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Electrocardiographic Alterations Using Vectors in Diabetic Patients (Type-2) of Rural Population: A Comparative Report

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ABSTRACT:

Background: An electrocardiogram, termed as ECG, is a very simple and common test, used to determine the healthy condition of an individual. The electrocardiogram is generally done in the evaluation of cardiovascular risk in diabetics. Thus we proposed in this work to evaluate electrocardiographic alterations in patients of rural population with type 2 diabetes. There is a lack of study found on various standard limbs leads (I, II & III), augmented unipolar limb leads and chest leads in diabetic patients especially who are living in rural areas. Hence, the present study aims to evaluate the effect of increased sugar on standard limb leads (II) using vectors in medium aged male subjects residing in rural area.

Materials & methods: This was a cross-sectional and descriptive observation that took place from 1 January 2022 to 1 October 2022 in the Physiology Departments of the University with varying age group in between 45 to 50 years, were recruited and divided into group A and control (B) group were considered. Study group received medications for six week to maintain normal blood sugar level. BMI was calculated, Height was taken and body weight was measured. ECG was taken using BPL ECG recorder (Cardiart 8108T). Baseline and post- test assessments were taken before and after the medication. PC based cardiovascular analyzer was used for recording pulse wave velocity (PWV) and arterial stiffness index (ASI).

Result: Significant difference (increase) was noted on heart rate, R-R interval was reduced significantly, and arterial stiffness and pulse wave velocity were increased in study groups when compared with control group. No significant reduction was observed on systolic blood pressure, diastolic blood pressure, pulse pressure, mean arterial blood pressure, body weight, height & BMI in study group when compared with control.

Conclusion: The ECG is certainly insufficient for an exhaustive exploration of the heart of the diabetic patient, but still very useful in our conditions of exercise to improve the care of our patients. Result of this study suggests that responses in diabetes type 2 are sympathetic dominance and hypertrophied in study group.

Key words: ECG, Standard Limb Leads-I, II, III, Chest Leads, IAYT (Integrated approach of yoga therapy)

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INTRODUCTION: The ECG must always be interpreted systematically and carefully because failure to go for proper explanations may be detrimental. The step by step sequence of interpreting ECG makes it easy for anyone, as well as reduces the chances of missing important abnormalities and also expedites the process. 'P' wave is atrial depolarization, 'QRS' is ventricular depolarization and 'T' wave is ventricular repolarization, but a gap in between P & QRS complex has not been given clearly which is actually less ionic movements (flow of current becomes slow) in the AV bundle, hence no deflection of the pointer. Again a gap in between QRS and T wave represents a complete depolarization of ventricle (Figure-1). Specialized conducting tissues in the heart are shown, designed to control the systole and diastole according to the response of autonomic nervous system (1-5).

As per earlier findings, effect of diabetes type-2 on electrocardiogram, explanation on R-R interval is there, QRS complex is also there on the basis of an activity of autonomic nervous system (both sympathetic and parasympathetic) but there is no explanation on using vector or resting membrane potential of pacemaker fiber or cardiac muscle fiber(6-8). We have reported recently the effect of sympathetic and parasympathetic on pace maker fiber as well as ventricular muscle fiber. There is no report so far on positive and negative waves of ECG (Standard limb lead-I/II/III) and the effect of ANS especially on nodal or ventricular fiber. P wave is positive wave (vector A of figure-1) comes when +ve charges are moved towards positive electrode, no response (no movement of pointer) before R wave indicating less flow of current (B of figure-1), Q wave is negative wave comes from ventricular septum depolarization (vector positive, C of figure-1), .R wave is big positive wave due to the thickest myocardium (D + ve vector of figure-1), S is negative wave (vector E of figure-1), no response in between R & T is due to complete depolarization (F vector of Figure-1), T is positive wave comes from ventricular repolarization (G vector –ve of figure-1).

Electrocardiogram with vectors commonly used among the range of complementary examinations for cardiovascular risk evaluation. It will help to determine a number of abnormalities regardless of the existence of cardiovascular risk factors but also and especially cardiovascular disease (CVD). The ECG poses in our regions a problem of availability and achievement due to lack of means. As a result, diabetic patients were neglected from getting any benefit, as well as from their realization on their care. Electrocardiographic abnormalities, their distribution and their determinants within this population remain limited. Such knowledge is valuable not only to help to better adapt international practical recommendations to local realities but also to highlight the particularities of our patients compared to those elsewhere. Most health care practitioners would agree that the majority of chronic diseases (Type 2 diabetes) are the result of poor lifestyle choices. In this, again a correlation is brought between ANS and cardiac muscle fibers using vectors (9-12) in diabetic type 2 patients and the same was compare with normal healthy subjects.

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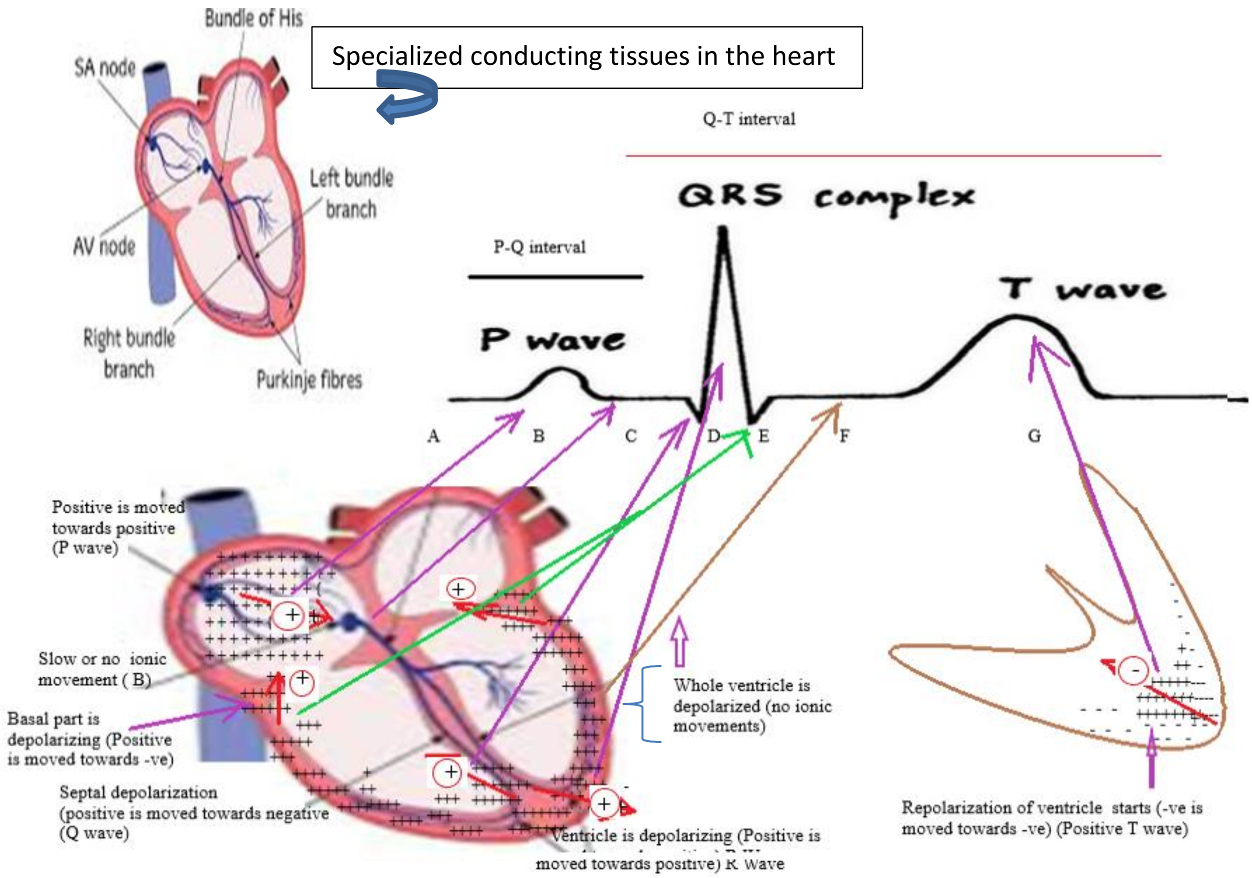

Figure-1: Showing specialized conducting tissues in the heart and explanation of various waves using cardiac vectors (A-G).

METHODS:

General protocol: Following approval of institute ethics committee of the University, medium aged (45-50 years) subjects were asked to give consent as per rules. All participants were divided into two groups. In the first study group-A male participants were asked to visit the department twice both in the morning and evening. The control group aged 45-50 years who were also asked to come regularly. Diabetic type -2 was receiving medications regularly for six weeks. The patients were informed about our study and his consent requested in view of its inclusion in our study. All patients were also aware of their diabetes status and the complications they would be exposed to. All patients were systematically checked up every day as part of the care of their disorders. This checkup included a physical examination, fasting blood glucose test, multi-reagent test urine, serum creatinine level, lipid balance including total cholesterol, HDL cholesterol and triglycerides, a glycated hemoglobin assay (HbA1c), a resting ECG, and arterial stiffness and pulse wave velocity determinations.

The interrogation and consultation of clinical records of the participants would allow to gather information on the status, circumstances of diabetes discovery, existing complications and their stages, on-going drug therapy, cardiovascular risk factors, family history. Each patient had a medical record with a complete physical examination.

Recording of ECG: Electrocardiogram of each subject was recorded by using BPL ECG Recorder – Cardiart 108T (1 Channel). ECG was recorded in supine position after several minutes' rest using digital surface ECG recorder,

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and was printed at a paper speed of 25 mm/sec and amplitude of 10 mm/mV. Absolute QT interval (m sec) was measured from the beginning of the QRS complex to the end of the T wave. The end of the T wave was defined as the intercept between the isoelectric line and the regression line derived from the descending slope of the T wave. U wave was carefully distinguished from T wave. Strictly, absolute QT interval is different in different leads. In the present study, QT interval in limb lead II was adopted, because this interval is longest in lead II, and T wave is easily distinguished from U wave in this lead. ECG data were diagnosed based on Minnesota code, transferred using A/D converter, and stored automatically to a personal computer. Thereafter, ECG recordings were reviewed by experienced cardiologists in a blind manner

Measurement of noninvasive parameters: A small portion of record from Periscope (Figure-1), PC based low-cost instrument, hence used with a computer,. It used ECG as a marker. Periscope thus facilitates use in epidemiological studies which has been validated and has good intraday and inner observer reproducibility for various estimated central and peripheral arterial velocities. In brief, PWV was determined by a non-invasive pulse wave analyzing device (Periscope). All participants, Group A & B, were asked to have vegetarian diet, asked to refrain from smoking and drinking caffeine-containing beverages 12 hours before the test. Procedure was performed always by the sale operator in the morning hours between 7 and 10 a.m. with subject resting in supine position at least 10 min before the recording. Electrodes for electrocardiogram were placed in ventral surface of both wrists and medial side of ankles and BP cuffs were wrapped on both upper arm brachial artery and tibial artery above ankles. The cuff was connected to a plethysmography sensor which determines volume pulse form and an oscillometer pressure sensor, which measures blood pressure volume waveform from the brachial and tibial arteries (Figure 1).

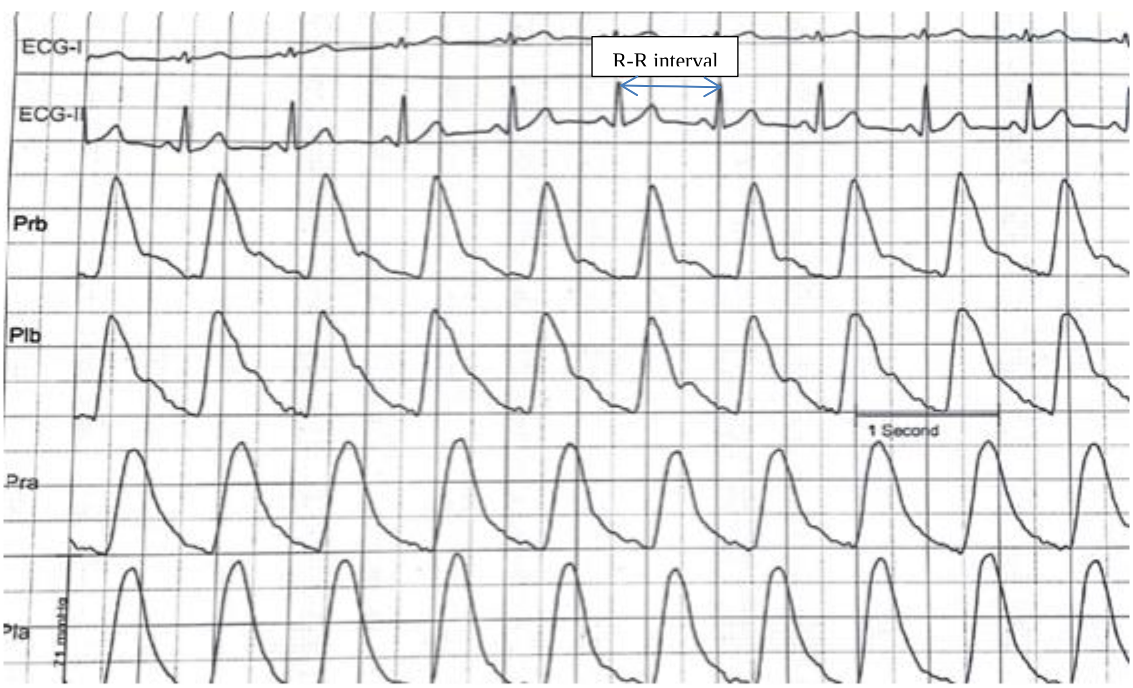

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Figure-2: A small portion of record is shown here. Standard limb lead-I & II are shown in upper two lines followed by pressure tracing of right brachial (Prb), left brachial (Plb), right ankle(Pra) and left ankle (Pla. Paper speed was 25mm/sec.

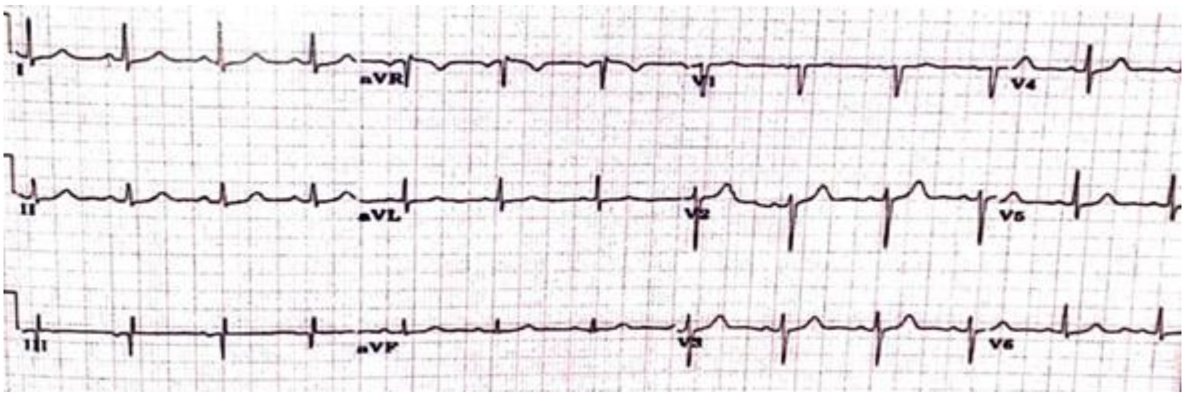

Figure-3: Record of one patient is shown here. All leads are shown. Paper speed was 25mm/sec.

Inclusion criteria: 1. Age 45-50 years
2. Pure vegetarian
3. Those who gave consent
4. Had border level value of arterial stiffness (+ve arterial stiffness)
5. Normal blood sugar level in both fasting and after meal, normal blood Pressure (SBP,DBP & PP) & no complication with renal diseases

Exclusion criteria: 1. Medication for any type of illness except diabetes
2. Smokers & Alcoholics
3. Any drug addiction
4. Value with normal arterial stiffness, hypertension, obesity
5. Complications with Renal diseases

STATISTICAL ANALYSIS: Students 'T' test was performed. < 0.05 was found significant.

RESULTS: The age of the subjects ranged from 45–50 yrs, the mean age being 42.60 ± 8.81 years. On analysis of the physical characteristics of the 50 subjects (20+20+10), the mean height (cm) was 159.38 ± 9.97, the mean weight (kg) was 64.21 ± 9.24 and the mean BMI (kg/m2) was 25.31 ± 3.29. Only males and no significant variation in height (P > 0.05), weight (P>0.05), and BMI (P=0.025) between diabetic type-2 and normal healthy subjects.

Major findings include:

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1. No significant difference (P>0.05) in pulse, SBP, and DBP between these two groups. *P<0.05 Pulse rate, beats/min, (PR) were increased significantly in diabetic groups when compared to control group (Table-1)
2. Significant increase was found with pulse wave velocity in diabetic type-2 group (P<0.02) when compared to control group (Table-1)
3. Significant increase with arterial stiffness in diabetic group when compared to control (P<0.01), it was highly significant(Table-1)
4. Significant alteration was with T wave, R-R interval, P-R interval and QT interval in diabetic type-2 patients when compared to control subjects. All were reduced significantly. (Table-2)
5. Duration of P wave, QRS complex remain unchanged in both the groups (P>0.05) (Table-2)

Table 1: Comparison of cardiovascular parameters of the two groups aged in between 45-50 (Group-A) & 45-50 years (Group-B), P value <0.05 is considered significant. ** <0.01 is highly significant.

Parameters	Mean + SD Group-A (n=20)	Mean + SD Control (B) (n=20)	P- value
P R (beats/min)	95.26±7.81	84.79±7.18	< 0.05*
SBP (mm Hg)	122.42±9.24	118.70±7.91	> 0.05
DBP(mm Hg)	80.01±4.50	77.64±6.64	>0.05
PP (mm Hg)	38.21+2.11	38.21+2.11	>0.05
C-F PWV(cm/s)	875+ 35.23	699+ 10.13	<0.02**
R Ank ASI (mmHg)	96+2.11	67+2.11	<0.01**

Table 2: Comparison of ECG parameters of the two groups aged in between 45-40 (Group-A) and 45-50 years (Group-Control), P value <0.05 is considered significant. ** <0.01 is highly significant.

Parameters	Mean + SD Group-A (n=50)	Mean + SD Group-B(n=50)	P-value
P wave (m sec)	102 + 6.11	110 + 3.03	>0.05*
QRS complex (m sec)	100+ 5.97	107+ 5.90	>0.05
T wave (m sec)	181+6.23	131+6.13	<0.05
R-R interval (m Sec)	600+20.12	786+ 21.02	<0.01**
P-R interval (m Sec)	112 + 4.65	132 + 6.11	<0.01**
Q-T interval (m Sec)	203+ 3.12	203+ 3.62	<0.01

DISCUSSION:

Autonomic nervous system plays an important role here. Depolarization vector of both right and left atrium (A of Figure-1) is affected in diabetic patients. Slow movement of ions/current in the AV bundle (B vector of figure-1) is also affected significantly in diabetic patients (13-20). QRS complex (Ventricular depolarization) is also reduced (C, D, E of figure-1) significantly in diabetic patients indicated hypertrophy Slow depolarization of ventricle (F of Figure-1) in diabetic subjects when compared to normal healthy subjects. T wave (Ventricular repolarization was prolonged, showing slow incomplete repolarization in diabetic subjects. T wave abnormalities, reported earlier (21, 22), seems to be same with our observation as QT interval is increased significantly, in one hand indicates repolarization disorders, might be related to left ventricular hypertrophy and/or hypertension..

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Heart rate was increased significantly indicating stimulation sympathetic. More secretion of adrenaline from the sympathetic nerve ending provides very useful information on characteristics of both smooth muscle and cardiac muscle in diabetic type-2 patients. We have already reported the mechanism involved when sympathetic becomes more active than parasympathetic (14-21).

CONCLUSION:

Electrocardiographic abnormalities are common in patients with diabetes type-2 patients which again are related to other associated risk factors. This makes it possible to better evaluate the impact of cardio-vascular risk on the heart but also to predict the occurrence of cardiovascular accidents in our context. Patients might be aware with ischemic heart disease, diabetic cardiomyopathy, or other abnormalities, might be advised to concentrate their treatment on the better monitoring and balance of associated cardiovascular risk factors;

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