Early Repolarization Pattern at High Risk for Sudden Cardiac Death Unmasked by Exercise Test

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Introduction

Early repolarization is characterized by elevation of the QRS-ST junction (J point) in leads other than V1 through V3 on 12-lead electrocardiography [1]. It was thought to be an innocent ECG finding [2,3]. However, lately this pattern was suspected as a possible predictor for serious ventricular arrhythmias [4,5].

Case Report

A 32 years old male patient complained of palpitation and recurrent pre-syncope for 3 years.

The patient was investigated 6 months previously at another place for the same complaint. He underwent an electrophysiological study that was reported to be normal. The patient was treated by bisoprolol. The patient continued to have symptoms. He was referred to our center for further evaluation.

The clinical examinations as well as routine laboratory investigations were normal. Electrolytes as well as thyroid function tests were all normal.

The ECG showed normal sinus rhythm at a rate of 50 beats per minute (b/min) with some premature ventricular contractions (PVCs). The P-R and corrected QT (QTc) intervals were normal (QTc interval: 395 ms). There was no intraventricular conduction abnormality, pre-excitation or Brugada pattern. However there was ST elevation of around 1 mm with J wave mainly in the inferolateral leads (J-point elevation and notching in the terminal portion of the QRS complex) (Figure 1).

The patient’s echocardiography was normal. A 24 hour ambulatory ECG recording revealed basic sinus rhythm with average heart rate between 50 and 70 with infrequent PVCs and few couplets. An exercise stress ECG was performed. The patient’s resting ECG showed frequent PVCs with no other changes apart from inferolateral early repolarization (Figure 2). The patient was exercised according to Bruce protocol for 13 minutes, achieving a heart rate of 184 bpm and disappearance of the PVCs. Blood pressure increased from 130/80 mmHg to 140/80 mmHg. He was free of symptoms during the test. The test was terminated because of achievement of target heart rate response and absence of ST-T changes and arrhythmias. During the 1st minute of the recovery period when the heart rate was 153 b/min, while the QTc interval was within normal (443 msec), the J point in the inferior leads showed exaggerated elevation ≥ 2 mm and without any preceding symptoms, the patient developed a very early R on T PVC (Figure 2) that initiated ventricular fibrillation (VF) (Figure 3). This was immediately treated by defibrillation with 200 Joules biphasic shock. Later, Coronary angiography showed normal anatomy.

The patient was diagnosed as having idiopathic exercise induced VF and had an implantable cardioverter defibrillator (ICD) implanted.

Discussion

Ventricular fibrillation triggered by exercise test in patients with otherwise normal heart is very rare [6]. Our patient had evidence of early repolarization on his resting ECG and had VF immediately after exercise test. It occurred very early in the recovery period, it can’t be explained by high vagal tone during recovery as the heart rate of 150/min and the absence of any vagal symptoms as nausea or vomiting
The mechanisms of ER-induced arrhythmias are incompletely understood. One possible scenario is that if ER is accelerated in certain myocardial cells, phase 1 notch of the action potential increases and/or all-or-none repolarization can occur, producing large voltage gradients. These voltage gradients can initiate arrhythmogenesis, either by propagation of the AP dome (“phase 2 re-entry”) or via boundary currents analogous to “injury currents” in acute myocardial infarction [10] that raise ER cells to threshold and induce spontaneous activity.

Our patient was a young non-athletic male who had history of recurrent dizziness and pre-syncope and an early repolarization pattern with inferior leads J point elevation more than 1 mm. The only test that unmasked the patient vulnerability to VF and sudden cardiac death was the exercise stress test. This test was not mentioned in previous studies in the assessment of these patients. We propose including this test in the evaluation of symptomatic patients with early repolarization or assessing its value in larger studies.

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References