Journal of Clinical and Medical Images

ISSN: 2640-9615

Research Article

Fragmented QRS Complex is associated with the Left Ventricular Remodeling in Patients with ST-Elevation Acute Myocardial Infarction

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Volume 3 Issue 5- 2020

Received Date: 03 Feb 2020

Accepted Date: 02 Mar 2020

Published Date: 06 Mar 2020

2. Keywords

Acute myocardial infarction; Fragmented QRS; Three-dimensional echocardiography; Left ventricular remodeling

1. Abstract

1.1. Objective: To investigate the relationship between fQRS and the left ventricular remodeling in patients with ST-elevation AMI in short-term and long-term period

1.2. Methods: A total of 140 patients with AMI were enrolled. Accoridng to the presence of fQRS in presenting electrocardiogram. The patients were divided into fQRS group and Non-fQRS group. Real-time three-dimensional echocardiograph parameters measured in-hospital and 6-month follow-up period were collected. The difference between two groups and the influencing factors of left ventricular remodeling were analyzed.

1.3. Results: LVESV was significantly higher and LVEF was significantly lower in short-term after PCI in fQRS group (P<0.01). There was no significant differences in LVEDV.Tmsv16-SD (ms),Tmsv16-SD (%), Tmsv 16-Dif (ms) and Tmsv 16-Dif (%) in fQRS group were significantly higher than those in Non-fQRS group (*P*<0.01). There were no significant differences in Tmsv 12-SD (ms), Tmsv 12-SD (%), Tmsv 6-SD (ms), Tmsv 6-SD (%), Tmsv 12-Dif (ms), Tmsv 12-Dif (%), Tmsv 6-Dif (ms) and Tmsv 6-Dif (%) between two groups. LVESV was significantly higher LVEF was significantly lower in long-term after PCIin fQRS group (P<0.01). There was no significant difference in LVEDV. Tmsv16-SD (%) and Tmsv 16-Dif (%) in fQRS group were significantly higher than those in Non-fQRS group (*P*<0.05), but no significant differences in Tmsv16-SD (ms), Tmsv 12-SD (ms), Tmsv 12-SD (%), Tmsv 6-SD (ms), Tmsv 6-SD (%), Tmsv 16-Dif (ms), Tmsv 12-Dif (ms), Tmsv 12-Dif (%), Tmsv 6-Dif (ms) and Tmsv 6-Dif (%) between two groups.

1.4. Conclusion: Left ventricular remodeling is more obvious in patients with AMI complicated with fQRS in short-term and long-term period.

3. Introduction

Acute myocardial infarction (AMI) is the disease with the highest mortality among cardiovascular diseases [1]. Electrocardiogram (ECG) plays a crucial role in the diagnosis and prognosis of acute myocardial infarction. Currently, there are multiple ECG parameters available to assess the prognosis of patients with acute myocardial infarction. Fragmented QRS (fQRS) is a new electrocardiographic marker associated with abnormal conduction caused by myocardial scarring or myocardial necrosis as well as conduction delay peripheral to the infarct area [2]. A meta-analysis [3] investigated the association between fQRS and nosocomial and long-term cardiovascular events in patients with acute myocardial infarction. The results showed no difference in the frequency of fQRS between STEMI and NSTEMI patients. fQRS was associated with multivessel disease and low ejection fraction, and in addition, fQRS was also associated with hospital mortality and long-term mortality and MACE events. Myocardial remodeling is an important phase of the development of acute myocardial infarction. It refers to the process of changes in myocardial size, shape and tissue structure resulting from myocardial injury or increased load, which may

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Citation: Yanmin Xu, Fragmented QRS Complex is associated with the Left Ventricular Remodeling in Patients with ST-Elevation Acute Myocardial Infarction. Journal of Clinical and Medical Images. 2020; V3(5): 1-8.

lead to cardiac dysfunction. At present, there have been few studies on fQRS and left ventricular remodeling in patients with acute myocardial infarction. The present study was intended to investigate the relationship between fQRS and short-term and long-term left ventricular remodeling and cardiac function in patients with acute myocardial infarction following PCI and to clarify the changes in functional structure and function so that early intervention and treatment may be administered and patient's prognosis may be improved.

4. Materials and Methods

4.1. Subjects

4.1.1. Study Population: The patients with the diagnosis of acute myocardial infarction confirmed at the Second Hospital of Tianjin Medical University from Feb. 2017 to Aug. 2017 and treated with percutaneous coronary intervention (PCI) were recruited, and 70 patients with positive fQRS wave and 70 patients with negative fQRS wave were included based on the matching principle in sex, hypertension level, diabetes status and disease course. There were 90 men and 50 women, with a mean age of 62.3±8.9 years.

4.1.2. Inclusion Criteria: Acute myocardial infarction was diagnosed based on the patient's symptoms, ECG findings, myocardial injury markers, cardiac catheterization and related clinical data, in accordance with the *Guidelines for the Diagnosis and Treatment of Acute ST-Segment Elevation Myocardial Infarction* (2015). Patients showed consent to three-dimensional cardiac ultrasound during the hospitalization period (near-term visit after the PCI) and at six months after the PCI (long-term visit after the PCI).

4.1.3. Exclusion Criteria: Patients with severe congenital heart disease; Severe valvular heart disease; Patients at the status post pacemaker implantation; Cardiomyopathy, Myocarditis, Pericarditis, etc; Patients with bundle branch block and pre-excitation syndrome; Other serious organ Insufficiency, such as cancer and liver and kidney dysfunction; Patients who died within 24 hours after the admission; Patients who were lost to follow-up were ruled out.

4.2. Study methods

4.2.1. Population Baseline Data: Based on the patient's medical history, the patient's following basic information was collected after the admission: age, sex, history of hypertension, history of diabetes, history of smoking, and time from admission to balloon dilation (D to B).

4.2.2. Laboratory Indicators: Troponin I (cTnI), creatine kinase (CK), creatine kinase isoenzyme (CK-MB), total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C) high-density lipoprotein cholesterol (HDL-D), and high-sensitivity C-reactive protein (hs-CRP) were collected after the admission 24 hours.

4.2.3. Coronary Arteriography Results: The results of coronary angiography were evaluated by two interventional cardiologists. The coronary angiography or PCI surgery was performed via the radial or femoral artery. Based on the coronary segmentation defined by the American College of Cardiology (ACC) and the American Heart Association (AHA), each coronary artery was divided into proximal, middle, and distal segments[15, 16], and the left main narrowing by over 50%, and narrowing of remaining coronary arteries by greater than 70% were considered to be significant stenosis. Formula for Gensini's score calculation: total score per patient = total score of all lesions × total score of stenosis severity. The Gensini scores were independently interpreted by two experienced interventional cardiologists.

4.2.4. Definition of fQRS in ECG: The electrocardiograms (0.5-100 Hz, 25 mm/s, 10 mm/mV) of all patients at admission were collected and the patients were divided into fQRS group and Non-fQRS group according to the presence or absence of fQRS. Definition of fQRS [17] at least 2 leads were of RSR' pattern (the presence of >2 notches on the R wave or the S wave) and no concurrent bundle branch block, with or without Q wave; fQRS often appears in two or more leads corresponding to the coronary blood supply area.

4.2.5. Three-Dimensional Echocardiography Image Collection and Analysis: The patients were asked to lie at the left lateral recumbent position and were connected with the chest lead ECG, and the electrocardiogram was recorded simultaneously. The cardiac sections were conventionally recorded using the X5-1 cardiac ultrasound probe, and the direction of the sound velocity was carefully adjusted on the apical four-chamber view to achieve optimal display of the image of the four-chamber heart. The image sharpness was adjusted, and the full-volume three-dimensional images obtained during four consecutive cardiac cycles at a steady state of the heart rhythm were captured, recorded and stored in the magneto-optical disc for offline analysis. The full-volume 3D images were quantitatively analyzed using the 3DQ advanced plug-in. The plug-in automatically generated the apical four-chamber, two-chamber, left-chamber short-axis views as well as the pyramid-shaped full-volume three-dimensional images, followed by the adjustment to the position of each reference line to make the intima image clear. The apical four-chamber and apical two-chamber views

captured during the end-diastolic and end-systolic phases were selected among the images captured during consecutive cardiac cycles, and two sampling points were selected on the left ventricular endocardial surface of the standard apical four-chamber view: ventricular septum (S), and lateral wall (L); two sampling points were selected on the left ventricular endocardial surface of the standard apical two-chamber view: anterior wall (A) and inferior wall (I). Then the cardiac apex of one of the aforementioned standard sections was chosen, the software would automatically outline three-dimensional endocardial contour for a frame-by-frame sequence analysis. At the end of the sequence analysis, 17 volume segments of the left ventricle, the left ventricular volume-time curve (VTC) of 17 segments and the time-displacement bull's eye view were automatically obtained.

4.2.6 Predictors of Cardiac Ultrasonography: Overallsystolic function of the heart: left ventricular end-diastolic volume (LVEDV), left ventricular end-systolic volume (LVESV), left ventricular ejection fraction (LVEF). Predictors of left ventricular systolic synchrony: the standard deviation of time to reach minimum systolic volume for 16 left ventricular segments (Tmsv16-SD): 6 basal segments, 6 intermediate segments, and 4 apical segments; the standard deviation of time to reach the minimum systolic volume for the 12 left ventricular segments (Tmsv12-SD): 6 basal segments, 6 intermediate segments; the standard deviation of time to reach the minimum systolic volume for 6 left ventricular segments (Tmsv6-SD): 6 basal segments; 6 basal segments; maximum difference of the time to reach the minimum systolic volume for 16 left ventricular segments (Tmsv16-Dif): 6 basal segments, 6 intermediate segments and 4 apical segments; the maximum difference of time to reach systolic volume for 12 left ventricular segments (Tmsv12-Dif): 6 basal segments and 6 intermediate segments; the maximal difference of the time to reach minimum systolic volume for 6 left ventricular segments (Tmsv6-Dif): 6 basal segments. In order to eliminate the influence of the heart rate in patients, the Tmsv n-SD and Tmsv n-Dif predictors of the corresponding myocardial segment were divided by the duration of one cardiac cycle (RR interval) to obtain the corrected percentage indicators: Tmsv16-SD%, Tmsv12-SD%, Tmsv6-SD%; Tmsv16-DIF%, Tmsv12-DIF%, Tmsv6-DIF%.

4.2.7. Statistical Methods: A statistical analysis was performed using the SPSS 19.0 software package. The normally distributed measurement data was expressed as mean±standard deviation and the t-test was used for comparison between groups. The non-normally distributed measurement data was expressed as median (P25, P75), and the rank sum test was used for comparison between groups. The count data was expressed as a percentage, and the chi-square test was used for comparison between groups. Logistic regression analysis was performed to investigate the factors affecting left ventricular remodeling and cardiac function, and when $p < 0.05$, the finding is considered statistically significant.

4.3. Study Results

4.3.1 Comparison of Baseline Data in the Two Groups: There were no significant differences in clinical data such as age, gender, smoking history, hypertension, diabetes, and D-to-B time between the fQRS group and the Non-fQRS group. The intergroup differences in laboratory indicators such as CTnI, CK-MB, CK, TG, TC, LDL-C, HDL-C, and Hs-CRP were not statistically significant. The intergroup differences in the Gensini score for coronary angiography results were not statistically significant (Table 1).

4.3.2. Comparison of Short-Term Results of Three-Dimensional Echocardiography between Two Group: Overall functional evaluation of the heart: the predictors of LVEDV, LVESV, LVEF and so on were obtained by using the real-time three-dimensional echocardiography (RT-3D) to trace the endocardium and they were indicative of the overall function of the heart. The non-fQRS group had lower left ventricular end-systolic volume (LVESV) and left ventricular ejection fraction (LVEF) than the non-fQRS group, showing statistically significant differences ($P<0.01$), and the difference from the comparison in left ventricular end-diastolic volume (LVEDV) was not statistically significant (Table 2).

Evaluation of left ventricular systolic synchrony: the predictors of left ventricular systolic synchrony were obtained by RT-3D technique, and the results showed that, the fQRS group had significantly increased Tmsv 16-SD (ms), Tmsv 16-SD (%), Tmsv 16-Dif (ms) and Tmsv 16-Dif (%) than the Non-fQRS group, showing statistically significant differences ($P<0.01$), and the differences from the intergroup comparison in the remaining predictors were not statistically significant: Tmsv 12-SD (ms), Tmsv 12-SD (%), Tmsv 6-SD (ms), Tmsv 6-SD (%), Tmsv 12-Dif (ms), Tmsv 12-Dif (%), Tmsv 6-Dif (ms), and Tmsv 6-Dif (%) (Table3).

4.3.3. Comparison of Long-Term Results of Three-Dimensional Echocardiography between Two Group: Overall functional evaluation of the heart: The fQRS group had lower left ventricular end-systolic volume (LVESV) and left ventricular ejection fraction (LVEF) than the non-fQRS group, showing statistically significant differences ($P<0.01$), and the difference from the comparison in left ventricular end-diastolic volume (LVEDV) was not statistically

significant (Table 4).

Evaluation of left ventricular systolic synchrony: the fQRS group had significantly increased Tmsv 16-SD (%) and Tmsv 16-Dif (ms) than the Non-fQRS group, showing statistically significant differences (P<0.05), and the differences from the intergroup comparison in the remaining predictors were not statistically significant: Tmsv 12-SD (ms), Tmsv 12-SD (%), Tmsv 6-SD (ms), Tmsv 6-SD (%), Tmsv 16-Dif (ms), Tmsv 12-Dif (ms), Tmsv 12-Dif (%), Tmsv 6-Dif (ms) and Tmsv 6-Dif (%) (Table5).

Table 1: Comparison of baseline data between fQRS group and Non-fQRS group

	fQRS group (n+20)	Non-fQRS group (n=20)	t	p
Age(y)	60.9±10.363	7±7.40.984		.25
Hypertension(%)	8	13	2.51	.06
Diabetes mellitus (%)	4	4	0.00	.15
cTnI(ng/ml)	11.0± 3.8	7.0±23.1	1.18	.08
CK-MB(U/L)	96.2±70.462	3±42.6	1.85	.06
TC(mmol/L)	4.6±0.94	5±1.0	0.50	.15
TG(mmol/L)	1.8±0.81	7±0.9	1.70	.32
LDL-C(mmol/L)	3.0±0.72	8±0.7	0.70	.45
Hs-CRP(mg/L)	6.6=4.14	7=3.2	0.08	1.24
D to B(min)	46.6±29.553	4±28.1	0.07	1.22
Gensini score(point)	64.5±32.251	7±27.2	1.36	.08

Table 2: Comparison of the short-term left ventricular systolic synchrony between fQRS group and Non-fQRS group

	fQRS group	Non-fQRS group	t	p
Tmsv16-SDms)	82.0 ±47.725	0 1±9.04	.044**	0.001
Tmsv16-SD (%)	9.5 ±4.92	6 ±2.24	.408**	0.001
Tmsv12-SD(ms)	30.5 ±19.524	0 1±2.01	.031	0.68
Tmsv12-SD (%)	3.3± 1.9	2.4± 1.4	1.043	0.71
Tmsv6-SD(ms)	28.5± 14.216	0± 10.51	.319	0.42
Tmsv6-SD (%)	3.0 ±1.31	7± 1.21	.343	0.41
Tmsv16-Dif (ms)	335.0 ±176.798	0± 66.53	.887**	0.01
Tmsv16-Dif (%)	37.4 ±23.210	9± 8.04	.225**	0.01
Tmsv12-Dif(ms)	95.5± 64.780	0 ±41.51	.096	0.70
Tmsv12-Dif (%)	10.8 6±.4	8.04±.5	1.265	0.59
Tmsv6-Dif (ms)	75.0 ±40.546	0 ±29.51	.461	0.48
Tmsv6-Dif (%)	7.8 ±3.84	5 ±3.21	.408	0.46

Table 3: Comparison of short-term results of whole cardiac function from three-dimensional between fQRS group and Non-fQRS group

	QRS group (n=20)	Non-fQRS group (n=20)	*t/z*	p
LVEDV（ml)	103.3±29.4	90.1±20.7	1.662	0.86
LVESV (ml)	43.6±35.9	32.2 2±24.7	2.778**	0.05
LVEF (%)	51.4±6.7	58.5±5.0	-3.841**	0.05

Table 4: Comparison of long-term results of whole cardiac function from three-dimensional between fQRS group and Non-fQRS group

	fQRS group (n=20)	Non-fQRS group (n=20)	*t/z*	p
LVEDV(ml)	100.5±28.2	84.7±22.4	1.988	0.46
LVESV(ml)	39.9±34.6	26.8± 23.4	3.000**	0.01
LVEF(%)	56.0±6.3	62.4±5.6	-3.398**	0.01

Table 5: Comparison of the long-term left ventricular systolic synchrony between fQRS group and Non-fQRS group

	fQRS group (n=20)	Non-fQRS?n=20)	t	p
Tmsv16-SD(ms)	46.5±20.524	0 ±17.01	.422	0.08
Tmsv16-SD(%)	4.8 ±2.4	2.5±2.31	.982**	0.01
Tmsv12-SD(ms)	18.5±10.0	21.0 ±10.00	.587	0.16
Tmsv12-SD(%)	1.9± 1.12	1±1.20	.496	0.15
Tmsv6-SD(ms)	18.0±8.2	15.0± 7.00	.418	0.14
Tmsv6-SD (%)	1.9 ±1.01	9±0.950	.026	1.36
Tmsv16-Dif (ms)	212.0±83.295	0±77.01	.343	0.08
Tmsv16-Dif(%)	23.9± 9.410	7±8.22	.034*	0.05
Tmsv12-Dif (ms)	65.0±29.570	0±31.50	.600	0.18
Tmsv12-Dif (%)	6.7± 3.66	8±3.70	.613	0.18
Tmsv6-Dif(ms)	45.5±21.03	7.02±4.5	.143	0.12
Tmsv6-Dif (%)	5.0 ±2.74	0±2.50	.365	0.36

4.3.4. Logistic Regression Analysis of Predictors for Left Ventricular Remodeling: The cut-off value was obtained by applying the ROC curve, and Tmsv16-SD% was transformed into a binary variable with 4.58% as the margin. A logistic regression analysis was performed with Tmsv16-SD% as the dependent variable for predictors of left ventricular remodeling (>4.58%=1, ≤4.58%=0) and fQRS (positive=1, negative=0), age, Gensini score and so on as independent variables. The results showed that, fQRS and age were risk factors for left ventricular remodeling.

4.3.5. Analysis of Factors Influencing Cardiac Function: After the clinical practice was taken into consideration, LVEF was transformed into a binary variable with 50% as the margin. A logistic regression analysis was performed with LVEF as the dependent variable for predictors of cardiac function (>50%=0, ≤50%=1) and fQRS (positive=1, negative=0), score and so on as independent variables. The results showed that, fQRS were a risk factor for left ventricular remodeling.

5. Discussion

The following theories have been proposed for the occurrence of fQRS [4]: non-transmural myocardial scarring; conduction block in infarct region; peri-infarction block; multifocal infarct; intracellular impedance changes. In brief, fQRS is caused by the delayed or continuity interruption of myocardial electrical activity resulting from dyssynchrony in electrical activity of ventricular myocytes as well as abnormal direction of excitation. Studies have shown that, fQRS was associated with ventricular arrhythmias under various conditions, such as ischemic/non-ischemic cardiomyopathy [5], hypertrophic cardiomyopathy [6], Brugada syndrome, acquired long QT syndrome [7] and arrhythmogenic right ventricular dysplasia [8,9]. Tigen et al [10]., by examining 60 patients with non-ischemic dilated cardiomyopathy, validated that the fragment-

ed QRS complex might be an effective predictor of the myocardial systolic dyssynchrony in patients with dilated cardiomyopathy, and claimed that, dilated cardiomyopathy patients with fragmented QRS complex might benefit more from cardiac resynchronization therapy (CRT). Basaran et al [11]. performed a cardiac magnetic resonance imaging on 20 non-ischemic heart disease patients with ECG-proved fragmented QRS complex to evaluate the association between the fragmented QRS complex and the myocardial fibrosis (expressed as delayed enhancement of strontium) and the fragmented QRS complex and the myocardial systolic dyssynchrony; the results suggested that, the fQRS production was significantly associated with intraventricular systolic dyssynchrony and myocardial fibrosis in patients with non-ischemic dilated cardiomyopathy concurrently with narrow QRS interval and sinus rhythm. An electrophysiological study suggested that, fQRS was a response to ventricular fragmented potential and was the pathological basis for arrhythmia. The study carried out by Ahmet Temiz et al [12]. indicated that, fQRS was associated with the occurrence of paroxysmal atrial fibrillation (PAF); the more fQRS leads were, the higher was the likelihood of PAF occurrence. Morita [13] et al. investigated the incidence of fQRS in 115 patients with type I Brugada syndrome, among which 43% had fQRS and other results included that, the incidence of fQRS in the ventricular fibrillation group was higher than the syncope group and the asymptomatic group, and the incidence of ventricular fibrillation and syncope in the fQRS group was 58% while the incidence of ventricular fibrillation in the non-fQRS group was only 6%. Therefore, the occurrence of fQRS in patients with Brugada syndrome was predictive of a high risk for ventricular fibrillation and syncope.

In the present study, the association between fQRS and left ventricular remodeling in patients with acute myocardial infarction was investigated by the real-time three-dimensional color Doppler ultrasound. The three-dimensional ultrasound technique was employed in the experiment to evaluate the short-term and long-term results of cardiac systolic function after PCI, showing that, after the hospital observation and the 6-month follow-up, the patients in the fQRS group had larger left ventricular end-systolic volume than the Non-fQRS group and had lower ejection fraction than the Non-fQRS group, showing statistically significant differences, and there was no significant difference from the comparison in left ventricular end-diastolic volume; the comparison after 6-month follow-up and hospital observation showed both the fQRS group and the Non-fQRS group had elevated left ventricular ejection fraction after 6-month follow-up, compared with during the hospitalization period, showing statistically significant differences, but the improvement in LVEDV and LVESV was not significant. The acute myocardial infarction patients concomitantly with fQRS had worse short-term and long-term systolic functions. Left ventricular volume and systolic function could predict the outcome of cardiovascular disease in many pathological [14-16]. Uslu et. al [17]. revealed that, coronary heart disease patients with fQRS had a lower LVEF, smaller left ventricular systolic and diastolic diameters and a larger volume; Gungor et. al [3]. found that, among the acute myocardial infarction patients, the fQRS positive group had a lower LVEF than the fQRS negative group. We argued that, the early concurrence of fQRS in acute myocardial infarction might be indicative a greater infarct size, lower left ventricular systolic function. Due to the interaction between left ventricular remodeling and cardiac function, left ventricular remodeling plays an important role in the decline of cardiac systolic function. Following the acute myocardial infarction was the harmful complication characterized by the left ventricular enlargement [18,19], changes in chamber geometry, and progressive deterioration of left ventricular function. Ventricular remodeling had a direct association with heart failure and poor prognosis [20,21]. Acute coronary syndrome had a significant effect on left ventricular dyssynchrony, and acute coronary syndrome has been shown to have a detrimental effect on left ventricular systolic function [22]. In patients with impaired left ventricular function, left ventricular dyssynchrony could predict left ventricular remodeling [23] and long-term prognosis [24]. Zhang et. al [25]. confirmed for the first time that, infarct size was the main determinant of left ventricular dyssynchrony following the acute myocardial infarction. Mollema et. al [26]. in their study demonstrated that, left ventricular dyssynchrony in patients with ST-segment elevation myocardial infarction might serve as an independent predictor for left ventricular remodeling at 6 months. The present study showed that, the fQRS group had significantly increased measurements in Tmsv 16-SD (ms), Tmsv 16-SD (%), Tmsv 16-Dif (ms), and Tmsv 16-Dif (%) than the Non-fQRS group, showing statistically significant differences, and the differences in the remaining predictors were not statistically significant: Tmsv 12-SD (ms), Tmsv 12-SD (%), Tmsv 6-SD (ms), Tmsv 6-SD (%), Tmsv 12-Dif The difference between (ms), Tmsv 12-Dif (%), Tmsv 6-Dif (ms), and Tmsv 6-Dif (%). After 6-month follow-up, during which the effect of heart rate was eliminated, the fQRS group had significantly increased measurements of Tmsv 16-SD (%) and Tmsv 16-Dif (%) than the Non-fQRS group, the differences in the remaining 12 segments and 6 segments were not statistically significant, indicating the fQRS group had a lower short-term and long-term systolic synchrony of 16 left ventricular segments after PCI

than the Non-fQRS group. Siva Sankara et. al [27]. investigated the effect of left ventricular dyssynchrony on prognosis and the results showed that, the left ventricular dyssynchrony was significantly elevated in patients with anterior myocardial infarction. The higher the left ventricular dyssynchrony, the higher was the Killips grade. Compared to the lesion located in the anterior descending branch and the circumflex branch, the patients whose lesion happened to be the right coronary artery had a relatively low left ventricular asynchrony, but there was no significant difference between the patients with the lesion located at the anterior descending branch and those at the circumflex artery. However, in the study performed by Ng et al [23]., the left ventricular dyssynchrony was higher in patients with stenotic proximal circumflex branch, and there was no significant difference between the patients with lesion at the anterior descending and those at the right coronary artery. At present, the relationship between the lesion site and the left ventricular systolic synchrony has not been established still, and further research is needed by performing large-scale clinicaltrials.

In the present study, the short-term and long-term left ventricular remodeling in the fQRS group and the Non-fQRS group was compared. The results showed that, in the fQRS group the 16-segment measurements were significantly smaller after six-month follow-up than those during the hospitalization, while in the Non-fQRS group there was no significant difference in the measurements of left-ventricular systolic synchrony after the six-month follow-up, compared with during the hospitalization. The comparisons indicate that, the long-term left ventricular remodeling was significantly improving in post-PCI patients with fQRS wave. Siva Sankara et. al [27]. observed that, among the patients with acute myocardial infarction who underwent PCI, those with high left ventricular synchrony had increased left ventricular diameter, decreased ejection fraction, and severe diastolic dysfunction after 6-month follow-up. The results of the present study showed that, in both fQRS group and the Non-fQRS group, the left ventricular ejection fraction increased from baseline after 6-month follow-up; the 16-segment systolic synchrony in the fQRS group was superior to baseline; in the Non-fQRS group, there was no significant difference in the left ventricular systole synchrony between at the baseline and after 6-month follow-up, which was inconsistent with the findings of Siva Sankara et. al. Left ventricular systolic dyssynchrony was an important predictor of left ventricular remodeling [28]. A study has confirmed that [29] acute myocardial infarction affected the ventricular systolic synchrony, and the degree of left ventricular systolic dyssynchrony had a close association with the size and the transmurality of myocardial infarct, and the left ventricular systolic dyssynchrony might serve as a predictor for left ventricular remodeling. In a logistic regression analysis, Tmsv16-SD% was used as the dependent variable of left ventricular remodeling predictor. The results showed that, fQRS and age had an effect on left ventricular remodeling, with relatively large OR value of fQRS and the 95% CI of OR.

We further compared the volume-time curve (VTC) of the 17 segments in the fQRS group and in the Non-fQRS group. The volume-time curve of the fQRS group was more disordered in the fORS group and in the non-fQRS group, and the difference of time for each segment to reach the left ventricular end-systolic volume was relatively large. The areas with an abnormal motion of the patients in the fQRS group had a larger range than those in the non-fQRS group, and the patients in the fQRS had a worse left ventricular systolic synchrony.

In summary, Left ventricular remodeling is more obvious in patients with acutemyocardial infarction complicated with fQRS in short-term and long-term, and theheart function is worse in patients with fQRS. FQRS can predict left ventricular remodeling and heart function .

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