ORIGINAL RESEARCH

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

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ABSTRACT
Background: Diabetes is the commonest endocrine disease affecting mankind. The present study was conducted to assess ECG abnormalities and treadmill test findings in patients with type 2 diabetes mellitus.
Materials & Methods: 80 diabetic and 50 non-diabetic subjects of both genders were enrolled. 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: Group I had 50 males and 30 females and group II had 20 males and 30 females. Out of 80 diabetes patients, ST depression & T wave inversion was found in 24, 10 had Left atrial enlargement(LAE), 6 had left ventricular hypertrophy(LVH), 4 had Right bundle branch block (RBBB) and 2 had left bundle branch block (LBBB). The difference was significant (P< 0.05). 52% had abnormal triglyceride (TG), 54% abnormal total cholesterol(TC), 55% abnormal high-density lipids (HDL), and 56% abnormal low-density lipids (LDL) having positive TMT test. The difference was significant (P< 0.05).
Conclusion: Patients with T2DM had a higher prevalence of ECG abnormality. T2DM patients are also found to be more TMT-positive.
Keywords: Diabetes, ECG abnormality, wave inversion

INTRODUCTION
Diabetes is the commonest endocrine disease affecting mankind. The incidence of this disease continues to be on the rise all over the world. In 2014, globally the prevalence of diabetes was estimated to be 9% among the population above 18 years of age.[1] World Health Organisation (WHO) projects that the 7th leading cause of death will be diabetes in 2030. India will be the diabetes capital of the world with a projected 109 million individuals with diabetes by 2035.[2] It has been recognized for several decades that diabetes mellitus is an established risk factor for cardiovascular morbidity and mortality. Coronary Artery Disease (CAD) is multifactorial in aetiology and has several important risk factors, out of which diabetes is one of the important modifiable risk factors.[3]
Studies have shown that in T2DM patients ECG abnormalities are common. This is even seen in people with a history of CVD. 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.[4] However, evidence is lacking for ECG abnormalities in T2DM.Early detection of asymptomatic coronary artery disease in type 2 diabetes may prevent catastrophic cardiac events. However, periodical thorough clinical examination and resting Electrocardiogram (ECG) may fail to detect coronary artery disease. Hence, sophisticated cardiovascular non-invasive tests should then be proposed for early detection of asymptomatic CAD in these patients.[5] Exercise electrocardiograph can identify the majority of patients likely to have significant ischemia during their daily activities and remains the most important screening test for significant CAD.[6]The present study was conducted to assess ECG abnormalities and treadmill test findings in patients with type2 diabetes mellitus.

MATERIALS & METHODS
The present study comprised 80 diabetic and 50 non-diabetic subjects of both genders. All gave their written consent for participation in the study.

Data such as name, age, gender, etc. were recorded. 5 ml of venous blood was collected from all subjects. 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. Data thus obtained was subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS
Table I Distribution of patients

Groups	Group I	Group II
Status	Type II DM	Healthy control
M:F	50:30	20:30

Table I shows that group I had 50 males and 30 females and group II had 20 males and 30 females.

Table II Assessment of ECG changes in diabetics

ECG changes	Number	P value
ST depression & T wave inversion	24	0.02
LAE	10	
LVH	6	
RBBB	4	
LBBB	2	

Table II, graph I shows that out of 80 diabetes patients, ST depression & T wave inversion was found in 24, 10 had LAE, 6 had LVH, 4 had RBBB and 2 had LBBB. The difference was significant (P< 0.05).

Graph I Assessment of ECG changes in diabetics
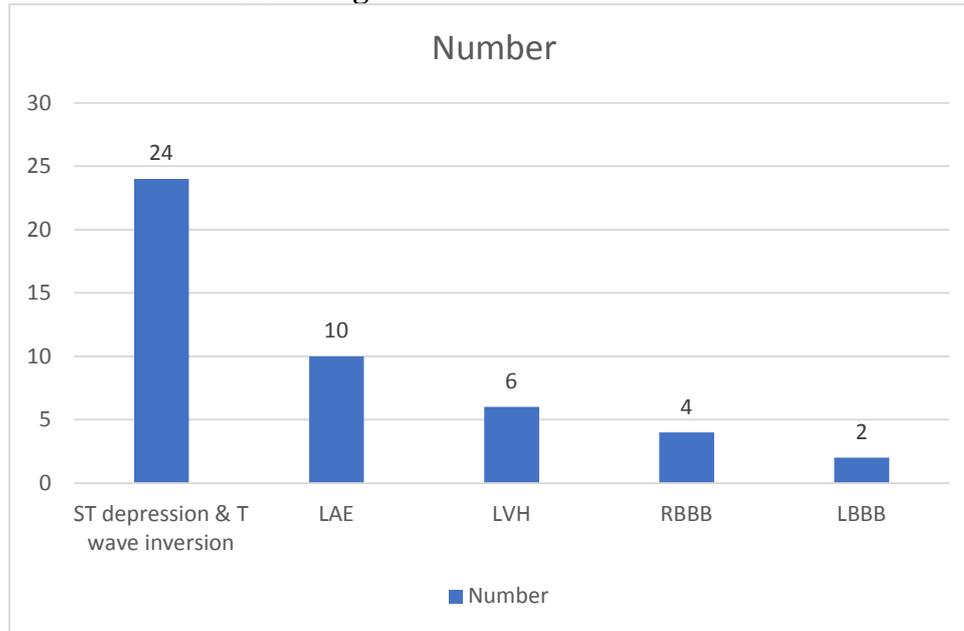
Table III Lipid profile in patients

Lipid		TMT		P value
		Negative	**Positive**	
TG	Abnormal	48%	52%	0.05
	Normal	100%	0%	
TC	Abnormal	46%	54%	0.03
	Normal	100%	0%	
HDL	Abnormal	45%	55%	0.05
	Normal	100%	0%	
LDL	Abnormal	44%	56%	0.01
	Normal	100%	0%	

Table III shows that 52% had abnormal TG, 54% had abnormal TC, 55% had abnormal HDL, and 56% had abnormal LDL having positive TMT test. The difference was significant (P< 0.05).

DISCUSSION

Diabetic patients are often hyperlipidaemic and they are at 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.[7] 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.[8] Rapid socioeconomic development and demographic changes, along with increased susceptibility for Indian individuals, have led to the explosive increase in the prevalence of diabetes mellitus in India over the past four decades.[9,10] The present study was conducted to assess ECG abnormalities and treadmill test findings in patients with type2 diabetes mellitus.

We found that group I had 50 males and 30 females and group II had 20 males and 30 females. Harms et al[11] analyzed the prevalence of ECG abnormalities and their cross-sectional associations with cardiovascular risk factors in people with type 2 diabetes. ECG abnormalities were defined using the Minnesota Classification and categorized into types of abnormalities. The prevalence was calculated for the total population (n = 8068) and the subgroup of people without a history of CVD (n = 6494). Approximately one-third of the

total population had minor (16.0%) or major (13.1%) ECG abnormalities. Of the participants without a CVD history, approximately one-quarter had minor (14.9%) or major (9.1%) ECG abnormalities, and for those with hypertension or very high CVD risk, the prevalence was 27.5% and 39.6%, respectively. ECG abnormalities were significantly and consistently associated with established CVD risk factors.

We observed that out of 80 diabetes patients, ST depression & T wave inversion was found in 24, 10 had LAE, 6 had LVH, 4 had RBBB and 2 had LBBB. Lakra et al[12]studied the ECG abnormalities and treadmill test findings in patients with type 2 diabetes mellitus. Age and sex distribution were similar in both groups.ST depression & T wave inversion (24%), LAE (20%), LVH (8%), RBBB (4%) and LBBB (4%) were the common ECG findings in diabetes group. The majority of patients with abnormal postprandial lipid profiles had positive TMT in the diabetes group

We found that 52% had abnormal TG, 54% abnormal TC, 55% abnormal HDL, and 56% abnormal LDL having positive TMT test. Raghavendra et al found that out of 100 non-diabetic controls, 58% were males and 42% were females, and in 100 diabetic cases, 52% were males and 48% females. Gupta et al[13]evaluated ECG changes in asymptomatic Type 2 DM patients. Fifty persons with age and sex-matched controls were included in the study. Relevant history and physical examination findings were recorded in a protocol. The variables studied were: gender, age, smoking, physical activity, waist circumference, Body Mass Index (BMI), and blood pressure. Resting ECG was recorded. The mean age of asymptomatic diabetic patients was 50.3 ± 11.90 years (age range 25-75 years). In this study, none of the control group had ECG abnormality whereas, 26% of asymptomatic diabetics had ECG abnormalities. Most of the asymptomatic cases with ECG changes had 5-10 years of duration of diabetes mellitus; 70% of patients with ECG changes had poor glycaemic control, increased triglyceride, and decreased High-Density Lipoprotein (HDL) levels. The 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).

The limitation of the study is the small sample size.

CONCLUSION

The authors found that patients with T2DM had a higher prevalence of ECG abnormality. T2DM patients are also found to be more TMT-positive.

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