Original Research Article

A study of ECG abnormalities and treadmill test findings in patients with type 2 diabetes mellitus

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Abstract

Background: Guidelines by the American Diabetes Association (ADA), and European Society of Cardiology and European Association for the Study of Diabetes recommend routine use of ECG in patients with type 2 diabetes mellitus (T2DM) having hypertension or any other cardiovascular disease (CVD). Limited evidence is available on the prevalence of ECG abnormalities in T2DM patients. **Aims and objective:** To study the ECG abnormalities and treadmill test findings in patients with type 2 diabetes mellitus.**Materials and methods:** Hundred subjects were studied in the Department of Medicine Gandhi Medical College, & Hamidia Hospital, Bhopal from August 2018 to July 2019 after dividing them into diabetes (n=50) and non-diabetes group (n=50). All the subjects underwent fasting and postprandial blood sugar, glycosylated haemoglobin (HbA1c), lipid profile (fasting and post prandial), Electrocardiography (ECG) and treadmill test (TMT) monitoring.**Results:** Age and sex distribution was similar in both the groups.ST depression & T wave inversion (24%), LAE (20%), LVH (8%), RBBB (4%) and LBBB (4%) were the common ECG findings in diabetes group. Majority of patients with abnormal post prandial lipid profile had positive TMT in diabetes group.**Conclusion:** Patients with diabetes had more ECG abnormality and majority were TMT positive.

Keywords: ST elevation, post prandial lipid levels, treadmill test, left atrial enlargement

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Introduction

Diabetes mellitus is characterized by a high incidence of cardiovascular disease(CVD),nearly 80% of Type 2 diabetic(T2DM) patientsdie of a cardiovascular incident[1].In diabetes, the post prandial phase is characterized by a rapid and large increase in blood glucose levels,and the possibility that the post prandial 'hyper-glycemic spikes' may be relevant to the pathophysiology of late diabetic complications has been recently reviewed. Poor control of hyperglycemia appears to play a significant role in the development of cardiovascular disease (CVD) in diabetes[2].Previous studies have shown that in T2DM patients ECG abnormalities are common (29.1%). This is even seen in people with history of CVD (24.0%). Traditional cardiovascular risk factors are responsible for the high prevalence of ECG abnormalities. ECG abnormalities can serve as an important tool in assessing CVD in patients with T2DM[3].However, evidenceis lacking for ECG abnormalities in T2DM. Hence, in present study we tried to evaluate ECG abnormalities and treadmill test findings in patients with type 2 diabetes mellitus.

Materials and methods

An observational, cross sectional and hospital-basedstudy was performed in the Department of Medicine Gandhi Medical College, & Hamidia Hospital, Bhopal from August 2018 to July 2019. Fifty patients with Type - 2 Diabetes Mellitus and 50 age and sex matched healthy controls were enrolled diagnosed according to ADA criteria (FBS> 126 mg/dl, PPBS> 200 mg/dl. Patients who were on usual dose of insulin or oral hypoglycemic drugs were also included. Those with familial hyperlipidaemia,nephropathy,hepatic disease, hypo-thyroidism, alcoholism, patient on drugs affecting the lipids (anti hyperlipidaemic agents, beta blockers, thiazide diuretics.) and those with fasting triglycerides >250 mg/dl were excluded. After 12 hours of overnight fast, a standardized meal was given to all subjects for providing 600 kilo calories consisting of 60% carbohydrates, 20-25% proteins, 15 -20% fats (3 Roti, one 1/2 cup rice, 1 cup of vegetable curry, 1 cup of dal and 1 cup of curd). Blood was collected in fasting and 4 hrs. after meal for lipid profile measurements. All the subjects underwent fasting and postprandial blood sugar, glycosylated haemoglobin (HbA1c), lipid profile (fasting and post prandial), ECG and TMT.All the data analysis was performed using IBM SPSS ver.20 software.Frequency distribution and cross tabulation were performed to prepare the tables. PRISM and Microsoft excel was used to prepare the tables. Quantitative data was expressed as mean and standard deviation whereas categorical data was expressed as numberand percentage.

Results

In present study majority of the diabetic patients were in age group between 51-60 years (38%) followed by 41-50 years (24%) and 61-70 years (20%). Similarly, majority of the non-diabetes patients belong to age between 51-60 (38%) followed 41-50 years (24%) and 61-70 years (20%). In present study the 50% were male and 50% were female with Male: Female ratio of 1:1.Out of 50 diabetes patients who underwent ECG findings, ST depression & T wave inversion was found in 12 (24%), 10 (20%) had LAE, 4 (8%) had LVH,2(4%) had RBBB and 2 (4%) had LBBB.None of the patients has ST elevation.

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Table 1: Comparing post prandial lipid levels with TMT findings in diabetes patients

Lipid		TMT		Total
		Negative	Positive	
TG	Abnormal	17 (48.58%)	18 (51.42%)	35
	Normal	15 (100%)	0 (0%)	15
TC	Abnormal	13 (46.42%)	15 (53.58%)	28
	Normal	22 (100%)	0 (0%)	22
HDL	Abnormal	8 (44.44%)	10 (55.56%)	18
	Normal	13 (100%)	0 (0%)	32
LDL	Abnormal	12 (46.1%)	14 (53.9%)	26
	Normal	24 (100%)	0 (0%)	24

On comparing the lipid profile with TMT findings; it was found that majority of patients with abnormal post prandial lipid profile had positive TMT.

Discussion

Diabetic patients are often hyperlipidaemic and they are at a high risk for coronary heart disease. The high cardiovascular mortality which is associated with Type 2 DM is due to a prolonged, exaggerated, postprandial state. The abnormal lipid profile in the postprandial state is more significant than the abnormal lipid profile in the fasting state in causing atherosclerotic complications in Type 2 diabetics[4].In present study majority of the diabetes patients had age between 51-60 years (38%) followed by 41-50 years (24%) and 61-70 years (20%). This means diabetes was more prevalent among the old age people. Equal number of age and sex matched control were taken for this study.Our study result was in line with study done by Raghavendra et al,where the higher prevalence of diabetic (45%) was present among age group 51-60 years, followed by age 41-50 years (30%) and 21 % patients had age between age group 30-40 years. Similarly, majority of non-diabetes patients (41%) belongs to age group between 51-60 years, followed by 4150 years (34%) and 30-40 years (25%).[5] Elisabeth et al studied 14 type 2 diabetic patients and 12 control subjects aged between 35 to 60 years old. Both diabetic and control subjects had similar ages (49.9±8.5 versus 48.9±8.1 years)[6]In Kumar JG et al study, the mean age of diabetic patients was 60.3±25.2 and non-diabetic patients was 50.5±34 years[7]In present study, gender distribution similar in both diabetes and non-diabetes group.Similarly, Gandiah et al observed 68% males and 32% females diabetic patients and 68% males and 32% female were nondiabetic patients.That means gender distribution was similar among the groups[4].In Raghavendra et al study out of 100 non-diabetic controls, 58% were males and 42% were females, and in 100 diabetic cases, 52% were males and 48% females[5].Whereas in Elisabeth et al study all 26 diabetic and non-diabetic patients were males[6]. In Kumar JG et al study 62.99% male and 37.01% female patients were in the diabetic group, 67.93% male and 32.07% female were in the nondiabetic group.[1] T2DM is considered a cardiovascular disease (CVD) risk equivalent. Its macrovascular complications are associated with two-fold increased risk of premature atherosclerotic CVD. Most of the diabetics with cardiovascular involvement are asymptomatic. Electrocardiograph (ECG) abnormalities are found to be predictors of silent ischaemia in asymptomatic persons. An abnormal ECG response is associated with statistically significant high risk for cardiac mortality and morbidity. In present study, most common abnormality observed was ST-T changes, followed by left atrial enlargement (LAE), left ventricular hypertrophy (LVH), left bundle branch block (LBBB) and right bundle branch block (RBBB).Gupta et al evaluated ECG changes in asymptomatic 100 Type 2 DM patients found that 12% had ST depression + T wave inversion, 6% had LAE, 4% had LVH and 2% each had RBBB and LBBB. None of the patients were observed to have ST elevation[9].A study from USA involving 635African American-Diabetes Heart Study (AA-DHS) participants reported that the prevalence of ECG abnormalities in diabetes patients was prolonged QTc (25.5%), T wave changes (22%), LVH (18.5%), sinus tachycardia (15.5%), ischaemic heart disease (IHD) (9%), conduction defects (7%) and ectopic beats (4%)[11]. Both the studies are in line with present study. Patients history, physical examination and non-invasive techniques like ECG, holter monitoring,stress test (TMT),stress echocardiography, stress thallium imaging is valuable in establishing the diagnosis of myocardial ischemia in diabetes. In present study on comparing the lipid profile with TMT findings it was found that majority of patients with abnormal post prandial lipid profile had positive TMT ($p<0.001$). Similar results were posted by Gupta RK et al where, out of 102 diabetic patients, TMT was positive in 32 (31.37%) patients; more in males (59.73%). mean cholesterol (189.81 mg %), triglycerides (135.19 mg %) and LDL (116.28 mg %) levels were significantly high in TMT positive cases ($P<0.001$) [8].Another study by Khanapure, et al recorded that out of 82 cases of asymptomatic T2DM patients, 32.9% were positive for TMT [9].The risk factors like age between 56 to 65 yrs. (46%), males (36%), duration of diabetes > 15yrs (50%), cases on sulfonyureas and metformin combination (33%) and on insulin therapy (45%), BMI between 30 to 34.9 (70.83%), abdominal waist to hip ratio between 0.86 to 0.99 (30%), HbA1C more than 10% (44%), FBS more than 200mg/dl (42%) and, PPBS more than 350mg/ dl (58%), total serum cholesterol level more than 240mg/dl (58%), TG level more than 200mg/dl (53%), HDL levels less than 30mg/dl (47%) and HDL level between 31 to 45 mg/dl (23%), LDL level more than 160mg/dl (45%), VLDL more than 40mg/dl (50%), showed high percentage of positive treadmill test[9].Present study has some limitations in terms of small sample size, single centered and cross sectional due to which it is not a pure replica of actual population[10-12].There is a need of a large randomized clinical trial to provide strength to present study findings.

Conclusion

Based on the present study findings it can be concluded that patients with T2DM had higher prevalence of ECG abnormality. T2DM patients are also found to be more TMT positive. We recommend to screen T2DM patients for CVD using ECG and TMT.

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