Indian Heart Journal 73 (2021) 664–666

Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Short Communication

Relationship of echocardiographic left ventricular dyssynchrony with QRS width on surface electrocardiogram in patients with systolic heart failure: An observational study

Shabbir Ali Shaik, Sai Satish Oruganti*

Department of Cardiology, Nizam's Institute of Medical Sciences, Punjagutta, Hyderabad, 500082, Telangana, India

ARTICLE INFO

Article history:
Received 14 December 2020
Received in revised form
22 July 2021
Accepted 4 August 2021
Available online 10 August 2021

Keywords:
Intraventricular conduction delay(IVCD)
Electrocardiogram (ECG)
Left ventricle
Ejection fraction (LVEF)
Heart Failure (HF)
Left bundle branch block (LBBB)

ABSTRACT

This study aimed to evaluate left ventricular dyssynchrony with QRS width on ECG in patients with systolic heart failure. 100 study patients were classified into two groups. Narrow QRS group-N- QRS (80-119 msec) and Wide QRS group-W- QRS (120-160 msec). Out of each 50 patients in W- QRS group, 38(76%) had LV dyssynchrony and 18 (36%) in N- QRS group had ventricular dyssynchrony. Dyssynchrony in narrow QRS patients with heart failure also needs attention as a therapeutic target in future studies.

1. Introduction

Left bundle branch block (LBBB), with wide QRS on ECG, is the most common cause of ventricular dyssynchrony in 30 %–50 % of patients with systolic heart failure (HF).[1] Ventricular dyssynchrony is also seen in patients with narrow QRS complex. In this study, we have assessed the relationship between echocardiographic LV dyssynchrony and QRS width on surface ECG.

2. Aims & objectives

To determine the echocardiographic left ventricular dyssynchrony and correlation with QRS width on surface ECG in patients with systolic HF.

3. Methods

100 patients with symptomatic HF of NYHA functional class II-IV in sinus rhythm and LVEF 40 % or less were included and 12-lead electrocardiogram was obtained. Left ventricular end systolic, end diastolic diameters, ejection fraction were assessed by 2D-Echo. Intraventricular dyssynchrony was measured by taking maximum delay between peak systolic velocities among the basal lateral and basal septal regions and the basal anterior and basal inferior regions and interventricular dyssynchrony by measuring the time delay between the onset of flow in the right and left ventricular outflow tracts using Pulse wave Doppler velocities. Patients were classified into two groups. Narrow QRS group-N- QRS (80–119 msec) and Wide QRS group-W- QRS (120–160msec).

4. Results

The mean age was 58.18 ± 10.41 years, ranging from 31 to 84 years. The clinical and demographic features depicted in Table- 1. The duration of heart failure ranged from 3 months to 7 years with mean of 2.54 ± 1.57 years. Majority were in NYHA functional class IV (52 %) and class III (45 %) respectively. 50 patients each were enrolled in W and N – QRS groups. The most common QRS morphology noted in W- QRS group was LBBB and in N- QRS group was intra ventricular conduction delay(IVCD) (Table- 2). The baseline echocardiogarphic parameters were shown in Table- 3. LV dyssynchrony by M-mode was noted in 38 (76 %) in W- QRS group and 18(36 %) in N- QRS group. The mean septal to posterior wall

* Corresponding author.
E-mail address: osaisatish@yahoo.com (S.S. Oruganti).

https://doi.org/10.1016/j.ihj.2021.08.004

Table 1
Clinical and demographic features of the study population.

Clinical and demographic factors	Group-W QRS (120–160) ms N = 50	Group-N QRS (80–119) ms N = 50	p-value
Age(years)	56+_ 4	57+_3	0.1605
NYHA CLASS II	2(4 %)	1(2 %)	1
CLASS III	20(40 %)	25(50 %)	0.421
CLASSIV	28(56 %)	24(48 %)	0.548
Diabetes	20(40 %)	23(46 %)	0.686
Hypertension	12(24 %)	15(30 %)	0.247
H/O Myocardial infarction	11(22 %)	10(20 %)	1
H/O PCI	11(22 %)	12(24 %)	0.813
H/O CABG	5(10 %)	7(14 %)	0.758
NSVT ON HOLTER	12(24 %)	11(22 %)	1
H/O VT	5(10 %)	3(6 %)	0.712

Table 2
Electrocardiographic features of patients with heart failure.

ECG parameter	Group-W QRS (120–160msec) (N = 50)	Group-N QRS (80–119 msec) (N = 50)
Mean QRS duration	146.2 ± 10.27 msec	97.8 ± 12.5 msec
LBBB morphology (complete/incomplete)	42(84 %)	15(30 %)
IVCD	5(10 %)	25(50 %)
QRBBB morphology	3(9 %)	10(20 %)
Mean QRS axis	−40.23 ± 15.23°	+96.4 ± 10.53°

Table 3
Echocardiographic parameters among patients with heart failure.

	Group-W QRS(120–160msec) (N = 50)	Group-N QRS (80–119 msec) (N = 50)	P-Value
2-D echo LVEF (teichholz's method)	32.13 ± 4.62 %	33.2 ± 3.22 %	0.1822
2-D echo LVEDD	5.777 ± 0.66 cm	5.54 ± 1.02 cm	0.1721
2-D echo LVESD	4.92 ± 0.62 cm	4.77 ± 0.86 cm	0.3196
2-D echo LA size	3.657 ± 0.51 cm	3.42 ± 0.68 cm	0.0515
2-D echo peak TR jet velocity	2.598 ± 0.67 m/sec	2.34 ± 0.48 m/sec	0.0292
2-D echo Pulmonary artery systolic pressure	40.46 ± 11.91 mmHg	36.46 ± 8.05 mmHg	0.0519

motion delay measured by M-mode in W- QRS group was 180 ± 35 msec where as in N- QRS group was 70 ± 16 msec, septal to lateral wall delay was 74 ± 16 msec and 51 ± 8 msec and interventricular delay was 79 ± 11msec and 30 ± 5 msec in W-QRS and N- QRS groups respectively (Table- 4). The number of patients with LV dyssynchrony on M-mode, tissue Doppler and Pulse wave Doppler in each group was shown in Table- 5. The results showed significant LV dyssynchrony on echocardiography in two thirds of W-QRS group and one third of N-QRS Group (Fig. 1).

5. Discussion

QRS duration may not always be related to mechanical dyssynchrony and baseline QRS duration alone is not the best predictor of response to CRT. In our study the LV dyssynchrony was seen in 66 % (76 % of wide QRS group and 36 % of narrow QRS group) of HF patients. Up to 30 % of HF patients with normal QRS duration may have significant mechanical dyssynchrony, conversely 20 %–30 % of HF patients with wide QRS duration may not have mechanical dyssynchrony.[2] Nelson et al, studied in 22 patients with dilated cardiomyopathy either wide (>120 ms) or narrow QRS (≤120 ms) with LV pacing induced change in QRS duration and found no

Table 4
Echocardiographic parameters of LV dyssynchrony using M-mode, Pulse wave,. Doppler and Tissue Doppler imaging (TDI).

Echocardiographic parameters	Group-W QRS (120–160) msec	Group-N QRS (80–119) msec
Onset of QRS to maximum of septal motion on M– mode	110 ± 30	40 ± 11
Onset of QRS to maximum of posterior wall motion on M-mode	300 ± 12	110 ± 15
Difference of two M-mode motions	180 ± 35	70 ± 16
Onset of QRS to peak of basal septal velocity	60 ± 10	140 ± 6
Onset of QRS to peak of basal lateral wall velocity	145 ± 9	190 ± 12
Difference of two TDI	74 ± 16	51 ± 8
Onset of QRS to peak of basal anterior wall velocity	105 ± 11	170 ± 12
Onset of QRS to peak of basal inferior wall velocity	70 ± 16	122 ± 10
Difference of two TDI	85 ± 12	48 ± 7
Left ventricular pre ejection period (Aortic PEP)	90 ± 15	53 ± 12
Right ventricular pre ejection period (Pulmonary PEP)	65 ± 10	24 ± 6
Difference of two PW Doppler velocities	79 ± 11	30 ± 5
Mean diastolic filling period for A-V delay	34 ± 8(%)	50 ± 7(%)

Table 5
Total number of patients with LV dyssynchrony on M-mode, Tissue Doppler Imaging(TDI) and Pulse wave Doppler in each group.

Echocardiographic parameters	Group-W QRS (120–160) ms	Group-N QRS (80–119) ms	Total (n = 10)	P-value
Difference of M-mode motion of septum to posterior wall < 130	12(24 %)	32(64 %)	44(44 %)	0.005
130 and above	38(76 %)	18(36 %)	56(56 %)	
Difference of TDI values between basal septal and lateral wall velocities < 65	20(40 %)	40(80 %)	60(60 %)	0.004
65 and above	30(60 %)	10(20 %)	40(40 %)	
Difference of TDI values between basal anterior and inferior wall velocities < 65	15(30 %)	37(64 %)	52(52 %)	<0.001
65 and above	35(70 %)	13(26 %)	48(48 %)	
Difference in aortic pre-ejection period and pulmonary pre-ejection period <40 ms	18(36 %)	38(76 %)	56(56 %)	0.005
40 ms and above	32(64 %)	12(24 %)	44(44 %)	
Diastolic filling period (atrio-ventricular delay) < 40 % and below	41(82 %)	16(32 %)	57(57 %)	<0.001
>40 %	9(18 %)	34(78 %)	43(43 %)	

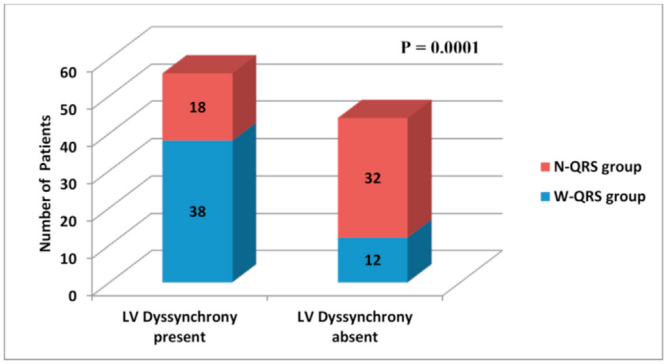

Fig. 1. Incidence of LV dyssynchrony on M mode echocardiography among patients with heart failure.

correlation between QRS width with hemodynamic response.[3] Therefore, QRS duration is not closely related to mechanical dyssynchrony, and baseline QRS duration is not the best predictor of response to CRT.[4,5] In our study the most common QRS morphology was LBBB in W-QRS group and IVCD in the N-QRS group. Linde C et al demonstrated favorable one year results in exercise tolerance, quality of life and decrease in HF related hospitalisation by CRT in patients with severe HF and IVCD.[6]

In our study apart from W-QRS group, significant LV dyssynchrony was also seen in about one third of N-QRS group, but further studies are needed to target its correction as a treatment modality.

6. Conclusions

In patients with systolic heart failure, dyssynchrony is significantly more common in those with a wide QRS. However, about one-third of those with a NQRS (especially with IVCD and QRBBB) do have echocardiographic dyssynchrony as noted in our study and this may be a therapeutic target for future studies.

7. Limitations

Small sample size.

References

1. Kashani A, Barold SS. Significance of QRS complex duration in patients with heart failure. *J Am Coll Cardiol*. 2005;46:2183–2192.
2. Bleeker GB, Schalij MJ, Molhoek SG, et al. Relationship between QRS duration and left ventricular dyssynchrony in patients with end-stage heart failure. *J Cardiovasc Electrophysiol*. 2004;15:544–549.
3. Nelson GS, Curry CW, Wyman BT, et al. Predictors of systolic augmentation from left ventricular preexcitation in patients with dilated cardiomyopathy and intraventricular conduction delay. *Circulation*. 2000;101:2703–2709.
4. Saxon LA, Ellenbogen KA. Resynchronization therapy for the treatment of heart failure. *Circulation*. 2003;108:1044–1048.
5. Bax JJ, Marwick TH, Molhoek SG, et al. Left ventricular dyssynchrony predicts benefit of cardiac resynchronization therapy in patients with end-stage heart failure before pacemaker implantation. *Am J Cardiol*. 2003;92:1238–1240.
6. Linde C, Leclercq C, Rex S, et al. Long-term benefits of biventricular pacing in congestive heart failure: results from the MUltisite Stimulation in cardiomyopathy (MUSTIC) study. *J Am Coll Cardiol*. 2002;40:111–118.