CASE REPORT

A rare form of extremely wide QRS complex due to reversed homologous electrical ventricular separation of acute heart failure

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Electrical ventricular separation, as a special complete intraventricular block, denotes that ventricles be electrically separated into two or more parts caused by severe and wide damage of myocardium and conduction. Electrical ventricular separation can be divided into homologous and heterologous, homologous electrical ventricular separation is a rare phenomenon, literally the excitement of whole ventricle originate from supraventricle, on ECG, there are two different QRS waves which connect with an isoelectric line, one ST segment and T wave. We report a valve heart disease presented with complicated electrophysiological characteristics, which has reversed complex homologous electrical ventricular separation with second degree intraventricular block.

KEYWORDS

acute heart failure, homologous electrical ventricular separation, intraventricular block, wide QRS complex

1 | INTRODUCTION

As a rare and severe arrhythmia, homologous electrical ventricular separation means the excitement of whole heart comes from supraventricle then conducts through atrioventricular node to ventricle, however partial ventricular myocardium depolarized remarkably later than others because of totally myocardial conduction block instead of bundle branch block. It shows that QRS complex composed of two waves which connected with an isoelectric baseline. Characteristics of electrocardiogram (ECG) include (1) supraventricular rhythm (sinus or atrial), (2) two QRS waves with isoelectric baseline, and (3) one T wave due to the slow repolarization of ventricle. Here, we reported a case which was presented with complex homologous electrical ventricular separation and valve heart disease.

2 | CASE PRESENTATION

A 59-year-old male complained having palpitation and dizziness within 1 hr, had a history of atrial fibrillation, severe mitral

insufficiency, and heart failure—the patient had undergone mitral valve replacement performed 3 years ago—warfarin, benazepril, and metoprolol were administrated after surgery. Previous coronary angiography showed no significant coronary artery disease. Physical examination revealed that BP was 70/50 mm Hg, Heart rate was 170 bpm, border of heart was enlarged to left and inferior, auscultated irregular low heart sounds and mechanical mitral prosthesis, moist rales could be heard at left lower lung. Transthoracic echocardiography revealed dilated left ventricle (left ventricular end diastolic diameter is 74 mm) and decreased left ventricular ejection fraction (31%), blood electrolyte was normal, ALT and AST increased obviously, thyroid hormone was normal, blood creatinine increased lightly, blood BNP was 4,051.81 pg/ml.

During hospitalization, because of the deterioration of heart function as well as the administration of antiarrhythmia medicines and cardioversion, frequently, several kinds of complicated ECGs occurred. Either in sinus rhythm or ventricular tachycardia, even after pacemaker was implanted, electrical ventricular separation could be found.

After temporarily paced from right ventricle, a thorough analysis of ECG demonstrated extremely wide QRS complex composed with two

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FIGURE 1 Temporary paced from apex of right ventricle, the duration of two QRS waves prolonged to 380 ms, second-degree intraventricular block can be diagnosed by the later QRS wave blocked

FIGURE 2 After DDD pacemaker was implanted and the development of ventricular function, ECG showed AAI pacing model, prolonged PR interval, and supraventricular narrow QRS complex. Homologous electrical ventricular separation was reversed

separated waves, connected with isoelectric baseline, in lead V_1 – V_3 , the amplitude of first partial is higher than second partial, interestingly in lead V_4 – V_6 , the amplitude of second partial is larger than first one, therefore, we proposed that first/second partial of QRS complex represent the depolarization of right/left ventricle individually, there is a separation between right ventricle and left ventricle, meanwhile, it also showed second degree type I intraventricular block (Figure 1).

However, the homologous electrical ventricular separation was reversed, following the development of ventricular function, ECG showed atrial pacing and supraventricular QRS complex without ventricular separation (Figure 2). After administrated with metoprolol, amiodarone, benazepril, spironolactone, and furosemide, the patient had no more hospitalizations at 2 months of follow-up.

3 | DISCUSSION

Electrical ventricular separation literally means that parts of the ventricle are controlled by different origins with different automaticity, manifested as ventricular fibrillation or special ventricular tachycardia which has more than two kinds of QRS complexes with individual rhythms, and always means terminal rhythm. However, homologous electrical

ventricular separation is totally different from common electrical ventricular separation, the excitation of whole ventricle originated from one source. In 1974, the first case of homologous electrical ventricular separation with second degree intraventricular block caused by overdose of procainamide was reported (Gay & Brown, 1974).

Even in heart failure with persevered ejection fraction, both prolongation of QRS duration and abnormal QRS morphology were associated with a high risk of fatal and nonfatal adverse outcomes (Cannon et al., 2016), therefore, homologous electrical ventricular separation means severe damage of myocardium. Regarding this case, due to severe insufficiency, there was remarkable heart enlargement and low ejection fraction. Therefore, the homologous electrical ventricular separation may be caused by (1) delayed depolarization of partial myocardial due to global fibrosis, (2) unstable hemodynamics caused by the frequent attack of ventricular tachycardia, exacerbated heart function, affected infusion of coronary artery, accordingly deteriorated myocardial conduction. (3) Further deteriorated electrical conduction of ventricle caused by frequently administrated antiarrhythmic agents. Above all, multiple ventricular arrhythmias and bizarre extremely wide QRS complex was presented. Followed by the improvement of emergent situation, homologous electrical ventricular separation can be reversed.

4 | CONCLUSION

Homologous electrical ventricular separation is a special and rare ECG manifestation, and it always indicates serious damage of ventricular function and conduction.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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