

A Hospital Based Cross-Sectional Study on Asymptomatic Cardiac Changes in Patients with Type 2 Diabetes Mellitus at a Tertiary Care Hospital, Khammam

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ABSTRACT

BACKGROUND

Silent ischemia can be predicted with simple, non-invasive and cost-effective technique called electrocardiogram (ECG) in asymptomatic diabetic patients. Risk of morbidity and mortality due to cardiac diseases is high in those with diabetes mellitus. Data on electrocardiogram changes is scarce in India in type-2 diabetic patients without symptoms. Therefore, this study was undertaken to study ECG changes in type-2 diabetic patients without symptoms of heart disease.

METHODS

Hospital based cross-sectional study was carried out over 18 months among 50 cases of type 2 diabetic patients without cardiovascular disease symptoms. Haematological investigations performed for all patients included lipid profile, fasting blood sugar, and HbA1c. 12-lead electrocardiogram in resting position was carried out, and abnormalities in the recorded electrocardiogram were noted in the study questionnaire.

RESULTS

Mean age of patients was 53.86 ± 3.34 years. Mean duration of diabetes was 11.27 ± 4.19 years. Majority (44 %) were using oral hypoglycaemic drugs and insulin. Mean values of fasting blood sugar (204.92 ± 22.83) and HbA1c (7.32 ± 0.60 %) were raised. Total cholesterol was 188.4 ± 20.39 mg / dl; high density lipoprotein was 40.24 ± 5.67 mg / dl; low density lipoprotein was 98.64 ± 14.01 and the triglycerides were 182.9 ± 18.44 mg / dl. 28 % had ECG changes and among them the most common was ST depression with T wave inversion in 35.7 % followed by left ventricular hypertrophy (LVH) in 28.6 %. Among variables compared between the two groups, only duration of diabetes (years), and HbA1c (%) were found to be statistically significant ($P < 0.05$).

CONCLUSIONS

This study shows that type 2 diabetes patients especially of longer duration should undergo cardiac evaluation even though they do not have any symptoms relating to cardiovascular system.

KEYWORDS

Diabetes, ECG, Cardiac Changes, Evaluation, Symptoms

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BACKGROUND

Diabetes mellitus is a group of metabolic disorders that is characterised by chronic hyperglycaemia resulting from defects in insulin secretion, insulin action, or both.¹ It is an important public health problem and one of the most important diseases of chronic nature. Day by day the number of people with diabetes is increasing worldwide as well as in India. It has acquired a form of pandemic all over the world including India.² Micro vascular and macro vascular complications are common in patients with diabetes especially among those with long standing poor glycaemic control. These constitute a heavy burden on not only the individuals but also on the society.

Diabetes is an independent risk factor for coronary heart disease as well as cardiovascular diseases and increases the risk of morbidity and mortality. Risk of coronary artery disease among patients with type-2 diabetes mellitus without previous episode of myocardial infarction is same compared to those without type-2 diabetes mellitus with previous episode of myocardial infarction.³

Dyslipidemia, obesity and hypertension are commonly seen co morbidities in patients with diabetes. These things together increase the risk of cardiovascular diseases. Diabetic patients are also noted to have increased coagulability, autonomic neuropathy, increased oxidative stress and endothelial dysfunction etc. all of which are directly associated with the increased risk of cardiovascular diseases.⁴

Hence, patients with diabetes have direct and indirect risk factors that can aggravate the risk of cardiovascular disease in such patients. Hence, the prevalence of myocardial infarction, congestive cardiac failure and stroke are seen commonly in patients with diabetes mellitus.⁵

Prognosis of coronary artery disease among patients with diabetes mellitus is not favourable and its prevalence among these patients is also very high. Prevalence of silent myocardial ischemia in patients with diabetes mellitus is around 10 - 20 % while it is only 1 - 2 % in persons without diabetes mellitus. Thus, diagnosis of silent myocardial ischemia is delayed.⁶

Studies have documented that asymptomatic coronary heart disease is common in patients with diabetes mellitus and hence screening of such cases for presence of coronary heart disease will prove beneficial. It can manifest like ischemic heart disease, diabetic cardiomyopathy, and hypertensive heart disease etc.^{7,8}

Silent ischemia can be predicted with a simple, non-invasive and cost-effective technique called electrocardiogram in asymptomatic diabetic patients. The risk of morbidity and mortality due to cardiac diseases is high in those patients with diabetes mellitus.⁹

Data on electrocardiogram changes is scarce especially in India in type-2 diabetic patients without symptoms. Therefore, present study was undertaken to study the electrocardiogram changes in type-2 diabetic patients without symptoms of heart disease.

METHODS

This cross-sectional study was conducted at Mamata Medical College, Khammam for a period of 18 months from January 2017 to June 2018.

Sample Size

50 patients were included in the study by applying the inclusion and exclusion criteria. Considering prevalence of ECG changes among type 2 diabetic patients without cardiovascular disease symptoms in the hospital settings as 70 % with 95 % confidence interval and allowable error as 20 %; the sample size came out to be 43 and hence, 50 cases were included in the present study.

Ethics and Consent

Approval was taken from the institutional ethical committee before commencing the study. The participants were informed regarding the purpose, procedures, risks and benefits of the study. Written and informed consent was obtained from all participants.

Inclusion Criteria

1. Type 2 diabetic patients without cardiovascular disease symptoms.
2. Duration of diabetes of more than one year.
3. Between 30 - 75 yrs. of age.
4. Patients willing to participate in the study.

Exclusion Criteria

1. History of myocardial infarction, angina, heart failure, left bundle branch block, arrhythmia.
2. Uncontrolled hypertension.
3. Significant aortic stenosis.
4. Cardiomyopathy.
5. Previous coronary bypass surgery.
6. Treatment with digoxin.
7. CVA with neurological deficit.
8. Patient refusal to participate in the study.

Fifty type 2 diabetic patients without cardiovascular disease symptoms presenting to medicine out-patient / in-patient were included in the study. A detailed clinical history followed by clinical examination was done for all patients included in the study. Haematological investigations performed for all patients included lipid profile, Fasting Blood sugar (FBS) and HbA1c.

12-lead electrocardiogram in resting position was carried out and abnormalities in the recorded electrocardiogram were noted in the study questionnaire.

Statistical Analysis

Microsoft Excel was used for data compilation and analysis was done using Epi-Info statistical software. Percentages

and proportions were used for presenting descriptive data. Students unpaired t test was used for comparing significance of difference between numerical data and chi square / Fischer's exact test were done as applicable for comparing nominal data. P < 0.05 was considered statistically significant.

RESULTS

Variables	Number	%	
Age (years)	31 - 40	2	4
	41 - 50	16	32
	51 - 60	22	44
	61 - 70	10	20
Gender	Female	27	54
	Male	23	46
Family history of diabetes	Yes	15	30
	No	35	70
Current smoker	Yes	11	22
	No	39	78
Current alcoholic	Yes	9	18
	No	41	82
Duration of diabetes mellitus (years)	< 5	4	8
	6 - 10	19	38
	11 - 15	18	36
	16 - 20	9	18

Table 1. Clinical and Demographic Characteristics of the Patients

Table 1 shows clinical and demographic characteristics of the patients. The (mean ± SD) age of patients under study was observed to be 53.86 ± 3.34 years. Majority of the patients were in the age group of 51 - 60 years (44 %). Females (54 %) were slightly more than males (46 %). Family history of diabetes was present in only 30 % of the cases. 22 % were current smokers and 18 % were current alcoholics. The mean duration of diabetes mellitus among patients of the study group was observed to be 11.27 ± 4.19 years.

Treatment for Diabetes Mellitus	N	%
Oral hypoglycaemic drugs	11	22
Oral hypoglycaemic drugs ± insulin	22	44
Insulin	17	34
Total	50	100

Table 2. Classification of Patients According to Treatment for Diabetes Mellitus

Table 2 shows classification of patients according to treatment for diabetes mellitus. Majority of the study participants (44 %) were using the oral hypoglycaemic drugs and insulin

Variable	Mean	Standard Deviation	
Anthropometry	Weight (kg)	73.12	9.31
	Height (cm)	1.63	0.25
	Body mass index (kg / m ²)	27.04	3.87
	Waist hip ratio	0.95	0.22
Blood pressure (mmHg)	Systolic	129.68	7.36
	Diastolic	80.56	3.48

Table 3. Distribution of Study Subjects as per Anthropometry and Blood Pressure

Table 3 shows distribution of study subjects as per anthropometry and blood pressure. Mean weight and height was 73.12 ± 9.31 kg and 1.63 ± 0.25 cm while the mean body mass index (BMI) was 27.04 ± 3.87 kg / m². Mean systolic blood pressure was 129.68 ± 7.36 mmHg while mean diastolic blood pressure was 80.56 ± 3.48 mmHg.

Biochemical Parameters	Mean	Standard Deviation
FBS (mg / dl)	204.92	22.83
HbA1c (%)	7.32	0.60
Total cholesterol (mg / dl)	188.4	20.39
HDL (mg / dl)	40.24	5.67
LDL (mg / dl)	98.64	14.01
Triglycerides (mg / dl)	182.9	18.44

Table 4. Distribution of Study Subjects as per Biochemical Parameters

Table 4 shows distribution of study subjects as per biochemical parameters. Mean values of fasting blood sugar (FBS) and HbA1c were raised in the study participants i.e. 204.92 ± 22.83 mg / dl and 7.32 ± 0.60 % respectively. Total cholesterol was 188.4 ± 20.39 mg / dl; high density lipoproteins (HDL) were 40.24 ± 5.67 mg / dl; low density lipoproteins (LDL) were 98.64 ± 14.01 and the triglycerides were 182.9 ± 18.44 mg / dl.

Type of ECG Changes	Number	%
ST depression + T wave inversion	5	35.7
Left ventricular hypertrophy	4	28.6
Right bundle branch block	1	7.1
Left atrial enlargement	3	21.4
Left bundle branch block	1	7.1
Total patients with ECG changes	14	28
Patients with normal ECG	36	72

Table 5. Types of ECG Changes in Patients of Study Group

Table 5 shows types of ECG changes in patients of study group. 28 % of the cases had ECG changes and among them the most common was ST depression + T wave inversion in 35.7 % followed by left ventricular hypertrophy in 28.6 % of the cases.

Variables	Patients with ECG Changes (N = 14)	Patients without ECG Changes (N = 36)	T Value	P Value
Age (years)	55.27 ± 6.28	52.22 ± 7.20	1.39	0.17
Duration of diabetes (years)	13.57 ± 4.20	10.18 ± 3.83	2.625	0.015
BMI (kg / m ²)	57.27 ± 7.20	55.27 ± 6.28	0.913	0.371
SBP (mmHg)	130.43 ± 6.19	129.39 ± 7.82	0.493	0.625
DBP (mmHg)	80.57 ± 4.11	80.56 ± 3.26	0.0081	0.9936
FBS (mg / dl)	199.36 ± 25.79	207.08 ± 21.57	0.9089	0.3747
HbA1c (%)	7.72 ± 0.78	7.16 ± 0.44	2.534	0.022
Total cholesterol (mg / dl)	191.07 ± 20.18	187.36 ± 20.66	0.5797	0.5675
HDL (mg / dl)	39.29 ± 6.27	40.61 ± 5.47	0.691	0.496
LDL (mg / dl)	98.79 ± 14.04	98.58 ± 15.19	0.046	0.9634
Triglycerides (mg / dl)	189.14 ± 18.87	180.47 ± 17.95	1.478	0.152

Table 6. Comparison of Patients with ECG Changes and without ECG Changes

Table 6 shows comparison of patients with ECG changes and without ECG changes. Among the variables compared between the two groups only duration of diabetes (years) and HbA1c (%) were found to be statistically significant (P < 0.05). Both the variables were found to be significantly more in patients with ECG changes (N = 14) compared to patients without ECG changes (N = 36).

DISCUSSION

In the present study, the mean age of patient was 53.86 ± 3.34 years and majority, 38 (76 %) of the patients belonged to the age group of 41 - 60 years. A slight female preponderance was observed with 23 (46 %) males and 27 (54 %) females. The mean duration of diabetes mellitus was

11.27 ± 4.19 years and in majority 29 (74 %) of the patients the duration of diabetes was 6 - 14 years. The mean body mass index (BMI) was 27.04 ± 3.87) and the mean waist-hip ratio (WHR) was 0.95 ± 0.22. Srinivasan MP et al.¹⁰ found that mean age was 56.47 ± 5.89 years which is slightly more compared to present study. Gupta S et al.¹¹ found the mean age slightly lesser compared to present study (50.3 ± 11.90 years) and males were more than females. In the north Indian study by Chauhan S et al.¹² the mean age of patients with type 2 diabetes mellitus was 49.56 ± 6.68 years which is less than that of the present study and in other similar Indian studies, 34 (68 %) patients were females. In the Asian study by Khoharo HK et al.¹³ the mean age was 47 ± 13 years, while the mean duration of diabetes was 13 ± 7 years.

In a study by Uusitupa M et al.¹⁴ the age-standardised total and cardiovascular mortality rates were substantially higher in diabetic men (17.8 and 15.0 %,) and women (18.5 and 16.6 %, P < 0.01 for both) than in non-diabetic control men (5.2 % both total and cardiovascular mortality) and women (4.2 and 2.2 %). Faglia E et al.⁷ reported that risk of cardiac events can be reduced to a great extent in subjects with type 2 diabetes mellitus.

However, in the Detection of Ischemia in Asymptomatic Diabetics (DIAD) prospective study by Young LH et al.¹² on a study population of patients with diabetes, the cardiac event rates were low and were not significantly reduced by MPI screening. Krane V et al.¹⁵ noted that diabetic patients with left ventricular hypertrophy were twice at risk of stroke and sudden death incidence was increased by 60 % among them.

In the present study, electrocardiographic changes were observed in 14 (28 %) patients. The mean QT interval was observed to be 400.08 ± 16.01 ms. the most common ECG abnormality in the patients was ST-T changes where in 5 (10 %) patients; ST depression and T wave inversion was observed. This was followed by left ventricular hypertrophy observed in 4 (8 %) patients, left atrial hypertrophy (LAE) in 3 (6 %) patients and bundle branch blocks were observed in 2 (4 %) with 1 (2 %) patient each with left bundle branch block (LBBB) and right bundle branch block (RBBB).

Similar findings were reported by other similar studies like a high prevalence of ECG abnormalities have been found (73 %) in the study by Tamburrini LR et al.¹⁶ De Santiago A et al.¹⁷ observed that future cardiovascular events can be predicted in diabetes patients. Khoharo HK et al.¹³ found that all cases had QTc prolongation with mean 0.52 + / - 0.19. Median QTc intervals were 0.590 (range. 0.515 - 0.780) and 0.631 (range 0.530 - 1.869) for males and females respectively. Cardiac autonomic neuropathy manifestations were prominent in diabetics of ± 5 years when compared with patients for < 5 years (P < 0.003). Adebayo R et al.¹⁸ found that 17 (21.5 %) had HHD without heart failure, 33 (41.8 %) had HHD with hypertensive heart failure (HHF), while 29 (36.7 %) were T2DM patients. The commonest indication for Holter ECG was palpitation (38 %), followed by syncope (20.3 %). Premature ventricular contraction was the commonest arrhythmic pattern among the 79 patients, especially among HHF patients.

In the present study; mean fasting blood glucose (FBS) of patients in the study group was 204.92 ± 22.83 mg / dl and mean glycated haemoglobin (HbA1C) was 7.32 ± 0.60 %. In the study by Menezes SA et al.¹⁹ it was found that among cases those who had higher glycohaemoglobin values (> 8.5) had more ECG changes (38 %).

In the present study, mean total cholesterol of patients was 188.4 ± 20.39) mg / dl, the mean high-density lipoprotein (HDL) level was 40.24 ± 5.67 mg / dl, the mean low-density lipoprotein (LDL) level was 98.64 ± 14 mg / dl and the mean triglycerides level of patients in the study group was 182.9 ± 18.44 mg / dl. Similarly, in the cross-sectional study by Gupta S et al.¹¹ poor glycaemic control was seen in 70 % patients with ECG changes, increased triglyceride and decreased high density lipoprotein (HDL) levels. There was no significant difference in biochemical parameters noted amongst the diabetics with or without ECG change. In the study on Nigerians by Olamoyegun AM et al.²⁰ mean fasting blood sugar (FBS), was 8.6 ± 5.6 mmol / l and two hours postprandial blood sugar level was 10.3 mmol / l; the mean systolic blood pressure was 141.8 ± 19.2 mmHg, and the mean diastolic blood pressure was 80.6 ± 13.2 mmHg. LDL triglycerides and / or other changes in lipoprotein composition characteristic of type 2 diabetes and manifesting as elevated serum triglycerides are atherogenic and they strongly predict increased cardiovascular mortality.¹⁴

CONCLUSIONS

28 % of patients with type 2 diabetes mellitus was found to have abnormal ECG changes. Duration of diabetes (years) and HbA1c (%) were found to be significantly more in patients with abnormal ECG changes. This study shows that type 2 diabetes patients especially of longer duration should undergo cardiac evaluation even though they do not have any symptoms relating to cardiovascular system. The present study assessed the ECG changes in asymptomatic type 2 diabetic patients; the presence of which could be an indicator of underlying cardiovascular pathology. Resting ECG can be recommended for routine screening of asymptomatic type 2 diabetic patients.

Limitations

1. The present study was a cross sectional study; a prospective long-term study in asymptomatic type 2 diabetic patients to estimate the occurrence of cardiovascular morbidity and mortality would give better results.
2. Relatively smaller sample size.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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REFERENCES

- [1] Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of the century. *World J Diabetes* 2015;6(6):850-867.
- [2] Haffner SM, Lehto S, Rönnemaa T, et al. Mortality from coronary heart disease in subjects with type 2 diabetes and in non-diabetic subjects with and without prior myocardial infarction. *N Engl J Med* 1998;339(4):229-234.
- [3] Wild S, Roglic G, Green A, et al. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27(5):1047-1053.
- [4] AlGhatrif M, Kuo YF, Al Snih S, et al. Trends in hypertension prevalence, awareness, treatment and control in older Mexican Americans, 1993-2005. *Ann Epidemiol* 2011;21(1):15-25.
- [5] De Mattos MAS, Tannus LRM, Cobas RA, et al. Impact of diabetes on cardiovascular disease: an update. *Int J Hypertens* 2013;2013:653789.
- [6] Sorajja P, Chareonthaitawee P, Rajagopalan N, et al. Improved survival in asymptomatic diabetic patients with high-risk SPECT imaging treated with coronary artery bypass grafting. *Circulation* 2005;112(9):I-311-I-316.
- [7] Faglia E, Manuela M, Antonella Q, et al. Risk reduction of cardiac events by screening of unknown asymptomatic coronary artery disease in subjects with type 2 diabetes mellitus at high cardiovascular risk: an open-label randomized pilot study. *Am Heart J* 2005;149(2):e1-e6.
- [8] Young LH, Wackers FJ, Chyun DA. Cardiac outcomes after screening for asymptomatic coronary artery disease in patients with type 2 diabetes: the DIAD study: a randomized controlled trial. *JAMA* 2009;301(15):1547-1555.
- [9] Stern S, Sclarowsky S. The ECG in diabetes mellitus. *Circulation* 2009;120(16):1633-1636.
- [10] Srinivasan MP, Kamath PK, Bhat NM, et al. Severity of coronary artery disease in type 2 diabetes mellitus: does the timing matter? *Indian Heart J* 2016;68(2):158-163.
- [11] Gupta S, Gupta RK, Kulshrestha M, et al. Evaluation of ECG abnormalities in patients with asymptomatic type 2 diabetes mellitus. *J Clin Diagn Res* 2017;11(4):OC39-OC41.
- [12] Chauhan S, Ghosh M, Agrawal PK, et al. Prevalence of silent myocardial ischemia in type 2 diabetes mellitus with microalbuminuria. *Int J Adv Med* 2017;4(1):40-46.
- [13] Khoharo HK, Halepoto AW. QTc-interval, heart rate variability and postural hypotension as an indicator of cardiac autonomic neuropathy in type 2 diabetic patients. *J Pak Med Assoc* 2012;62(4):328-331.
- [14] Uusitupa MI, Niskanen LK, Siitonen O, et al. Ten-year cardiovascular mortality in relation to risk factors and abnormalities in lipoprotein composition in type 2 (non-insulin-dependent) diabetic and non-diabetic subjects. *Diabetologia* 1993;36(11):1175-1184.
- [15] Krane V, Heinrich F, Meesmann HM, et al. Electrocardiography and outcome in patients with diabetes on maintenance hemodialysis. *Clin J Am Soc Nephrol* 2009;4(2):394-400.
- [16] Tamburrini LR, Di Monte M, Ponte E, et al. The heart, the elderly and diabetes mellitus. Epidemiologic study of 333 ambulatory clinical cases. *Minerva Med* 1991;82(10):665-673.
- [17] De Santiago A, García-Lledó A, Ramos E, et al. Prognostic value of ECGs in patients with type-2 diabetes mellitus without known cardiovascular disease. *Rev Esp Cardiol* 2007;60(10):1035-1041.
- [18] Adebayo R, Ikwu An, Balogun Mo, et al. Evaluation of the indications and arrhythmic patterns of 24 hour holter electrocardiography among hypertensive and diabetic patients seen at OAUTHC, Ile-Ife Nigeria. *Diabetes Metab Syndr Obes* 2014;7:565-570.
- [19] Menezes SA, Delasalle A, Arunachalam. A study of electrocardiographic changes in type 2 diabetes patients. *Int J Res Med Sci* 2015;3(12):3470-3473.
- [20] Michael OA, Olarinde OO, Tunji OY, et al. Prevalence, variants and determinants of electrocardiographic abnormalities amongst elderly Nigerians with type 2 diabetes. *J Med Medical Sci* 2013;4(8):324-328.