Original Article

Coronary Artery Disease

A Comparative Study of QT Dispersion for Coronary Artery Disease in Cardiac Stress Test by Transesophageal Atrial Pacing

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ABSTRACT

Objective: To compare the QT dispersion for coronary artery disease in cardiac stress test by transesophageal atrial pacing in patients with coronary heart disease.

Study Design: Comparative study.

Place and Duration of Study: This study was conducted at the Cardiology Department, Mayo Hospital, Lahore, Punjab Institute of Cardiology and Umar Cardiac Center, Lahore from January 2015 to August 2015.

Materials and Methods: Fifty consecutive inpatients underwent cardiac stress testing (CST) by TEAP firstly, and then accepted selective coronary arteriography (SCA). These patients were suspected to have coronary heart disease (CHD), 28 were positive (CAD) and 22 were negative, normal coronary group (NCA), as control group. Measurements of QTd in two groups before and after CST were analyzed in and between groups.

Results: QTd was high in CAD than NCA group at baseline or every stages after CST (P<O.05, 0.01); QTd instantly and 2mm after CST was significantly greater than before CST in CAD group, but QTd 4mm and 6mm after CST dropped by the baseline . In NCA group, there were no differences of QTd measurements to be observed before and every stage after CST. Measurement of QTd immediately or 2mm after CST (~ 6Oms: positive) with the sensitivity (80.5%), specificity (90.4%), positive predictive value (91. 5%), negative predictive value (81.O %) and accuracy (85.5%).

Conclusion: Patients with CAD have greater QTd than normal subjects; and QTd increased further in CAD during CST by TEAP, whereas, NCA group with no significant change.

Key Words: Coronary artery disease, QT depression, cardiac stress testing, transesophageal atrial pacing

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INTRODUCTION

Campbell[1] in 1985 first proposed the QT dispersion (QTd) concept refers to the standard 12-lead ECG QT interval on the biggest stage (QTmax) and minimum QT interval (QTmin); the difference between the dispersion of myocardial repolarization extent..[2] QTd was firstly suggested to measure spatial dispersion of ventricular recovery times. Later, it was publicized that QTd does not directly respond the dispersion of salvage times, its upshots mainly from deviations in the T loop morphology and the error of QT measurement. The dedication of both automatic and manual measurement of QTd is low, and significantly lower than that of the QT interval.[3]

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QTd is amplified in cardiac patients, also compared with healthy subjects and predictive value of QTD were stated, these values were mostly overlapping in both healthy subjects, cardiac patients and in patients with and without hostile result. Disorders such as long QT syndrome[4], hypertrophic cardiomyopathy,[5] acute myocardial infarction,[6] and congestive heart failure, presented to cause an increase in QTd, the risk of severe arrhythmias and unexpected death.[7] QTd was also measured in patients with CAD. Studies performed with arterial pacing[8,9] or exercise stress test (EST) also.[10] It is reported that acute ischemia caused significant increase In QTd. Few other studies have also shown that QTd in patients with CHD increased significantly[2], it also increased acute myocardial ischemia.[11] Which indicates, QTd as a delicate indicator. Treadmill exercise test is a clinical diagnosis of CHD. An important means of TEAP cardiac stress test, treadmill exercise test works as a supplement, especially for the elderly, infirm, and disabled patients stocks.[12] However, the sensitivity of both techniques are limited, women exercise test false positive rate [13] False negative rate of the latter, thus affecting the accuracy of diagnosis. Research revealed that[4,13] the sensitivity and accuracy of the test can be improved by plate movement test, when combined with indicators of

changes in QTd, but on TEAP cardiac stress test, QTd index has the same effect, at home or out of home rarely reported. It is thought that the QT dispersion (QTd, QTcd) is related with the uneven repolarization of myocardiocytes of ventricle, reflecting the unstable electricity of heart. The increase of QT dispersion is considered to be closely associated with malignant arrthymia post-myocardio-infarction and sudden death. This study was planned and performed to compare the QT dispersion for coronary artery disease in cardiac stress test by transesophageal atrial pacing. This study also focused on the diagnostic value of QT dispersion for CAD in TEAP heart stress test.

MATERIALS AND METHODS

Fifty consecutive OPD patients underwent CST by TEAP firstly, and then SCA. These patients were suspected to have CHD, out of which 28 were positive (CAD) and 22 were negative (NCA group), as control group. Measurements of QTd in two groups before and after CST were analyzed among groups. Patient with acute 'myocardial infarction, cardiac functional class III or IV, persistent atrial fibrillation, atrial flutter, II degree above degree atrioventricular block and Left or right branch block Cambodia were excluded from the study. At first TEAP cardiac stress test, then SCA was performed. According to coronary angiography patients were divided into two groups CAD and NCA. Esophageal electrode were inserted through the nose to the esophagus and Lead ECG performed, P waves were positive and negative in two phases also amplitude provided maximum with fixed electrode and test pacing thresholds. Then higher threshold was adjusted to 2V, the heart rate was above 5-10 beats / min began at pacing. Positive criteria: stimulation after termination was R-wave-based, ST-segment based on the original horizontal or down-sloping. Secondly coronary angiography was performed, by using Seldinger femoral artery retrograde by Judkins method[15], respectively; patients underwent selective left and right coronary angiography. Projection position: conventional LAO, Team O, and different angles of head position and / or foot position, if necessary, appropriate adjustments were made based on imaging findings projection angle in order to fully reveal the lesion segments. Coronary angiography positive standard: At least one major coronary artery or its major branches, twenty-three, 50% luminal diameter stenosis. All subjects were measured, load test before and after, each period of ST segment depression level and each period QTmax, QTmin. This was done through formula (QT = QTmax-QT min), measurement does not know the results of coronary angiography.

Statistical analysis: Descriptive and inferential statistics were applied. Measurement data were expressed as mean ± standard deviation (mean±SD). The average number of groups was compared using two sample t-tests, each group before and after, the each period was compared using analysis of variance ANOVA, pair-wise comparisons using q test (Newman-Keuls method). For statistical inference chi-square test was applied. The data was analyzed using statistical package for social sciences (SPSS) version 16.P value <O.05 for the difference was statistically significant.

RESULTS

A standards-compliant inductees the general cases. Total of 54 cases, but there were three cases; In the process of doing load test, because they cannot tolerate being forced to cease stimulation test Experience with one case occurred during the load test is terminated angina trial, so the actual data was available for analysis in 50 cases. Coronary angiography showed: positive (CHD group) 28 cases, of which three lesions in 8 cases, double vessel disease in six cases, Single vessel disease, 14 cases: negative (i.e. NCA) 22 cases, two groups of age, six females and 16 males, esophagus electrode depth (ESO depth) and other general information was compared. There was no significant difference (P> 0.05), Table 1.

Table No.1: Two groups of age, gender, BSO depth comparison of general information

Category	n	Gender	Age	ESO depth	Pacing voltage	Expected Heart rate
		(M/F)	(old)	(cm)	(V)	(Beats/Min)
CAD	28	19/9	56.8 + 11.5	37.0 + 4.5	18.0 + 6.4	140 + 9.0
NCA	22	16/6	54.5 + 10.4	38 + 5.6	19.0 + 6.8	142 + 10.5

Table No.2: groups load test before and after comparison between groups QTd

Category	N	Before the test	After the test			
			0 min	2 min	4 min	6 min
CAD	28	55.5 ± 11.4	71.5 ± 11.0	69.5 ± 12.5	57.5 ± 9.0	56.0 ± 10.6
NCA	22	39.0 ± 10.5	43.0 ± 10.0	41.0 ± 10.5	42.5 ± 9.8	40.0 ± 8.5
p value		<0.05	<0.01	<0.01	<0.05	<0.05

* testing before and after (4min, 6min) Compare P <O. 01

Table No.3: Coronary involvement count relations with QTd.

Load test	three lesions	Double Vessel disease	Single vessel disease
	n=8	n=6	n=14
Before the test	57.0 + 13.0	55.0 + 11.0	53.5 + 10.0
After the test			
0 min	72.5 + 12.5*	70.0 + 11.0*	68.0 + 10.5*
2 min	70.0 + 13.8*	67.0 + 10.6*	64.0 + 11.5*
4 min	58.5 + 9.0	55.0 + 10.0	53.6 + 10.8
6 min	57.6 + 10.0	56.0 + 11.2	54.3 + 9.6

* Compared with the pre-test, P all <0.01

Table No.4: two load test results, QTd Comparison of changes.

Category	n	Load test		After the test QTd	
		Positive	Negative	> 60ms	< 60ms
CAD	28	14(50%)	14(50%)	24(85.7%)	4(14.3%)
NCG	22	5(22.7%)	17(77.3%)	2(9.0)	20(81%)

*Note: chi-square value= 6.90, P-value < 0.01

Table No.5: ST load test > O.1 mv standards and QTd > 60ms

Diagnostic criteria	Sensitivity	Specify	PPV	NPV	Accuracy
ST standard	50.00%	77.30%	75.00%	53.80%	61.90%
QTD standard	85.70%	81%	95.50%	85.00%	90.50%
P value	0.0114	0.3377	0.1409	0.0314	0.0041

In CHD patients with NCA, load test before and after in groups of QTd was determined. Comparison of CHD load test, before and after in each period of QTd was greater in CAD group, CHD load test after O min and 2 min of QTd were greater than before the test and also 4 min and 6 min after the test, but the difference was not statistically significant. Also no significant difference reported in NCA group load test before and after in each period. (Table 2)

There was also no significant difference (P> 0.05) in between vessel disease, weather before or after each load test session; however subgroups stimulate end load test at 0 min and 2 min were significantly improved, compared with the pre-test. (Table 3)

The two load test results, QTd Comparison of changes were calculated in each category, total number of patients with coronary angiography, results were shown in Table 4.

Criteria to determine the load test results, the sensitivity, specificity, positive predictive measured value, negative predictive value, and accuracy were better to varying degrees, including sensitive emotional, negative predictive value, accuracy and compares the standard ST load test > O.1mv. The difference was significant. (Table 5)

DISCUSSION

Refers to the 12-lead ECG, the difference between the largest QT and the shortest QT interval reflects regional myocardial repolarization dispersion degree.[1,2] Myocardial depolarization lasted for a very short, corresponds to the action potential of myocardial cells in phase 0, approximately 1ms, so QT interval period mainly affected by the repolarization process. Highamd et al[14] proved monophasic action potential (MAP) short duration (APD) and the surface ECG through research. As interval is closely related to the formation of QTd also provoked the addition of myocardial repolarization is sequence and characteristics are often related.

Later, Day et al[9] study revealed that increased QTd and intraventricular conduction delay and excitement abnormalities. Regional myocardial ischemia inevitably affects the board department of myocardial repolarization process, thus affecting the QT interval and QT. Later a large number of studies showed significant increase in QTd myocardial ischemia.[15,16] In this study, the crown vein angiography is the gold standard for the diagnosis of CHD, the measurement of esophageal pacing stress test before and after CHD, QTd were higher than normal group (p value < 0.05 ~ 0.01), results in line with the reported nausea. Another study showed coronary acute myocardial ischemia, QTd further increased CHD myocardial ischemia sensitive indicators of stress test.[11,17]

The study also found that after the success of coronary thrombolysis and PTCA immediately after (the first time, the second time after expansion) QTd or QTcd was with a significant decline.[18,19] TEAP cardiac stress test Inspected by rapid pacing increased cardiac load induced myocardial ischemia, ST Ischemic depression, thus supporting the diagnosis of CHD cases. In this study CHD load test immediately after (O min), 2min of QTd significantly increased compared with pre-test (p all <0.01), 4 min, 6 min to recover to baseline (p> 0.05), But still higher than NCA group, indicating that the increase in myocardial ischemia is the QTd unique result, and with the load lifted, relieve myocardial ischemia. QTd down to resting levels; while NCA

group, since the coronary reserve function well, resting or loads are not induced myocardial ischemia, so load test before and after each period of QTd did not change significantly (P all> 0.05), which is in line with the relevant literature. [20]

We also study the degree of CAD and the relationship between QTd. D. Wang et al [21] reported that QTd count with coronary involvement related to three> double vessel> single, which can be considered QTd, which reflect the degree of coronary artery involvement. In our study, our results regardless of load test, before or after, QTd did not show the amount due to coronary involvement count and appear to have a statistically significant difference, and whether the sample is too small for the number of cases, pending further study. We also examine QTd in TEAP load test of significance. Treadmill exercise test is commonly used in clinical diagnosis of CHD one of the methods, but the elderly, infirm, limb disabled patients unable to complete test: The TEAP cardiac stress test for CAD diagnosis regardless of age, physical condition impact exercise test can be used as supplementary examination.[12] But the research TEAP has its own unique clinical price value. However, the limited sensitivity of these two methods, women in particular false positive exercise test with high currency.[13,4] The latter high false negative, indicating that the traditional criteria for the diagnosis of myocardial ischemia ST has its limitations.. To solve this problem, Stoletnity et al[15] have examined the QT dispersion in exercise test to diagnose CAD, and coronary angiography results were compared with analysis of trials found that exercise, after exercise test true positive group QTd were significantly higher false positive and true negative group : In terms of QTd > 60ms to predict significant coronary artery disease, the sensitivity, specificity was significantly improved, so that QT dispersion index could be used as a sensitive exercise test results and specific supplementary indicators, the domestic a similar report.[22] In this study, the results of coronary angiography as the standard analysis TEAP cardiac stress test the sensitivity of the diagnosis of coronary heart disease (50.0%) and negative predictive value (53.8%), accuracy (6 1.9%) are relatively low, and low in previous reports (respectively 74%, 86.7%, 85%). Analysis of the causes and the methods used in addition to the results criteria, patient selection and other aspects of differences, some may be inherent in the trial, such as its load was less than treadmill exercise test, coupled with the traditional criteria for the diagnosis of myocardial ST limitations of ischemia, which may lower the sensitivity, false negative rate will be higher. Recent studies have shown[23] exercise test failed to induce vacancy bloody changes in the ST segment, coronary angiography showed coronary stenosis, which also significantly increased QTd after exercise, further explanation of QTd than ST standard more sensitive diagnosis of myocardial ischemia. Our results show that immediately after the load test terms of time or 2min QTd > 60ms, as the standard diagnostic CHD, the sensitivity (85.70%, P = 0.0114), negative predictive value (85.0%, P = 0.0314) and accuracy (90.5%, P = 0.0041) and ST Down > O.1 mV standard comparison the difference was statistically significant. TEAP cardiac stress test showed that QTd indexes can indeed improve the test for coronary artery myocardial ischemia diagnostic sensitivity, reduce the false-negative, and thus improve accuracy. QTd load test in diagnosis of CHD as an effective indicator of myocardial ischemia. Be noted that, despite the use 9F esophageal electrode, there are still three cases because they cannot tolerate the termination of the esophagus electrical stimulation test, how to further reduce the pacing threshold, improve patient compliance is worth studying. In addition, the evaluation of the diagnostic test, the sample size of this study is limited, the future still need to carry out more in-depth studies and for observation of a large series.[24,25]

CONCLUSION

QTd in patients with CHD than those with normal coronary artery: But it affected coronary angiographic findings counts irrelevant. TEAP cardiac stress test; CHD group immediately after the test and 2min step increase of QTd Beng → step increased. The NCA group showed no change. ST only down > 1mv criteria to determine TEAP cardiac stress test results in the diagnosis of CHD sensitivity and negative predictive value and accuracy is low. TEAP cardiac stress test, the combination of QT dispersion analysis, initial indications are that the test can improve the sensitivity of diagnosis of CAD, reducing false negatives, and thus improve accuracy. QTd as TEAP cardiac stress test in the diagnosis of CHD valid indicator of myocardial ischemia.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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