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Original Research Article

A study of QT_C interval in normal healthy individuals

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Abstract

Objective: Present study is undertaken to understand genesis of variability in QT_C interval in healthy subjects as per age, sex and weight parameters and planning preventive measures for any abnormal findings.
Materials and methods: 315 healthy normotensive healthy subjects (male=179, female=136) in age group of 0 to 51 years and above were selected for the study. After recording anthropometric parameters ECG was recorded in supine position in standard limb leads with paper speed of 25 mm/sec. All ECG records were analysed for rate, rhythm, waves (P, Q, R, S, T) and intervals (PR, QRS, ST, QT) in all leads. The QT interval was measured from the beginning of the QRS complex to the end of the T-wave in lead II, corrected QT (QT_C) interval was calculated by using Bazett's formula ($QT_C = QT/\sqrt{RR}$).
Results: Corrected QT_C interval was determined in all age groups. It is observed that in all age groups i.e., male and females recorded normal QT_C values without any significant variation. Except female subjects in age group 0 to 10 recorded higher non-significant values of QT_C interval. Similarly males in age group 51 and above recorded significant ($P<0.05$) higher QT_C values than female subjects, within normal limits. Similarly a positive correlationship between age, heart rate and QT_C in both study groups was recorded.
Conclusions: QT_C interval is affected by various physiological factors such as age, sex, sympathetic tone, posture, meals, heart rate, and diurnal pattern and fluctuations observed in QT_C interval can be critically analysed in due course of the treatment. Hence in present study it is concluded that considered physiological parameters have not caused any significant effect on QT_C interval in both study groups.
Keywords: QT_C interval, Bazett's formula, physiological parameter.

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1. Introduction

Electrocardiography is the non-invasive technique to identify patients at high risk of arrhythmias and sudden cardiac death, for selecting patients for planning prophylactic anti arrhythmic treatment [1]. To assess the risk of malignant arrhythmias and sudden death associated with an aberrant QT interval in recorded electrocardiogram, it is necessary to evaluate QT interval properly [2].

Factors like older age, female sex, low left ventricular ejection fraction, left ventricular hypertrophy, ischemia, slow heart rate, and electrolyte abnormalities including hypokalaemia and hypomagnesemia cause QT prolongation and torsades de pointers [3,5-12]. Multiple factors and certain drugs also are known to cause QT prolongation and torsades de pointers. However, QT interval includes the duration of ventricular depolarization (QRS) and repolarization (J point to end of T wave). It corresponds to the duration of cellular action potential. "Long" and "short" QT intervals are considered as risk markers for cardiac arrhythmias and sudden death [13].

Present study was undertaken to understand genesis of variability in QT_C interval in healthy subjects as per age, sex and weight parameters and planning preventive measures for any abnormal findings.

2. Material and Methods

Total 315 healthy normotensive subjects (male=179, female=136) in age group of 0 to 51 years and above were selected for the study.

Patients with hypertension, diabetic mellitus, patients on ventricular repolarization interfering drugs (such as quinidine, procainamide, amiodarone etc.), ischaemic heart disease or any cardiovascular abnormality were excluded in the study. Age, sex, body weight (kg) and height (cm) of each subject was recorded and ECG was recorded in supine position in standard limb leads (Lead I, II, III, BPL Cardiart 108T) with paper speed of 25mm/sec. ECG was recorded in standard limb leads, since they are most valuable for diagnosis of arrhythmias and also for preliminary studies of functional abnormalities of the heart [14-18].

After recording ECG in standard limb leads, all ECG records were analysed for rate, rhythm, waves (P, Q, R, S, T) and intervals (PR, QRS, ST, QT) in all leads. Heart rate more than 100 beats/minute was considered as tachycardia and heart rate less than 60 beats/minute was considered as bradycardia.

The QT interval is different in different leads. This is caused by the varying projections on different lead vector axes. The QT interval was measured from the beginning of the QRS complex to the end of the T-wave in lead II, corrected QT (QT_C) interval was calculated by using Bazett's formula ($QT_C = QT/\sqrt{RR}$) [19].

All obtained results were tabulated and for each recorded parameter mean and standard deviation (SD) were calculated. To find level of significance change the data was anlayzed by applying Student t- test. The P values less than 0.05 ($P<0.05$) were considered as statically significant. Pearson's correlation coefficients were used to assess the associations between the continuous variables.

3. Result

All subjects were grouped in different age groups and distributed as per their gender and anthropometric parameters (Table I and II). It was found that, any significant variation in average age, weight, MI in different age group was not observed in males and females. Majority of the subjects recorded normal BMI (Table: III) and were distributed accordingly (Fig: I).

Table I: Distribution of subjects in various age groups according to age and sex

S. No	Age Group (in years)	Males	Females	Total
1	0 – 10	3	8	11
2	11 – 20	58	53	111
3	21 – 30	68	49	117
4	31 – 40	30	12	42
5	41 – 50	10	6	16
6	51 & above	10	8	18
Total		179	136	315

Table II: Average age, weight, BMI in different age group for males and females

S. No	Age Group (in years)	Sex	Age (in years)	Weight (Kg)	Height (m)	BMI (Kg/m^2)
1	0 – 10	Male	6.67 ± 1.53	15.70 ± 1.15	1.00 ± 0.04	14.58 ± 0.72
		Female	6.000 ± 1.20	12.75 ± 2.96	0.97 ± 0.11	13.40 ± 0.22
2	11 – 20	Male	17.80 ± 2.04	45.86 ± 12.86	1.59 ± 0.10	17.71 ± 4.03
		Female	18.94 ± 1.26	48.93 ± 8.82	1.58 ± 0.13	19.16 ± 0.21
3	21 – 30	Male	25.87 ± 2.72	50.37 ± 9.03	1.62 ± 0.07	19.34 ± 0.21
		Female	23.92 ± 2.54	49.22 ± 7.19	1.58 ± 0.13	19.34 ± 2.06
4	31 – 40	Male	34.47 ± 3.00	54.32 ± 11.53	1.66 ± 0.10	19.44 ± 2.57
		Female	35.58 ± 3.23	51.50 ± 7.34	1.63 ± 0.91	19.25 ± 0.09
5	41 – 50	Male	46.20 ± 3.36	56.50 ± 10.10	1.66 ± 0.20	20.42 ± 4.50
		Female	46.70 ± 2.07	53.50 ± 8.55	1.59 ± 0.66	20.98 ± 2.16
6	51 & above	Male	57.80 ± 5.67	54.50 ± 12.00	1.61 ± 0.91	20.70 ± 3.27
		Female	58.12 ± 5.30	52.87 ± 12.61	1.58 ± 0.14	22.57 ± 1.58

Table III: Distribution of the subjects as per the body mass index

S. No	BMI (Kg/m^2)	Frequency (Male)	Frequency (Female)
1	Thinness (BMI<18.49)	61	8
2	Normal (BMI = 18.5 to 24.09)	118	128
3	Overweight (BMI > 25)	-	-
Total		179	136

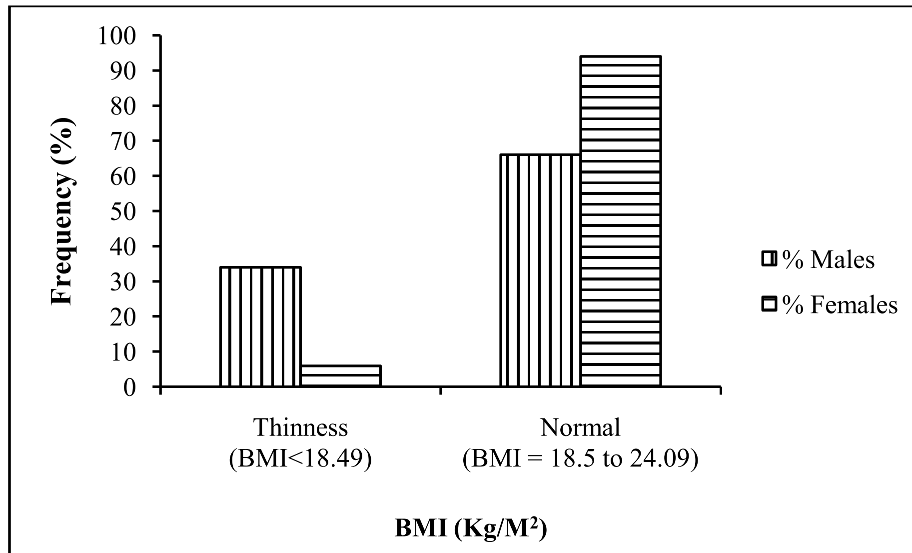

Fig I: Distribution of the study subjects as per BMI

Average heart rate per minute was recorded in every age group within normal physiological limits without any statistical significant variation (Table: IV).

Table IV: Average heart rate / minute in lead II in different age groups in males and females

S. No	Age Group (in years)	Male	Female
1	0 – 10	98.20 ± 8.622	87.40 ± 14.65
2	11 – 20	82.48 ± 18.33	83.76 ± 16.28
3	21 – 30	75.60 ± 16.17	76.20 ± 12.25
4	31 – 40	76.82 ± 12.67	79.52 ± 11.71
5	41 – 50	69.68 ± 13.03	71.78 ± 15.94
6	51 & above	77.85 ± 13.11	70.67 ± 11.17

Table V: Duration of RR interval, QT interval and QT_C interval in seconds in lead II in different age groups

S. No	Age Group (in years)	Sex	RR-interval (seconds)	QT-interval (seconds)	QT_C-interval (seconds)
1	0 – 10	Male	0.64 ± 0.06	0.35 ± 0.03	0.45 ± 0.42
		Female	0.07 ± 0.13	0.40 ± 0.06	0.50 ± 0.45
2	11 – 20	Male	0.73 ± 0.12	0.33 ± 0.07	0.43 ± 0.33
		Female	0.77 ± 0.12	0.35 ± 0.03	0.40 ± 0.37
3	21 – 30	Male	0.80 ± 0.15	0.34 ± 0.04	0.47 ± 0.31
		Female	0.78 ± 0.13	0.34 ± 0.03	0.39 ± 0.38
4	31 – 40	Male	0.78 ± 0.13	0.33 ± 0.04	0.39 ± 0.36
		Female	0.80 ± 0.16	0.36 ± 0.03	0.40 ± 0.41
5	41 – 50	Male	0.73 ± 0.13	0.30 ± 0.05	0.38 ± 0.32
		Female	0.86 ± 0.22	0.37 ± 0.04	0.41 ± 0.41
6	51 & above	Male	0.79 ± 0.12	0.40 ± 0.03	0.45 ± 0.41*
		Female	087 ± 0.13	0.37 ± 0.04	0.41 ± 0.38

(Values are average ± standard deviation)

(Paired t test, $^{*}P<0.05$)

($QT_C = QT/\sqrt{RR}$, **QT_C** values of 0.440–0.450 s in men and 0.440–0.470 s in women [19])

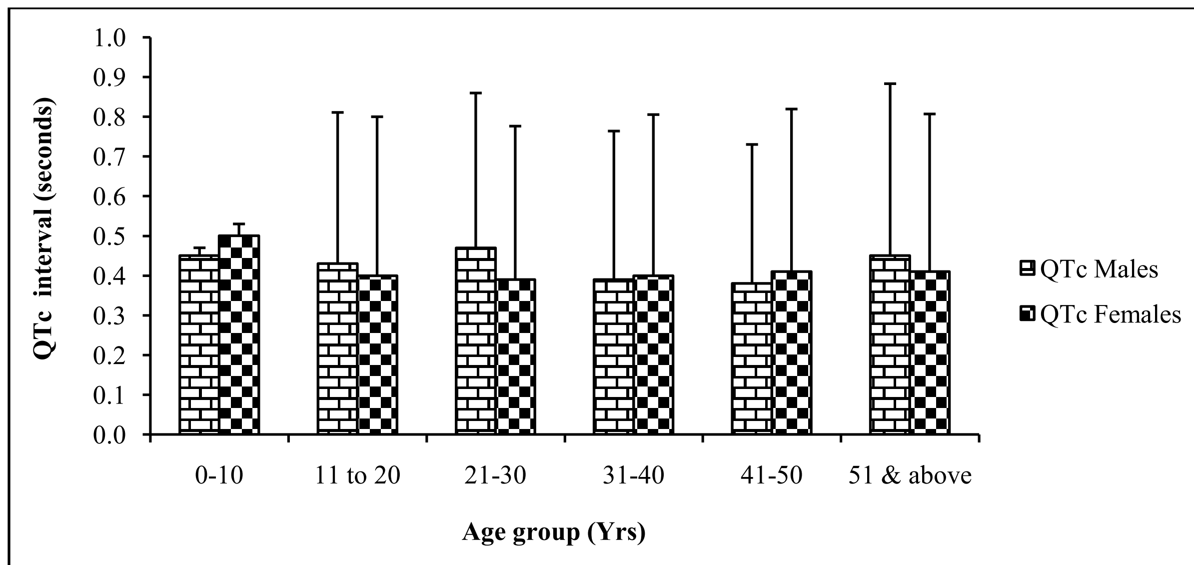

Fig II: Mean QT_C intervals in males and females in different age groups

Corrected QT_C interval was determined in all age groups by using Bazet's formula. It is observed that in all age groups i.e., males and females recorded normal QT_C values without any significant variation. Except female subjects in age group 0 to 10 recorded higher non-significant values of QT_C interval. Similarly, males in age group 51 and above recorded significant ($P<0.05$) higher QT_C values than female subjects, within normal limits.

3.2. Correlation between age and QT_C interval

The correlation between age and QT_C as continuous variable between males and females indicated significant effect of age on corrected QT_C interval with a positive correlation. Pearson coefficient value in males was recorded as 0.311 with a P value of < 0.05 and in females Pearson's coefficient was recorded as 0.530 with a P value of < 0.05.

3.3. Correlation between heart rate and QT_C interval

The correlation between heart rate and QT_C as continuous variables in males showed Pearson's correlation coefficient as 0.359 with a P value of <0.05 and in females Pearson's correlation coefficient was 0.235 with a P value of <0.05, indicating heart rate has significant effect on corrected QT interval with a positive correlation.

3.4. Correlation between Body Mass Index and QT_C interval

No correlation was observed between body mass index and QT_C interval, since body mass index and QT_C interval were analysed as continuous variables.

4. Discussion

This study was undertaken to assess the variation in QT_C interval in healthy male and female subjects in different age groups. We have noticed that, age and heart rate has significant positive correlation with determined QT_C interval in both study groups. QT_C interval was recorded within normal defined time duration in all age groups except female subjects in age group of 0 to 10 years, which was found non-significant. However even QT_C interval durations less than 0.440 seconds in the some of the female and male subjects were considered normal according to latest guidelines (QT_C interval: 0.360 – 0.480 seconds) [22]. In general population short QT interval is rare and is not associated with any increased cardiac risk [2].

In both study groups heart rate was also recorded within normal physiological limits, hence neither prolonged nor shortened QT_C interval was recorded as observed in other clinical cases [2].

There are different formulas used to determine QT_C interval which can record different values, since recorded ECG can show variations in QT interval, hence Bazett's formula was used to determine QT_C interval. Most of the studies used Bazett's formula, since it is convenient to determine and interpreted QT_C even in most of the patients with normal heart rates [21].

From literature survey it is indicated that, QT_C interval is affected by various physiological factors such as age, sex, sympathetic tone, posture, meals, heart rate, and diurnal pattern and fluctuations observed in QT_C interval can be critically analysed in due course of the treatment [24-25]. Hence in present study it is concluded that considered physiological parameters have not caused any significant effect on QT_C interval in both study groups.

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