Commentary article

Interventional Cardiology

Fragmented QRS in different clinical scenarios: A troubling red flag requiring appropriate differential diagnosis

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Description

A fragmented QRS is an electrocardiographic finding which requires careful evaluation because of the possible ambiguity between the marker of a definite pathologic substrate and a benign finding, where minor delayed ventricular activation may ensue at the Purkinje-local myocardium level.

Diagnostic role of QRS fragmentation (QRSf)

QRSf has been described in the late 60s [1], as inhomogeneous ventricular activation due to myocardial scar/fibrotic tissue creating slow conduction and local block. Being first reported in patients with coronary artery disease-related scars, QRSf has been consistently observed also in other disease etiologies, such as Hypertrophic cardiomyopathy, Arrhythmogenic cardiomyopathy, sarcoidosis, infiltrative diseases and radiotherapy-related fibrosis [2-5]. It was observed that acute myocardial injury, as caused by transient ischemia or inflammatory response, may also be associated with the slowing of myocardial conduction velocity, hence to QRSf which may partially subside [6,7]. The pathophysiology of QRSf has thus broadened to include also acute myocardial ischemia and inflammation as potentially modifiable/reversible causes of conduction delay/functional block within the myocardium, as observed in our previously published case report (partial QRSf modification after steroids) [8]. The diagnostic role of QRSf for myocardial fibrosis underlying a structural heart disease has emerged as a simple and potential tool, triggering focused workflow/imaging for precise diagnosis in the individual patient.

Prognostic meaning of QRSf

QRSf has also proved as a prognostic indicator. QRSf is associated with cardiovascular events and with life-threatening ventricular arrhythmias in many clinical settings, owing to its close correlation with a myocardial substrate prone to reentry. Indeed, QRSf is a risk marker of the substrate for ventricular arrhythmias independently of disease etiology, being predictive of malignant ventricular arrhythmias in coronary artery disease patients as well as in other cardiomyopathies, and the broad population of heart failure patients [8-15]. These latter appear to have a significantly increased risk of both sudden cardiac death and all-cause mortality in the presence of QRSf [13].

One key issue of QRSf is its definition, the boundary between a benign variant and a pathologic finding being somewhat uncertain. While some extreme fragmentations, as reported in our clinical case [8], pose hardly any doubt of a pathologic finding, most frequently sensitivity and specificity of QRSf rely on experience, and the final diagnosis stands on multi-modality integration of other information sources rather than on precise metrics.

Indeed, a classification proposal different from Das, et al., [9], and Maheshwari, et al., [16], has been developed, which encompasses a broader range of QRSf morphologies and provides reference metrics for its appraisal. This proposal attempts to address an unmet clinical need, that is to discriminate benign variants from pathological ECGs. The manifold appearance of QRSf and the complexity of measuring peak amplitude, widths and peak-to-peak ratios on several leads requires an algorithmic approach to ECG reading and classification proposal. In other words, this is another potential application of artificial Intelligence to firstly screen suspected abnormal findings, and later to assist the differential diagnostic decision amongst the many patterns of QRSf as shown in Figure 1 [17].

QRSf is yet another red flag attracting the cardiologist's attention to potential cardiac abnormalities and prompts a thorough investigation to precise diagnosis and targeted therapeutic interventions [18-20]

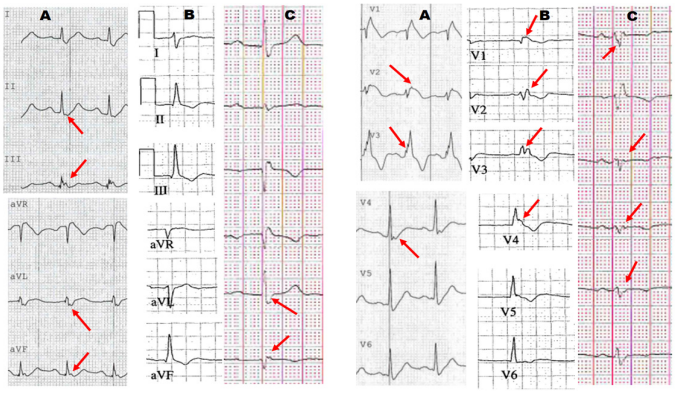

Figure 1: QRSf (➡) in different clinical scenarios. Note: (A) Brugada pattern during fever 39°C in an asymptomatic young male; (B) Right ventricular arrhythmogenic cardiomyopathy in a 45 years old male with recent-onset AF; (C) Biventricular arrhythmogenic cardiomyopathy in a 40 years old female.

Conclusion

The clinical relevance of QRSf provides new insights into ECG as the first imaging technique of the myocardium and dictates a renovated approach at its acquisition and analysis:

- Immaculate skin preparation for maximize the informative content as for the Ultra High Frequency (UHF) ECG.
- Use of Artificial Intelligence to classify patterns of QRSf and of cardiac conduction.
- Algorithmic approach to pattern classification for a first screening in the differential diagnosis process.

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