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ORIGINAL ARTICLE

Association between Prolonged QRS Duration (>110 milliseconds) and In-hospital Outcomes of Patients with Heart Failure: Data from the Medical Registry of a Tertiary Hospital in Bangladesh

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ABSTRACT

Background: *Heart failure is a major cause of morbidity and mortality worldwide. Electrocardiographic parameters, particularly QRS duration, may provide important prognostic information in patients with heart failure. This study aimed to evaluate the relationship between QRS duration on admission ECG and in-hospital outcomes among patients admitted with heart failure.* ***Methods & Materials:*** *This retrospective observational study was conducted in the Department of Cardiology at Dhaka Medical College Hospital, Dhaka, from 01 January to 31 December 2025. A total of 100 adult patients admitted with a primary diagnosis of heart failure were included.* ***Results:*** *The mean age of the study population was 59.27 ± 11.63 years and 67% were male. Sinus rhythm was observed in 93% of patients. Hypertension and diabetes mellitus were present in 50% and 54% of patients respectively, while ischemic heart disease was highly prevalent (88%). Patients with prolonged QRS duration (>110 ms) had higher rates of in-hospital mortality (10.00% vs 4.00%), cardiogenic shock (36.00% vs 18.00%), requirement of intravenous inotropic/vasopressors support (36.00% vs 18.00%) and need for mechanical ventilation (12.00% vs 4.00%) and p = 0.269 compared with those with normal QRS duration (≤110 ms). The mean hospital stay was also longer in the prolonged QRS group (10.66 ± 6.647 vs 7.52 ± 5.686 days; p = 0.013).* ***Conclusion:*** *Prolonged QRS duration on admission ECG is associated with poorer in-hospital outcomes among patients with heart failure. QRS duration may serve as a simple and useful marker for early risk stratification in hospitalized heart failure patients.*

Keywords: *Heart failure, QRS duration, electrocardiography, in-hospital outcomes, cardiogenic shock, arrhythmia.*

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INTRODUCTION

Heart failure (HF) is a major global public health problem and one of the leading causes of hospitalization, morbidity and mortality worldwide [1,2]. Recent reviews and registry data show that HF prevalence and hospitalizations are rising, driven by aging populations, improved survival after myocardial infarction and the growing burden of hypertension, diabetes and ischemic heart disease [3,4]. In low- and middle-income countries, particularly in Asia and South Asia, HF now accounts for a substantial proportion of acute medical and cardiology admissions and imposes considerable costs on health systems [4,5]. Hospitalized HF patients in Asian registries have notable in-hospital mortality (approximately 2.8–8.4%), prolonged length of stay, frequent complications and high early readmission rates, underscoring the need for simple tools to identify patients at high short-term risk [6,7]. South Asian patients with HF tend to present at a younger age than their Western counterparts and often have multiple cardiovascular risk factors, including high rates of diabetes, hypertension and ischemic heart disease [8,9,10]. At the same time, access to advanced diagnostics and therapies (such as device therapy and specialized HF programs) can be limited, making early risk stratification using low-cost, routinely available tools even more important in tertiary hospitals in this region [6,11]. The standard 12-lead electrocardiogram (ECG) is one of the most accessible investigations in cardiology and is performed in virtually all patients admitted with HF. Among ECG parameters, QRS duration, the time required for ventricular depolarization, provides information about intraventricular conduction and electrical synchrony. Prolonged QRS duration reflects electrical dyssynchrony and is often associated with structural heart disease, left ventricular systolic dysfunction and bundle branch block [12,13]. Numerous cohort and trial analyses in HF populations have shown that prolonged QRS duration (commonly ≥120 ms) is relatively frequent and is associated with increased all-cause and cardiovascular mortality, higher rates of HF hospitalization and overall worse prognosis, independent of conventional risk factors and left ventricular ejection fraction [14,15]. While this evidence establishes QRS prolongation as an

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adverse long-term prognostic marker, most prior work has focused on chronic or ambulatory HF cohorts, device-therapy selection (e.g., cardiac resynchronization therapy), or carefully selected trial populations. Data on the relationship between QRS duration and short-term, in-hospital outcomes in unselected HF admissions are more limited. Some studies in acute HF, including the Korean Acute Heart Failure (KorAHF) registry and related analyses, have shown that prolonged QRS duration is associated with higher 30-day in-hospital mortality, particularly among patients presenting with cardiogenic shock, suggesting that QRS duration may also be useful for risk stratification in the acute setting [16]. Furthermore, many studies have used QRS thresholds of ≥120 or ≥150 ms, yet emerging data indicate that even moderately prolonged QRS duration (for example, >110 ms) may carry prognostic significance. Population and atrial fibrillation cohorts have reported that individuals with QRS in the 90–119 ms range already have higher risks of death, HF and hospitalization compared with those with narrower QRS complexes, supporting the clinical relevance of intermediate QRS prolongation [17,18]. However, there is a paucity of local, hospital-based data from South Asia examining whether such thresholds are useful for predicting in-hospital outcomes among HF patients in real-world tertiary care settings. Given that ECG is inexpensive, universally available and already part of routine assessment for HF admissions, evaluating the prognostic value of QRS duration offers a low-cost and immediately implementable risk-stratification approach. Determining whether prolonged QRS duration (>110 ms) on admission ECG predicts in-hospital mortality and adverse clinical events—such as cardiogenic shock, ventricular arrhythmias, or need for intensive care—could improve early clinical decision-making, triage and resource allocation in tertiary hospitals. In this context, the present study aims to assess the association between prolonged QRS duration (>110 ms) and in-hospital outcomes among patients admitted with HF using data from a tertiary hospital's medical registry, thereby generating context-specific evidence to inform local HF management strategies and contribute to the broader understanding of ECG-based risk markers in acute HF care. The objective of this study was to determine the association between prolonged QRS duration (>110 ms) on admission ECG and in-hospital mortality among patients admitted with heart failure.

METHODS & MATERIALS

This retrospective observational study was conducted in the Department of Cardiology at Dhaka Medical College Hospital, Dhaka from 01 January to 31 December 2025. The study population consisted of adult patients admitted with a primary diagnosis of heart failure. Heart failure was diagnosed based on compatible clinical symptoms and signs such as dyspnea, fatigue, peripheral edema, raised jugular venous pressure, pulmonary crackles, together with echocardiographic evidence of cardiac dysfunction and elevated NT-proBNP levels according to established guideline criteria [1,2]. Patients aged ≥18 years who had at least one standard 12-lead electrocardiogram (ECG) recorded within 24 hours of hospital admission and had available in-hospital outcome data were included. Patients with pacemaker-dependent rhythm, congenital heart disease, incomplete ECG or outcome data, transfer to another facility, or those receiving dialysis were excluded. A total of 100 patients were included using consecutive sampling.

The primary exposure variable was QRS duration measured on the admission ECG [19]. Patients were categorized into two groups: normal QRS duration (≤110 ms) and prolonged QRS duration (>110 ms) [19]. The primary outcome variable was in-hospital mortality, defined as death occurring during the index hospitalization for heart failure. Secondary outcomes included development of cardiogenic shock, requirement of intravenous inotropes or vasopressors, need for endotracheal intubation /mechanical ventilation, occurrence of significant arrhythmias (ventricular tachycardia, ventricular fibrillation, cardiac arrest, or atrial fibrillation) and total length of hospital stay.

Demographic characteristics, comorbidities, laboratory parameters, echocardiographic findings and treatment variables were recorded. Covariates included age, gender, hypertension, diabetes mellitus, ischemic heart disease, chronic kidney disease, chronic obstructive pulmonary disease, prior stroke, serum sodium, potassium, creatinine, hemoglobin, NT-proBNP levels, left ventricular ejection fraction, heart failure phenotype (HFrEF, HFmrEF, HFpEF) and medications such as ACEI/ARB/ARNI, beta-blockers, mineralocorticoid receptor antagonists and SGLT2 inhibitors.

Data were collected from the hospital medical registry using a structured case record form. ECG data were retrieved from electronic or scanned records and QRS duration was recorded from automated ECG measurements or manually measured using ECG calipers when necessary. Patient identifiers were removed and unique study identification numbers were assigned. Data were cleaned and analyzed using SPSS version 29. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between groups were performed using the independent t-test or Mann–Whitney U test for continuous variables and chi-square or Fisher's exact test for categorical variables. A p-value <0.05 was considered statistically significant. The study protocol was approved by the Institutional Review Board of Dhaka Medical College, Dhaka.

RESULTS

Table I presents the baseline demographic characteristics of the study population. The mean age of the patients was 59.27 ± 11.63 years. Among the 100 participants, 67% were male and 33% were female, indicating a predominance of male patients. The mean length of hospital stay was 9.09 ± 6.36 days. Regarding electrocardiographic findings, sinus rhythm was observed in 93% of patients.

Table I: Baseline Demographic Characteristics of the Study Population (*n* = 100)

Characteristics	n	%
Age (years), Mean ± SD	59.27 ± 11.63	
Gender		
Male	67	67.0
Female	33	33.0
Length of Hospital Stay (days), Mean ± SD	9.09 ± 6.36	
ECG Rhythm		
Sinus	93	93.0
AF (atrial fibrillation)	6	6.0
SVT (supraventricular tachycardia)	1	1.0

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Table II shows the laboratory and echocardiographic characteristics of the study population. The mean left ventricular ejection fraction was 31.80 ± 5.42% in the HFrEF group, 43.64 ± 2.307% in the HFmrEF group and 54.80 ± 4.266% in the HFpEF group. The mean serum sodium level was 139.45 ± 3.432 mmol/L among patients with sodium ≥135 mmol/L, while those with hyponatremia (<135 mmol/L) had a mean level of 129.73 ± 3.493 mmol/L. The average serum potassium was 4.23 ± 0.864 mmol/L and the mean serum creatinine level was 1.81 ± 1.108 mg/dL. The mean hemoglobin level was 10.96 ± 2.114 g/dL. Additionally, the mean NT-proBNP level was 11625.24 ± 11278.697 pg/mL.

Table II: Laboratory and Echocardiographic Characteristics of the Study Population (*n* = 100)

Variable	Mean ± SD
Left Ventricular Ejection Fraction – HFrEF (≤40%)	31.80 ± 5.42
Left Ventricular Ejection Fraction – HFmrEF (41–49%)	43.64 ± 2.307
Left Ventricular Ejection Fraction – HFpEF (≥50%)	54.80 ± 4.266
Serum Sodium ≥135 mmol/L	139.45 ± 3.432
Serum Sodium <135 mmol/L	129.73 ± 3.493
Serum Potassium (mmol/L)	4.23 ± 0.864
Serum Creatinine (mg/dL)	1.81 ± 1.108
Hemoglobin (g/dL)	10.96 ± 2.114
NT-proBNP (pg/mL)	11625.24 ± 11278.697

Table III shows the distribution of major comorbidities among the study population. Hypertension was present in 50.0% of patients and diabetes mellitus in 54.0%. A very high proportion of patients had ischemic heart disease (88.0%), indicating that coronary artery disease was a major underlying condition. Chronic kidney disease was observed in 37.0% of patients, while stroke and chronic obstructive pulmonary disease were present in 7.0% and 14.0% respectively.

Table III: Comorbidities of the Study Population (*n* = 100)

Variable	n	%
Hypertension (HTN)	50	50.0
Diabetes Mellitus (DM)	54	54.0
Ischemic Heart Disease (IHD)	88	88.0
Chronic Kidney Disease (CKD)	37	37.0
Stroke	7	7.0
Chronic Obstructive Pulmonary Disease (COPD)	14	14.0

Table IV presents the treatment profile of the study population. Beta-blockers were used in 64.0% of patients, while ACEI/ARB/ARNI therapy was administered in 63.0%. Mineralocorticoid receptor antagonists (MRA) were prescribed in 74.0%, representing the most frequently used medication group. Additionally, SGLT2 inhibitors were used in 67.0% of the patients.

Table IV: Treatment Profile of the Study Population (*n* = 100)

Variable	n	%
Beta-blocker use (BB)	64	64.0
ACEI/ARB/ARNI use	63	63.0
Mineralocorticoid Receptor Antagonist (MRA)	74	74.0
SGLT2 inhibitor use (SGLT2I)	67	67.0

Table V shows the comparison of in-hospital outcomes between patients with normal QRS duration (≤110 ms) and those with prolonged QRS duration (>110 ms). In-hospital mortality was higher among patients with prolonged QRS duration (10.00%) compared with those with normal QRS duration (4.00%). Similarly, cardiogenic shock occurred in 36.00% of patients with prolonged QRS duration compared with 18.00% in the normal QRS group and the requirement for I/V inotropes or vasopressor support was also higher in the prolonged QRS group (36.00% vs 18.00%). The need for endotracheal intubation/mechanical ventilation was observed in 12.00% of patients with prolonged QRS duration compared with 4.00% in the normal QRS group. The mean length of hospital stay was longer in the prolonged QRS group (10.66 ± 6.647 days) compared with the normal QRS group (7.52 ± 5.686 days) and this difference was statistically significant (p = 0.013). Regarding significant arrhythmias, cardiac arrest occurred in 10.00% of patients with prolonged QRS duration compared with 4.00% in those with normal QRS, while ventricular tachycardia occurred in 4.00% and 2.00% of patients respectively. Most patients in both groups did not develop significant arrhythmias (94.00% vs 86.00%).

Table V: Comparison of In-Hospital Outcomes According to QRS Duration

Variable	Normal QRS ≤110 ms (n = 50)	Prolonged QRS >110 ms (n = 50)	p value
In-hospital mortality (Yes)	2 (4.00%)	5 (10.00%)	0.436
Cardiogenic shock (Yes)	9 (18.00%)	18 (36.00%)	0.07
I/V inotropes or vasopressor support (Yes)	9 (18.00%)	18 (36.00%)	0.07
Endotracheal intubation / mechanical ventilation (Yes)	2 (4.00%)	6 (12.00%)	0.269

Length of hospital stay (days), Mean ± SD	7.52 ± 5.686	10.66 ± 6.647	0.013
Development of significant arrhythmias			
Cardiac arrest	2 (4.00%)	5 (10.00%)	0.437
Ventricular tachycardia (VT)	1 (2.00%)	2 (4.00%)	
No significant arrhythmias	47 (94.00%)	43 (86.00%)	

DISCUSSION

The present study evaluated the association between prolonged QRS duration (>110 ms) and in-hospital outcomes among patients admitted with heart failure. Our findings demonstrate that patients with prolonged QRS duration had a higher frequency of adverse in-hospital outcomes, including in-hospital mortality, cardiogenic shock, need for inotropic/vasopressor support, endotracheal intubation/mechanical ventilation, significant arrhythmias and longer hospital stay compared with patients with normal QRS duration (≤110 ms). These findings suggest that QRS prolongation on admission ECG may serve as an important and easily obtainable prognostic marker in hospitalized heart failure patients.

In our study, the mean age of the patients was 59.27 ± 11.63 years, with a predominance of males (67%). Similar demographic patterns have been reported in cardiovascular disease studies in South Asia where male patients constitute a larger proportion of hospitalized cardiac cases. For example, Kashyapi et al. reported a predominance of male patients in studies evaluating ECG markers and short-term cardiac outcomes, highlighting the gender distribution commonly seen in regional cardiovascular populations [20]. Likewise, Rahman et al. observed that ECG parameters, including QRS duration, are frequently associated with more severe coronary disease among predominantly male patients with myocardial infarction [21].

Electrocardiographic markers have long been recognized as valuable tools for cardiovascular risk stratification. In our cohort, sinus rhythm was present in 93% of patients and the primary ECG parameter studied was QRS duration. Modern research has emphasized the growing importance of ECG-based parameters for predicting outcomes in cardiovascular disease. Sufian et al. highlighted that patterns identified in standard 12-lead ECG recordings can reflect underlying structural heart disease and help predict clinical outcomes using advanced analytical approaches [22]. Similarly, Patel and Bavaria demonstrated that ECG parameters are closely associated with adverse cardiac events during hospitalization, supporting the prognostic relevance of electrocardiographic markers in acute cardiovascular conditions [23].

Our results showed that in-hospital mortality was higher in the prolonged QRS group (10.00%) compared with the normal QRS group (4.00%), suggesting a potential relationship between ventricular conduction delay and adverse clinical outcomes. This observation aligns with findings from larger registry studies. Kronberg et al. reported that increased native QRS duration is associated with worse outcomes in patients with heart failure, particularly in those with impaired ventricular function [24]. Prolonged QRS duration reflects intraventricular conduction delay and mechanical dyssynchrony, which may lead to impaired cardiac efficiency and worse clinical outcomes.

In the present study, cardiogenic shock occurred in 36.00% of patients with prolonged QRS duration compared with 18.00% in those with normal QRS duration and the requirement for I/V inotropes or vasopressor support was also higher (36.00% vs 18.00%). These findings suggest that patients with conduction abnormalities may present with more severe hemodynamic compromise. Similar observations were reported by Wang et al., who demonstrated that changes in QRS duration were associated with alterations in left ventricular function and clinical severity in patients with acute cardiac conditions [25]. Additionally, Norvik et al. found that QRS duration may serve as an important biomarker for predicting immediate clinical outcomes in patients with critical cardiac events [26].

The present study also demonstrated that the mean length of hospital stay was longer in patients with prolonged QRS duration (10.66 ± 6.647 days) compared with those with normal QRS duration (7.52 ± 5.686 days). This suggests that conduction abnormalities may be associated with greater clinical complexity and prolonged hospitalization. Similar findings have been reported by Cui et al., who observed that QRS-related ECG markers can predict cardiovascular outcomes and disease severity among patients with acute decompensated heart failure [27]. Furthermore, analyses from the VICTORIA trial reported by Yogasundaram et al. demonstrated that baseline electrocardiographic measurements are strongly associated with clinical outcomes in high-risk heart failure patients [28].

Arrhythmic complications were also observed in our cohort. Cardiac arrest occurred in 10.00% of patients with prolonged QRS duration compared with 4.00% in those with normal QRS duration, while ventricular tachycardia occurred in 4.00% and 2.00% of patients respectively. These findings support the concept that ventricular conduction abnormalities may increase susceptibility to malignant arrhythmias. Similar associations between ECG markers and arrhythmic risk have been reported in other cardiovascular studies. Punkka et al. demonstrated that abnormalities in QRS electrical parameters are associated with increased mortality in patients with acute coronary syndromes [29].

LIMITATIONS

This study has several limitations. First, it was a single-center retrospective study, which may limit the generalizability of the findings to other populations or healthcare settings. Second, the sample size was relatively small (n = 100) due to the limited study period, which may reduce the statistical power to detect smaller differences between groups.

CONCLUSION

In conclusion, this study demonstrates that prolonged QRS duration (>110 ms) on admission ECG is associated with worse in-hospital outcomes among patients with heart failure. Patients with prolonged QRS duration showed higher rates of in-hospital mortality, cardiogenic shock, requirement of inotropic support, mechanical ventilation, significant arrhythmias and longer hospital stay compared with those with normal QRS duration. These findings suggest that QRS duration may serve as a simple, inexpensive and readily available ECG marker for early risk stratification in hospitalized heart failure patients, particularly in resource-limited tertiary care settings. Further large multicenter prospective studies are recommended to validate these findings and explore the prognostic significance of QRS duration in long-term outcomes.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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