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.
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 cor pulmonale
III. Patients with rheumatic heart disease and congenital heart disease
IV. Patients with gestational diabetes mellitus.

RESULTS AND OBSERVATIONS

About 100 patients of DM type 1 and type 2 attending the outpatient clinics and admitted in ICU 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).
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).

**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:

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<th>Males</th>
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<td>BMI</td>
<td>22.6</td>
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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 BMI above 25.

**Smoking and Alcoholism**
16 males (25%) and one female (2.7%) among the study group were chronic smokers (bidies 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%).

**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.4 The incidence of cardiac autonomic neuropathy in other series varies from 17% to 68%.

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.

**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.4 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.

**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. 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. 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 (bidies 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. 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**