

Evaluation of ECG Abnormalities in Patients with Asymptomatic Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes Mellitus (DM) is the most common chronic disease. DM 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. Electro Cardio Graph (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.

Aim: The aim of the study was to evaluate ECG changes in asymptomatic Type 2 DM patients.

Materials and Methods: A cross-sectional comparative study was conducted in a tertiary care hospital in North India. One hundred diabetics presenting to Medicine OPD/IPD were included in the study who had no symptoms of heart disease and no diabetic complications. Fifty person 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, and waist circumference, Body Mass Index (BMI) and blood pressure. Resting ECG was recorded.

Results: 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% asymptomatic diabetics had ECG abnormalities. Most of the asymptomatic cases with ECG changes had 5-10 year of duration of diabetes mellitus; 70% patients with ECG changes had poor glycaemic control, increased triglyceride and decreased High Density Lipoprotein (HDL) levels. 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).

Conclusion: ECG changes are present in quarter of asymptomatic Type 2 DM patients. However, nonspecific ST-T changes, LVH and LAE are common.

Keywords: Cardiovascular disease, Poor glycemic control, Silent angina

INTRODUCTION

DM is the most common chronic disease and is considered as a CVD risk equivalent. It is frequently associated with various other cardiovascular risk-factors. It is well-established that dyslipidaemia is a major risk-factor for macrovascular complications in patients with Type-2 Diabetes Mellitus (T2DM) and affects 10%-73% of this population [1].

Ischaemic chest pain is blunted in diabetes mellitus and myocardial ischaemia or infarction may be associated with milder symptoms or may be totally silent (symptomatic). Silent infarctions (asymptomatic) are more common in diabetics (39%) as compared to non-diabetics (22%) [2-5].

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 [3].

MATERIALS AND METHODS

A cross-sectional comparative study was conducted at a tertiary care hospital in North India in Bareilly district. One hundred diabetics presenting to Medicine OPD/IPD were included in the study that had no symptoms of heart disease and no diabetic complications. Fifty persons with age and sex matched controls were included in the study. Ethical committee clearance was taken. Informed consent was taken from the participants. Type 2 DM patients who fulfilled the following criteria for the diagnosis of diabetes mellitus given by the American Diabetes Association (ADA). Fifty patients gave consent for measuring their lipid profile.

Inclusion Criteria

1. Type 2 DM patients who fulfilled the following criteria for the diagnosis of diabetes mellitus [6].

- Symptoms of diabetes plus random blood glucose concentration ≥ 11.1 mmol/L (200 mg/dL) or
 - Fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) or
 - Haemoglobin A1c $\geq 6.5\%$ or
 - 2 hour plasma glucose ≥ 111 mmol/L (200 mg/dL) during an oral glucose tolerance test.
2. Patients who had no cardiovascular complaints.

Exclusion Criteria

1. T2DM patients with concomitant diseases or conditions affecting lipid levels like chronic liver disease and hypothyroidism.
2. Patients on drugs like oral contraceptive pills, steroids, diuretics, anti-arrhythmics and anti-ischaemic drugs.
3. Patients with microvascular, macrovascular and other complications of type 2 DM.
4. Patients with any cardiovascular disorders.

A 12-lead resting ECG was done both for cases and controls.

The following ECG abnormalities were specifically looked for: ST-segment elevation or depression, T-wave aberrations (inversion or tall T-wave), bundle branch block, LVH, arrhythmias, prolonged QT and other changes to detect signs of myocardial ischaemia in asymptomatic patients [2].

LVH was defined according to three different criteria [7]:

1. Cornell voltage ($SV_3 + RaVL > 20$ mm in women and 28 mm in men)
2. Cornell voltage-duration product $\{(RaVL + SV_3) \times QRS \text{ complex duration}\} > 2440$ mm ms

3. Sokolow- Lyon index (SV1 + RV5/6 > 35 mm).

QTc prolongation was defined as a QTc > 430 ms in both men and women.

Normal range is 350-430 ms [8].

Bazett's formula

$QTc = QT / \sqrt{RR}$

STATISTICAL ANALYSIS

Statistical analysis of the data was done using the Statistical Package for the Social Science (SPSS 17.0) using unpaired t-test and chi-square test. A $p < 0.05$ consider statistically significant. The data was compiled using Microsoft Excel sheet (Windows 2007).

RESULTS

Mean age of asymptomatic diabetic patients was 50.3 ± 11.90 years (Age range 25-75 years). These abnormalities are more seen in age 35-44 and 45-54 years. In this study, none of the control group had ECG abnormality whereas 26% asymptomatic diabetics had ECG abnormalities. This study reveals that most of the asymptomatic T2DM cases with ECG changes had 5-10 year of duration of diabetes mellitus; 70% patients with ECG changes had poor glycaemic control. Mean QT interval of diabetic patients was 400 ms. In the present study, most common abnormality observed was ST-T changes followed by LAE, LVH, LBBB and RBBB [Table/Fig-1-5].

Parameters	Cases (n=100)	Controls (n=50)	p-value
Mean FBS	205.04±91.47	83.68±8.80	<0.001**
Mean HbA1c	8.92±1.64	5.33±0.22	<0.001**
Mean total cholesterol (normal value: 130-200 mg/dl) {n=50}	169.04±47.36	169.68±15.61	0.9279
Mean LDL (normal value: <130 mg/dl) {n=50}	91.52±32.21	100.26±16.54	0.0910
Mean HDL (High risk: <40 mg/dl) {n=50}	39.66±10.17	52.02±11.15	<0.001**
Mean triglycerides (normal value: <150) {n=50}	185.70±76.87	125.22±17.14	<0.001**

[Table/Fig-1]: Comparison of mean values of biochemical parameters in cases and controls.

* $p < 0.05$ is considered to be statistically significant.

** highly significant. Independent t-test was applied.

Variables	T2DM with ECG changes (n=26)	T2DM without ECG changes (n=74)	p-value
Age (years)	51.0±10.05	50.05±12.61	0.8074
Gender			
Male	12	50	0.052
Female	14	24	
Mean systolic BP (mm of Hg)	122.8±8.47	126.43±7.66	0.1590
Mean diastolic BP (mm of Hg)	78.8±4.04	79.62±3.88	0.5196
Mean total cholesterol	186.0±46.79	163.08±46.71	0.1348
Mean LDL	90.6±36.58	91.84±31.08	0.9064
Mean HDL	43.2±6.61	38.41±10.95	0.1456
Mean triglycerides	183.6±91.86	186.43±72.30	0.9105

[Table/Fig-2]: Comparison of mean value of biochemical parameters in a group of asymptomatic diabetics with and without ECG changes.

* $p < 0.05$ is considered to be statistically significant. Independent t-test was applied.

Duration of diabetes	<5 years	5-10 years
Number	52	48
ECG changes	2	24

[Table/Fig-3]: Correlation of duration of diabetes with ECG changes.

Duration of diabetes (years)	Cases	HbA1c control	ECG Changes
<1	32	8 fair control 24 poor control	2
2-5	20	6 fair control 14 poor control	0
5-10	40	12 fair control 28 poor control	22
>10	8	8 Poor control	2

[Table/Fig-4]: Correlation of duration of diabetes with HbA1c and ECG changes in cases and controls.

Variable	LAE	LVH	BBB	ST elevation	ST depression + T wave inversion
Number (n=100)	6	4	2 RBBB 2 LBBB	0	12

[Table/Fig-5]: ECG changes in asymptomatic Type 2 DM (Cases).

DISCUSSION

Diabetes is an important risk-factor for CVD. Diabetes is associated with premature atherosclerosis due to endothelial vasomotor dysfunction, vascular effects of advanced glycation products, adverse effect of circulating free fatty acids and increased systemic inflammation [9]. These commonly present like coronary artery disease, chronic heart failure or arrhythmias due to diabetic cardiomyopathy. Most diabetic CVD are asymptomatic (silent/painless ischaemia) due to autonomic neuropathy [9]. Hence, the main aim of this study was to observe the cardiovascular involvement in asymptomatic diabetics (patients without cardiovascular complaints).

In this study, mean age of asymptomatic diabetic patients was 50.3 ± 11.90 years (age range 25-75 years) with female preponderance and none of the control group had ECG abnormality whereas 26% asymptomatic diabetics had ECG abnormalities. There was no significant difference in biochemical parameter noted amongst the diabetics with or without ECG changes [Table/Fig-2]. In other similar studies the prevalence of ECG abnormalities in diabetics varied from 24.9%-44.3% depending on the cohort studied [2, 10-12]. A study on 221 patients from Spain showed that ECG abnormalities were found in 24.9% at the beginning and 44.3% were found at the end of the study with average duration of follow up of 5.9 years [12]. The present study is cross-sectional where 26% asymptomatic diabetics had ECG abnormalities. In the longitudinal study from Spain, the presence of ECG abnormalities could predict the occurrence of future cardiovascular event in patients with T2DM more accurately than any other risk-factor alone [13].

This study reveals that most of the asymptomatic cases with ECG changes had 5-10 years of DM [Table/Fig-3]; 70% patient with ECG changes had poor glycaemic control [Table/Fig-4]. These results were consistent with other similar studies [2, 11]. In the present study, the most common abnormality observed was ST-T changes followed by LAE, LVH, LBBB and RBBB (n=26) [Table/Fig-5]. In a study on African Americans, the variants and prevalence of ECG abnormalities detected were as follows: 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%). ECG abnormalities among older diabetics were high and included prolonged QTc, LVH, IHD and conduction defects [11].

LIMITATION

1. Small sample size.
2. Long term follow up is needed as atherosclerosis and development of cardiovascular events are a chronic and continuous process.
3. Normal resting ECG does not rule out CVD.

CONCLUSION

ECG changes are present in quarter number of asymptomatic T2DM patients. However, non-specific ST-T changes, LVH and LAE are common.

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Date of Submission: **Oct 18, 2016**
Date of Peer Review: **Dec 16, 2016**
Date of Acceptance: **Jan 10, 2017**
Date of Publishing: **Apr 01, 2017**

FINANCIAL OR OTHER COMPETING INTERESTS: None.