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Review Article

Normal P, QRS & T Axis on an Electrocardiogram (ECG) as Seen in Plateau Specialist Hospital, Jos. Central Nigeria

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Abstract

Background: In making cardiovascular diagnosis, ECG stands out. QRS axis determination is the only considered axis. The P and T axis are most often ignored. Normal values of these axis need further scrutiny.

Materials and Methods: This was a secondary analysis carried out on a study on normal adult ECG in the ECG room of the Plateau State Hospital, Jos Nigeria. A number of normal ECG were reviewed over a 3-month period considering sex, age, PR interval, QTc and the P, QRS and T axis were analyzed. The axis was analyzed in relation to gender and age.

Results: A total of 81 normal ECG recordings with about 70% women with a mean age of 41 years with no significant gender difference were analyzed. Normal P axis (y = 0.07x +49.64) and normal T axis (y = 0.23x =30.08) had a positive relationship with age, while that of the normal QRS axis (y = -0.38x +55.37) was negative.

Conclusions: The normal P, QRS and T axis did not differ with gender. The normal P and T axis appear to increase slightly with age, the QRS axis which is the commonly observed axis appear to decrease with age.

Keywords: Normal P axis; QRS axis; T axis; gender; age

Introduction

The use of ECG in making diagnosis of heart diseases is widely accepted in most communities. however, the presence of a very few number of Specialists and health care providers having limited idea on the use of ECG has made it necessary to point out this basic information. It has been said that before one knows an abnormality one has to be conversant with what is normal. Determination of axis of the heart is one of the several uses of ECG tracing while making some diagnosis of heart diseases. The most commonly referred axis of the heart is the QRS axis, this generally gives an idea of the overall left ventricular vector direction. It can easily be determined using the standard limb leads (I, II & III). The P & T axis are less commonly considered. Most ECG machines have in-built interpreters that give all the P, QRS and T axis.

Documented characteristics of a P-wave mostly emphasis morphology, duration, and amplitude. Standard literature gives a normal P wave axis range 0^0 to 75^0. P-wave axis abnormality has

been documented in patient with SLE [1]. Ischemic stroke was also documented to be associated with abnormal P-wave axis, where it was found present not only on patient with AF resulting stroke alone. It was associated with increased mortality [2]. Normal QRS axis range between -30° to 90° in adults. It has been observed that at birth QRS axis range between 30° to 190°, by 6-8 years 0° to 120° [3]. This represents the major of ventricular activation dominated by the left ventricle. The terms left axis deviation, right axis deviation and extreme Heart axis describes various abnormalities. The main factors determining QRS axis are heart rotation, ventricular enlargement/hypertrophy, wall infarction and heart conduction defects. Normal T axis range between 15° -75° [3]. This is the marker of ventricular repolarization. It is similarly affected by factors affecting the QRS axis. When deviated by >60^0 in either direction is said to be associated with a cardiac event in adults [4,5].

Generally, a lot of factors need to be considered while interpreting an ECG. Patients age, gender, race, body habitus, heart orientation and physiology can affect the axis of the heart. Similarly, technicalities of procedure, posture, temperature, or eating can affect ECG interpretations. This analysis was carried out on the normal individual group of another study. We needed to know if there were some peculiar difference in normal individuals as compared to already documented study findings elsewhere.

Material and Method

The study was a descriptive study carried out in plateau state Hospital. A 400-500 bed capacity state hospital within Jos, Central Nigeria, rendering secondary health care and training of resident in family medicine. The institution runs an average of 100 ECG in a month. The study was carried out over a 3-month period.

Design

All ECG recordings in adult greater than 18 years during a 3-month period considered to be normal by the (iocare ECG-3010) ECG machine endorsed by a specialist in cardiology were compiled. The sex, age, PR interval, QTc with axis (P, QRS & T) were recorded for analysis. Ethical clearance was obtained from the management of the Plateau state hospital for the study Data collected were recorded as mean and standard deviation for categorical variables and percentages for proportions for non-categorical variables. Analysis was done with the use of Epi-info.7.1. student T-test was used to determine the difference between means of the sexes. A p-value of <0.005 was considered a significant difference between means. The 95% confidence interval was determine using 2020 MathIsFun.com v0.90 internet software. A liner regression was determined between the age and the three-normal axis.

Result

A total of 81 ECG records were analyzed consisting of 55 females and 26 adult males, With a mean age of 41years. No significant difference between gender findings.

Discussion

What is normal is the expected findings in a community, what is considered normal in on part of the world may not be particularly normal in another part. ECG is readily available, simple test to assess cardiovascular state that requires interpretation based on normal community findings. The need for knowing this community specific normal cannot be over emphasized. Cardiac axis was observed in this study. Gender did not appear to affect axis of the heart though other ECG parameters like voltage amplitude and QT interval have been shown to be affected by the gender of the individual [7] (Table 1). PR interval has been shown to progressively increased with age both in normal adults [8], and pediatrics [9]. We looked at it based on age groups and observed a slight progressive increased. Similarly, QTc increases with both age and male gender [10] and was also observed the same in the study. These findings give credence to the observations of subject less than 55 years in the study (Table 2 & 3).

Table 1: Age group proportions and findings.

	Age range years	n	%	Cum%	P° (m+sd)	QRS° (m+sd)	T° (m+sd)	PR msec (m+sd)	QTc msec (m+sd)
1	15 - 24	12	14.8	14.8	54.5+19.6	44.4+19.7	37.9+13.4	155.3+18.3	421.3+27.7
2	25 - 34	22	27.2	42	48.2+20.2	48.0+26.2	37.2+16.4	160.4+20.6	417.1+27.6
3	35 - 44	13	16.1	58	56.9+18.7	43.1+36.7	41.7+15.9	160.3+19.1	431.0+25.4
4	45 - 54	20	24.7	82.7	52.4+11.4	31.2+23.2	36.7+12.5	163.5+23.8	419.8+26.8
5	55 - 64	5	6.2	88.9	56.6+9.7	31.6+25.5	43.4+9.5	177.8+43.6	421.8+11.6
6	65 - 74	3	3.7	92.6	38.7+25.4	30.0+12.1	38.6+10.7	172.0+29.4	438.3+32.9
7	75 - 84	5	6.2	98.8	64.6+17.3	35.8+32.0	54.0+17.5	164.2+17.1	432.8+20.7
8	85 - 94	-	-		-	-	-	-	-
9	95 - 104	1	1.2	100	43.0+NaN	36.0+NaN	68+NaN	144+NaN	436.4+NaN

n – number, % percentage, Cum% -cumulative percentage, P° – P-wave axis, QRS° – QRS axis, T° – T-wave axis, PR- PR- interval, QTc – QT corrected, msec - milliseconds, m- mean, sd – standard deviation

Table 2: Gender difference of axis.

	Female (mean + SD)	Male (mean + SD)	T test
P°	54.0 + 16.6	49.9 + 19.3	0.98
QRS°	41.5 + 27.8	35.6 + 24.7	0.91
T°	40.3 +15.6	38.7 + 13.7	0.43

P° – P-wave axis, QRS° – QRS axis, T° – T-wave axis

Table 3: Calculated reference range of variables.

	Mean	Standard deviation	Minimum	Maximum	Reference range 95% confidence interval6
P°	52.7	17.5	8	90	48.9 - 56.5
QRS°	39.6	26.8	0	145	33.8 - 45.4
T°	39.7	14.9	7	72	36.5 - 42.9
PR (msec)	161.9	22.6	120	253	157 - 167
QTc (msec)	422	27.7	351	496	417 - 429

P° – P-wave axis, QRS° – QRS axis, T° – T-wave axis, PR- PR- interval, QTc – QT corrected, msec - milliseconds, m- mean

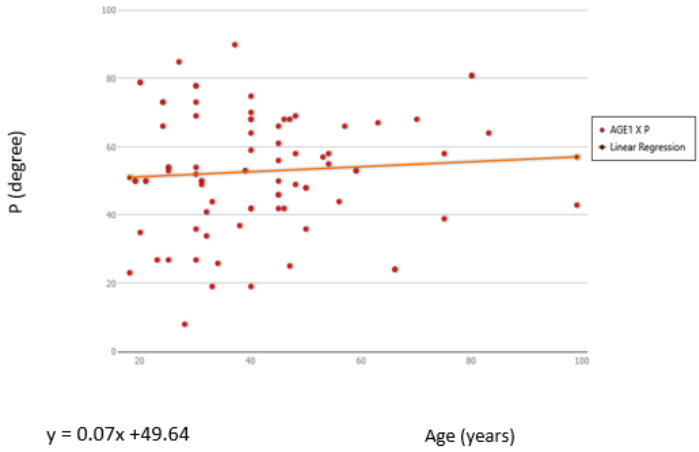

Figure 1: Scatter diagram of age and P wave axis.

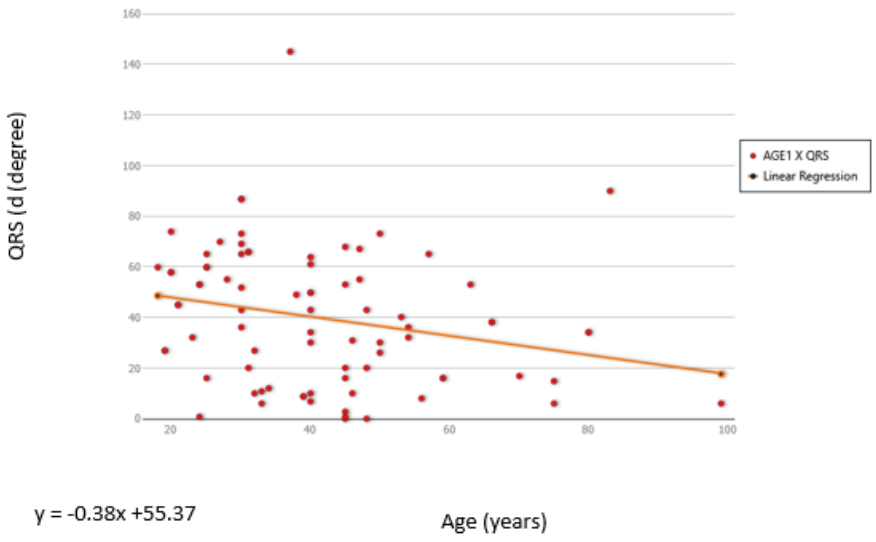

Figure 2: Scatter diagram of age and QRS axis.

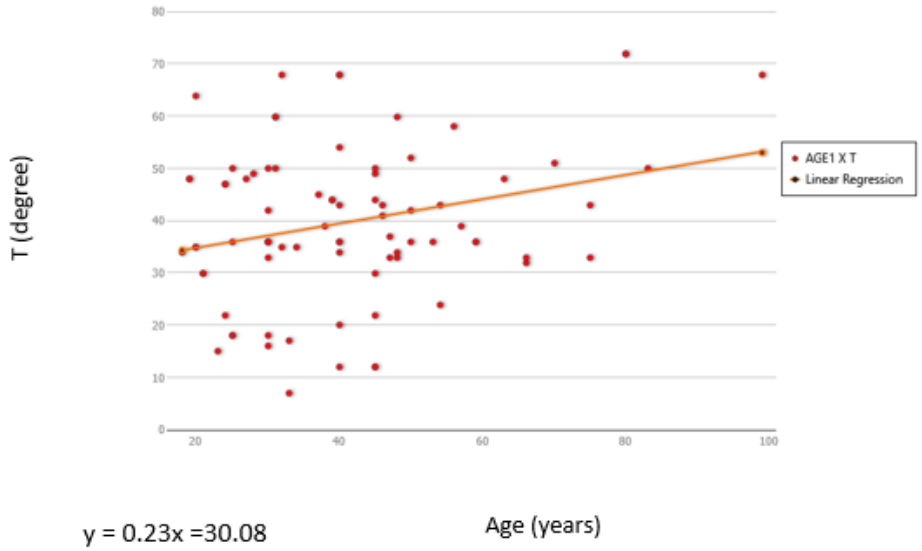

Figure 3: Scatter diagram of age and T-wave axis.

The calculated reference range (95% confidence interval) was way narrower than published normal ranges. This resulted from the sample size of 81. However, these values were within the published normal ranges. Linear regression between age and normal p-wave axis shows a very slight positive relationship that (Figure 1). A negative relationship was observed when comparing age and QRS axis. Truncal obesity gets more prominent with age, and with elevation of the diaphragm by an increased in intra-abdominal pressure. The resultant elevation of the heart reduces the QRS axis of the Heart (Figure 2). T-wave axis was observed to be slightly increased with age (Figure 3). This study was secondary observation made on another study, limitations was acknowledged by the number of normal subjects and representation of age groups above 55yrs old. Absence of height and weight (BMI) made our truncal obesity claim speculative while explaining reduction of QRS axis with age.

Conclusion

The normal P, QRS and T axis do not differ with gender. The P and T axis appear to increase slightly with age, the QRS axis which is the commonly observed axis appear to decrease with age. A wider research however is likely statistically significant indexes.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

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