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A STUDY ON ECG CHANGES IN DIABETIC PATIENTS AND ITS RELATION TO CARDIAC DYSAUTONOMIA.

General Medicine

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ABSTRACT

Background: Autonomic dysfunction in diabetics is common and often asymptomatic. Patients with diabetic autonomic neuropathy are more prone for sudden cardiac death probably due to silent myocardial infarction or primary malignant ventricular arrhythmias. The ECG is liable to show more abnormalities in people with diabetes than non-diabetics.

Materials and methods: The present study is an analytical study. ECG taken in 50 diabetic patients was analysed and compared to 50 age and sex-matched controls coming to out-patient and admitted as in-patients in the Department of General Medicine in ASRAM from August 2017 to July 2018.Parameters assessed for cardiac dysautonomia-

Parasympathetic function:

1) Resting heart rate.
2) Abnormal Heart rate response to deep breathing. (HRBD) (<10 beats per minute)

Sympathetic function:

1) Blood pressure (BP) response to standing . (drop of SBP>30 mmHg)
2) QTc prolongation. (>460msec).

Results: The mean resting heart rate, P-R interval, QTc interval are significantly higher in the study group than the control group ($p<0.05$). The QRS interval is prolonged in the study group as compared to that of controls but not significant. The QRS axis is significantly towards the left in the study group compared to controls. The ECG changes of ischemia and intraventricular conduction blocks are significantly greater in the study group. 28 % Of study group have abnormal HRBD(parasympathetic dysfunction and 6 % Of study group showed a significant drop of systolic blood pressure(SBP) (sympathetic dysfunction).There is no sign. There is a positive correlation between QTc prolongation and postural fall in SBP. The ECG changes of ischemia are significantly greater in the study group than the control group. The QRS duration is not significantly prolonged in the study group.

Conclusions: This study highlights the importance of simple non-invasive investigation like ECG in diagnosing asymptomatic cardiac autonomic dysfunction, a precursor of symptomatic cardiac neuropathy.

KEYWORDS

Cardiac Autonomic Dysautonomia (CAN), Cardiac Autonomic Reflex Tests (CARTS), Heart Rate Response to Deep Breathing(HRDB), QTc (corrected) interval, beats per minute (bpm).

INTRODUCTION:-

- Diabetes mellitus (DM) is a global health epidemic affecting 415 million people worldwide by 2018.[1]
- The ECG is liable to show more abnormalities in people with diabetes than non-diabetics.
- Autonomic dysfunction in diabetics is common and often asymptomatic.
- Patients with cardiac autonomic neuropathy (CAN) are more prone for sudden cardiac death probably due to silent myocardial infarction or primary malignant ventricular arrhythmias.[2]

AIMS AND OBJECTIVES:-

- To study the various ECG abnormalities in Type 2 Diabetes mellitus patients as compared to controls.
- To study the prevalence of cardiac dysautonomia in type 2 diabetes mellitus patients by various ECG markers

MATERIALS AND METHODS:-

Study group - 50 patients with diabetes mellitus.
Control group - 50 age and sex-matched controls.
Period of study - August 2017 to July 2018.
Place of study –
Out-patients and In-patients in General Medicine department, ASRAM.

Inclusion criteria-
All diabetic patients except with the following exclusion criteria.

Exclusion criteria-

1) Age >60
2) Documented ischemic / valvular / congenital heart disease.
3) Hypertension
4) Uremia.
5) Dyselectrolytemia
6) Hypo/hyperthyroidism
7) Chronic lung disorders
8) Fever and any other infection.

ECG was taken both in the study and control group, analysed; and the following parameters are assessed for autonomic dysfunction and compared in both groups.

Parasympathetic function:

1) Resting heart rate.
2) Abnormal Heart rate response to deep breathing. (HRBD) (<10 beats per minute)

Sympathetic function:

1) Blood pressure (BP) response to standing. (a drop of SBP>30 mmHg)
2) QTc prolongation. (>460msec)

OBSERVATIONS AND DATA ANALYSIS

1) Age And Sex Distribution:
More than half of the study and control population belongs to the age group of 41-50 years (56%); followed by 26% in 31-40 years, 16% in 51-60 years and 2% in 21-30 years.

2)Duration of Diabetes:
56% of the study population has a duration of diabetes for less than five years followed by 28% having a duration of 6-10 years, 12% of 11-15 years, 2% of 16-20 years and 2% of >20 years duration.

ECG Abnormalities:

1) Resting Heart Rate:
The mean resting heart rate of study (diabetics) group (84.2±12.86bpm) is significantly higher ($p<0.05$) than that of the control group (75.2±10.65). Normal range – 56- 110bpm. The p-Value = 0.0001 – unpaired 't' test .

2) R-R Interval[Figure1]**:**
The R-R interval of the study group (725.4±121.49msec) is significantly lower ($p<0.05$) than that of controls (815.4±114.41msec) correlating with the increased heart rate signifying parasympathetic damage.

3) PR-Interval[Figure1]**:**
The PR interval of the study group (162.4±11.67msec) is significantly ($p<0.05$) higher than that of the control group (138.2±16.99msec).

4) QRSDuration[Figure1]**:**
The QRS duration is prolonged in the study group (68.4±11.67msec) as compared to that of controls (65±8.69msec). But it is not statistically significant. ($p>0.05$).

5)QRSAxis:
The QRS axis of the study group is more towards left (26.4±30.54 degrees) as compared to that of controls (67.6±27.82 degrees), which is statistically significant($p<0.05$). Typical range in the study group is -45 to +90 and -15 to +100 in the control group.

6) QTcInterval[Table1)(Figure1,2]**:**
Table -1

GROUPS	QTc INTERVAL	
	Range(msec)	Mean(msec)
Study(diabetics)	345-595	405.16 ± 40.38
Control	302-415	365.38 ± 25.3

p-value- 0.0001 * Unpaired 't' test

The QTc interval in the study group (405.16±40.38 msec) is significantly prolonged ($p<0.05$) than the controls (365.38±25.3 msec).

7) ECG changes of Ischemia and Infarction:
The ECG changes of ischemia and infarction are significantly higher in the study group (26% & 10% respectively) when compared to the control group (12% & 6%).

8)Correlation between ECG and symptoms of IHD[Table2]**:**
Table 2

GROUPS	ECG CHANGES	SYMPTOMATIC		ASYMPTOMATIC	
		NO.	%	NO.	%
Study (diabetics)	18	13	72.22%	5	27.78%
Control	9	8	88.89%	1	11.11%

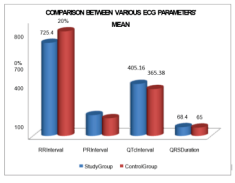
Prevalence of asymptomatic heart disease in the study group (27.78%) is higher when compared to the control group (11.11%).

9) Incidence of Intraventricular Conduction Blocks[Figure2]**:**
The prevalence of intraventricular conduction defect is higher in the study group(8%) when compared to that of controls (2%).

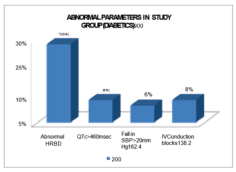
10) Heart rate Response to Deep Breathing(HRDB)[Figure2]**:**
28% of the study group have abnormal HRBD (<10 beats per minute), suggesting early parasympathetic dysfunction. Normal - >15 beats per minute.

11) A significant postural drop of SBP (>30 mmHg)[Figure2]**:**
6% of the study group show a significant postural decrease of SBP (>30 mm Hg) on standing which probably indicates sympathetic nervous system dysfunction.

12) QTc interval correlation with a significant postural drop in SBP (SBP>30mm Hg):
There is a positive correlation between QTc prolongation and significant postural fall in SBP. All three patients had substantial QTc prolongation.



(a)Bar Diagram 1



(d)Bar Diagram 2

DISCUSSION:
This study compares the ECG changes of 50 type 2 diabetes patients with an equal number of age and sex-matched controls to find out any differences in abnormalities, if any, in diabetic patients. By using conventional ECG parameters, this study also delineates the prevalence of autonomic dysfunction in the diabetic population.

Kahn J.K. et al. found that patients with cardiac dysautonomia have higher resting heart rates and lower maximal heart rates during exercise than diabetic patients with-out autonomic neuropathy [5].

The measurement of PR interval that reflects the AV conduction showed that mean PR interval was (162.4±31.72) in people with diabetes as against (138.2±16.986) in non- diabetic population, which was statistically significant.

A Pourmoghaddas et al.[6] found that the prevalence of prolonged QTc interval was significantly higher in the case group in comparison with the control group, eight vs 2% respectively (p-value = 0.012, OR = 4.3). It is comparable with our study, which also shows long QTc in 8% of diabetics as compared to 0% in non-diabetics.

Abnormality of the parasympathetic nervous system is more common than (3 fold) abnormality in the sympathetic nervous system

Kannel et al.[7] found that the risk of cardiovascular risk in people with diabetes is double that of non-diabetics. Various studies [8,9] had established that the prevalence of IHD is high in people with diabetes without a doubt.

The prevalence of asymptomatic silent ischemia was significantly higher in people with diabetes (27.78%) compared to non-diabetics (11.11%) in our study.

Negrusz-Kaweck et al.[10] found that the incidence of silent ischemia in type 2 Diabetics was 20.22%.

Other studies [11] also reported a similar prevalence of asymptomatic ischemia in diabetics.

O'Sullivan et al. [12] found that silent ischemia was present in 64.7% with autonomic neuropathy against 41.1% without autonomic neuropathy. They concluded that autonomic neuropathy might prevent the development of angina pain.

There is an increased incidence of conduction blocks in people with diabetes as compared to non-diabetics. Partman and Bradley [13] found that the incidence of RBBB in people with diabetes is about2.5%.In this study, there was an increasing prevalence of both incomplete RBBB/LAFB in diabetics (4%/4% respectively) as compared to non-diabetics (2%/0%).

The CAN Subcommittee of Toronto Consensus Panel on Diabetic Neuropathy[4]defined CAN and advised the application of cardiac autonomic reflex tests (CARTs) (discovered by Ewing et al. in the 1970s) in diagnosing.

Abnormalities associated with CAN- resting tachycardia, orthostatic hypotension,

perioperative instability, loss of reflex heart rate variations(HRV), exercise intolerance, non-dipping, reverse dipping, etc.

Reduced heart rate variability is the earliest indicator of CAN (i.e., abnormalities of heart rate control and vascular dynamics).

The HRBD (Heart Rate response to Deep Breathing) is abnormal in people with diabetes, indicating parasympathetic damage. It was positive in 28% of diabetics in this study.

I.Domuschiev, et al.[14] found that the heart rate response to deep breathing was the most sensitive test, positive in 33.3%, followed by heart rate response to standing (31%).

The QTc interval correlated well with postural hypotension. All patients who had both symptoms and signs of postural hypotension (three) had significant QTc prolongation.

H. Oka [15] et al. found that QTc interval prolongation significantly correlates with a postural drop in SBP. In short, the QTc interval can be taken as a marker of sympathetic nervous system dysfunction.

Decreased sympathetic outflow to the heart and resistance vessels accompanies a decrease in SBP, exercise capacity and maximum heart rate. [16]

This inability to increase rate variation may contribute to postural hypotension. [17,18]

RESULTS:

1. The mean resting heart rate of study (diabetics) group (84.2±12.86bpm) is significantly higher ($p<0.05$) than that of the control group(75.2±10.65).
2. The R-R interval of the study group (725.4±121.49msec) is significantly lower ($p<0.05$) than that of controls (815.4±114.4 1msec).
3. The PR interval of the study group (162.4±11.67msec) is significantly ($p<0.05$) higher than that of the control group(138.2±16.99msec).
4. The QRS duration is prolonged in the study group (68.4±11.67msec) as compared to that of controls (65±8.69msec). But it is not statistically significant. ($p>0.05$).
5. The QRS axis of the study group is more towards left (26.4±30.54 degrees) as compared to that of controls (67.6±27.82 degrees), which is statistically significant($p<0.05$).
6. The QTc interval in the study group (405.16±40.38 msec) is significantly prolonged ($p<0.05$) than the controls (365.38±25.3msec).
7. The ECG changes of ischemia and infarction are significantly higher in the study group (26%&10% respectively) when compared to the control group (12%&6%).
8. Prevalence of asymptomatic heart disease in the study group (27.78%) is higher when compared to the control group(11.11%).
9. The prevalence of intraventricular conduction blocks in diabetics (8%) is higher than that of controls(2%).

10.28% of the study group have abnormal HRBD suggesting early parasympathetic dysfunction.

11.6% of the study group show a significant postural drop of SBP (>30 mm Hg) on standing, which probably indicates sympathetic nervous system dysfunction.

12.There is a positive correlation between QTc prolongation and significant postural fall in SBP (>30 mm Hg). All three patients had significant QTc prolongation.

CONCLUSIONS:

The following ECG manifestations were present in type 2 diabetic patients compared to the non-diabetic population.

1. High resting heart rate
2. Prolongation of the PR-interval
3. Increased prevalence of ischemia and infarction
4. Increased incidence of asymptomatic IHD
5. The leftward QRS axis
6. No significant difference in QRS duration.

The manifestations suggestive of cardiac dysautonomia in type 2 Diabetics were

1. AbnormalHRBD≤10bpm in 28%.
2. Prolonged QTc interval (QTc>460 msec) in8%.
3. Significant postural drop in SBP (>30 mm Hg) in6%.
4. There is a positive linear correlation between QTc prolongation (QTc>460 msec) and postural drop on SBP (>30 mmHg).

Thus, the evaluation of various cardiovascular reflexes in people with type 2 diabetes gives an easy and feasible bedside technique to determine the presence of cardiac dysautonomia.

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