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Original Article

Changing Pattern of P and QRS Waves of Electrocardiogram among the Different Grades of Hypertensive Patient of Bangladesh

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Abstract

Background: Determination of the electrocardiographic changes among the hypertensive patients can reveal the early cardiac abnormalities especially of left ventricular hypertrophy. **Objectives**: The purpose of the present study was to find out the P and QRS waves of electrocardiographic (ECG) changes in different grades of hypertensive patients. **Methodology:** This cross sectional study was conducted among mild to severe grade hypertensive patients attended in the Department of Medicine at Rajshahi Medical College and Hospital, Rajshahi during the period of July 2009 to June 2010 for a period of one year. Data were collected by face to face interview with a pre-designed structured questionnaire. Measurement of the blood pressure and the 12-lead surface electrocardiogram were done among the study group in a resting state. **Results:** A total number of 400 hypertensive patients were recruited for this study. In mild hypertension, high voltage QRS complex was noted as the main ECG abnormality (24.8%) which was followed by wide P-wave (15.2%). In moderate hypertension, the high voltage QRS complex was 31.0%, wide P wave 25.0%. In severe hypertension, wide P wave and high voltage QRS complex were 56.0%and 20.0% cases respectively. Chi-square test was done between category of hypertension and ECG changes of the study group. The results were statistically highly significant ($p<0.001$). **Conclusions:** The study results revealed an association between hypertension and ECG changes which was more pronounced in severe hypertension. [*Journal of Current and Advance Medical Research 2016;3(2):33-38*]

Keywords: Electrocardiographic changes; hypertension; ECG; P wave; QRS waves

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Introduction

Hypertension is reported to be the fourth contributory risk factor to premature death in developed countries and the seventh in the developing countries[1]. Kearney et al[2] reported that the estimated total number of adults with hypertension in 2000 was 972 million world-wide of which 333 million in economically developed countries and 639 million in economically developing countries. The report states that the overall prevalence of hypertension in 2000 was 26.4% of the world's adult population (M-26.6%, F-26.1%). Kearney et al[2] also predicted that the burden of hypertension will increase to 1.56 billion (60%) by the year 2025.

The electrocardiogram (ECG) is the graphical display of the various electrical changes of the heart. It plays an important role in the diagnosis of various heart diseases. It is one of the methods of assessing the effects of hypertension on one of its target organ heart. It remains one of the most sensitive methods for establishing left ventricular hypertrophy (LVH) and is often abnormal even when there is no left ventricular heave and chest x-ray shows no classical or obvious left ventricular enlargement[3]. An ECG does not determine whether one has hypertension or not but it can reveal the effects of long standing hypertension. So in a sense, the findings of ECG may be a reflection of hypertension. There had been found a linear correlation between the electrocardiographic changes with the severity and duration of the hypertension[4].

ECG is the most readily available non-invasive technique for the detection of cardiac diseases[5]. Though LVH is diagnosed more accurately by the modern sophisticated method echocardiogram, still ECG is being widely used world-wide for its simplicity, accessibility, easy availability and cost-benefit[6-7].

Currently, the European Society of Hypertension Guidelines has recommended that ECG should be done in all cases of hypertension to assess the presence or absence of LVH[8]. In Bangladesh, so far we concern, such type of study relating ECG changes in hypertensive patients has not been conducted. The present study has been designed to find out the common electrocardiographic changes in hypertensive patients through ECG analysis by the 12-Lead surface electrocardiogram.

Methodology

This was a descriptive type of cross-sectional study was carried out in the Department of Physiology at Rajshahi Medical College (RMC), Rajshahi form July 2009 to June 2010 for a period of 1(one) year. Hypertensive patients attending Medicine Department of Rajshahi Medical College and Hospital (RMCH), Rajshahi were selected as study population. Hypertensive patients both male and female and their age range from 30 to 60 year were included in this study. The subject was considered to be hypertensive if s/he had a systolic blood pressure ≥140 mm of Hg and diastolic blood pressure ≥90mm of Hg with or without anti-hypertensive treatment. Hypertensive patients with pre-existing valvular diseases, ischemic heart diseases, heart block, strokes, chronic systemic diseases, pregnan**cy** and diabetes mellitus were excluded from this study. Institutional approval was taken from the concern Department and Authorities. Ethical clearance was approved by Institutional Review Board (IRB), Rajshahi Medical College, Rajshahi prior of the starting of the study. The study populations were categorized into 3 different grades according to their severity. Grade I or mild hypertension was defined when systolic blood pressure (SBP) was 140-159 mm Hg and diastolic blood pressure (DBP) was 90-99 mm Hg. Grade II or moderate hypertension was defined when SBP was 160-179 mm Hg and DBP was 100-109 mm Hg. Grade III or severe was defined when SBP was ≥180 mm Hg and DBP ≥110 mm Hg**.** Before data collection, the written informed consent of the patient was taken. Data were collected by face to face interview. Blood pressure was measured by auscultatory method. Measurement of blood pressure; BP machine (Sphygmomanometer, Arenoid, Alr K2; made in Japan and Stethoscope, Littman; made in Japan)] and the 12-lead surface electrocardiogram [ECG machine (Matura ELI-100 EKG; made in China)]; were done in a resting state of the patient. All the findings were carefully preserved in the data collection form. Finally data were processed and analyzed with the help of a computer based on SPSS software programme, version-16. After entry into computer, results were analyzed according to objectives and variables of the study.

Results

A total of 400 hypertensive patients of different grades were included in this study. A 12-lead surface electrocardiogram was done in all cases to find out the selective ECG changes among them. The results were presented in the forms of tables, charts and graphs with necessary interpretation and inference. Collected data were analyzed by using

computer based on SPSS software version-16. The test of significance was conducted by Chi-square test. The level of significance was set up at 0.05 and p <0.05 was considered to be statistically significant.

Table 1: Distribution of hypertensive patients into different grades

Category of hypertension	Frequency	Percent
Grade-I (mild)	250	62.5
Grade-II (moderate)	100	25
Grade-III (severe)	50	12.5
Total	**400**	**100**

Table 1 shows that out of 400 hypertensive patients, 250 were in grade-I category (mild), 100 were in grade-II category (moderate) and 50 were in grade-III (severe) category which were 62.5%, 25% and 12.5% respectively.

Table 2: Relationship of hypertensive patients between grades and P wave width

Grade of hypertension	P wave width		Total
	Normal	Widen	
Grade-I	212 (84.8)	38 (15.2)	250 (100)
Grade-II	75 (75)	25 (25)	100 (100)
Grade-III	22 (44)	28 (56)	50 (100)
Total	**309(77.25)**	**91(22.75)**	**400 (100)**

x^2=39.85, df=2, p<0.001.

Table 2 shows the relationship between different grades of hypertension and P wave width. Widen P wave was found in 91(22.8%) out of 400 patients and the remaining 309 patients showed normal P wave. In grade-I hypertension, widen P wave was found in 38(15.2%) out of 250 patients, in grade-II, 25(25%) out of 100 and in grade-III, 28(56%) out of 50 patients. There was an association between severity of hypertension and P wave width. The association was statistically highly significant (p<0.001). Table 3 shows the relationship between different grades of hypertension and QRS height. High amplitude QRS complex was found in 103(25.75%) out of 400 hypertensive patients and normal QRS height in the remaining 297(74.25) patients.

Table 3: Relationship of hypertensive patients between grades and QRS height

Grade of hypertension	QRS height		Total
	Normal	High	
Grade-I (Mild)	188 (75.2)	62(24.8)	250 (100)
Grade-II (Moderate)	69 (69)	31(31)	100 (100)
Grade-III (Severe)	40 (80)	10(20)	50 (100)
Total	**297(74.25)**	**103(25.75)**	**400 (100)**

x^2=2.42, df=2, p=0.29 (>0.05)

High amplitude QRS was observed in 62(24.8%) out of 250 in grade-I hypertension, 31(31%) out of 100 in grade-II and 10(20%) out of 50 patients in grade -III. There found no association between severity of hypertension and QRS height. The height of the QRS complex was increased from grade-I to grade-II hypertension but diminished in grade-III hypertension.

Discussion

Systemic hypertension is an important public health problem with significant morbidity and mortality through-out the world[9]. Due to increase left ventricular work in hypertension, left ventricular hypertrophy (LVH) is a major complication of it[10]. It is well known that LVH is associated with an increased incidence of ventricular arrhythmia and sudden cardiac death[11]. If the blood pressure remains consistently at a higher level, biventricular hypertrophy gradually develops, particularly after episodes of congestive cardiac failure[12]. So it is very important to detect LVH early in the course of hypertension to halt its progression.

In the present study, an attempt was made to find out the selective ECG changes in hypertensive patients to create increased awareness and improve life expectancy. A total of 400 hypertensive patients of both sexes, age range from 30-60 years without any systemic disorders were studied. Hypertensive patients were categorized into three different grades according to their severity (mild, moderate and severe).

Though there were many limitations during conducting this study, an honest and sincere effort had been made to find out the similarities and dissimilarities of these findings with other studies and also try to seek the reasons of the dissimilarities of the findings.

Changes in P Wave Width

In ECG, P wave is usually studied for its height and width. In the present study, the width of the P wave was taken into consideration. The height of the P wave was not considered because tall pecked P wave (>2.5 mm in limb lead) is an indicative of chronic pulmonary diseases[13]. Widening of the P wave (>2.5 mm in any lead) is due to left atrial enlargement. Wide P wave is a non-invasive indicator of prolonged and heterogeneous atrial conduction. Hypertensive patients have an increased risk of atrial fibrillation which may be related to impaired homogeneity of atrial conduction[14]. Electrocardiographic presentation of left atrial enlargement as marked by widen P wave is a sensitive and frequent manifestation of systemic hypertension[15]. Different studies showed that abnormal P wave usually persisted and may provide the earliest clue to hypertensive heart disease. At times, it may be the sole sign of cardiac abnormality in hypertension[16].

The present study revealed wide P wave 15.2% in mild hypertension, 25.0% in moderate and 56.0% in severe hypertensive cases. These findings were consistent with the findings of Terazi et al[16] and Ross[17] and little discordance with Agomuoh and Odia[3] and Cristal and Koren[19] in case of mild hypertension.

In mild hypertension, Agomuoh and Odia[3] observed wide P wave in 21.2% cases, Cristal and Koren[19] in 23.0% cases and Ross[17] in 12% cases. In moderate hypertension, Cristal and Koren[19] observed wide P wave in 25%, and Terazi et al[16] in 28% and Ross[17] in 24.0% cases. In severe hypertension, Ross[17] noticed wide P wave in 50.0% cases. It was found that most of the findings of the different workers were very close to the current study results. The small variations might be due to selection of the sample criteria and the cardiac status of the patients.

Changes in QRS Amplitude

High amplitude QRS complex in left precordial lead (V5 and V6) is usually suggestive of LVH. A small increase in QRS height may represent an early manifestation of LVH[19]. The present study revealed high voltage QRS complex in 24.8%, 31% and 20% in mild, moderate and severe cases respectively which was in agreement with the findings of Terazi et al[16] and disagreed with the works done by Agomuoh and Odia[3], Morrison et al[20], Cristal and Koren[19], Chi et al[21], George et al[22] and Evans[23]. Agomuoh and Odia[3] noted high voltage QRS complex in 37.1%, and Cristal and Koren[19] in 5.4% and Terazi et al[16] in 28% cases of mild hypertension. Morrison et al[20] reported 45%, Cristal and Koren[19] 15.4% and Chi et al[21] 15% high voltage QRS complex in moderate hypertension. In severe hypertension, George et al[22] found high voltage QRS complex in 40% and Evans (1962) in 38% cases. The reason of these variations might be due to heterogeneity of the populations, cardiac status and treatment habit of the patients because QRS complex is the most inconsistent wave in ECG and the amplitude of the QRS complex is readily affected by antihypertensive drugs and tends to regress on regular treatment[15].

In the present study, it was observed that there was an increased incidence of high voltage QRS complex in moderate than mild hypertension but less in severe hypertension. The possible explanation of it is that the severe hypertensive patients always take treatment in comparison to mild and moderate group and high voltage QRS complex does not persist after adequate treatment. It becomes normalize within few days after treatment whereas the changes in other ECG waves, especially of P wave resist to regression even after adequate treatment[15]. In the current study, the hypertensive patients with complications were avoided during collection of samples. This might be the cause for getting low incidence of high voltage QRS complex in severe hypertension in this study.

Conclusions

This study revealed an association between hypertension and ECG changes which was more pronounced in severe hypertension. The most commonly affected ECG changes in hypertension were high-voltage QRS complex and wide P wave. High voltage QRS complex was the main ECG abnormalities in mild and moderate hypertension. In severe hypertension, the abnormal changes are detected in wide P wave. This might be due to gradual development of ischemic changes and chamber enlargement especially of left ventricular hypertrophy in severe hypertension.

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