were totally silent detected on routine ECG (Table 9).

Parasympathetic involvement was more common than sympathetic involvement (Table 11).

The most common symptoms of autonomic neuropathy in this study were postural giddiness, impotence, and bowel disturbances (Table 12).[2]

Table 11: Cardiac autonomic neuropathy in this study

Pattern	Male	Female	Total (%)
Parasympathetic	13	9	22 (61.11)
Sympathetic	7	7	14 (38.88)

N=36, males=20, females=16

Table 12: The symptomatology of autonomic neuropathy

Symptoms	Number of cases (%)
Postural giddiness	8 (22.22)
Impotence	3/20 (15.00)
Constipation	7 (19.45)
Disordered sweating	5 (13.89)
Bladder disturbances	4 (11.12)
Diarrhea	3 (8.34)

N=36, males=20, females=16

Table 13: The mean lipid levels in the study group

Lipid levels	Males (mg%)	Females (mg%)
Total cholesterol	200.4	214.8
LDL-cholesterol	117.7	117.4
Triglycerides	161.2	163.5
HDL-cholesterol	40.9	40.3

LDL: Low-density lipoprotein, HDL: High-density lipoprotein

Congestive Cardiac Failure

In this series of study, 10 patients presented with signs and symptoms of congestive cardiac failure (4 males and 6 females).

Dilated Cardiomyopathy

Four patients (2 males and 2 females) who presented with congestive cardiac failure were evaluated with echocardiography. All four patients had dilated chambers and decreased ejection fraction. Diagnosis of diabetic cardiomyopathy was made excluding other causes of dilated cardiomyopathy.

Lipid Profile

The mean total cholesterol level was higher in females compared to males (214.8 vs. 200.4 mg%). The mean triglyceride level was again higher in females (163.5 mg% vs. 161.5 mg%). High-density lipoprotein (HDL)-cholesterol was less in females compared to males (40.3 mg% vs. 40.9 mg%) (Table 13).

Build table showing the mean body mass index (BMI) in the study:

Males	Females
22.6	23.1

The mean BMI of male patients in this study group was 22.6 and that of females was 23.1. BMI of females was higher. 13 males and 5 females had BM1 above 25.

Smoking and Alcoholism
16 males (25%) and one female (2.7%) among the study group were chronic smokers (biddies and or cigarettes). 18 males (28.12%) consumed alcohol; none of the female patients were alcoholics.

DISCUSSION

In the present study, 100 patients of DM were studied and following observations were made.

Age
The mean age of the study group was 55.54 years (males - 55.73 years and females 55.19 years). The mean age group of the study group by Meenu Walia *et al.* was 53.71 ± 8.17 years for males and 52.61 ± 7.05 for females. The age range in this study group is 40-82 years.

Sex
In the present study, group of 100 patients, 64 were male patients, and 36 were female patients. The ratio of male:female is 1.7:1.

Duration of DM
The mean duration or DM in this study was 9.00 years. 9.07 years being in males and 8.86 years for females.

Levels of Hyperglycemia
The mean fasting blood glucose level in this study was 185.9 mg% (males - 184.5 mg% and females - 188.55 mg%). Meenu Walia *et al.* reported an FBS value of 155.67 ± 53.92 mg% in males and 173.61 ± 71.70 mg% in females.[3] The values in our study correlate with the above-mentioned study.[4]

The mean post prandial blood sugar level at the time of presentation in the study group was 263.3 mg% (males - 264.15 mg% and females - 261.89 mg%).

IHD
In this study of 100 patients of DM, 40 patients had IHD.

Out of 40 patients of IHD, 18 patients had angina pectoris. Only 4 patients had typical history of chest pain correlating with angina pectoris and resting ECG was showing ischemic changes. Rest of 14 patients (17.94%) had latent coronary artery disease which was detected by thread mill test. Gupta and Pandit have reported in their study a prevalence of 36.3% of latent coronary artery disease. Meenu Walia *et al.* reported the prevalence of coronary artery disease among type 2 diabetes patients to be 15.57%.[5] The present study

correlates with the above-mentioned studies. Various other studies report widely variable prevalence of coronary heart disease among diabetics in India (6.6-33%).[6]

MI
Among 22 patients with MI in the present study, 10 patients were male and 12 patients were females. Females outnumber males in this study, which correlates with the study reported by Partamian and Bradley in their series.[7]

In this series of 22 patients with MI, 18 patients (36.36%) of patients presented with atypical manifestations or silent infarction, which was detected during routine electrocardiographic recording.

Margolis *et al.* reported 23% of silent infarctions in their study.[4] Other authors have estimated the occurrence of unrecognized MI between 0 to 60%.

The immediate mortality (within 1 week) in this series of 22 patients was 31.2%. Seven patients died within 1 week of admission. Four died within 24 h of admission. Three died between 24 h to 1 week. Partamian and Bradley have reported immediate mortality in their patients at 38% (immediate mortality was arbitrarily defined as 2 months of attack in their study).[7]

Two patients out of four who died within 24 h presented with cardiogenic shock (systolic blood pressure. less than 90 mm Hg). Two patients who died between 24 h and 1 week had diabetic ketoacidosis and one patient developed fatal ventricular arrhythmias.

Pattern of MI
12 out of 22 patients had evidence of anterior/anterolateral infarction (55.54%). Four patients (18.18%) had evidence of inferior wall MI. Two patients had evidence of inferior wall MI with right ventricular extension. Four patients had subendocardial infarction (18.18%).

Cardiac Autonomic Neuropathy
36 out of 100 patients studied had evidence of cardiac autonomic neuropathy (36%). Tankhiwale *et al.* have reported an incidence of 30% in a study of type 2 DM patients.[8] The incidence of cardiac autonomic neuropathy in other series varies from 17% to 68%.

In our study, parasympathetic involvement was more common than sympathetic involvement, which correlates with Thankiwale *et al.* study.

Predominant symptoms of patient with autonomic neuropathy in our series were postural giddiness (22.22%), constipation (19.45%), and impotence (15%). Tankhiwale *et al.* in their series have reported giddiness (14.3%),

nocturnal diarrhea (11.7%), and impotence (11.7%) as predominant symptoms in their study.[8]

Diabetic Cardiomyopathy

In this study, 4 out of 100 patients (2 males and 2 females) had evidence of dilated cardiomyopathy. Echocardiography done on these patients revealed left ventricular dysfunction, dilated chambers, and decreased ejection fraction.[6] ECG showed non-specific ST-T changes in one patient. All 4 presented with features of congestive cardiac failure.

Sudden Cardiac Death

There were no cases of sudden cardiac death in our series.

Congestive Cardiac Failure

In our study, 10 patients presented with signs and symptoms of congestive cardiac failure. Females outnumber male patients (6 vs. 4).

BMI

The mean BMI in males in this study is 22.6 and females are 23.1. Females are more obese than males. 13 males and 5 females had BMI above 25. Meenu Walia *et al.* in their study group reported a mean BMI in males and females as 21.32± 3.64 and 22.22 ± 4.80, respectively 70. Our study correlates with the above study.

Smoking and Alcoholism

About 16 males and one female (25% and 2.7%, respectively) among study group were chronic smokers (biddies and cigarettes). 18 males (28.12%) males consumed alcohol almost regularly; none of the female patients were alcoholics.

Lipid Profile

The mean total cholesterol, low-density lipoprotein (LDL)-cholesterol, triglyceride, and HDL-cholesterol levels were 207.8 mg%, 117.57 m%, 162.35 mg%, and 40.6 mg%, respectively. In our study, 22 (22%) of patients had HDL-cholesterol below 40 mg% and 11 patients (11%) of patients had hypertriglyceridemia (>250 mg%).

The mean HDL-cholesterol in females was less than in males. The mean total cholesterol and triglyceride levels were higher in females when compared to males. Meenu Walia *et al.* in their study have reported lipid profile levels as follows mean total cholesterol 205.7 ± 55.9; HDL-cholesterol 42.78 ± 8.53, and triglyceride level 175.24 ± 92.75.[9] Our study correlates with the above-mentioned study.

CONCLUSION

With the present study, it can be concluded that there is a high occurrence of coronary artery disease with coronary risk factors in patients with DM. Even modifiable risk factors such as smoking are present in a significant proportion of patients. All patients with DM should be screened for latent coronary artery disease (as it has prognostic implications). Furthermore, all patients with prolonged history of DM should be screened clinically with simple tests for the presence of cardiac autonomic neuropathy and managed accordingly. Diabetic dyslipidemia is commonly present in many cases. Hypercholesterolemia, high LDL-cholesterol, hyper-triglyceridemia, and low HDL-cholesterol are all significant predictors of coronary artery disease in DM.

REFERENCES

1. Anjan D. Conducting tissue involvement in diabetes mellitus. Med Update 2001;11:616-9.
2. Gupta SB, Pandit RB. Silent myocardial ischemia and cardiac autonomic neuropathy in diabetes. Indian Heart J 1992;44:227-9.
3. Mehta KC. Acute myocardial infarction 111 diabetes mellitus. Med Update 2001;11:620-8.
4. Margolis JR, Kannel WS, Feinleib M, Dawber TR, McNamara PM. Clinical features of unrecognized myocardial infarction – Silent and symptomatic. Eighteen year follow-up: The Framingham study. Am J Cardiol 1973;32:1-7.
5. David N. Understanding the ABC's of HbA1c's role in monitoring diabetes control. Postgrad Med 2002;j-15:289-95.
6. Panja M, Sarkar C, Kumar S, Mazumder B, Sinha DP, Chattopadhyay D. Diabetic cardiomyopathy. J Assoc Physicians India 1998;46:635-9.
7. Partamian JO, Bradley RF. Acute myocardial infarction in 258 cases of diabetes. Immediate mortality and five-year survival. N Engl J Med 1965;273:455-61.
8. Tankhiwale SR, Pazare AR, Kudrimoti MB. Cardiac autonomic neuropathy and their relation with other angiopathies in NIDDM. J Diabetes Assoc India 1989;3l:71-3.
9. Sesaiah V. Classification and diagnosis of diabetes mellitus. In: A Hand Book on Diabetes Mellitus. 3rd ed. USA: American Diabetes Association; 2007.