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Novel indices of ventricular repolarization to screen post myocardial infarction patients

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Abstract

We propose novel indices of ventricular repolarization intervals, the JTp/JT, Tpe/JTp and Tpe/JT ratios. These indices have been compared with the duration of the ventricular repolarization intervals and other ratios in 17 normal subjects and 17 patients with old myocardial infarction. In the intervals and other ratios, the best separation between groups is obtained with the Tpe/QTp and Tpe/QT ratios with 94% sensitivity and 82% specificity, the proposed ratios increased sensitivity to 100% and specificity to 94%. These indices should be further tested to determine their usefulness in discriminating between OMI patients with and without susceptibility to ventricular arrhythmias.

Keywords: Ventricular repolarization; QT interval; JT interval; JTp interval; Tpe interval; Intervals ratios; Myocardial infarction

1. Introduction

Prolongation of the QT interval is associated with a high risk of ventricular arrhythmias and sudden cardiac death in post myocardial-infarction (post-MI) patients. However, this index has a low sensitivity and specificity due in part to: (a) an inaccurate measurement of the QT interval because of different definitions for the end of the *T* wave, (b) the measurement leads used and (c) the influence of the heart rate (HR) and the autonomic tone [1,2].

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Other intervals of ventricular activity have been considered to assess the risk of malign ventricular arrhythmias in post-MI patients. The JT interval better describes the duration of the repolarization than the QT interval when there is a prolongation of the QRS interval in patients [3]. In another study, the JT interval was significantly longer in post-MI patients with delayed ventricular conduction and susceptibility to sustained ventricular tachycardia (VT) than in controls [4]. On the other hand, a QRS prolongation can contribute to the risk of cardiac death independently of repolarization abnormalities [5,6].

The QTpeak (QTp) interval comprises more than 50% of the ventricular repolarization and it is easier to measure than the QT interval. However, its suitability as a measure of the repolarization instead of the QT interval remains unclear because it is known that the Tpeak-Tend (Tpe) interval is influenced by disease and exercise, yet its variation is not reflected in that of the QTp interval [7]. Although it has been reported that the QTp and Tpe intervals are longer in post-MI patients than in normal subjects, those differences were only significant for the QTp interval [8]. A different study in patients with coronary artery disease susceptible to ventricular fibrillation (VF) also showed that the QTp and JTpeak (JTp) intervals were significantly longer [6].

The Tpe interval corresponds to the final part of the ventricular repolarization and it has been proposed as a more representative measure of that repolarization, because it is less dependent on HR, autonomic modulations and QRS duration than the QT and QTp intervals [9]. Furthermore, it has been experimentally shown that it correlates with the dispersion of the repolarization [10], and it has been hypothesized that it represents the transmural dispersion of the repolarization, defined as the difference in action potential duration between mid-myocardial M-cells, epicardial and endocardial cells [11].

In agreement with this last hypothesis, a separate study has shown that the Tpe interval and the Tpe/QT ratio are significantly larger in post-MI patients with VT than in patients without VT [12]. In other studies, however, the Tpe/QT and Tpe/QTp ratios did not display any significant difference in patients with coronary disease compared with normal subjects [13,14]. Another variable that can simplify the measurement of the dispersion of the repolarization is the QTp/QT ratio in the V3 lead, because it has been demonstrated that it has an acceptable correlation with the dispersion of the ventricular repolarization invasively evaluated in the human heart [15]. But its clinical value in post-MI patients has not been assessed to date.

In summary, clinical studies with different intervals of ventricular activity have shown their inconsistency and low sensitivity and specificity for diagnosis and/or prognosis. The objective of this work is to evaluate novel indices based in ratios between intervals of ventricular repolarization in normal subjects and in patients with old myocardium infarct (OMI).

2. Methods

2.1. Subjects and data acquisition

The study group has been 17 normal subjects (13 men, 4 women; age 40 ± 12 years) and 17 OMI patients (13 men, 4 women; age 44 ± 15 years). Of the 34 records analyzed, 28 records belonged to the two 15-lead CSE (Common Standards for Quantitative Electrocardiography) data bases (12-lead ECG plus Frank's orthogonal XYZ leads) [16]. These databases are available for testing and development of ECG wave recognition and measurement programs, and consist of a set of ECGs with different morphologies, normal as well as pathological (OMI), sampled at 500 Hz.