Brief Report

The Role of Lead aVR and Lead V1 in the Diagnosis of Arrhythmogenic Cardiomyopathy in Apparently Normal Hearts

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Abstract

Arrhythmogenic cardiomyopathy is electrocardiographically characterized by right precordial T-wave inversions and epsilon waves as major criteria. Additionally, terminal activation delay of 55 ms or more serves as a minor criterion. Although ther are more and more evident pathological data of right ventricles without dilatation or aneurysm, typical fibrofatty abnormalities and myocardial atrophy exist. The ECGs of these patients lack the right precordial T-wave inversion and epsilon waves. Lead aVR and lead V1 could become more and more relevant. 413 cases with arrhythmogenic cardiomyopathy (292 males, mean age 46.3 ± 11.6 years) and a collective of normal proband (1496 patients, 859 males with an age range of 18 - 81 years) were analyzed with regard to ECG appearance of lead aVR and the amplitude of inverted T-waves in lead V1. With a specificity of 99.9%, a positive predictive value of 99.7% and a negative predictive value of 98% lead V1 and aVR were most relevant to diagnose arrhythmogenic cardiomyopathy if an amplitude of Q waves of 3mm or more, R waves of 2 mm or less, inverted T waves of 2 mm or less in lead aVR and inverted T waves in lead V1 were present. These two leads appear most relevant to make the diagnosis of arrhythmogenic cardiomyopathy even in cases without right ventricular dilatation and right ventricular aneurysms.

Keywords: Arrhythmogenic Cardiomyopathy, lead aVR, Lead V1, Amplitude of Inverted T-waves

1. Background

According to a presentation of Christina Basso, leading pathologist at the university hospital of Padua, Italy, right ventricular dilatation is meanwhile a rare event in cases with arrhythmogenic cardiomyopathy. Right ventricles often present without dilatation, aneurysms and wall thinning, but the typical presentation of fibrofatty abnormalities with myocardial atrophy in a normally seized and thickened ventricle. In all cases the ECG revealed no typical abnormalities like right precordial T-wave inversions or epsilon waves in right precordial leads.

2. Methods

We analyzed 413 cases with arrhythmogenic cardiomyopathy (292 males, mean age 46.3 ± 11.6 years) and a large collective of normal proband (n = 1596, 859 males with an age range between 18 and 81 years) of the university clinic of Glasgow, U.K. (director of the section electrocardiography, institute of health and Wellbeing, royal infirmary Glasgow: Prof. Peter Macfarlane). Although specificity of typical changes in lead aVR (large Q-wave, small R-wave and T-wave inversions) and the analysis of the amplitude of negative T-waves are, per se, moderate (81 and 86%, respectively), the combination of these two parameters should be analyzed with regard to statistical values. As the last step, the amplitude of inverted T-waves in lead V1 of 2 mm or more should be added.

For statistical analysis sensitivity, specificity, positive predictive value and negative predictive value were calculated.

3. Results

In 413 cases with arrhythmogenic cardiomyopathy (292 males, mean age 46.3 ± 11.6 years) epsilon waves were detected in 99 cases (24%); T-wave inversions in right precordial leads were present in 227 cases (55%). At right ventricular angiography deep horizontal fissures in the right ventricular outflow tract could only be seen in 57 cases, whereas a mixture of deep horizontal fissures and bulging were seen in the other cases. Magnetic resonance imaging was not performed in any cases. True aneurysms could not completely be excluded by MRI.

If lead aVR criteria of large Q waves of 3 mm or more, small R waves of 2 mm of less and negative T-waves in the Glasgow collective were combined to an amplitude of negative T-waves in lead aVR of 2 mm or less and compared to data in arrhythmogenic cardiomyopathy (1, 2) sensitivity was 94%, specificity 97%, positive predictive value 88% and negative predictive value was 97%.

If additionally combined to an amplitude of negative T-waves in lead V1 of 2 mm or more the statistical analysis would be as follows: sensitivity 94%, specificity 99.9%, positive predictive value 99.7% and negative predictive value 98%.

4. Discussion

According to the results of the Glasgow collective the ECG of apparently normal hearts with a fibrofatty focus without right ventricular dilatation and without ventricular aneurysms should be analyzed as follows:

With the two components of lead aVR (large Q waves of 3 mm or more, R waves of 2 mm or less (1) and an amplitude of negative T-waves of 2 mm or less (2) sensitivity is 94%. These results can be further enhanced by analysis of the amplitude of negative T-waves of 2 mm or more in lead V1 with a sensitivity of 97% (3). An amplitude of inverted T-waves of 2 mm or more could be described in cases with unclassifiable arrhythmic cardiomyopathy associated with Emery-Dreifuss caused by a mutation in FHL with typical fibrolipomatosis of the right ventricle and hypertrabeculation of the left ventricle (4).

Nevertheless, right precordial T-waves inversions and epsilon waves are valuable parameters in dominant arrhythmogenic cardiomyopathy with dilated right ventricles and right ventricular aneurysms.

However in apparently normal hearts but with arrhythmogenic cardiomyopathy without dilatation and aneurysms, ECG analysis should be directed to the amplitude of inverted T-waves in lead V1 and its exclusion in lead aVR.

The simple means of standard ECG remains the gold standard method in the diagnosis of arrhythmogenic cardiomyopathy in spite of specific cardiac imaging techniques like nuclear magnetic resonance technique (5) or right ventricular angiography (6). In the future, bipolar ECG, could be a technique, especially for lead V1, to improve outcomes (7).

In apparently normal hearts with pathologic features of arrhythmogenic cardiomyopathy without right ventricular dilatation, wall thinning and aneurysms, the ECG presents with highly typical features in lead aVR and lead V1. Epsilon waves and right precordial T-wave inversions are typical signs of arrhythmogenic cardiomyopa-

thy with right ventricular dilatation and right ventricular aneurysms.

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