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Keywords- Atrioventricular conduction; Idiopathic dilated cardiomyopathy; Left/right bundle branch block

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Abstract

Broad QRS and bundle-branch blocks are associated with poor outcomes in patients with DCM, however, studies on changes in QRS duration and morphology over long-term are limited. We retrospectively analyzed changes in ventricular activation and AV conduction in serial ECGs of 165 DCM patients with a follow-up of at least 5 years from 2003-2022. The mean QRS duration at the last follow-up was 114.2±29 vs 106.2±25.3 msec at the baseline($p<0.0001$). Individuals who showed ≥10msec increase in QRS duration also had a higher prevalence of ventricular conduction defects (68%).13.8% of patients developed broadening of QRS, with an LBBB pattern in over 50%.

Keywords: Atrioventricular conduction; Idiopathic dilated cardiomyopathy; Left/right bundle branch block

Introduction

Although ECG abnormalities are common in patients with idiopathic DCM, only a few studies have looked at serial changes on long-term follow-up.[1-4] There is little information on the progression of disturbances of ventricular activation and AV conduction on ventricular systolic function. This study aimed to correlate these ECG abnormalities with echocardiography to shed light on the natural history of DCM, identify simple markers of increased mortality, and characterize patients who develop QRS prolongation during follow-up.

Methods

This was an observational study of 165 consecutive patients of DCM (2003 –2022) with a minimum follow-up of 5 years. The protocol was per the Helsinki Convention and was approved by the institute's ethics committee. Successive ECGs of patients were manually validated and analyzed for rhythm, conduction anomalies (according to the ACC/AHA recommendations for standardization and interpretation of intra-ventricular conduction disturbances), QRS duration (manually calculated using the EP Callipers app (version 3.7.0, Copyright 2015-2022 EP Studios, Inc.)), and morphology.[5] Patients with CIED or any of the following—electrolyte disturbances, post CPR status, ACS, or rate dependent-BBB were excluded. A global quantitative estimation of LV function was performed using Simpson's technique.

Results

The study cohort consisted of 165 patients with a mean age of 41.5 ± 13.52 years and a mean TDF of 9.30 years ± 3.29. 45.5% were females. Majority of the patients were on GDMT (beta-blockers-100%, ACEI/ ARB-100%, ARNI-16.4%, MRA- 99.4%, ivabradine-2.4% and SGLT-2i- 29.1%). Although the rhythm, AV conduction, and QRS morphology disturbances in ECG were numerically higher during follow-up(T1) compared to baseline(T0), the difference failed to reach the level of significance(Table 1). Mean QRS duration at the last follow-up was 114.2±29 vs 106.2±25.3 msec at the baseline($p<0.0001$)(Table 2). 28.2% showed ≥10msec increase in QRS duration and had a higher prevalence of ventricular conduction defects (68%)(Fig.1). 13.8% of them developed broadening of QRS, with an LBBB pattern in over 50%. None of the patients with a complete BBB had a resolution of their conduction defects with time.

The mean QRS durations of patients with a baseline QRS ≤120ms and those with ≥120ms were 88.41±10.62ms and 132.65±13.58ms, respectively. The mean QRS durations at follow-up in these groups were 95.8±12.09 and 149.3±18.7, respectively. This difference was significant($p<0.0001$). The difference in the absolute value of LVEF (%) at follow-up among these groups was also significant (37.1% ± 14.06 vs 28.4% ± 10.1, 95%, $p<0.0001$) demonstrating a negative poor correlation seen between means QRS duration and mean LVEF.

Predictors of QRS widening were increasing age (p =0.0006), DM (p =0.05), and poor LVEF (p <0.0001).

Discussion

This was a single-center observational study conducted in 165 patients with DCM with a mean follow of 9.30 ± 3.29 years, to assess the progressive changes in ventricular activation and AV conduction on ECG and their potential impact on LV systolic function assessed by 2D echo. To the best of our knowledge, our study cohort was younger, and the duration of follow-up was longer than that of the present literature. Also, all our patients were receiving GDMT.

Development of conduction disturbances in patients on GDMT carries a worse prognosis. Higher SD/MVAs and mortality rates are observed in these subsets of patients, especially with fresh LBBB, which hints towards the possibility that early CRT-D implantation (3–9 months following optimal medical therapy) could improve these patients' prognoses.

The study was limited by its retrospective design and small cohort size. The patients themselves were carefully chosen since they were referred to and monitored at a tertiary facility. The majority of the patients in this patient cohort were stable. We did not establish a correlation between the progression of HF, the degree of interstitial myocardial fibrosis, cardiac mortality and QRS prolongation, conduction irregularity, LVID in diastole, moderate or severe MR or TR.

Conclusion

Significant QRS prolongation and development of new onset LBBB can be seen in patients with DCM on long term follow up. Thus, patients who did not meet the QRS duration criteria for CRT at the first visit may do so at follow-up.

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Abbreviations

ACC/AHA- American College of Cardiology and American Heart Association
ACEi- Angiotensin-Converting Enzyme Inhibitors
AFib- Atrial fibrillation
ARB- Angiotensin II Receptor Blockers
ARNI- Angiotensin receptor neprilysin inhibitor
AV- Atrio Ventricular
BBB- Bundle branch block
CHB- Complete Heart Block
CIED- Cardiac Implantable Electronic Device
CRT- Cardiac Resynchronization Therapy
DCM- Dilated Cardiomyopathy
DM- Diabetes Mellitus
ECG- Electrocardiography
GDMT- Guideline Directed Medical Therapy
HF- Heart Failure
HTN- Hypertension
ICD- Implantable Cardioverter Defibrillator
IVCD- Intraventricular Conduction Defects
LAHB- Left Anterior Hemi Block
LBBB- Left Bundle Branch Block

LPHB- Left Posterior Hemi Block

LV- Left ventricle

LVEF- Left Ventricular Ejection Fraction

LVID- Left Ventricular Internal Diameter

MR- Mitral Regurgitation

MRA- Mineralocorticoid Receptor Antagonist

MVA- Malignant Ventricular Arrhythmia

NSR- Normal Sinus Rhythm

PPI- Permanent Pacemaker Implantation

RBBB- Right Bundle Branch Block

SD- Sudden Death

SGLT2i- Sodium-Glucose Cotransporter-2 inhibitor

SSS- Sick Sinus Syndrome

TDF- Total Duration of Follow-Up

TR- Tricuspid Regurgitation

T0- Baseline

T1- Follow-up

2 D- 2 Dimensional

Table1: Rhythm, AV conduction, QRS morphology at baseline (T0) and follow-up (T1)

	T0 (n=165)		T1 (n=165)		p value*
	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	
Rhythm					
NSR	152	92.1	140	84.8	0.405
AFib	11	6.7	19	11.5	
Paced (PPI,CRT)	2	1.2	6	3.6	
AV conduction block					
Normal	150	90.9	138	83.6	0.180
First degree	12	7.3	17	10.3	
CHB	3	1.8	9	5.5	
SSS	0	0	1	0.6	
QRS morphology					
Normal	98	59.4	82	49.7	0.654
IVCD	13	7.9	14	8.5	
LAHB	9	5.5	13	7.9	
LPHB	2	1.2	5	3.0	
RBBB	2	1.2	3	1.8	
LBBB	37	22.4	46	27.9	

Bi/Tri-fascicular block	4	2.4	2	1.2	

*Chi-square test, the level of significance set at $p < 0.05$

AFib- Atrial Fibrillation; AV-Atrio Ventricular; CHB- Complete Heart Block; CRT- Cardiac Resynchronization Therapy; IVCD- Intra Ventricular Conduction Defect; LAHB- Left Anterior Hemi Block; LBBB- Left Bundle Branch Block; LPHB- Left Posterior Hemi Block; NSR- Normal Sinus Rhythm: PPI- Permanent Pacemaker Implantation; RBBB- Right Bundle Branch Block; SSS- Sick Sinus Syndrome; T0- Baseline; T1- Follow-Up

Table2: Comparison of Mean QRS duration at baseline(T0) and follow-up(T1) in patients with idiopathic DCM

Leads	Visits	N	Mean QRS duration	Standard Deviation	Mean difference	p-value*
V1/V2	T0	156	108.39	25.40	8.60	***0.001***
	T1	156	116.99	29.57		
V5/V6	T0	156	106.74	25.52	7.75	***0.001***
	T1	156	114.49	30.08		
Lead II	T0	156	105.29	25.40	8.12	***0.001***
	T1	156	113.42	29.57		
Lead I	T0	156	104.26	25.41	7.48	***0.001***
	T1	156	111.74	29.75		
Mean QRS duration (Average of all 4 leads)	T0	156	106.17	25.26	7.99	***0.001***
	T1	156	114.16	29.57		

*Paired t-test, the level of significance set at $p < 0.05$

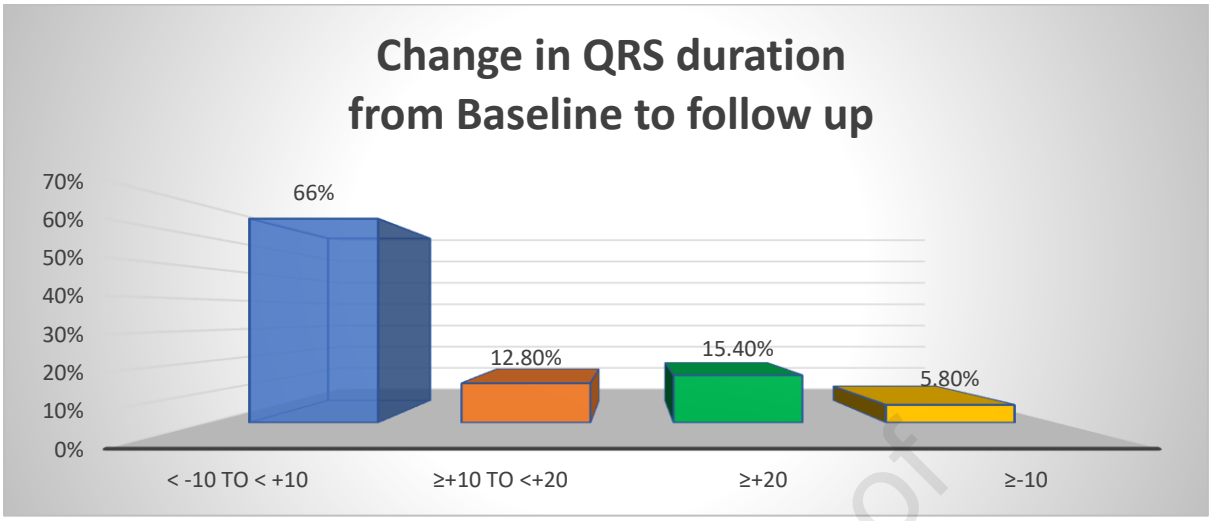

Figure 1: Distribution of patients according to change in mean QRS duration from baseline to follow-up, X-axis denotes change in QRS duration, Y-axis represents percentage of patients

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: