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RESEARCH ARTICLE
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DIAGNOSTIC ACCURACY OF PROLONGED QRS COMPLEXES > 140MS ON ECG AS A PREDICTOR OF LEFT VENTRICULAR SYSTOLIC DYSFUNCTION KEEP ECHOCARDIOGRAPHY AS A GOLD STANDARD

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ABSTRACT:
Objective: This study aimed to evaluate the diagnostic accuracy of prolonged QRS duration (>140 ms) on electrocardiography (ECG) as a predictor of left ventricular systolic dysfunction (LVSD) in patients, using echocardiography as the gold standard for diagnosis.
Methodology: We assessed 120 patients aged 40 years and above. The patients were selected based on clinical suspicion of LVSD, and those with known valvular heart disease, significant arrhythmias, or previous interventions such as pacemakers were excluded. Each participant underwent a 12-lead ECG to measure QRS duration and an echocardiographic assessment to determine left ventricular ejection fraction (LVEF), with LVSD defined as LVEF < 50%. Prolonged QRS duration (>140 ms) was categorized as a positive criterion for predicting LVSD.
Results: Of the 120 participants, prolonged QRS duration (>140 ms) demonstrated sensitivity 78.8%, specificity 70.4% and diagnostic accuracy diagnostic accuracy 75.0% for predicting LVSD.
Conclusion: Prolonged QRS duration (>140 ms) on ECG can be considered a useful screening tool for identifying LVSD, although its specificity is moderate.

Keywords: QRS duration, left ventricular systolic dysfunction, electrocardiography, echocardiography, diagnostic accuracy

INTRODUCTION:

Heart failure (HF) impacts over 6 million individuals in the US, leading to more than 1 million inpatient stays annually. In individuals aged 65 and older, hospital admissions for heart failure as the primary diagnosis outnumber those for any other medical condition. HF is a serious condition that leads to considerable suffering and death, frequent hospitalizations, and high costs for society.[1-3] Left ventricular systolic dysfunction (LVSD) significantly raises the risk of developing heart failure by more than eight times and nearly doubles the likelihood of premature death.[4] Although timely diagnosis may significantly decrease this risk, individuals frequently receive a diagnosis only after the onset of symptomatic disease, primarily due to inadequate screening methods.[5, 6] The diagnosis typically depends on echocardiography, a specific imaging technique that requires significant resources to implement widely.[7-9]

Some patients with left bundle branch block exhibit no signs of cardiac disease upon clinical evaluation and echocardiography. It is projected that approximately 10% to 36% of patients with left bundle branch block might have LVSD.[10, 11] A number of investigations show that certain ECG parameters associated with left bundle branch block are connected to LV failure and poorer outcomes. Echocardiography is regarded as the benchmark for assessing functional heart issues.[12, 13] Some studies have shown that extended QRS duration in individuals with left bundle branch block could serve as a sign of LVSD.[14-16]

The diagnostic accuracy of prolonged QRS complexes (greater than 140ms) on an electrocardiogram (ECG) as a predictor of LVSD warrants investigation due to its potential for early detection and intervention. Considering the easy access and non-invasive characteristics of echo, discovering a significant link between extended QRS duration and LVSD might provide a practical and affordable method for early detection of patients susceptible to heart failure or other cardiovascular issues. This research focuses on assessing the sensitivity, specificity, and overall diagnostic precision of extended QRS complexes (>140ms) in forecasting LVSD, utilizing echocardiography as the benchmark for comparison.

METHODOLOGY:

The study was conducted as a cross-sectional observational analysis involving 120 patients aged 40 years and older at Cardiology Department of MTI-Mardan medical complex from April-2024 to October 2024. The participants were recruited based on specific inclusion criteria which focused on individuals with suspected left ventricular systolic dysfunction (LVSD). Exclusion criteria included patients with known valvular heart disease, significant arrhythmias, or previous interventions that could interfere with the assessment of left ventricular function, such as pacemakers.

Upon enrollment, all patients underwent electrocardiography (ECG) to assess QRS duration. The QRS duration was measured directly from the ECG readings, with a threshold of greater than 140 ms considered indicative of prolonged QRS duration. All participants also underwent echocardiography to evaluate left ventricular ejection fraction (LVEF), which served as the gold standard for diagnosing LVSD. The echocardiographic examination followed standard protocols, and an LVEF of less than 50% was considered diagnostic for LVSD.

The data collection process involved recording relevant demographic and clinical characteristics of the participants, including gender, presence of comorbidities such as hypertension and diabetes, and other risk factors. The QRS duration was categorized based on whether it exceeded 140 ms, and these measurements were cross-referenced with the echocardiographic results to identify those with LVSD.

For the statistical analysis, SPSS 24 was employed. Continuous variables were summarized using means and standard deviations while categorical variables were summarized using frequencies and percentages.

RESULTS:

The study included 120 patients, with mean age 52.7±4.7 years. Clinical characteristics included a mean left ventricular ejection fraction (LVEF) 40.4±6.3% and a mean body mass index (BMI) 25.3±2.2 kg/m².

Demographically, male participants predominated at 82 (68.3%), compared to 38 females (31.7%). A slight majority resided in urban areas (67, 55.8%), while 53 (44.2%) were from rural regions. Socioeconomic status varied, with 42 participants (35.0%) classified as lower class, 50 (41.7%) as middle class, and 28 (23.3%) as upper class. (Table 1)

Comorbidities were reported as follows: 26 participants (21.7%) had diabetes, while 94 (78.3%) did not. Hypertension was present in 50 (41.7%), absent in 70 (58.3%), and a family history of cardiovascular disease (CVD) was noted in 15 (12.5%) versus 105 (87.5%) without such history. (Table 2)

The diagnostic accuracy of prolonged QRS complexes (>140 ms) for predicting left ventricular systolic dysfunction (LVSD) on echocardiography demonstrated a sensitivity of 78.8% and

specificity of 70.4%. Positive and negative predictive values were 76.5% and 73.1%, respectively, with an overall diagnostic accuracy of 75.0%. Among 68 cases with prolonged QRS, 52 correlated with LVSD positivity, whereas 38 of 52 negative QRS cases aligned with absence of LVSD. These findings underscore the moderate clinical utility of QRS duration as a non-invasive marker for LVSD assessment. (Table 3)

Figure 1 Age distribution

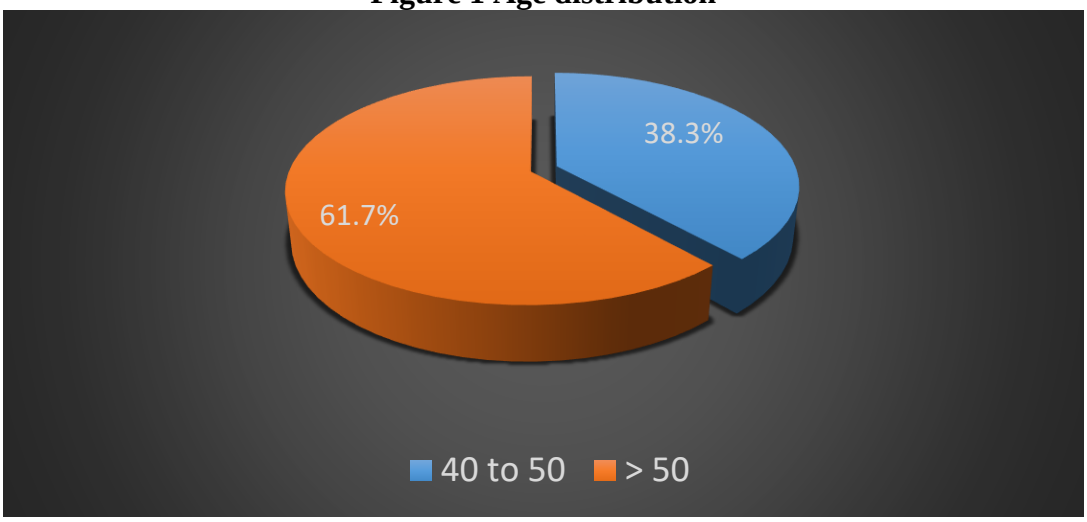

Table 1 Demographics

Demographics		N	%
Patient's Gender	Male	82	68.3%
	Female	38	31.7%
Residence status	Rural	53	44.2%
	Urban	67	55.8%
Socioeconomic status	Lower class	42	35.0%
	Middle class	50	41.7%
	Upper class	28	23.3%

Table 2 Comorbidities

Comorbidities		N	%
Diabetes	Yes	26	21.7%
	No	94	78.3%
Hypertension	Yes	50	41.7%
	No	70	58.3%
Family history of CVD	Yes	15	12.5%
	No	105	87.5%

Table 3 Diagnostic accuracy of prolonged QRS complexes > 140ms on ECG as a predictor of left ventricular systolic dysfunction

		LVSD on ECHO		Total
		Positive	Negative	
LVSD on ECG (QRS duration > 140ms)	Positive	52	16	68
		78.8%	29.6%	56.7%
	Negative	14	38	52
		21.2%	70.4%	43.3%
Total		66	54	120
		100.0%	100.0%	100.0%

Sensitivity:	78.79%
Specificity:	70.37%
Positive Predictive Value:	76.47%
Negative Predictive Value:	73.08%
Diagnostic accuracy:	75.00%

DISCUSSION:

The findings revealed significant insights into the potential utility of QRS duration as a non-invasive screening marker, particularly in clinical settings where echocardiography may not always be immediately available or feasible.

Our study included 120 participants with a mean age of 52.7 ± 4.7 years, where 68.3% of participants were male. The clinical characteristics showed that the average left ventricular ejection fraction (LVEF) was 40.4 ± 6.3%, which classifies the cohort as having mild to moderate LVSD. The results indicated that prolonged QRS duration, specifically those exceeding 140 ms, demonstrated a sensitivity of 78.8% and specificity of 70.4%. These values reflect the ability of prolonged QRS duration to detect LVSD, though not perfectly, given the moderate sensitivity and specificity.

The sensitivity of 78.8% in our study indicates that QRS duration >140 ms is useful for identifying the presence of LVSD, but there remains a 21.2% rate of false negatives. The specificity of 70.4% shows that while QRS prolongation can indicate LVSD, it is not highly specific, as 29.6% of patients with a prolonged QRS duration did not exhibit LVSD on echocardiography. These findings suggest that while prolonged QRS duration is a valuable diagnostic parameter, it should be used in conjunction with other clinical assessments, this resonates with a study by Ahmed et al., where a QRS duration >140 ms was found to have a sensitivity of 76.3% and specificity of 75.4% in predicting LVSD in patients with left bundle branch block (LBBB), reveals similar diagnostic accuracy.[17] This consistency underlines the importance of QRS duration as a relatively effective marker for LVSD, particularly in the presence of conduction abnormalities such as LBBB.

Moreover, the positive predictive value (PPV) in our study was 76.5%, indicating that most patients with a prolonged QRS duration and LVSD as confirmed by echocardiography truly had LVSD. The negative predictive value (NPV) of 73.1% suggests that a normal QRS duration is somewhat effective at excluding LVSD, but with some risk of false positives. This diagnostic utility for excluding LVSD with a normal QRS duration is consistent with the findings of van der Bijl et al., who observed that QRS duration is a significant predictor of left ventricular remodelling and function improvement in heart failure patients.[18]

However, despite these promising findings, it is essential to note the limitations of using QRS duration alone for diagnosing LVSD. Our study corroborates the notion that while prolonged QRS is a useful diagnostic tool, it should not replace echocardiography, which remains the gold standard for diagnosing systolic dysfunction. Prolonged QRS duration can also be influenced by a variety of other factors, including the morphology of the QRS complex (LBBB vs. non-LBBB), underlying comorbidities, and the severity of heart failure. For instance, studies like those of Hummel et al., have shown that prolonged QRS duration is independently associated with increased long-term mortality in patients with heart failure, further highlighting the prognostic value of this parameter.[19]

CONCLUSION:

In conclusion, our study underscores the moderate diagnostic utility of prolonged QRS duration (>140 ms) as a predictor of LVSD. While this ECG parameter shows promise, particularly in screening for LVSD in clinical settings, it should be used in combination with other diagnostic tools such as echocardiography to confirm the diagnosis and guide treatment decisions. Our findings are consistent with prior studies, validating the use of QRS duration in predicting LVSD, especially when integrated with clinical findings and other diagnostic modalities. Further studies with larger sample sizes and

more diverse populations are necessary to refine the diagnostic thresholds for QRS duration and enhance its clinical applicability.

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