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RESEARCH ARTICLE

Correlation of blood pressure and QT interval

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ABSTRACT

Background: There is a direct relation between blood pressure and cardiovascular risk. In addition, QT interval prolongation is associated with increased rate of cardiovascular morbidity and mortality. Thus, it is wise to investigate the correlation of blood pressure and QT interval to find out the risk of sudden death in individuals with increase in blood pressure. **Aims and Objectives**: The aim of the present study was to see the effect of blood pressure on the QT corrected interval. **Materials and Methods**: This study included 48 healthy men and 32 healthy women between 17 and 68 years age divided into three groups, young (<30 years), middle aged (30-60 years) and elderly (>60 years). The heart rate, systolic, and diastolic blood pressure and mean arterial pressure (MAP) were recorded and a standard supine 12 lead electrocardiographic was done. The individuals were categorized for QTc prolongation, into three gender-specific categories. For women, the cutoff points were ≤450 ms (normal), 451-470 ms (borderline), and >470 ms (prolonged), and for men ≤430 ms (normal), 431-450 ms (borderline), and >450 ms (prolonged). **Results**: Out of the eighty individuals taken for the study, 48 individuals (60%) were males and 32 (40%) were females. The MAP (in mm of Hg) was 87.8 ± 4.5 in young age group, 89.5 ± 5.8 in middle-aged group, and 97.7 ± 5.4 in elderly age group. QTc was found to be 374.9 ± 31 (ms) in young group, 386.3 ± 14.8 (ms) in middle-aged group, and 414.5 ± 11.8 (ms) in old age group. **Conclusion**: MAP correlated most with the QTc interval (r = 0.327) and was an important predictor of QT and QTc interval.

KEY WORDS: Blood Pressure; Diastolic Blood Pressures; Mean Arterial Pressure; QT; QTc; Systolic Blood Pressure

INTRODUCTION

According to the Global Burden of Disease study age-standardized estimates (2010), nearly a quarter (24.8%) of all deaths in India are attributable to cardiovascular diseases (CVD).[1] Experimental and clinical evidence has strongly implicated prolonged and heterogeneous ventricular repolarization in the development of ventricular tachyarrhythmias and sudden cardiac death.[2,3] Therefore, electrocardiographic (ECG) patterns of ventricular repolarization may represent a potential tool for risk stratification.

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The QT interval is an indirect measure of the duration of ventricular depolarization and repolarization and corresponds to the total duration of ventricular activation and recovery, the ventricular action potential. A prolongation of the QT interval is associated with an increased rate of cardiovascular morbidity and mortality related to electrical instability and risk of ventricular arrhythmogenesis.[4] Blood pressure is a continuously distributed variable in a population. There is a direct relation between cardiovascular risk and blood pressure; the higher the blood pressure, the higher the risk of both stroke and coronary events.[5-7] Not many investigations have been done to find out the relationship between blood pressure and QT interval.[8]

The present work has been designed to study the effect of blood pressure on QT interval, in a population of healthy individuals. Further aims of the study were to evaluate the prevalence of a prolonged corrected QT interval in the study population and to investigate the independent association of corrected QT interval with blood pressure, which is also an independent risk factor for CVD.

MATERIALS AND METHODS

This study included 48 healthy men and 32 healthy women between 17 and 68 years age, who had responded favorably to the appeal for cooperation in carrying out the investigation.

The healthy individuals were judged on the following criteria:
1. No history, current, or past, of any cardiac disease including hypertension.
2. Normal cardiac physical examination.
3. Not under any drugs which are able to effect ventricular repolarisation.

The total study group was divided into three subgroups for further correlation of age and other data:
1. Young (<30 years)
2. Middle aged (30-60 years)
3. Elderly (>60 years).

Blood Pressure Measurement

Blood pressure was measured in the sitting position, in the right arm and according to the recommendation of the WHO study group.[9] A sphygmomanometer (Medicare Company) with an adult size cuff was used to measure blood pressure. The systolic blood pressure (SBP) and the diastolic blood pressures (DBP) were measured three times over a period of three minutes and the lowest reading was recorded. The mean arterial pressure (MAP) was calculated using the formula DBP plus one-third of pulse pressure.

ECG Measurement and Interpretation

Standard supine 10-sec, 12-lead resting ECG was recorded with a computerized ECG (Recorders and Medicare Systems (P) Ltd. Chandigarh, India) at a sampling frequency of 50 Hz and stored digitally. All ECGs were processed by RMS software to obtain ECG measurements and interpretation. For women, the cutoff points for QTc were ≤450 ms (normal), 451-470 ms (borderline), and >470 ms (prolonged), and for men ≤430 ms (normal), 431-450 ms (borderline), and >450 ms (prolonged).

Statistical Analysis

Differences in clinical characteristics of patients between subgroups of QTc duration were assessed and results are shown as mean ± standard deviation. To assess whether QTc was independently related to systolic and DBP and MAP, univariate regression analysis was used. Pearson's correlation analysis was used to assess the relationship between numerical variables.

RESULTS

The mean QTc was higher in the 30-60 years age group and highest in the group with age >60 years (Table 1), so we can conclude that the elderly persons are prone for high QTc and constitute high risk group.

The SBP was more with advancing age and QTc significantly correlated with SBP (Graph 1). The scatter diagram Graph 2 shows a significantly positive correlation ($P < 0.001$, Pearson's coefficient $r = 0.305$) between QTc and SBP.

The Graph 3 shows the distribution of QTc with DBP. With increasing age, diastolic pressure was more and a positive correlation was observed between them. A statistically significant positive correlation was seen between QTc and diastolic pressure ($P < 0.001$, Pearson coefficient $r = 0.290$) (Graph 4).

The bar Graph 5 shows the distribution of QTc and MAP in the three different age group of the study population. MAP was more in the elderly age group in whom the QTc was also more. On correlation analysis, a significant positive correlation was observed.

The Graph 6 shows a significant correlation ($P < 0.001$, Pearson's coefficient $r = 0.327$) between QTc and MAP.

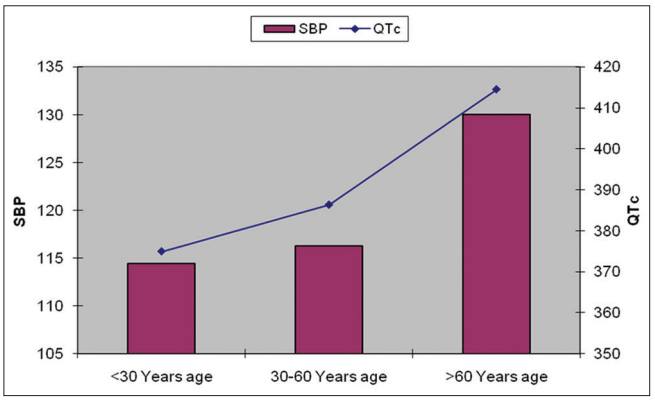
DISCUSSION

The present study investigated the association between systolic, diastolic, and MAP in the three different age groups of the study population in an attempt to find out any correlation with QTc. We found that the MAP correlated

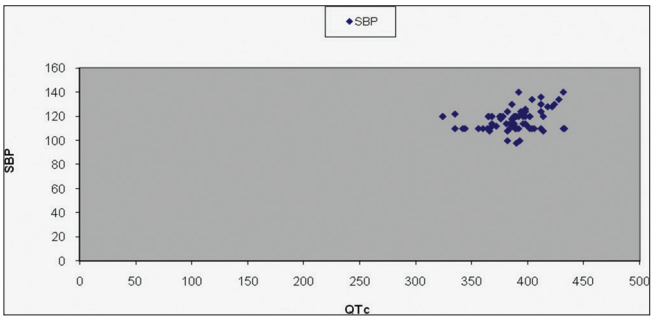
Table 1: Baseline characteristics of the study population as per mean±SD

Parameters	<30 years age	30-60 years age	>60 years age
Age (in years)	22.2±3.3	42.3±8.7	63.8±2.3
HR (beats/min)	73.4±9.6	75±7.1	74.9±5.1
SBP (mm of Hg)	114.4±5.9	116.3±7.6	130±5.7
DBP (mm of Hg)	73.8±5.7	76.3±5.9	82.4±5.3
MAP (mm of Hg)	87.8±4.5	89.5±5.8	97.7±5.4
QT (ms)	316.3±12.1	317.1±7.9	331.9±12.6
QTc (ms)	374.9±31	386.3±14.8	414.5±11.8

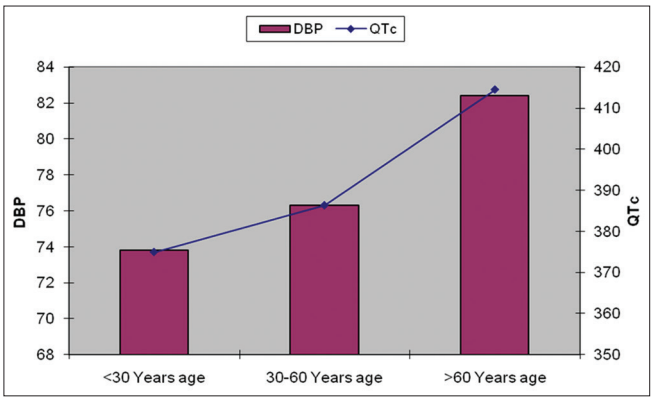
SD: Standard deviation, SBP: Systolic blood pressure, DBP: Diastolic blood pressures, MAP: Mean arterial pressure



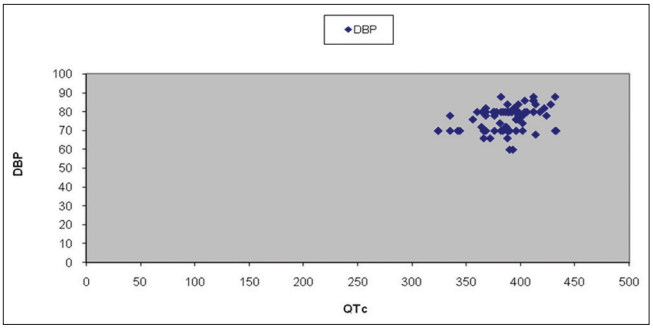
Graph 1: Distribution of QT corrected with systolic blood pressure



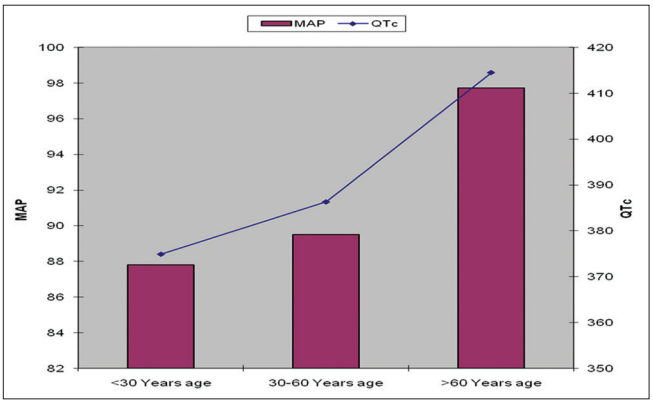
Graph 2: Correlation of QT corrected with systolic blood pressure



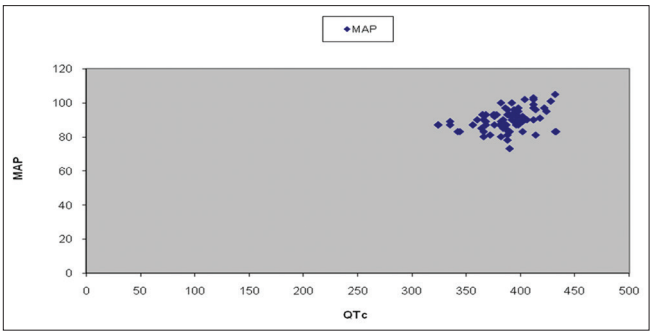
Graph 3: Distribution of QT corrected with diastolic blood pressure



Graph 4: Correlation of QT corrected with diastolic blood pressure



Graph 5: Distribution of QT corrected with mean arterial pressure



Graph 6: Correlation of QT corrected with mean arterial pressure

most (r = 0.33, P < 0.001) with QTc. The systolic and DBP also significantly correlated with QTc but the strength of association was less (r = 0.31 and 0.29 for SBP and DBP) than association between MAP and QTc.

The result is consistent with the finding of Mangoni et al.[10] who found a positive QTc interval correlation with SBP, DBP, and MAP. Leotta et al.[11] found a significant positive relationship between QTc and SBP in male individuals and opined that QT measurement may represent a useful marker in the screening of young individuals for cardiovascular prevention. The cause of such association is unknown but it might be due to changes in the ultrastructure of cardiac myocytes.[12]

The authors have taken only one independent risk factor for the study. They propose to study the effect the body mass index on QT interval which may have an influence in the QT interval. The present study was nonfunded and the conflicts of interest were none.

CONCLUSION

In our study, the systolic, diastolic, and MAP had a significant association with QTc. MAP correlated most with the QTc interval (r = 0.327) and was an important predictor of QT and QTc interval.

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