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Original Research Paper

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VARIATION IN HEART RATE AND P-QRS-T COMPLEXES IN HEALTHY PERSONS OF DIFFERENT AGE GROUPS

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ABSTRACT

Background And Aims: Electrocardiograph through recording the electrical behavior of the heart can identify many myocardial disease, occasionally is the independent marker cardiac disease. Sometime it can over-diagnose the cardiac conditions in absence of the real cardiac disease. Hence the aim of this study was to show the degree of variations in the electrocardiograph in the healthy individuals. **Methods:** Study was conducted after getting the ethical consent and also consent from the individual. ECG was taken in each patient in supine position by BPL ARDIAT 308 machine. Axis, voltage and duration of P, QRS and T waves, QRS-T angle, and corrected QT interval was measured in each patient. Their values were expressed as mean and percentages. **Results:** Total number of patients were 668, males were 294 and females 364. Mean voltage of QRS is 0.831 ± 0.0932. Mean QRS axis is 39.341 ± 29.619 and 4 patients showed QRS axis of more than 100 degree. Mean duration of P wave is 102.103 ± 11.876. Voltage of P wave was 0.05 to 0.2 millivolt with mean of 0.83 millivolt. P wave axis of 660 persons was demonstrated as between +10 degree and + 90 degree with mean of 52.322 ± 19.152. Duration of PR interval were between 0.1 to 0.2 milliseconds with a mean of 145.091 ± 19.946 milliseconds. Mean QRS voltage is 1.246 ± 0.487. Mean duration of T wave is 0.262 ± 0.9815. Mean duration of corrected QT interval is 416.591 ± 32.756. Mean QRS-T angle in degree 26.106 ± 24.487. **Conclusion:** This study will provide the frequency distribution and statistical assessment of all the waves of electrocardiograph. Variations in different components help in arriving the correct diagnosis.

KEYWORDS : Electrocardiogram, healthy persons, Heart rate, P-QRS-T complexes, Variations

INTRODUCTION:

Normal electrocardiogram can be defined as normal sinus rhythm, normal PR, QRS and QT intervals along with normal size and direction of P, QRS and T waves. It measures the electrical behavior of the heart, can detect pathology in the heart in the form of myocardial disease. Electrocardiogram may be abnormal in absence of any cardiac disease or may be normal in presence of cardiac disease. In young healthy person ranges of normal ECG is based on analysis of routine P-QRS complexes[1]. But only the unequivocal changes in electrocardiogram should be considered. Studies of large group of clinically normal individuals determine the normal data for ECG management. There will be large overlap in between the normal and abnormal electrocardiogram if 100th percentile range of each measurement and thus rendering the measurement of ECG is futile. Hence arbitrary limit 95th to 98th percentile has been used. But 2% to 6% of normal persons demonstrate the values that are outside the normal value and thus are considered as abnormal[2]. So dogmatic criteria should be avoided for differentiating normal from abnormal electrocardiogram.

Electrocardiographic changes that mimic abnormal may occur in different demographic profile like, age, sex, chest configuration, body weight, and different types of food containing high glucose through the shifting of potassium from extracellular to intracellular level. That is why electrocardiogram should be taken in basal condition to avoid these changes. Physiological variation in ECG also occurs after smoking, exercise also in different races, like in Negroes amplitude of R and S wave is larger as compared to Caucasians, whereas, duration of QRS complexes are larger in Caucasian men as compared Negro men[3]. In case of pregnancy direction of axis of QRS will move towards left. Again in normal person right precordial T waves may be flattened. In normal healthy persons of more than 70 years old 30% - 80% of electrocardiographic readings are beyond the normal limit.

Right and left coronary arteries originating from aorta will supply the cardiac myocardium, conducting tissues of the heart. Sinoatrial node in the right atrium generates electrical impulses and from there it is conducted into atrio-ventricular node. From there tis impulse passes through the right and left branches to Purkinje fiber system to supply the right and left ventricular myocardium. Impulses generated by sinoatrial node are 70-80 per minute, and it is regulated by parasympathetic and sympathetic nervous system producing bradycardia and tachycardia respectively[4,5,6].

So the aim of this study is to find out the normal variations in the electrocardiographic findings in healthy people.

MATERIALS AND METHODS:

This retrospective study was conducted in MGM Medial College & LSK Hospital, Kishanganj after obtaining ethical clearance from local Ethical Committee. Written consent was obtained from all the patients included in our study. All these patients are advised not to take cigarette at least half an hour prior to intake of ECG.

Exclusion criteria were: Previous history of cardiac disease, intake of medications altering the heart rate, rhythm, resting blood pressure more than 140/90 mm of Hg and patients suffering from systemic diseases.

Prior to ECG height, weight, blood pressure and heart rate were recorded in all the included patients. Electrocardiogram was taken in resting condition and in supine position of the patients with CARDIART 308 machine. In case of 12 lead ECG at least three complexes were taken in each lead. In case of Q wave appeared in lead III, electrocardiogram was taken in deep inspiration. Electrocardiogram was analyzed as follows: Limb leads are I, II and III. Augmented unipolar leads are aVR, aVL and aVF. Limb leads are V1 to V6. Speed of recording was 25 mm/sec. Rate and rhythm of electrocardiograph were recorded.

Duration, voltage and axis of P wave was recorded in I, II, III, avR, avL and avF.

Duration of PR interval was recorded in II, III and V1 to V6.

Duration of QRS was recorded in V1 to V6.

QRS axis was recorded in Lead I, II, III, and avR, avL and avF.

Axis was determined by examining Lead I, II, III and avR, avL and avF.

QT_C interval was recorded in V1 to V6 and Lead I, III and III.

Changes in ST segment was recorded in V4, V5 and V6.

Axis and voltage of T wave were recorded in Lead I, II, III, avR, avL, avF and V2, V4 and V5.

P wave is the atrial depolarization. It was measured in lead II from the point where the upward deflection of P wave starts and upto a point where it will again touch the baseline. Its amplitude was measured using upper portion of base line. Its axis of P vector was measured in the frontal plane using standard reference system.

PR interval was measured from beginning of P wave to beginning of QRS complex in any unipolar or bipolar leads. It reflects the slow amplitude conduction through the AV node. Normal duration of PR interval is 0.12 – 0.2 seconds.

QRS complex reflects the depolarization of ventricles. It was measured from the onset of QRS complex to beginning of ST segment. Duration of QRS complex is <0.12 seconds.

QT interval was measured from beginning of QRS complex to end of T wave in I, II, avL, V5 and V6. QT_C interval was calculated from the following formula $QT_C = QT/\sqrt{R} \times R$ seconds. Its value in men is ≤0.45 seconds and in female ≤0.47 seconds.

ST segment was measured from the junction of ST segment to beginning of T wave which is normally isoelectric.

Axis of T vector was measured by using hexaxial reference system in Lead I, II, III, avR, avL and avF and its voltage was determined in Lead I, II and avF.

Statistical Analysis:

The value was expressed as mean and its percentile was calculated in case of each parameter.

RESULTS:

Total 668 electrocardiograph were analyzed obtained from healthy adult having age 7 to 96 years out of which 374 were females and 294 males. Heart rate varied from 59 to 105 with a mean of 79.11 ± 10.554. According to definition of bradycardia (less than 60 beats/minute) and tachycardia (more than 100 beats/minute) 14 subjects (2.095%) demonstrated heart rate of 59/minute and 3 persons (0.449%) demonstrated 102-105 beats/minute respectively.

Table 1: Duration Of QRS Complexes In Milliseconds In Percentage Of Heathy Subjects In Both Sexes:

Duration in milliseconds	Subjects (n=668)	Males	Females	Percentage
0.02 – 0.04	3	2	1	0.449
0.04 – 0.06	4	0	4	0.598
0.06 – 0.08	259	87	172	38.772
0.08 – 0.1	383	192	191	57.335
0.11 – 0.12	19	13	6	2.844

Table 1 demonstrated 19 subjects (2.844%) demonstrated QRS duration of more than 100 milliseconds. Mean voltage of QRS is 0.831 ± 0.0932.

In table 2, only 4 persons (0.598%) demonstrated QRS axis of less than -35 degree. Mean QRS axis is 39.341 ± 29.619 and 4 patients showed QRS axis of more than 100 degree.

Table 2: Range Of Degree Of QRS Axis In Percentage Of Healthy Subjects Involving Both Sexes:

QRS axis in degree	Subjects (n=668)	Males	Females	Percentage
-59 to -30	4	3	1	0.598
-31 to 0	85	29	56	12.724
+1 to +30	179	78	101	26.796
+31 to +60	251	94	157	37.574
+61 to +90	145	89	56	21.706
+91 to +120	4	1	3	0.598

Table 3: P Wave Duration In Healthy Subjects In Both Sexes.

Duration Of P Wave In Milliseconds	Subjects (n=668)	Males	Females	Percentage
0-110	546	240	306	
111 - 120	122	54	68	

In Table 3: 122 persons demonstrated duration of P wave of more than 111 milliseconds but upto 120 milliseconds. Mean duration of P wave is 102.103 ± 11.876.

Voltage of P wave was 0.05 to 0.2 millivolt with mean of 0.83 millivolt which is within normal limit.

P wave axis of 660 persons was demonstrated as between +10 degree and + 90 degree with mean of 52.322 ± 19.152 and in only 6 persons it was -30 to -11 degree.

Duration of PR interval were between 0.1 to 0.2 milliseconds with a mean of 145.091 ± 19.946 milliseconds which was upto upper limit of normal in all the studied persons.

Table 4: Range Of Duration Of QRS Voltage In Percentage Of Healthy Subjects In Both Sexes:

QRS voltage in millivolts	Subjects (n=668)	Males	Females	Percentage
0.1 – 0.5	6	4	2	0.898
0.6 – 1.0	84	44	40	12.574
1.1 – 1.5	170	73	97	25.449
1.6 – 2.0	260	112	148	38.922
2.1 – 2.5	148	58	90	22.155

In table 4: There was no evidence of left ventricular hypertrophy according to voltage criteria i.e. more than 2.5 millivolt. Mean QRS voltage is 1.246 ± 0.487.

Table 5: Range Of Duration Of T Wave Voltage In Percentage Of Heathy Subjects In Both Sexes:

T wave voltage in millivolt	Subjects (n=668)	Males	Females	Percentage
0.05 – 0.1	122	39	83	18.263
0.11 – 0.15	139	57	82	20.808
0.16 – 0.20	109	47	62	16.317
0.25 – 0.30	193	94	99	28.892
0.35 – 0.45	95	43	42	14.221
0.50 – 0.55	9	6	2	1.347

In table 5: there is no evidence of early repolarization. Mean duration of T wave is 0.262 ± 0.9815.

Table 6: Range Of Duration Of Corrected QT Interval In Milliseconds In In Both Sexes:

Corrected QT interval in milliseconds	Subjects (n=668)	Males	Females	Percentage
300 – 350	5	2	3	0.748
351 – 400	186	124	62	27.844
401 - 450	419	147	272	62.724
451 - 500	58	23	35	8.682

In table 6: Corrected QT interval were within normal limit which were returned to baseline post-exercise. Mean duration of corrected QT interval is 416.591 ± 32.756.

Table 7: Range Of Degree Of QRS-T Angle In Degree In Both Sexes:

QRS-T angle in degree	Subjects (n=668)	Males	Females	Percentage
0 – 29	452	200	252	67.664
30 – 59	157	62	95	23.502
60 - 89	40	22	18	5.988
90 - 120	19	10	9	2.844

Mean QRS-T angle in degree 26.106 ± 24.487.

DISCUSSION:

In the present study in total 668 apparent healthy subjects in absence of any cardiovascular diseases or any systemic illness electrocardiogram was performed. Many studies were performed to demonstrate the variation in different components of waves in the normal electrocardiogram and each study showed added advantage in clinical practice like which electrocardiograph may be apparently abnormal that may be really a normal variation[7,8,9].

In the two studies Bradycardia was demonstrated in 2.67% of normal subject which may be due to recording of ECG in the morning just arising from the sleep, again in another study of 639 patients 6% apparently normal subject demonstrated sinus bradycardia[10,11,12]. Whereas the present study demonstrated bradycardia in 2.095% subject. Sinus tachycardia was showed in only 0.449% (3 patients) demonstrated tachycardia in the present study which may be compared with study done by Graybiel et al (3%)[10]. But another study showed sinus tachycardia in 9.33% of subject, it may be due to very less number of patients involved in that study and may be due to anxiety during performing electrocardiogram[11]. Present study demonstrated only 4 subject having QRS axis of less than -35 degree with mean value of axis of 39.341 ± 29.619 degree, whereas, in the study done by Mahendrappa SK et al no subject showed QRS axis of less than -35 degree but here the mean value was high i.e. 52.84 ± 23.8213 degree, and in the study of Graybiel et al the mean QRS axis was very high i.e. 64.2%[10,12]. Again in one study 10.02% subject demonstrated QRS axis between -35 to 0 degree, 87.98% +1 to 90 degree and 2% between 91 and 110 degree which very similar to the present study where 12.754% subjects showed QRS axis between – 35 to 0 degree and 86.076% showed +1 to 90 degree[12]. In the study done by Graybiel 1.4% subject showed QRS axis of more than +100 degree whereas in the present study only 0.598% (4 out of 668 subjects) showed QRS axis of more than +100 degree[10].

In this present study QRS voltage was between 0.04 to 0.12 seconds with mean value of 0.083 ± 0.0932, 97.154% subjects demonstrated the QRS duration between 0.04 to 0.1 seconds which was similar to the study done by Mahendrappa SK et al[12]. But in the study by Graybiel et al mean value of the 0.087 seconds with variation of QRS between 0.06 and 0.14 seconds[10]. Another study demonstrated mean value of QRS duration of 0.081 seconds with variation of QRS complexes between 0.08 and 0.11 seconds[13]. Similar study done by Lüderitz et al also demonstrated 97.8% subjects QRS duration between 0.06 and 0.1 seconds which was nearly similar to the present study[14]. In the present study 19 subjects (2.844%) demonstrated QRS duration of more than 100 milliseconds whereas, one previous study demonstrated that only 3 out of 200 patient had QRS duration of more than 100 milliseconds[15].

The present study demonstrated mean value of QRS voltage 1.246 ± 0.487 having ranges from 0.1 to 2.5 millivolts whereas study done by Blackbern HW et al this QRS voltage varied between 0.2 and 2.26 millivolts with mean value of 0.968 millivolts and in the study of Kannman et al mean value voltage was 0.59 along with the range in between 0.1 and 1.65[16,17]. In all the studies voltage of QRS complex were within normal limit.

In the present study mean value of T wave voltage was 0.262 ± 0.9815 millivolt which was near to the mean value of 0.28 millivolt as demonstrated by New York heart Association, but in the study done by Blackbern this mean value was 0.36 ± 0.13 millivolt in the age group of 20-39 years[16,18].

In the present study, mean value of corrected QT interval was 416.591 ± 32.756 (0.4165 ± 0.03275) having ranges from 300 to 500 milliseconds, whereas in the study done by Burch GE and Winsor the range was 300 to 486 milliseconds with mean value of 382 millisecond[13]. In other studies like Stewart and Manning ranges were from 290 to 470 milliseconds[7]. Due to difficulty in measuring corrected QT interval this should be cautiously utilized as a diagnostic sign.

The present study showed 91.166% of subject demonstrating QRS-T angle between 0 and 59 degree which was nearly similar to the study done by Mahendrappa SK et al[12] who demonstrated 97.73% subjects having value between 0 and 70 degree. Hiss and Lamb also demonstrated 96% subjects having QRS-T angle between 0 and 70 degree[19]. Again mean value of QRS-T angle in the present study was 26.106 ± 24.487 whereas, mean value in the study of Mahendrappa SK et al was 70.9 ± 18.521 degree[12].

CONCLUSION:

Any variation in the normal in the electrocardiograph is a million dollar question and it is also difficult to say whether the graph is normal or not. Hence this study was done which demonstrated frequency distribution as well as different implications of different waves in the graph. This are assessed commonly in the healthy individual during investigations. So knowledge about the common variations in electrocardiograph will be useful for arriving clear-cut diagnosis but clinical correlation ultimately the final.

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Conflict Of Interest: Nil

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