

## Original Research Article

# Relationship between QRS duration on admission electrocardiogram and angiographic severity of coronary artery disease in patients with acute anterior myocardial infarction

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### ABSTRACT

**Background:** Early risk stratification in myocardial infarction (MI) is crucial, but the prognostic role of admission electrocardiography (ECG) findings remains underexplored. This study evaluated the relationship between QRS duration and severity of coronary artery disease (CAD) in acute anterior MI (AMI).

**Methods:** A cross-sectional study was conducted at the Department of Cardiology, Sir Salimullah Medical College and Mitford Hospital, Dhaka, from November 2019 to October 2020. One hundred patients with first anterior MI, admitted within 12 hours of chest pain onset and treated with thrombolysis, were enrolled. Patients were stratified into two groups: QRS ≤ 100 ms (normal) and QRS > 100 ms (prolonged). CAD severity was assessed using Gensini score, with ≥ 36 indicating moderate-to-severe disease.

**Results:** Patients with prolonged QRS duration were significantly more likely to have severe CAD, with an eightfold higher risk compared to those with normal QRS (95% CI: 3.2-19.3; p < 0.001).

**Conclusions:** Prolonged QRS duration on admission ECG is strongly associated with severe CAD in acute anterior MI, suggesting its value for early risk stratification.

**Keywords:** Coronary artery disease, Anterior myocardial infarction, QRS duration, Gensini score

### INTRODUCTION

Cardiovascular disease (CVD) continues to be the foremost cause of mortality worldwide. In 2015, nearly 20 million deaths were attributed to CVD, representing one-third of global mortality, while an estimated 423 million people (approximately one in seventeen) were living with the disease.<sup>1</sup> Bangladesh, like many low- and middle-income countries, is undergoing a rapid epidemiological transition. While mortality linked to communicable illnesses has declined markedly over recent decades, deaths from chronic conditions have risen sharply. CVD, cancer, chronic respiratory disorders, and diabetes—the “fatal four” non-communicable diseases—are

expanding at a concerning rate.<sup>2</sup> National hospital surveillance data confirmed this trend, with the Health Bulletin 2013 reporting that AMI accounted for 3.7% of hospital deaths across 504 government facilities, making it the single leading cause of mortality in public hospitals.<sup>3</sup> Globally, MI is the most common manifestation of acute coronary syndrome (ACS) and remains a major contributor to premature morbidity and mortality.<sup>4</sup> ECG is an accessible tool of central importance in acute MI, particularly for evaluating the QRS complex, which represents ventricular depolarization. Normally lasting 60-100 milliseconds, the QRS duration may widen to ≥ 120 ms due to conduction abnormalities. Prolongation may result from bundle branch block, myocardium-to-myocardium

conduction, ventricular arrhythmia, Wolff-Parkinson-White syndrome, metabolic disturbances, or paced rhythm. There is increasing recognition that QRS width has prognostic implications. Prolonged QRS duration in anterior MI has been associated with poorer outcomes.<sup>5</sup> This observation has been substantiated by studies indicating that QRS prolongation at admission predicts adverse cardiac events in both ST-elevation and non-ST-elevation ACS.<sup>6,7</sup> Beyond its diagnostic role, QRS prolongation is strongly linked with ventricular function. Patients with wide QRS complexes frequently exhibit systolic dysfunction and higher mortality.<sup>8</sup> Furthermore, prolonged QRS duration correlates with increased ventricular volume, reduced left ventricular ejection fraction (LVEF), and greater risk of sudden cardiac death.<sup>9</sup> Despite substantial evidence from international populations, few studies have investigated the relationship between admission QRS duration and the angiographic severity of CAD in Bangladesh. Understanding this association is highly relevant, given the epidemiological shift and rising burden of CVD in the country. Therefore, the present study aims to assess the relationship between QRS duration and angiographic severity in Bangladeshi patients presenting with acute MI.

**METHODS**

This cross-sectional analytical study was conducted at the Department of Cardiology, Sir Salimullah Medical College and Mitford Hospital, Dhaka, from November 2019 to October 2020. We enrolled 100 consecutive patients presenting with first-time acute AMI within 12 hours of symptom onset who received thrombolytic therapy. Exclusion criteria included prior MI, PCI/CABG, pre-existing conduction abnormalities (bundle branch blocks, Wolff-Parkinson-White syndrome, pacemaker rhythm), arrhythmias, anti-arrhythmic drugs, valvular/congenital heart disease, cardiomyopathy, hyperkalemia, or non-coronary troponin elevation causes. Written informed consent was obtained and baseline risk

factors documented. Routine investigations included serum troponin, glucose, renal function, electrolytes, and lipid profile. Standard 12-lead ECGs (25 mm/s, 10 mm/mV calibration) were performed within 12 hours. QRS duration was manually measured across precordial leads and averaged; patients were categorized as normal ( $\leq 100$  ms) or prolonged ( $> 100$  ms). All underwent transthoracic echocardiography and coronary angiography. Coronary severity was assessed using Gensini score, calculated independently by two cardiologists.

**Statistical analysis**

Data were analyzed using SPSS version 26.0. Descriptive statistics summarized baseline characteristics. Group comparisons used Chi-square tests for categorical and t-tests for continuous variables. Odds ratios (OR) with 95% confidence intervals estimated associations. Spearman's correlation assessed QRS-Gensini-LVEF relationships. Statistical significance was  $p < 0.05$ .

**RESULTS**

Age, sex, BMI, hypertension, smoking, diabetes, family history of CAD, fasting blood sugar, HDL cholesterol, triglycerides, and serum creatinine did not differ significantly between groups ( $p > 0.05$ ). Serum total cholesterol, LDL cholesterol, and troponin I were significantly higher in the prolonged QRS group ( $p = 0.021$ ,  $p = 0.003$ ,  $< 0.001$ ) (Table 1).

Severe CAD (Gensini  $\geq 36$ ) was more frequent in patients with prolonged QRS ( $> 100$  ms) compared to normal QRS (76.8% vs. 29.5%, OR=7.9, 95% CI: 3.2-19.3;  $p < 0.001$ ). The number of vessels involved did not differ significantly between groups ( $p = 0.37$ ). Reduced LVEF ( $< 50\%$ ) was more common in the prolonged QRS group, with a significant association (OR and p value as reported) (Table 2).

**Table 1: Baseline characteristics between prolonged and normal QRS durations.**

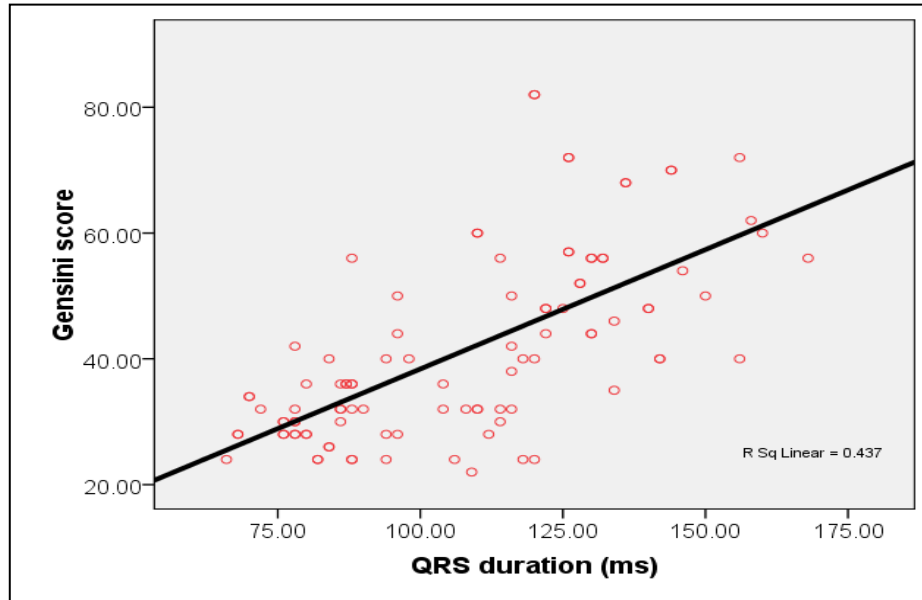
Baseline characteristics	Prolonged QRS $> 100$ ms, (n=56) (%)	Normal QRS $\leq 100$ ms, (n=44) (%)	P value
Age (in years), mean $\pm$ SD	50.9 $\pm$ 8.7	49.1 $\pm$ 5.9	0.244
Sex (male)	44 (78.6)	31 (70.5)	0.352
BMI (kg/m <sup>2</sup> ), mean $\pm$ SD	25.2 $\pm$ 2.7	25.0 $\pm$ 3.7	0.734
Hypertension	35 (62.5)	25 (56.8)	0.565
Smoking	27 (48.2)	17 (38.6)	0.338
Diabetes mellitus	23 (41.1)	20 (45.5)	0.66
Family history of CAD	10 (17.9)	12 (27.3)	0.259
Fasting blood sugar (mmol/l)	7.2 $\pm$ 1.8	7.1 $\pm$ 1.2	0.756
Serum total cholesterol (mg/dl)	202.2 $\pm$ 22.0	192.0 $\pm$ 20.7	0.021*
Serum LDL cholesterol (mg/dl)	138.0 $\pm$ 15.9	125.0 $\pm$ 23.6	0.003*
Serum HDL cholesterol (mg/dl)	36.8 $\pm$ 4.2	38.6 $\pm$ 4.8	0.082
Serum triglycerides (mg/dl)	204.7 $\pm$ 43.0	198.6 $\pm$ 25.0	0.377
Serum creatinine (mg/dl)	1.13 $\pm$ 0.29	1.09 $\pm$ 0.20	0.503
Serum troponin-I (nmol/l)	18.5 $\pm$ 12.8	8.2 $\pm$ 1.7	$< 0.001$ *

\*P value is significant

**Table 2: Association between QRS duration and CAD severity, vessel involvement, and LVEF.**

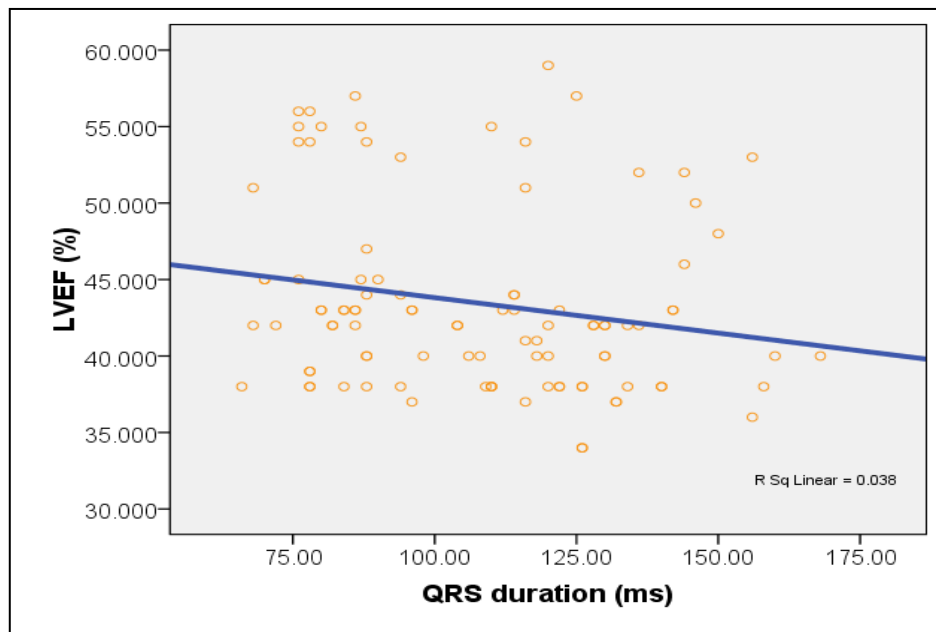
QRS duration (ms)	CAD severity by Gensini score, N (%)		OR (95% CI)	P value	No. of vessels involved	LVEF (%)			OR (95% CI)	P value
	≥36 (Severe CAD)	<36 (Mild CAD)				SVD (n=14)	DVD (n=80)	TVD (n=6)		
>100 ms	43 (76.8)	13 (29.5)	7.9 (3.2-19.3)	<0.001*	8 (57.1)	43 (53.8)	5 (83.3)	0.37		
≤100 ms	13 (23.2)	31 (70.5)	-	-	6 (42.9)	37 (46.2)	1 (16.7)			

\*P value is significant.



**Figure 1: Positive linear relationship between QRS duration (ms) and Gensini score.**

\*As QRS duration increases, Gensini score also rises, indicating greater CAD severity. The correlation strength is reflected by  $R^2=0.437$ .



**Figure 2: Negative correlation between QRS duration (ms) and LVEF (%).**

\*As QRS duration increases, LVEF decreases, with a weak correlation ( $R^2 = 0.038$ ).

## DISCUSSION

CVDs remain the dominant cause of mortality worldwide, and in developing countries such as Bangladesh their burden continues to rise. Effective control requires improved understanding of prognostic markers that guide timely intervention. The pathophysiology of CAD is driven by atherosclerosis, inflammation, and progressive endothelial dysfunction, the latter being a critical determinant of vascular instability and adverse outcomes following AMI. In this study, we examined the prognostic role of QRS duration on the surface ECG in patients with acute anterior MI. Our findings show that patients with prolonged QRS duration (>100 ms) were markedly more likely to have severe angiographically defined CAD compared with those with normal QRS complexes. Over three-quarters of patients with prolonged QRS duration had severe CAD, and the odds of significant disease were nearly eight-fold higher than in patients with normal QRS duration. These results underscore the simple yet powerful value of QRS duration as a marker of disease burden. Baseline clinical profiles were similar between groups. Patient age (mean ~51 years) was comparable with previous Bangladeshi series.<sup>10</sup> Likewise, the male predominance in our cohort was similar to earlier reports.<sup>11-13</sup> Traditional risk factors such as diabetes, hypertension, family history, and obesity were not significantly different between groups, consistent with local studies.<sup>14</sup> A significant inverse relationship was observed between QRS duration and LVEF. More than 60% of patients with reduced LVEF (<50%) exhibited prolonged QRS, compared with one-third with preserved function. This observation is in agreement with prior studies demonstrating that QRS widening reflects structural remodeling, reduced systolic function, and excess mortality risk.<sup>9</sup> Previous investigators have highlighted the protective role of coronary collateral circulation in limiting infarct size and preserving ventricular performance.<sup>15,16</sup> QRS duration has also been widely validated as a prognostic marker in heart failure and MI.<sup>17,18</sup> Ischemia-mediated conduction delays manifest electrocardiographically as QRS prolongation.<sup>19,20</sup> Subsequent work has further observed that higher admission QRS scores correspond to impaired reperfusion in anterior MI.<sup>21</sup>

Morphological refinements, such as fragmented QRS, have been shown to predict poor collateral formation and adverse ventricular remodeling.<sup>22,23</sup> Prolonged QRS has also been associated with higher early mortality after MI and was confirmed in large trial data.<sup>24</sup> Unlike much of the earlier literature, which concentrated on non-ST elevation ACS, our study specifically examined anterior wall MI. We confirmed that prolonged QRS duration at admission is strongly associated with angiographic severity of CAD, consistent with previous evidence.<sup>24</sup>

Collectively, these findings underscore the clinical utility of QRS duration as an inexpensive and widely available

marker for early risk stratification, particularly in resource-limited settings.

## Limitations

This study has several limitations. Few comparable studies limited contextualization within existing literature. Male predominance (78.6%) may have introduced sex-related confounding, as QRS duration differs by gender. The single-center design and small sample size limit generalizability. Multicenter studies with balanced gender representation are needed for validation.

## CONCLUSION

This study demonstrates the prognostic value of QRS duration in acute AMI. Patients with prolonged QRS duration (>100 ms) showed an eight-fold increased likelihood of severe CAD and reduced LVEF compared to those with normal QRS duration. These associations were independent of conventional risk factors. As a non-invasive, inexpensive, and universally available tool, QRS duration provides valuable bedside prognostic information. Incorporating this simple marker into early assessment protocols may improve risk stratification and guide management decisions, particularly in resource-limited healthcare settings.

## Recommendations

Based on these observations, several recommendations emerge for future research. First, larger multicenter studies are essential to validate these findings in the Bangladeshi population. Broader sample sizes and diverse patient groups would enhance generalizability and provide more reliable evidence. Second, given male predominance in this cohort, future research should ensure balanced gender recruitment. Equal representation may reveal sex-based differences in clinical presentation and disease severity, offering deeper insights into QRS duration's prognostic role.

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