



A COMPARATIVE STUDY OF DIFFERENT CARDIAC ELECTRICAL PARAMETERS IN PREHYPERTENSIVE CASES AND NORMOTENSIVE CONTROLS

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ABSTRACT

Aim: To compare blood pressure (SBP and DBP), heart rate, P wave duration, PR interval, QRS complex, QT interval, ST duration and T wave duration in young prehypertensive cases and normotensive controls.

Materials and Methods: Total 600 subjects including 300 prehypertensive cases (20-45yrs age) and normotensive controls (20-45yrs age) were examined from February 2019 to July 2020. The case and controls were taken from general population and medicine outpatient department of UPUMS, Saifai, Etawah. Detailed history and clinical examination was carried out and anthropometric measurements were recorded. Blood pressure of each subject was recorded by using manual sphygmomanometer in supine position. Electrocardiogram of each subject was recorded in supine position by using Clarity ECG: CMECG-01, Clarity Medical Private Limited. It is computer based automatic 12 lead ECG machine.

Results: The mean difference between SBP and DBP, QRS duration, QT interval, ST changes, and T wave duration in prehypertensive cases and normotensive controls was found statistically significant, while the mean of heart rate, P wave duration, PR interval showing no statistical significance.

Conclusion: The finding according to the present study suggested that most of the patient in the study, prehypertensive group had significantly higher BP, QRS interval, QT duration, ST changes, and T wave changes as compared to normotensive controls. The heart rate, p wave and PR interval had no significant comparative difference. Hence, the early evaluation of the prehypertensive individual with the help of electrocardiographic parameters may help to assess the cardiovascular status of an individual.

KEYWORDS : BP, ECG, Sphygmomanometer, Cardiovascular, Prehypertension.

INTRODUCTION

It is well known that blood pressure (BP) in the prehypertensive range, defined by the Joint

National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) as a systolic BP (SBP) of 120–139mm Hg and/or a diastolic BP (DBP) of 80–89mm Hg, is associated with the future development of frank hypertension (HTN).¹⁻⁵ But what is less well understood are the cardiovascular risks delivered by prehypertension, before established HTN to manifest. It remains controversial whether prehypertension alone or higher BP within the prehypertensive range is independently associated with coronary heart disease (CHD) risk or whether any observed increased risk is the result of associated risk factors. In 1 report, 64% of prehypertensive subjects had >1 cardiovascular disease (CVD) risk factor.⁶ Several studies have reported on the CHD risk of prehypertension. Manious et al. analyzed participants in the first National Health and Nutrition Examination Survey (1971–1975) and ascertained major CVD events over the next 18 years.⁷ They divided prehypertension into categories, “low prehypertension” (120–129/80–84 mm Hg) and “high prehypertension” (130–139/80–89 mm Hg), and found that unadjusted analysis demonstrated risk for both groups but adjustment attenuated the statistical significance of the risk in the low prehypertension (unadjusted hazard ratio (HR) = 1.56, 95% confidence interval (CI) = 1.23–1.98; adjusted HR = 1.24, 95% CI = 0.96–1.59) but not in the high prehypertension group (unadjusted HR = 2.12, 95% CI = 1.64–2.76; adjusted HR = 1.42, 95% CI = 1.09–1.84).⁷ In the Framingham Heart Study, BP levels of 130–139/85–89 mm Hg were associated with twice the risk of CVD compared with BP levels <120/80 mmHg.⁸ In the past decade, overall CVD events have significantly declined in the general population, but the CVD risks due to prehypertension are unclear.

Due to unabated cardiovascular risk factors over long period, this prehypertension may establish into frank hypertension. Hypertension is one of the major risk factors associated with cardiovascular events. The disease burden is estimated to be as high as to 30% amongst the general population in the United States.⁹

An electrocardiogram (ECG) is a test which measures the electrical activity of your heart to show whether or not it is working normally. An electrocardiogram can be a useful way to find out whether your high blood pressure has caused any damage to your heart or blood vessels. Because of this, you may be asked to have an ECG when you are first diagnosed with high blood pressure. Some of the things an ECG

reading can detect are: cholesterol clogging up your heart's blood supply, a heart attack in the past, enlargement of one side of the heart, abnormal heart rhythms.

To examine the association between prehypertension and CHD and CVD outcomes in the modern era, we used a cross section comparative study from general population and also sample from medicine outpatient department at UPUMS, Saifai, Uttar Pradesh, India. Specifically we wanted to examine association of prehypertension with early changes in cardiovascular system and CVD mortality and whether these associations were explained by co-occurring risk factors.

MATERIAL AND METHODS

The aim of the study is to evaluate, change in different cardiac electrical parameters with the help of ECG in prehypertensive individuals. The study is a cross sectional comparative study between prehypertensive and normotensive subjects.

The study was conducted in the department of physiology, Uttar Pradesh University of Medical Sciences, Saifai, Etawah for a period of February 2019 to July 2020, with the permission of ethical committee, on the subjects from general population and medicine outpatient department. A total 600 subject were examined and divided into two groups of 300 each, cases and controls. The 300 cases who are prehypertensive subjects (BP = 120-139/80-89mmHg, JNC VII criteria), apparently healthy male and female between age 20-45 years with either obese, smoker, sedentary habit and positive family history of hypertension and 300 Normotensive controls were healthy male and female, non obese, Non smoker, physically active and Negative family history of hypertension of same age group as for cases, selected from general population and medicine outpatient department, UTTER PRADESH UNIVERSITY OF MEDICAL SCIENCE, SAIFAI, ETAWAH, UP. The nature and purpose of study were described to each subjects and informed consent was obtained from those willing to participate in the study.

A pre-structured proforma was given to each subject to record personal details and pertinent medical history from both cases and controls. A detailed history of each subject was taken which include their chief complaints, present history, drug history, personal history, past history, and family history. Thorough general, physical and systemic examination was carried out to rule out any clinically apparent disease. Following an explanation to each subject about the nature and purpose of study, those subjects who are willing to participate was included and

informed consent was taken from each subject. After proper preparation of each subject, blood pressure was recorded in resting supine position, with the help of Stethoscope and manual sphygmomanometer. Electrocardiogram of each subject was recorded in supine position by using Clarity ECG: CMECG-01, Clarity Medical Private Limited. It is computer based automatic 12 lead ECG machine. The ECG recorded was evaluated for, Heart rate, P wave, PR interval, QRS complex, QRS axis, QT interval, QTc interval, ST segment, T wave etc.

Statistical Analysis

The data was entered on Microsoft excel 2016 and the result was expressed as Mean ± S.D. Group A was compared with group B. Student t-test for two means was used for comparison between the groups and p value < 0.05 was considered as significant.

RESULT

The following observations were made after data analysis of cases and controls. The difference in mean of systolic BP of prehypertensive cases 128.77±6.17 mmHg and normotensive controls was found 113.5.66 mmHg; the P value comes out to be statistically highly significant (0.001) suggesting possible a association between increased BP and cardiovascular risk. There were same findings in DBP with mean (84.1±3.6) in prehypertensive and (73.67±5.25) and P value 0.001 show highly significant association. DBP is more dangerous than the SBP, because one time it is rised, it remain rised continuously whole the time. The difference in mean heart rate was (85.61±10.7 and 84.98±10.26), among the cases and controls was found to be not significant. The difference in mean P value was (126.78±23.39 and 125.01±16.78) among cases and controls and found no significant association with atrial function in this study. The difference in mean PR interval was (160.22±24.42 and 157.99±19.77) among cases and controls and has no statistical significance with conduction delay from SA node to AV and bundle of his. The difference in mean QRS duration among prehypertensive cases (83.05±18.77) and normotensive controls (79.75±13.08), with P value (0.008) comes out to be highly significant suggesting an association between the QRS duration and ventricular activity of the heart between cases and controls. The difference in mean QT interval among prehypertensive cases (358.65±55.59) and normotensive controls (348.28±43.6), with P value (0.009) comes out to be highly significant suggesting an association between the QT interval and depolarization and repolarization process of the ventricles. The difference in mean ST segment duration among prehypertensive cases was (81.33±13.61) and normotensive controls (79.18±11.65), with P value (0.02) comes out to be highly significant suggesting an association between the ST segment duration and myocardial infarction in the heart. The difference in mean T wave duration was among the prehypertensive cases (194.42±29.57) and normotensive controls (187.74±2429), with P value (0.001) comes out to be highly significant, suggesting an association between T wave duration and cardiac ventricular repolarization abnormality.

QRS duration(ms)	83.05±18.77	79.75±13.08	0.008
QT duration(ms)	358.65±55.59	348.28±43.6	0.009
ST duration(ms)	81.33±13.61	79.18±11.65	0.02
T wave duration(ms)	194.42±29.57	187.74±2429	0.001

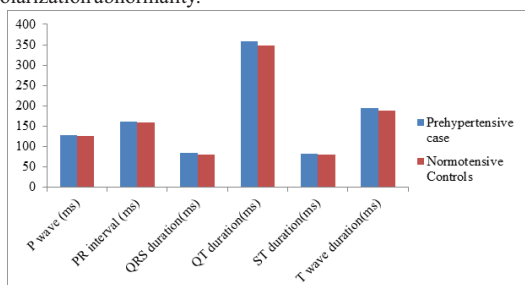
DISCUSSION:

The prevalence of prehypertension is increases in recent scenario of individuals changing lifestyle i.e. stressful life, less or no physical activity, sitting official work, watching extra time television and laptop, consuming fast food, cigarette smoking, tobacco chewing etc are increasing now a days. So keeping all these factors in mind, this study, the ECG is the best tool for early detection of any cardiovascular abnormality.

High blood pressure or Hypertension is often called 'the silent killer' because it shows no early symptoms and, simultaneously, is the single most significant risk factor for atherosclerosis and all clinical manifestations of atherosclerosis. It is an independent predisposing factor for heart failure, coronary artery disease, stroke, renal disease, and peripheral arterial disease. It is the most important risk factor for cardiovascular morbidity and mortality in industrialized countries.¹⁰ Abundant evidence have been present that if risk factors continuous in the life of an individual than the prehypertension may change into frank hypertension. In this study the SBP and DBP was found significantly higher in study groups as compared to controls, possible cause may be the prehypertensive subjects with associated risk factors, this is in line with the study conducted by Stamler J et.al. found the association of increased BP with cardiovascular risk.¹¹ In our study we found that mean heart rate of cases was higher as compared to controls. This is in accordance with Belinda George et.al.¹² The increased resting heart rates in diabetics may be due to cardiac parasympathetic damage alone or combined parasympathetic and cardiac sympathetic damage.¹³ As we have enrolled patients of middle age we found that increased HR might be due to early parasympathetic damage. The P wave duration is higher in prehypertensive study subjects as compared to normotensive controls but not statistically significant. This is in accordance with the study done by kumar S et.al. found in acute stroke patient, wide biphasic p-wave in 8 patients (7.6%) and broad p-wave in 2 patients (1.6%) at the time of admission.¹⁴ These findings appear to be persistent, hence may or may not be associated with ECG changes in acute stroke, likely related to smoking / underlying COPD, etc. In this study PR interval was found to be increased in study groups as compared to the controls but it is not statistically significant. The similar result was found in the study conducted by Amit Srivastava et.al.¹⁵ Found that PR interval were within normal range and was not statistically significant. The analysis of the PR interval pattern could be performed in order to evaluate not only the sympathetic–parasympathetic balance, but also to reveal the atrioventricular conduction properties.¹⁶ In our study, the QRS duration was found to be increased statistically significant in prehypertensive cases as compared to the normotensive controls (P value 0.008). This is in line with a study conducted by Goldstein¹⁷ gave a figure of 26% for this ECG change. But he gave an overall estimate of this illness, rather than acute stroke forms the basis for left ventricular hypertrophy and Bundle branch blocks.¹⁸ The underlying mechanism is volume/pressure overload. In this study QT interval was found to be statistically significant increased in prehypertensive study subjects as compared to the controls (P value 0.009). Similar findings were also reported by Sommargren CE *et al* and Villa A *et al*.¹⁹ In this study, ST duration was found to be increased significantly in the prehypertensive study group as compared to control (P value 0.02). This is similar to the study by Okin PM et al⁵ showed that ECG strain pattern of ST depression and T-wave inversion is strongly associated with left ventricular hypertrophy (LVH) in hypertensive patients.²⁰ In this study, the T wave duration was found to be increased statistically significant in prehypertensive subjects as compared to the normotensive controls (P value 0.001). A follow – up study on older patients revealed that T – wave axis deviation is a strong independent risk indicator of fatal and non - fatal cardiac events.²¹ Therefore, it is necessary to investigate factors affecting or causing these electrocardiographic changes.

CONCLUSION:

Our study shows that prehypertension is associated with QT prolongation, QRS prolongation and other ECG wave prolongation. Most frequently prehypertension may progress to frank hypertension



Graph-1: Comparison of quantitative ECG parameters b/w prehypertensive cases & normotensive controls

Table - 1

Comparison of quantitative ECG parameters b/w prehypertensive cases & normotensive controls			
ECG Parameters	Prehypertensive case	Normotensive Controls	P value
SBP(mmHg)	128.77±6.17	113.28±5.66	<0.001
DBP(mmHg)	84.1±3.6	73.67±5.25	<0.001
Heart rate(beats/min)	85.61±10.7	84.98±10.26	0.459
P wave (ms)	126.78±23.39	125.01±16.78	0.273
PR interval (ms)	160.22±24.42	157.99±19.77	0.22

if the lifestyle risk factors remain unabated. The ECG abnormalities associated with frank hypertension were Left ventricular hypertrophy (LVH), ST segment depression, Left bundle branch block (LBBB) and T wave inversion. Long standing hypertension causes hypertrophy of heart especially left ventricular enlargement which leads many adverse outcomes including cardiac ischemia, which ultimately lead to overt cardiac failure. Hence, utmost precaution and widespread awareness among people is required to maintain optimal blood pressure from the very initial time of diagnosis. Also, regular follow-up and medications are required for longevity and physical well-being. Although our study is by no means exhaustive, it does provide a glimpse into variety of ECG changes in absence of any cardiac disease in prehypertensive patients. Further study is required to evaluate the effects of prehypertension on electrocardiogram.

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