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Research Article

Tpeak-Tend Dispersion and the Presence of Significant Coronary Stenosis in Patients with Chronic Stable Angina

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Received: June 01, 2018; **Published:** July 19, 2018

Abstract

Introduction: Prolonged measures that reflect the depolarization and ventricular repolarization as the QT interval have been associated with the presence of coronary artery disease.

Objective: This study aims to determine the relationship between the QRS duration, the QTc, QT dispersion, Tpeak-Tend and the Tpeak-Tend dispersion and the presence of significant coronary stenosis.

Methods: The study group included 65 patients with chronic stable angina who underwent invasive coronary angiography. It was divided into two groups: Group 1 (patients with significant stenosis of at least one coronary artery) and Group 2 (patients without significant lesions). Measurements were performed on the electrocardiogram obtained prior to invasive study.

Results: The QTc, Tpeak-Tend and the Tpeak-Tend dispersion were significantly higher in Group 1. The Tpeak-Tend dispersion was the marker that showed the biggest difference (Group 1: 34 ± 13 vs Group 2: 24 ± 8 milliseconds; $P = 0.0009$).

Conclusions: The electrocardiogram especially Tpeak-Tend dispersion is an element to consider for suspected significant coronary stenosis in patients with chronic stable angina.

Keywords: *Chronic Stable Angina; Coronary Angiography; QT Interval; Tpeak-Tend; Significant Coronary Stenosis*

Abbreviations

CSA: Chronic Stable Angina; ECG: Electrocardiogram; ICA: Invasive Coronary Angiography; QT: QT Interval; QTc: Corrected QT Interval; SCS: Significant Coronary Stenosis; Tp-e: Tpeak-Tend Interval

Introduction

Stable ischemic heart disease includes all patients with: chronic stable angina (CSA), asymptomatic ischemia, prior myocardial infarction, prior coronary revascularization, and non-obstructive atherosclerosis. The main cause is the formation of an atherosclerotic plaque that obstructs or narrows the coronary arteries [1].

Prolongation of some electrocardiographic measurements that reflect the depolarization and ventricular repolarization have been associated with an increase in the occurrence of malignant ventricular arrhythmias and sudden cardiac death in patients with ischemic heart disease or not [2,3].

Objective of the study

The objective of this study is to determine the relationship between QRS duration, QT interval (QT), corrected QT interval (QTc), QT dispersion, Tpeak-Tend (Tp-e) and Tp-e dispersion with the presence of significant stenosis in patients with chronic stable angina.

Materials and Methods

A retrospective study was performed at the Institute of Cardiology and Cardiovascular Surgery, Havana, Cuba; which included patients from February 2017 until April 2018.

Population studied

Sixty-five patients with CSA who underwent invasive coronary angiography (ICA) who showed no exclusion criteria (prior acute coronary syndrome, prior revascularization, structural heart disease or left ventricular systolic dysfunction) were included in the study. The diagnosis of CSA and ICA indication was made by the treating physicians in each case. It was divided into two groups: Group 1 (patients with significant stenosis of at least one coronary artery) and Group 2 (patients without significant lesions).

A purpose of this study was considered as significant coronary stenosis (SCS) to a ≥ 70% luminal diameter narrowing, by visual assessment, of an epicardial stenosis measured in the "worst view" angiographic projection; or ≥ 50% luminal diameter narrowing, by visual assessment, of a left main stenosis measured in the "worst view" angiographic projection [4].

Electrocardiographic measurements

An electrocardiogram (ECG) was done at each individual during their admission by using a Cardiocid BB as 12-lead ECG at a paper speed of 25 mm/sec. Electrocardiographic measurements were performed manually. The QT interval was measured manually from the beginning of the QRS complex to the end of the T wave, defined as the insertion of the tangent of the descending portion of the T wave and the isoelectric line [5]. QTc was obtained by Bazett's formula [6]. QT dispersion was defined as the difference between the maximum and minimum values of QT interval of all 12 leads [7]. The Tp-e was obtained using the highest value obtained in the precordial leads, by the difference between the QT interval and peak QT interval (measured from onset of the QRS complex to the peak of the T wave). In the case of negative T waves or biphasic peak QT interval was measured until the first nadir of the T wave, shunts with lower T wave amplitude 1.5 mm were not measured. The Tp-e dispersion was obtained from the difference between the maximum and minimum value of Tp-e obtained in the precordial leads [8]. The measurements were performed by two independent observers, in the case of a difference of > 20ms a third measurement was performed by another observer.

Statistics

The statistical package of Microsoft Excel 2010 was used for data analysis. The results of continuous variables were represented as: mean ± standard deviation (mean ± SD) and those categorical variables as numbers and percentages (n, %) A value of P <0.05 was considered significant, a value between .01 and .05 moderately significant and a value of P <.01 as highly significant. Group differences were analyzed by one-way ANOVA followed by Scheffe's multiple comparison tests. Numeric variables were compared using dependent-samples t test. To examine prognostic value from Tp-e dispersion and determine cutoff values, analysis of receiver operating characteristic (ROC) curves were made.

Results and Discussion

Results

Table 1 summarizes the characteristics of the 2 groups. Age in both groups was similar, but the male (82%) predominated in Group 1 and females (65%) in Group 2. In Group 1, 29% presented one-vessel disease, while 71% showed significant stenosis of two or more vessels, being the left anterior descending coronary artery the affected more frequently (76%). QTc, Tp-e and Tp-e dispersion were significantly higher in Group 1, being the Tp-e dispersion which had a higher statistical significance (Group 1, 34 ± 13 vs Group 2, 24 ± 8 milliseconds; P = 0.0009). Although there wasn´t a significant difference it shows QRS duration and QT dispersion were also higher in Group 1.

Characteristics	Group 1 (n = 45)	Group 2 (n = 20)	*P*
Sex			
Male	37 (82)	7 (35)	
Female	8 (18)	13 (65)	
Age (years)	60 ± 9	58 ± 12	
Location of SCS	Left main 6 (13)		
	LAD 34 (76)		
	CX 18 (40)		
	RCA 30 (67)		
QRS duration	95 ± 18	88 ± 15	0.12
QT interval	400 ± 41	370 ± 25	0.0006*
QTc interval	432 ± 39	405 ± 32	0.009*
QT dispersion	46 ± 23	37 ± 18	0.12
Tp-e	87 ± 13	73 ± 18	0,001*
Tp-e dispersion	34 ± 13	24 ± 8	0.0009*

Table 1: *Demographic characteristics and electrocardiographic parameters in patients with CSA and SCS (Group 1) and without SCS (Group 2).*

Values are presented as mean ± SD or n (%). RCA = right coronary artery; CSA = chronic stable angina; CX = circumflex; LAD*: Left Anterior Descending Coronary Artery; SCS: Significant Coronary Stenosis; Tp-e: Tpeak-Tend Interval; *: Significant.*

The area under the ROC curves for Tp-e dispersion was 0.708; indicating that a value of ≥ 40 milliseconds is relatively good discriminator.

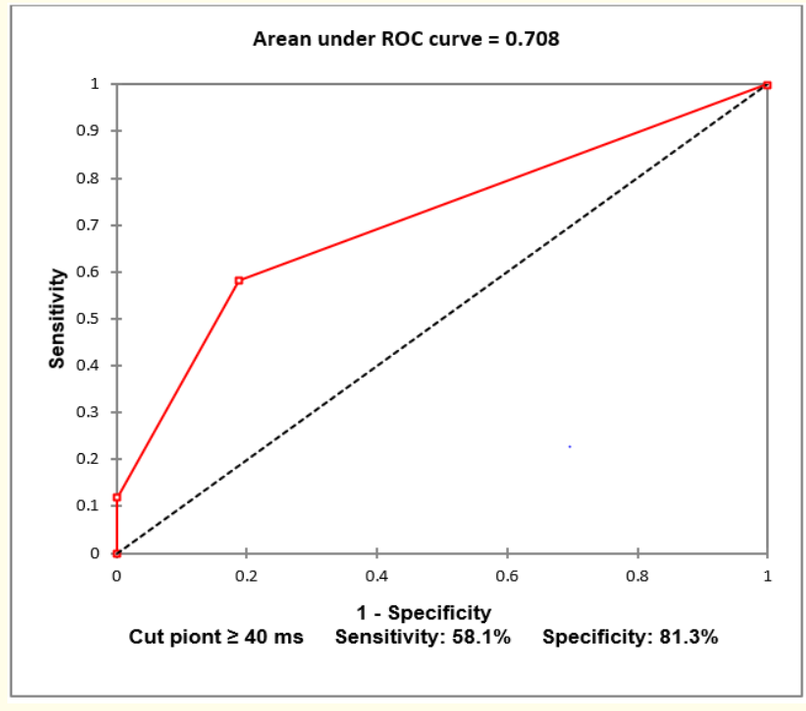

Figure 1: *Tpeak-Tend interval (Tp-e) dispersion receiver-operating characteristic (ROC) curve. The cut point that better optimizes the values of sensibility and specificity are for values ≥ 40 ms.*

Discussion

During the transmural ischemia Kenisberg., *et al.* [9] showed that the event presented earlier is the prolongation of the QTc, which has modified the classical concept of the ischemic cascade. This also described the value of QTc prolongation as an independent predictor of cardiovascular risk in patients with acute coronary syndrome [2]. Then one would expect that such ischemic changes that affect the depolarization and ventricular repolarization and expressed in the surface electrocardiogram are also altered in patients with CSA.

The study of Bingul., *et al.* [10] showed that in patients with stable ischemic heart disease, the QT interval is significantly prolonged in patients with one, two or three vessel disease, finding values of 404 ± 26, 415 ± 28 and 414 ± 25 milliseconds ($P < 0.001$). In this study the QTc using Bazett's formula was also shown greater in patients with one-vessel disease (427 ± 20 milliseconds), two-vessel disease (439 ± 23 milliseconds) and three-vessel disease (448 ± 31 milliseconds) $P < 0.001$.

Similar data to ours where the QT interval was significantly higher in patients with SCS (400± 41 milliseconds, $P = 0.0006$) and the QTc 432 ± 39 milliseconds, $P = 0.009$).

When comparing these two studies shows that the QT dispersion was higher in the group with CSC. However, in our work this difference was not significant.

We have not found literature relating the relationship between Tp-e, Tp-e dispersion and the presence of SCS.

Study Limitations

They have been shown in various publications significant intra- and interobserver variability of manual measurements of the QT, so we would expect this to happen in the other measurements. Another limitation is the small number of patients in the sample studied.

Conclusion

In conclusion, our data demonstrated that Tp-e dispersion was the best ECG parameter to differentiate patients with non-significant coronary lesions from patients with significant stenosis. Apart from the proved ability of QTc, Tp-e and Tp-e dispersion parameters in predicting malign arrhythmias, we can conclude that these parameters may be used as non-invasive screening tools in patients with CSA.

Conflict of Interest

Any conflict of interest exists.

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Volume 5 Issue 8 August 2018