

Changes of Ventricular Repolarization in Acute Myocardial Infarction following Coronary Angioplasty

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Abstract

The long JT_c interval of ECG can cause the life threatening arrhythmic events and is a non-questionable factor of sudden death. According to some authors, the JT interval gets shorter during 4-6 hours after percutaneous transluminal coronary angioplasty (PTCA) in acute myocardial infarction (AMI). The aim of this study was to determine the influence of early reperfusion on the course of JT interval in patients with AMI undergoing PTCA. Coronary angiography and PTCA was performed for 35 patients with AMI. The measurement of repolarization parameters (JT , JT_a , JT_c , JT_{ac}) was performed in 12-lead ECG before PTCA and 4-6 hours after it by using computerised ECG analysis system "Kaunas-Load". During 4-6 hours after successful PTCA and reopening of infarction-related artery, the duration of ventricular repolarization was statistically credibly prolonged without exceeding normal values in all ECG leads, except the mean value of JT_{ac} in V1-V6 leads.

1. Introduction

QT(JT) interval in 12-lead electrocardiogram (ECG) reflects the repolarization of ventricles, and prolongation of repolarization could be caused by ischemic heart disease, cardiomyopathy, prolapse of mitral valve, disturbances of electrolyte balance (hypokalemia, hypomagnesemia, hypocalcemia), usage of some preparations (antiarrhythmics of IA, IC or III classes, phenothiazines, threecycle antidepressants) and also alcohol, organophosphatic insecticides, contrast preparations during coronarography [1]. The local alterations of cardiac cells, that happen due to myocardial necrosis and ischemia, disturbances of substance supply, deviations of autonomic nervous system regulation, act the transmembranic action potential [1]. An acute myocardial ischemia is related with local shortening of action potential [2, 3], and this shortening is caused by activation of some potassium channels during repolarization.

Disturbances of repolarization increase the danger of ventricular arrhythmias [4, 5, 6], however, the prolonged

repolarization, as risk factor of sudden death, is quite differently ranked by various authors. Some of them state, that prolonged QT or increased dispersion of QT(JT) interval may be a risk factor of sudden death [7, 8, 9], while others predicate, that neither prolonged QT, nor JT do not increase the risk of sudden death [10, 11, 12, 13].

Myocardial ischemia, awaked during PTCA, increases the duration of QT and JT [14, 15, 16, 17], but at first hours after successful procedure the duration of these intervals constantly decreases [14, 16, 18]. The reperfusion can influence the duration of repolarization directly - through electrophysiological processes, or indirectly - through autonomic nervous regulation of the heart [14]. The existence of repolarization disturbances can indicate the appearance of restenosis after PTCA [2,18].

The aim of this study was to determine the influence of early reperfusion on the course of JT interval in patients with acute myocardial infarction (AMI) undergoing percutaneous transluminal coronary angioplasty (PTCA).

2. Methods

Coronary angiography and PTCA was performed for 35 patients with AMI (16 women, 19 men, age - 40-80 years), 15 patients - with MI of anterior wall and 20 - with MI of lateral and inferior wall. For most patients during coronarography the multiple injuries of coronary arteries (CA) have been detected (Figure 1).

Before PTCA a 12-lead ECG was recorded for every patient, and JT and JT_a (JT_a - interval from point J till apex of T wave) intervals were measured in V₁-V₆ leads. 12-lead ECG recording and analysis was performed by using ECG computer analysis system "Kaunas-Load" [19]. ECGs were recorded before investigation and 24 hours after PTCA. In standard 12-lead ECG JT interval was measured by computer program or visually in the computer screen by using high sensitivity ruler. All 12 ECG leads were recorded synchronously, duration of record - 10 seconds. The noises conditioned by electric set, muscles tremor and breathing have been filtered, and baseline drift eliminated. The interval JT was measured in limb leads I, II, III, aVR, aVL, aVF and in chest leads V₁-

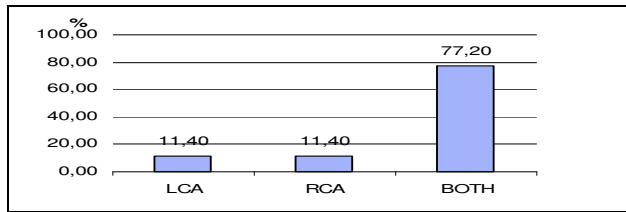


Figure 1. Distribution of coronary arteries injuries: LCA – left coronary artery, RCA – right coronary artery, BOTH – left and right coronary arteries.

V₆. The main rules of JT measurement: a) if amplitude of T wave in the lead was equal to zero, the JT interval in this lead was assessed as undetermined; b) when U wave or P wave superpose the end of T wave, a tangent of T wave descending slope is extended till crossing with baseline, and distance from point J till crossing is appreciated as JT interval.

The corrected JT – JTC and corrected JTa – JTAc were calculated according to Bazett's formula: $JTc = \text{measured JT(s)} / \sqrt{R-R(s)}$. If JTc exceeded 0,35s and JTac – 0,27s, then duration of ventricular repolarization was assessed as abnormally prolonged. The mean values of intervals JT, JTa, JTC, JTAc for all chest leads V₁-V₆ and V₂, V₅ leads were determined.

For all patients the successful PTCA was performed, and sufficient blood flow in coronary arteries (TIMI 2-3) has been obtained. The statistical package SPSS 9.0 for Windows was used for calculation of statistic characteristics, and criterion of reliability less than 0,05 was assessed as statistically significant.

3. Results

ECGs were recorded before PTCA and 6 hours after it, and heart rate did not differ significantly. For all patients in ECG, recorded 6 hours after PTCA the statistically significant prolongation of intervals JT, JTa, JTc, JTAc has been determined as compare with duration

of those intervals before PTCA, but this prolongation did not exceed the maximal normal values 0,35 for JTc and 0,27 – for JTAc. The duration of JT, JTa, JTc intervals in chest leads V₁-V₆ after PTCA was statistically significantly longer as compare with values before PTCA, but prolongation did not exceeded maximal normal values. The mean duration of JTAc interval in chest leads V₁-V₆ at 6 hours after PTCA was statistically significantly shorter as compare with its values before PTCA procedure (table 1).

Various sources of literature indicate, that during PTCA the duration of JT increases greatly [14, 15, 16, 17, 20], but after restoring the circulation in coronary arteries it begin decrease in first hours after PTCA [14, 16, 18]. However, in our investigation we did not observe the JT shortening after 6 hours following PTCA. Such results can be influenced by following factors: 1) we did not investigated the dynamics of JT interval, but stated only, that JT interval after 6 hours was longer as compared with its value before PTCA, and we did not investigated JT interval during PTCA procedure or 12 or more hours after PTCA; 2) there are no common standards for JT measurement, particularly for detection of T wave ending [14]. The investigation revealed that after PTCA the duration of JT was increased, but this prolongation did not exceed the limits of normal values.

Some authors stress the importance of terminal part of ventricular repolarization and indicate, that initial part of repolarization (measured in ECG from J point till T wave apex) did not add greatly to JT dispersion or prolongation [21]. In this investigation we determined prolongation of repolarization of ventricles and confirmed that for prolongation of JT interval a most important is the terminal part of JT interval (JTe – from apex of T wave till ending of T wave). It reflects the assessment of heart repolarization. When the repolarization was estimated in single V₂ and V₅ leads such changes were not observed.

Finally we state that for estimation of JT interval changes the JTa and JTe intervals must be measured.

Table 1. Changes of ventricular repolarization before PTCA and 6 hours after PTCA.

ECG lead	JT (s)		JTa (s)		JTc (s)		JTAc (s)	
	Before PTCA	After PTCA	Before PTCA	After PTCA	Before PTCA	After PTCA	Before PTCA	After PTCA
V ₂	0,297	0,315 (p<0,05)	0,197	0,210 (p<0,05)	0,325	0,345 (p<0,05)	0,214	0,229 (p<0,05)
V ₅	0,291	0,313 (p<0,05)	0,194	0,223 (p<0,05)	0,316	0,339 (p<0,05)	0,210	0,24 (p<0,05)
V ₁ -V ₆ mean	0,297	0,314 (p<0,05)	0,199	0,221 (p<0,05)	0,324	0,341 (p<0,05)	0,240	0,219 (p<0,05)

Besides, the JT changes must be assessed not in separate ECG lead, but JT average value must be measured in all chest leads.

4. Conclusions

After successful percutaneous transluminal coronary angioplasty the repolarization remain prolonged till 6 hours. The most important part for estimation of JT interval prolongation is terminal part of this interval.

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