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QTc dispersion as a predictor of coronary artery disease severity in Bangladeshi patients with chronic coronary syndromes

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Abstract

Background: Coronary artery disease (CAD) is a leading global and national health burden. Accurate assessment of CAD severity is crucial for effective management. QTc dispersion, a simple electrocardiographic parameter, has been explored as a potential predictor of CAD. This study aimed to evaluate the association between QTc dispersion and coronary angiographic severity in Bangladeshi patients with chronic coronary syndromes (CCS).

Methods: A cross-sectional study was conducted on 92 CCS patients undergoing coronary angiography at Sir Salimullah Medical College Mitford Hospital, Dhaka, from November 2020 to October 2021. Patients were divided into two groups based on QTc dispersion (≥50 ms or <50 ms). Coronary angiographic severity was assessed using the Gensini score.

Results: Patients with increased QTc dispersion (Group B) had a significantly higher mean age, were predominantly male, and exhibited significantly higher Gensini scores compared to those with normal QTc dispersion (Group A). A strong positive correlation was observed between QTc dispersion and Gensini score ($r=0.742$, $p<0.001$).

Conclusion: Our findings suggest that QTc dispersion is a significant predictor of CAD severity in Bangladeshi patients with CCS. Incorporating QTc dispersion into routine clinical practice may aid in risk stratification and the development of personalized treatment strategies for these patients.

Keywords: Chronic coronary syndromes; QTc dispersion; Electrocardiogram; Coronary angiography; Gensini score; Bangladesh

1. Introduction

Coronary artery disease (CAD) is a leading global health concern, with a disproportionate impact on South Asian nations like Bangladesh. Characterized by the narrowing of coronary arteries, CAD manifests in various clinical presentations, including chronic coronary syndromes (CCS). Despite the high prevalence of CCS, particularly chronic

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stable angina (CSA) at 25.9% in Bangladesh, the country faces significant challenges in managing this epidemic due to its large population and limited healthcare resources.[1-6] Electrocardiography (ECG) is a cornerstone in cardiovascular assessment, and the QT interval, a measure of ventricular repolarization, has emerged as a potential marker of CAD severity. QT dispersion (QTD), reflecting variations in repolarization across the heart, has been associated with increased risk of life-threatening arrhythmias and adverse outcomes in various cardiac conditions.[7-13] While coronary angiography (CAG) remains the gold standard for diagnosing and characterizing CAD, it is invasive and resource-intensive. Angiographic scoring systems, such as the Gensini score, quantify the severity of CAD but are not universally accessible. [14-15]

This study aims to investigate the relationship between QTD and the angiographic severity of CAD in patients with CCS in Bangladesh. By exploring this association, we seek to evaluate the potential of QTD as a simple, non-invasive tool for assessing CAD severity in a resource-limited setting.

2. Methodology

This study employed a cross-sectional analytical design to evaluate the association between QTc dispersion and the severity of coronary artery disease (CAD) among patients with chronic coronary syndromes (CCS) who underwent coronary angiography at Sir Salimullah Medical College Mitford Hospital, Dhaka, from November 2020 to October 2021.

2.1. Study Population and Sampling

- **Study Population:** All patients with CCS who underwent coronary angiography during the study period were considered.
- **Sampling:** A purposive sample of 92 patients meeting the inclusion criteria was recruited.

2.2. Inclusion and Exclusion Criteria

- **Inclusion criteria:** Patients aged >18 years with CCS undergoing coronary angiography.
- **Exclusion criteria:** Acute coronary syndrome, congenital long QT syndrome, atrial fibrillation, bundle-branch blocks, intra-ventricular conduction defects, atrio-ventricular block, sinus node dysfunction, pacemaker, cardiomyopathy, congestive heart failure, history of myocardial infarction, coronary artery bypass surgery, coronary angioplasty, electrolyte imbalance, and use of QT prolonging medications.

2.3. Data Collection

After obtaining ethical approval, eligible patients provided written informed consent. Demographic, clinical, ECG, and laboratory data were collected using a structured questionnaire. A 12-lead ECG was obtained to calculate QTc dispersion. Coronary angiography was performed to assess the presence and severity of CAD using the Gensini score.

2.4. Variables

- **Demographic:** Age, gender, family history of CAD
- **Clinical:** Risk factors for CAD (diabetes mellitus, hypertension, dyslipidemia, smoking)
- **ECG:** QTc dispersion
- **Laboratory:** Random blood sugar, serum creatinine, serum electrolytes, lipid profile
- **Outcome:** Presence and severity of CAD (angiographic evaluation and Gensini score)

2.5. Data Analysis

Data were analyzed using SPSS version 22.0. Descriptive statistics were used to summarize data. Student's t-test and chi-square test were employed for comparing continuous and categorical variables, respectively. Univariate and multivariate linear regression analysis determined the association between risk factors and QTc dispersion, and the severity of CAD. A p-value <0.05 was considered statistically significant.

Ethical Considerations: Ethical clearance was obtained, and strict confidentiality was maintained throughout the study.

3. Results

In the study, 92 patients of chronic coronary syndromes were included among whom 46 patients with normal QT_C dispersion (<50 ms) named as group A and rest 46 patients with increased QT_C dispersion (≥50 ms) named as group B. Majority participants of chronic coronary syndromes were in 51-60 years of age (45.6%) followed by 41-50 years of age (30.4%). Mean age in group B was higher (55.22±8.50 years) than group A (52.58±10.05 years) patients (p=0.233). Majority participants in group B were male (87.0%) while female was predominant in group A (52.2%) patients. The study was statistically significant (p<0.001). Regarding risk factors, positive family history of CAD, dyslipidemia and smoking was significantly more among group B patients than group A (p<0.05). Regarding investigation profile, mean values of total cholesterol, LDL and TG was significantly higher in group B patients (p<0.001)

Table 1 Sample Characteristics: (n=92)

Age group	**Group A (n=46) frequency (%)**	**Group B (n=46) frequency (%)**	**Total (n=92) frequency (%)**	***p* value**
≤40 years	5 (10.9%)	4 (8.7%)	9 (9.8%)	
41-50 years	18 (39.1%)	10 (21.7%)	28 (30.4%)	
51-60 years	16 (34.8%)	26 (56.5%)	42 (45.6%)	0.391*
61-70 years	5 (10.9%)	5 (10.9%)	10 (10.9%)	
>70 years	2 (4.3%)	1 (2.2%)	3 (3.3%)	
Mean±SD (years)	52.58±10.05	55.22±8.50	53.90±9.34	†0.233
Gender				
Male	47.8%	87%		
Female	52.2%	13%		
Risk Factors				
Family history of CAD	14 (30.4%)	31 (67.4%)	45 (48.9%)	0.002
Diabetes mellitus	14 (30.4%)	18 (39.1%)	32 (34.8%)	0.458
Hypertension	27 (58.7%)	33 (71.7%)	60 (65.2%)	0.216
Dyslipidaemia	12 (26.0%)	29 (63.0%)	41 (44.6%)	0.002
Smoking	17 (36.9%)	33 (71.7%)	39 (54.2%)	0.002
investigation profile				
RBS, mmol/L	7.81±3.28	7.25±2.69	7.53±2.99	0.432
Serum creatinine, mg/dL	1.05±0.27	1.05±0.31	1.05±0.29	0.961
Total Cholesterol, mg/dL	156.94±30.41	202.72±37.01	179.83±40.77	<0.001
LDL, mg/dL	106.89±27.01	138.72±34.24	122.81±34.56	<0.001
HDL, mg/dL	36.83±1.88	38.97±10.41	37.90±7.50	0.229
TG, mg/dL	141.67±13.78	187.61±62.81	164.64±50.73	<0.001

*p value measured by chi-square test,†p value measured by independent sample's t-test

Electrocardiographic results of the group A and B are shown in the above table. There were no significant differences in RR interval. QT maximum, QT_C maximum were significantly higher in group B than group A (p<0.05). QT minimum and QT_C minimum were higher in group A significantly (p<0.05). QT_C dispersion were higher among group B patients which was highly significant (p<0.001).

Table 2 Electrocardiographic measurements of the study population (n=92)

Variables	Group A (n=46) mean±SD	Group B (n=46) mean±SD	*p* value*
RR interval (ms)	830.56±104.80	818.89±130.23	0.677
QT maximum (ms)	356.67±39.57	384.44±35.17	0.002
QT_C maximum (ms)	394.28±43.38	427.81±41.25	0.001
QT minimum (ms)	323.06±36.63	300.83±30.08	0.006
QT_C minimum (ms)	356.86±40.54	335.67±36.70	0.023
QT_C dispersion (ms)	37.42±10.31	92.28±20.78	<0.001

**p* value measured by independent student t test.

Patients in group B had significantly higher evidence of different extent of coronary artery stenosis. Double and triple vessel disease and left main stenosis were significantly more prevalent among group B patients ($p<0.05$).

Table 3 Extent of vessel involvement among study population (n=92)

Vessel involvement	Group A (n=46) frequency (%)	Group B (n=46) frequency (%)	Total (n=92) frequency (%)	*p* value*
Normal	15 (32.6%)	3 (6.5%)	18 (19.6%)	0.003
SVD	31 (67.4%)	9 (19.6%)	40 (43.5%)	<0.001
DVD	0	13 (28.3%)	13 (14.1.9%)	0.001
TVD	0	19 (41.3%)	19 (20.6%)	<0.001
LMS	0	2 (4.3%)	2 (2.2%)	0.151

**p* value measured by chi-square test; SVD: Single vessel disease; DVD: Double vessel disease; TVD: Triple vessel disease; LMS: Left main stenosis

Patients with increased QTc dispersion. Mean Gensini score was significantly higher among group B (39.50±20.95) than group A (1.92±7.35) patients ($p<0.001$).

Table 4 Distribution of Gensini score among study population (n=92)

Gensini Score	Group A (n=46)	Group B (n=46)	*p* value*
Mean±SD	1.92±7.35	39.50±20.95	<0.001
Minimum	0	0	
Maximum	40	86	

**p* value measured by independent sample's t-test

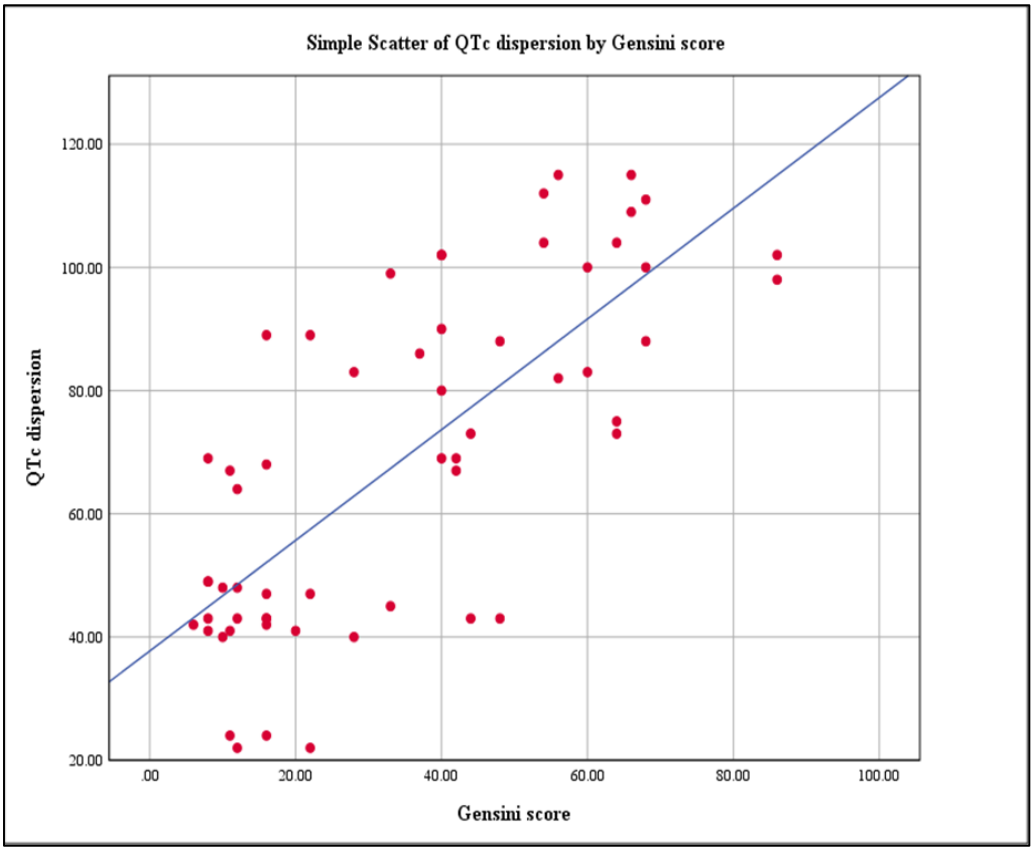

Figure 1 Scatter plots of correlation between QT_C dispersion and Gensini score among study population (n=92)

Scatter plot of correlation between QT_C dispersion and Gensini score showed in above figure. In bivariate correlation it was found that QT_C dispersion was significantly correlated with Gensini score (r=0.709, p<0.001).

Male sex (β=0.407, p<0.001), family history (β=0.346, p=0.003), smoking (β=0.408, p<0.001) and QTc dispersion (β=0.664, p<0.001) were significantly correlated with Gensini score in univariate linear regression analysis.

Table 5 Univariate analysis of the predictors of angiographic severity by Gensini score in patients of chronic coronary syndromes (n=92)

Variables	β	95% CI	*p* value*
Age	0.100	-0.361-0.885	0.405
Sex (male)	0.407	9.856-32.602	<0.001
Family history	0.346	5.963-27.753	0.003
DM	0.148	-4.503-19.613	0.216
HTN	0.123	-5.805-18.392	0.303
Dyslipidemia	0.202	-2.152-29.451	0.089
Smoking	0.408	10.930-35.882	<0.001
QT_C dispersion	0.664	0.413-0.671	<0.001

β: Standardized Coefficients**; CI:** Confidence interval**; DM:** Diabetes mellitus**; HTN:** Hypertension; ***Univariate linear regression done to measure significance.**

In multivariate linear linear regression analysis, Gensini score had highly significant association with QTc dispersion (β=0.565, p<0.001).

Table 6 Multivariate analysis of the predictors of angiographic severity by Gensini score in patients of chronic coronary syndromes (n=92)

Variables	β	95% CI	*p* value
Sex (male)	0.099	-4.372-14.707	0.283
Family history	0.165	-0.137-16.244	0.054
Smoking	0.163	-0.941-19.644	0.074
QT_C dispersion	0.565	0.289-0.575	<0.001

β: Standardized Coefficients**; CI:** Confidence interval**; *Multivariate linear regression done to measure significance**

4. Discussion

This study aimed to evaluate the association between QTc dispersion and the severity of coronary artery disease (CAD) in Bangladeshi patients with chronic coronary syndromes (CCS). Our findings demonstrate a significant correlation between increased QTc dispersion and the severity of CAD as assessed by the Gensini score.

4.1. Patient Characteristics

The patient population primarily comprised middle-aged males, consistent with the established prevalence of CAD in this demographic. The observed predominance of males in our study aligns with previous research, which attributes this disparity to protective hormonal factors in premenopausal women and lower smoking rates among Bangladeshi females.[3,8,11,16,17]

4.2. Risk Factors

Traditional CAD risk factors such as hypertension, smoking, family history, diabetes mellitus, and dyslipidemia were prevalent in our patient cohort. Notably, smoking and dyslipidemia were significantly more common in patients with increased QTc dispersion. These findings underscore the importance of addressing modifiable risk factors for preventing and managing CAD. [9, 18]

4.3. QTc Dispersion and CAD Severity

Our study revealed a significant positive correlation between QTc dispersion and the Gensini score, indicating that increased QTc dispersion is associated with more severe CAD. These findings are consistent with previous studies that have explored the relationship between QTc dispersion and CAD.[19]

Furthermore, multivariate analysis confirmed QTc dispersion as an independent predictor of CAD severity, even after controlling for other established risk factors. This suggests that QTc dispersion may serve as a valuable adjunct to traditional risk assessment tools in identifying patients at higher risk for adverse cardiac events.

Limitations and Future Directions

It is important to acknowledge the limitations of this cross-sectional study, including its relatively small sample size and the absence of a long-term follow-up to assess the prognostic value of QTc dispersion. Future prospective studies with larger sample sizes are warranted to further elucidate the role of QTc dispersion in predicting cardiac outcomes.

5. Conclusion

In conclusion, our findings suggest that QTc dispersion is a significant predictor of CAD severity in Bangladeshi patients with CCS. Incorporating QTc dispersion into routine clinical practice may aid in risk stratification and the development of personalized treatment strategies for these patients.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Acknowledgement

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Statement of Ethical approval

An ethical clearance was taken from Sir Salimullah Medical College.

Statement of Informed consent

Informed consent was obtained, with participants having the freedom to withdraw at any point.

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