QRS fragmentation in patients with arrhythmogenic right ventricular cardiomyopathy and complete right bundle branch block: a risk stratification

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Abstract

Background: Patients with arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D) and complete right bundle branch block (RBBB) very often have recurrent ventricular tachycardia and develop biventricular heart failure in the follow up, requiring heart transplantation and/or diuretics. In other patients with ARVC/D excluding RBBB, QRS fragmentation in the S wave of right precordial leads identifies patients with recurrent ventricular tachycardia, primary ventricular fibrillation, and recurrent implantable cardioverter defibrillator discharges; QRS fragmentation ≥ 3 leads characterized patients who died from sudden cardiac death.

Method: In a cohort of 374 patients with ARVC/D (208 males; mean $\pm$ SD age 46.5 ± 14.8 years), there were 22 patients with complete RBBB: 17 patients with ARVC/D developed complete RBBB and had biventricular heart failure in a follow up of 4–6 years. In five patients with ARVC/D, complete RBBB was initially evident. In all patients with ARVC/D and RBBB, QRS fragmentation ≥ 3 of all 12 ECG leads and QRS fragmentation in the S wave of right precordial leads were analysed.

Results: QRS fragmentation ≥ 3 of all 12 ECG leads and in the S wave of right precordial leads were present in 16/17 patients who developed RBBB and none of the five patients with initial RBBB. In one patient with initial RBBB, QRS fragmentation ≥ 3 leads was present ($r = 17.45$; $p < 0.0001$).

Conclusion: Patients with recurrent ventricular tachycardia who develop biventricular heart failure requiring heart transplantation and/or diuretics are characterized by QRS fragmentation in the S wave of right precordial leads and ≥ 3 of all 12 ECG leads. These results are statistically significant. Patients with initial RBBB have an overall benign prognosis.

Keywords

Biventricular heart failure, QRS fragmentation, recurrent ventricular tachycardia, right bundle branch block

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Introduction

The development of complete right bundle branch block (RBBB) in patients with arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVC/D) is a not-so-rare event. Patients with ARVC/D and RBBB have a poor prognosis with recurrent ventricular tachycardia and development of severe biventricular heart failure later on.¹ Some patients require heart transplantation. All patients with symptoms of biventricular heart failure were treated with angiotensin-converting enzyme inhibitors, beta blockers, and diuretics. In 2008, QRS fragmentation were detected as a diagnostic marker of ARVC/D² and in 2011 QRS fragmentation were described as a prognostic marker³ of

arrhythmic events (recurrent ventricular tachycardia, primary ventricular fibrillation, recurrent implantable cardioverter defibrillator discharges and sudden cardiac death).

QRS fragmentation was used to characterize patients with ARVC/D and RBBB who have a poor prognosis and

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Figure 1. ECG of a patient with recurrent ventricular tachycardia and developing heart failure
QRS fragmentation is present in more than 3 leads.

develop biventricular heart failure after years as a risk stratification.

Method

In a cohort of 374 patients with modified diagnostic criteria of ARVC/D⁴ with a mean±SD age of 46.5±14.8 years (208 males), there were 22 patients (6%) who fulfilled the diagnostic criteria of complete RBBB. In these 22 patients, QRS fragmentation should be detected at standard 12 lead ECG writing at a paper speed of 50 mm/s and 10 mm/mV amplitude technique.

Of these 22 patients, there were 17 patients with recurrent ventricular tachycardia who developed biventricular heart failure in the follow up and five patients with complete RBBB when the diagnosis was made and a stable clinical course in a follow up of 4–6 years.

QRS fragmentation in the S wave of right precordial leads and QRS fragmentation in ≥3 leads were used.

Results

In all patients with ARVC/D and complete RBBB, QRS fragmentation were present with 2.4±1.8 leads involved in a range of 1–7.

QRS fragmentation ≥3 of all 12 ECG leads and in the S wave of right precordial leads were present in 16/17 patients who developed RBBB and biventricular heart failure and none of the five patients with initial RBBB. In one patient with RBBB right from the beginning, QRS fragmentation ≥3 leads was present ($r=17.45$; $p<0.0001$). Figure 1 shows an example of a patient with recurrent ventricular tachycardia and developing heart failure. Figure 2 shows an example of a patient with no sustained ventricular tachycardia and no heart failure.

Discussion

In patients with complete RBBB and ARVC/D, QRS fragmentation was more prevalent in comparison with other patients with complete RBBB.⁵ It is also known, that patients who develop complete RBBB often have biventricular heart failure in follow up.^{1,6}

For the first time, it is possible to make a risk management for those patients who develop complete RBBB and biventricular heart failure. These patients have recurrent ventricular tachycardia and ECG without conduction delay with epsilon potentials,⁷ T wave inversions in right precordial leads,⁸ and terminal activation delay.⁹ In a follow up of at least 4 up to 6 years, these patients develop complete

Figure 2. ECG of a patient with no ventricular tachycardia and no heart failure. QRS fragmentation is present in less than 3 leads.

RBBB and later on biventricular heart failure, requiring heart transplantation in some cases. These patients are treated with angiotensin-converting enzyme inhibitors, beta blocking agents, and diuretics.

A diagnosis of complete RBBB predicts a worse outcome of patients with arrhythmogenic right ventricular cardiomyopathy. Out of 22 patients with complete RBBB, 17 developed severe biventricular heart failure, making heart transplantation and diuretic therapy necessary. This was particularly true for patients who developed complete RBBB. In 16 patients, QRS fragmentation in the S wave of right precordial leads and in ≥ 3 leads were present. Four patients who had complete RBBB from the very beginning had a benign prognosis. In one patient, QRS fragmentation ≥ 3 leads other than in the S wave of right precordial leads was present and the prognosis of the patient was uneventful.

If a patient with ARVC/D develops complete RBBB, the patient must be treated with an implantable cardioverter defibrillator and aggressive anti-failure agents.

In conclusion, for the first time, QRS fragmentation has been shown to help to predict the development of heart failure of patients with complete RBBB. Due to a low rate of patients with complete RBBB, these results are questionable and must be assessed in larger multicentre studies. In

healthy volunteers, complete RBBB can be diagnosed in about 3%,¹⁰ but a complete RBBB in 6% of cases with ARVC/D is not enough to make the results or the study more relevant.

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References

1. Peters S, Trümmel M and Koehler B. Special features of right bundle branch block in patients with arrhythmogenic right ventricular cardiomyopathy/dysplasia. *Int J Cardiol* 2012; 157: 102–103.
2. Peters S, Trümmel M and Koehler B. QRS fragmentation as a diagnostic marker of arrhythmogenic right ventricular dysplasia-cardiomyopathy. *Heart Rhythm* 2008; 5: 1417–1421.
3. Peters S, Trümmel M and Koehler B. Prognostic value of QRS fragmentation in patients with arrhythmogenic right ventricular cardiomyopathy. *J Cardiovasc Med* 2012; 13: 295–298.
4. Marcus FI, McKenna WJ, Sherrill D, et al. Diagnosis of arrhythmogenic right ventricular cardiomyopathy/dysplasia. Proposed modification of the Task Force Criteria. *Eur Heart J* 2010; 31: 806–814.

5. Zhang L, Wu R, Zareba W, et al. Right bundle branch block: the morphology differences between patients with and without arrhythmogenic right ventricular dysplasia. *Heart Rhythm* 2011 (Supplement); 8: P04–P141.
6. Peters S, Peters H and Thierfelder L. Heart failure in arrhythmogenic right ventricular dysplasia-cardiomyopathy. *Int J Cardiol* 1999; 71: 251–256.
7. Marcus FI and Fontaine G. Arrhythmogenic right ventricular dysplasia/cardiomyopathy: a review. *Pacing Clin Electrophysiol* 1995; 18: 1298–1314.
8. Marcus FI. Prevalence of T-wave inversion beyond V1 in young normal individuals and usefulness for the diagnosis of arrhythmogenic right ventricular cardiomyopathy/dysplasia. *Am J Cardiol* 2005; 95: 1070–1071.
9. Cox MG, Nelen MR, Wilde AA, et al. Activation delay and VT parameters in arrhythmogenic right ventricular dysplasia/cardiomyopathy: toward improvement of diagnostic ECG criteria. *J Cardiovasc Electrophysiol* 2008; 19: 775–781.
10. Willems JL, Robles de Medina EO, Bernard R, et al. Criteria for intraventricular conduction disturbances and pre-excitation: World Health Organizational/International Society and Federation for Cardiology Task Force Ad Hoc. *J Am Coll Cardiol* 1985; 5: 1261–1275.