BENHA MEDICAL JOURNAL bmj

Print ISSN 1110-208X

Online ISSN 2357-0016

Original article

Correlation between QT Interval Prolongation or Dispersion in Positive Exercise ECG Patients and Severity of Coronary Artery Disease

Hany H. Ebaid [a], Hesham Rashid [a], Mohamed A. Tabl [a], Mohamed A. Mahmoud [b]

[a] Department of Cardiology, Faculty of Medicine Benha University, Egypt.

[b] Department of Cardiology, Alagoza police hospital, Egypt.

Corresponding to: Mohamed A. Mahmoud, Department of Cardiology, Alagoza police hospital, , Egypt.

Email:

dr.redamohamed@gmail.com

Received:

Accepted:

Abstract

Purpose: Exercise stress testing is a cost-effective, noninvasive and safe approach for assessing coronary artery disease (CAD), but it is documented that it has low specificity and predictive value. Consequently, there is a search for other factors that might enhance this test's precision. This work aimed to determine if QT interval prolongation or dispersion in a positive exercise electrocardiographic test (ECG) patient may indicate CAD. ***Methods***: A cross sectional study included 150 stress ECG positive patients; clinical history and physical examination data were collected from the recruited patients; they also were subjected to coronary angiography. Occlusion rate≥ 70% in the left anterior descending artery, circumflex or right coronary artery or ≥ 50% in the left main coronary artery was considered obstructive CAD. Patients were divided into 3 groups (normal, non-obstructive CAD and obstructive CAD). Gensini score was calculated to quantify angiographic atherosclerosis. ***Results*** : Among the studied patients, 19 (12.7%) patients had normal angiogram, 20.7% had non obstructive CAD and 67.3% of them had obstructive CAD. QT interval significantly increased in obstructive CAD patients at peak exercise and at recovery, QT dispersion (QTd) significantly increased in obstructive CAD at beginning and peak exercise, corrected QT also significantly increased in obstructive CAD. QTd at peak exercise had the best validity to predict obstructive CAD patients with sensitivity 86.1%, specificity 56.7% at a cutoff point 39. ***Conclusion***: QT dispersion had good sensitivity and total accuracy 79.4% that increase capability of stress ECG to detect obstructive CAD.

Key words: Stress ECG; artery Coronary disease; QT prolongation & dispersion

Introduction

CAD, also refereed as coronary heart disease (CHD) or ischemic heart disease (IHD), is characterized by a decrease in blood flow to the heart muscle caused by the accumulation of plaque in the heart's arteries. It is the most prevalent cardiovascular disorder. Stable angina, unstable angina, myocardial infarction, and sudden cardiac death are examples [(1)].

Several diagnostic techniques, involving electrocardiogram (ECG), cardiac stress testing, coronary computed tomographic angiography, and coronary angiogram, may be helpful [2].

ECG is a noninvasive and cheap method of diagnosis but it is of low accuracy in detecting patients with CAD with sensitivity 66% and specificity 33.7% [3].

Exercise testing is the most frequently available and reasonably affordable approach for initial screening and severity assessment of probable coronary disease [4], Total accuracy of exercise-ECG test was 45.1% with a sensitivity of 68.1% and specificity 36.6% [5].

Consequently, there is a search for other factors that might enhance this test's precision. QT and adjustments QTc interval in the surface ECG are precise measures that provides diagnostic and mortality information associated with cardiovascular illnesses [6].

Variables such as cardiac ischemia, age, activity, smoking, gender, diabetes and genetics may affect QT intervals [7].

Catecholamine release causes an elevated heart rate during exercise in healthy persons, and therefore, the QT interval is predicted to shorten. Some researchers have reported that QT dispersion (QTd) would be an indicator for CAD [8].

Regarding QT interval, some studies supposed that QT interval prolongation predict presence of obstructive CAD and QTc improved model performance to predict obstructive CAD [9].

Patients and methods

An observational cross sectional diagnostic study was performed on 485 individuals with chronic coronary artery disease suffering unstable angina pectoris and exertional dyspnea who did exercise test, that revealed 150 individuals were enrolled in this study who revealed positive exercise test. The participant patients were selected from patients attending Benha university hospital and Al-Agoza police hospital during the period from July 2021 to the end of June 2022.

The study excluded individuals with negative exercise test, cardiac pacemaker, left bundle branch block, acute coronary syndrome, symptoms of pre-excitation, active cardiac infection, biphasic T wave . atrial fibrillation and patients in which we were unable to detect an isoelectric line between the T and P waves in maximally exercising individuals due to ECG abnormalities.

The study was accepted by ethics& research committee, Faculty of Medicine, Benha University under number MD.4.7.2020. A written consent was taken from each patient before participation.

All individuals were subjected to

Personal data collection: (Age, gender, smoking status and family history).

Clinical data: (any hypertension, co-morbidities, diabetes mellitus, hyperlipidemia). General examination was done for all patients (heart rate, body mass index (BMI) & systolic and diastolic blood pressure).

Exercise ECG test:

Prior to the test, patients were needed to be chest-pain-free for at least one week, to discontinue use of anti-anginal, anti-arrhythmic, and antipsychotic medications (each according to its half-life), and to fast for three hours (without smoking cigarettes). All patients used the standard Bruce protocol.

For the treadmill exercise testing, the Bruce protocol was followed. The primary goal heart rate was 85 percent of the age-predicted heart rate. Exercise was performed until ST depression, angina pectoris, dyspnea, palpitations, or tiredness occurred.

Throughout the trial, continuous 12-lead ECGs were digitally collected. the data at 500 Hz utilizing the Cardio Soft exercise ECG system, that has computer-driven calipers onscreen. A ST-segment depression of at least 1 mm horizontal or downward sloping 80 ms after the J point was deemed abnormal. All saved ECG findings were analyzed offline using the conventional 12-lead ECG tracing at 50 mm/s paper speed and 10 mm/mV amplitude. Two cardiologists collected measurements. As indicated before, the lead II and V 5 of each ECG was utilized to establish the QT interval because its high amplitude T wave allowed for an accurate determination of the end of the T wave. We utilized the mean value of leads II and V 5 generated from at least three cardiac cycles and evaluated from the earliest beginnings of the QRS complex to the end of the T wave. When the T and U waves were near together, the termination of the T wave was determined as the moment when its descending limb returned to the TP baseline.

When the end of the T waves did not enter the isoelectric line, the slope approach was used to identify the end of the T waves; It is determined by the intersection of the tangent at the highest downslope of the T wave and the isoelectric line.

If the target HR was attained or if any of the following occurred, the test was terminated: limiting symptoms (evidence of poor peripheral perfusion, chest pain, fatigue or leg cramps, dyspnea), exertional hypotension, ST-depression > 3 mm; bundle branch block; or serious arrhythmias (couplets, multiform complexes, salvos, triplets or ventricular tachycardia).

During the stress test, systolic blood pressure, diastolic blood pressure, heart rate, QT interval, corrected QT (QTc), and QT dispersion were recorded at three phases (starting, peak exertion, and second minute of recovery) (resting period after the exercise).

Correcting the QT interval was done utilizing Bazett's formula ($QTc=QT/\sqrt{RR}$) [10].

QT dispersion: QT interval was manually recorded in the maximum number of pericardial and limb leads (≥ 8 leads) after being magnified on a Cannon photocopier (× 3). It is calculated from the beginning of the Q-wave to the conclusion of the T-wave. If the end of the T-wave is not visible, such as when it is fused with the U-wave or P-wave as in the case of rapid heart rate, a straight line is drawn tangential to the downstroke of the T-wave until it meets the base line (identified from the level of the PR segment) and this is considered the end of the T-wave. Difference between the highest and the lowest QT is QTd [11].

Coronary angiography

Selected individuals giving positive stress test were subjected to coronary angiography. Occlusion rate ≥ 70% in the left anterior descending artery, circumflex or right coronary artery or ≥ 50% in the left main coronary artery were considered obstructive CAD.

Participants were split into three groups: normal angiogram, non-obstructive and obstructive groups

Patients' Gensini scores were computed. The Gensini score is a commonly utilized method for assessing angiographic atherosclerosis, with a score of zero indicating atherosclerotic disease absence. The Gensini score takes into consideration the degree and location of arterial constriction. The Gensini score was calculated by assigning a severity score to every coronary stenosis as follows:1 point for less than or equal to 25 percent narrowing, 2 points for 26 to 50 parcent narrowing, 4 points for 51 to 75 percent narrowing, 8 points for 76 to 90 percent narrowing, 16 points for 91 to 99 percent narrowing, 32 points for total occlusion.

Each lesion score is then computed on the basis that accounts for the significance of the lesion's position in the coronary circulation (5 for the left main coronary artery, 2.5 for the proximal segment of the left anterior descending coronary artery, 2.5 for the proximal segment of the circumflex artery, 1.5 for the mid-segment of the left anterior descending coronary artery, 1.0 for the right coronary artery, the distal segment of the left anterior descending coronary artery, the posterolateral artery, and the obtuse marginal artery, and 0.5 for other segments). Eventually, the Gensini score will be computed by adding the scores for each coronary segment [12].

Statistical analysis.

On an IBM compatible computer, SPSS (Statistical Package for Social Science) version 21.0 was used to gather, tabulate, and analyze the data (SPSS Inc., Chicago, IL, USA). Quantitative data was characterized as frequency and percentage and compared using the Chi-square test (χ^2). Quantitative data was reported as mean, standard deviation, and range and compared using the student t-test when the data was normally distributed, Pearson and Spearman correlation are linear correlation tests that evaluate the relationship between quantitative data with normal and non-normal distributions, correspondingly. ROC curve is a graphical plot which illustrates the diagnostic performance of certain quantitative parameter. A P-value < .05 was statistically critical.

Results

Studied cases were divided after angiography into 12.7% with normal angiogram. 20.7% were non obstructive CAD patients and 67.3% were obstructive CAD patients (figure 1). The sensitivity of stress ECG for prediction of obstructive CAD was 67.3%.

A significant association was noted between normal and obstructive groups as obstructive CAD group showed significantly higher percentage of male sex, smoking, DM and hypertension than in normal group. While family history increased significantly in obstructive group than normal and non- obstructive groups respectively, with non-significant association with each of age or hyperlipidemia.

BMI had higher value in non-obstructive and obstructive CAD patients than normal cases with significantly higher value among obstructive CAD patients than non-obstructive cases. Systolic blood pressure had significantly higher values in non-obstructive cases than normal cases and in obstructive patients than normal cases with non-significant difference between non-obstructive and obstructive CAD cases. obstructive patients showed considerably higher diastolic blood pressure than normal group (table 1).

Exercise ECG testing at beginning revealed significantly lower systolic and diastolic blood pressure in normal group than non-obstructive and obstructive groups, QT dispersion significantly increased from normal to non-obstructive to obstructive groups with non-significant difference regarding heart rate and QT interval. at peak exercise, systolic BP was significantly higher in non-obstructive than normal groups, diastolic BP was significantly higher among obstructive group than both normal and non-obstructive groups, QT interval and QT dispersion significantly increased from normal to non-obstructive to obstructive groups consecutively with non-significant difference regarding heart rate.

At recovery, systolic BP was significantly higher in non-obstructive than normal groups, diastolic BP was significantly higher among obstructive group than normal group, heart rate was significantly lower in normal group than both non-obstructive and obstructive groups, QT interval significantly increased from normal to non-obstructive to obstructive groups consecutively with non-significant difference regarding QT dispersion. Regarding corrected QT, it was significantly higher in both non-obstructive and obstructive groups than normal (table 2).

Spearman correlation analysis showed significant positive correlation between Gensini score and QT interval (at beginning, at peak & at recovery), corrected QT & QT dispersion at peak (table 3). Corrected QT had positive significant association with systolic & diastolic blood pressure. Regarding QT dispersion, there was positive significant association with systolic & diastolic blood pressure, fasting blood sugars, HbA1c, TG and N/L ratio (table 4)

ROC curve analysis of QT (at Peak) showed AUC (0.65) and 95% CI (0.52 – 78), At a cutoff point 235, sensitivity 74.8%, specificity 63.2% and accuracy 73.3%. QT dispersion had AUC 0.82 and 95% CI (0.74 – 0.91), the sensitivity was 81.7% and specificity 78.9% at cutoff point 34. Corrected QT had sensitivity 93.9%, specificity 26.3% with AUC 0.50 (figure 2A).

ROC curve analysis demonstrated that QT (at Peak) with AUC 0.55 and 95% CI (0.45 – 65), At a cutoff point 235, sensitivity 75.2%, specificity 23.3% and accuracy 63.4%. QT dispersion had AUC 0.78 and 95% CI (0.69 – 0.86), the sensitivity was 86.1% and specificity 56.7% at cutoff point 39. Corrected QT had sensitivity 90.1%, specificity 23.3% with AUC 0.48 (figure 2B).

Table 1: Socio-demographic criteria in relation to severity of CAD among the studied patients

	Severity of CAD among the studied cases N = 150				P value
	Total N = 150	**Normal n = 19**	**Non obstructive CAD n = 30**	**Obstructive CAD n = 101**	
Age (years)					0.13[1]
Mean ±SD	58.64±9.45	55.05±9.33	59.33±9.40	59.30±9.28	0.07[2]
Range	38 – 78	39 – 69	40 – 73	38 – 78	0.99[3]
Sex					0.11[1]
Male	108 (72.0)	9 (47.4)	21 (70.0)	78 (77.2)	0.007[2]
					0.42[3]
Smoking					0.09[1]
	104 (69.3)	8 (42.1)	20 (66.7)	76 (75.2)	0.004[2]
					0.35[3]
DM					0.35[1]
	63 (42.0)	4 (21.1)	10 (33.3)	49 (48.5)	0.03[2]
					0.14[3]
Hypertension					0.26[1]
	77 (51.3)	7 (36.8)	16 (53.3)	70 (69.3)	0.007[2]
					0.11[3]
Hyperlipidemia					0.59[1]
	88 (58.7)	11 (57.9)	15 (50.0)	62 (61.4)	0.77[2]
					0.27[3]
Family history					0.78[1]
	69 (46.0)	5 (26.3)	9 (30.0)	55 (54.5)	0.02[2]
					0.02[3]
BMI (kg/m2)					0.002[1]
Mean ±SD	35.05±4.30	30.84±2.79	33.27±2.35	36.37±4.30	<0.001[2]
Range	25 – 45	25 – 35	29 – 39	28 – 45	<0.001[3]
Systolic blood					0.004[1]
pressure	139.67±16.65	128.16±14.36	139.67±11.96	142.13±17.41	0.001[2]
Mean ±SD	100 – 160	100 – 145	120 – 160	100 - 160	0.38[3]
Range					
Diastolic blood					0.24[1]
pressure	87.93±8.58	84.21±9.02	86.67±5.47	89.01±9.06	0.036[2]
Mean ±SD	70 – 100	70 – 95	80 – 100	70 – 100	0.09[3]
Range					

X^2 = Chi square test

1 = comparing normal cases with non-obstructive cases
2 = comparing normal cases with obstructive cases
3 = comparing non obstructive cases with obstructive cases

Table 2: Exercise ECG in relation to severity of CAD among the studied patients

			The studied cases N = 150		**P value**
Beginning	**Total N= 150**	**Normal N = 19**	**Non obstructive CAD N = 30**	**Obstructive CAD N = 101**	
Systolic blood pressure					0.003[1]
Mean ±SD	140.37±16.61	131.84±12.82	143.33±12.68	141.09±17.83	0.03[2]
Range	100 – 160	120 – 145	130 – 160	100 – 160	0.52[3]
Diastolic blood pressure	88.17±8.22				0.04[1]
Mean ±SD	70 – 100	89.74±5.13	86.67±4.79	88.32±9.39	0.35[2]
Range		85 – 95	80 – 90	70 – 100	0.20[3]
Heart rate					0.57[1]
Mean ±SD	85.72±10.21	89.21±15.38	87.07±6.74	84.66±9.77	0.23[2]
Range	62 – 105	75 – 105	64 – 102	62 – 105	0.13[3]
Q-T interval					0.38[1]
Mean ±SD	385.6±11.17	369.47±68.67	384.67±36.46	388.91±38.44	0.24[2]
Range	280 – 440	280 – 430	280 – 440	280 – 440	0.58[3]
Q-T dispersion					<0.001[1]
Mean ±SD	42.40±9.53	33.74±4.93	40.53±2.40	43.34±9.88	<0.001[2]
Range	40 – 80	22 – 21	32 – 46	30 – 80	0.01[3]
At peak					
Systolic blood pressure					0.005[1]
Mean ±SD	156.33±15.51	149.47±10.26	158.33±10.45	157.03±17.24	0.07[2]
Range	110 – 175	140 – 160	145 – 170	110 – 175	0.70[3]
Diastolic blood pressure					0.19[1]
Mean ±SD	98.73±7.80	94.74±5.13	96.67±4.79	100.09±8.54	0.009[2]
Range	80 – 110	90 – 100	70 – 100	80 – 110	0.04[3]
Heart rate					0.61[1]
Mean ±SD	149.81±19.21	151.16±16.97	153.37±9.74	148.52±21.58	0.62[2]
Range	110 – 179	110 – 169	142 – 168	110 – 179	0.08[3]
Q-T interval					0.002[1]
Mean ±SD	146.67±36.85	232.63±13.68	249.67±23.12	263.17±46.97	<0.001[2]
Range	210 – 360	210 – 250	230 – 300	210 – 360	0.02[3]
Q-T dispersion					<0.001[1]
Mean ±SD	38.21±13.13	27.68±5.94	35.13±6.38	41.11±14.36	<0.001[2]
Range	0 – 66	20 – 40	18 – 46	0 – 66	0.03[3]
At recovery					
Systolic blood pressure					0.005[1]
Mean ±SD	146.03±14.16	139.47±10.26	148.33±10.45	146.58±15.43	0.06[2]
Range	110 – 165	130 – 150	135 - 160	110 – 165	0.56[3]
Diastolic blood pressure					0.05[1]
Mean ±SD	90.90±9.45	92.11±7.69	88.33±2.40	91.43±1.87	0.80[2]
Range	70 – 110	85 – 110	85 – 90	70 – 110	0.009[3]
Heart rate					0.004[1]
Mean ±SD	103.29±12.83	93.26±13.15	103.73±7.01	105.04±13.34	0.001[2]
Range	70 – 110	70 – 110	86 – 120	85 – 130	0.48[3]
Q-T interval					0.03[1]
Mean ±SD	366.09±22.71	358.53±5.77	361.80±4.44	368.79±27.07	0.001[2]
Range	164 – 410	340 – 370	360 – 380	164 – 410	0.01[3]
Q-T dispersion					0.72[1]
Mean ±SD	38.32±11.93	39.47±9.73	40.27±5.52	37.52±13.56	0.55[2]
Range	0 – 76	18 – 70	26 – 66	0 – 76	0.11[3]
Corrected Q-T					0.03[1]
Mean ±SD	377.99±55.53	354.54±49.15	384.06±36.05	383.77±58.29	0.03[2]
Range	263 – 487	271 – 391	334.7 – 430	263 – 487	0.97[3]
Gensini score					<0.001[1]
Mean ±SD	30.84±28.02	0.0 ±0.0	8.57±4.68	43.26±26.04	<0.001[2]
Range	0 – 98	0 – 0	2.5 – 24	12 – 98	<0.001[3]

1 = comparing negative cases with mild cases

2 = comparing negative cases with severe cases

3 = comparing mild cases with severe cases

Table 3 : Correlation between Gensisni score and QT interval and dispersion

Parameters	Gensini score	
	R	**P value**
QT interval (at beginning)	**0.20**	**0.01**
QT interval (at peak)	**0.34**	**<0.001**
QT interval (at rest)	**0.20**	**0.01**
Correct QT	**0.45**	**<0.001**
QT dispersion (at beginning)	**0.02**	**0.83**
QT dispersion (at peak)	**0.41**	**<0.001**
QT dispersion (at rest)	**0.15**	**0.07**

r = correlation coefficient

Table 4: Correlation between corrected QT and QT dispersion among ischemic cases and personal data and lab investigations

Parameters	Corrected QT		QT dispersion	
	r	**P value**	**r**	**P value**
Age	0.04	0.61	0.16	0.07
BMI	0.08	0.30	0.11	0.21
Systolic blood pressure	0.32	<0.001	0.32	<0.001
Diastolic blood pressure	0.23	0.004	0.27	0.002

r = correlation coefficient

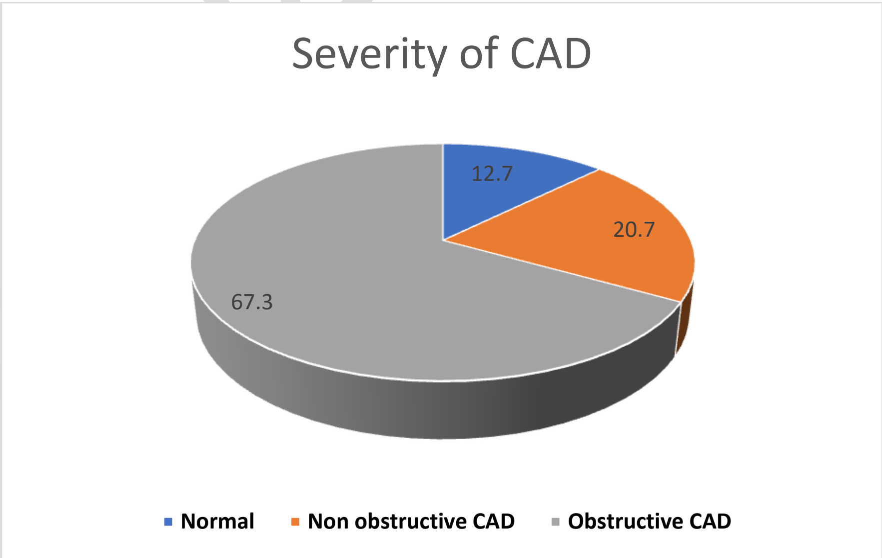
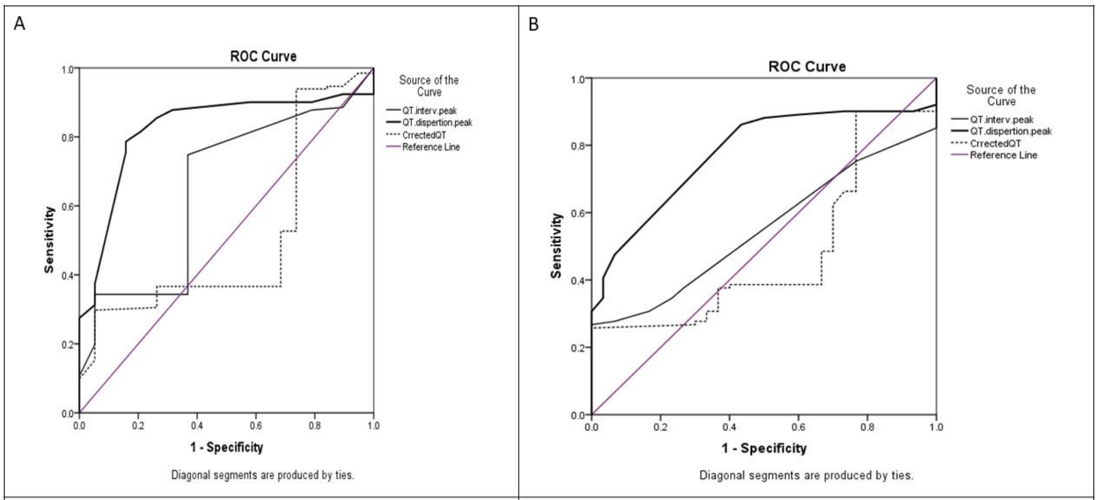


Figure 1: Demonstrated the distribution of the studied cases according to the severity of CAD



A	Sensitivity	Specificity	PPV	NPV	Accuracy
QT interval (peak)	74.8%	63.2%	93.3%	26.7%	73.3%
QTd (peak)	81.7%	78.9%	96.4%	38.5%	81.3%
QTc	93.9%	26.3%	89.8%	38.5%	85.3%

B	Sensitivity	Specificity	PPV	NPV	Accuracy
QT interval (peak)	75.2%	23.3%	76.8%	21.9%	63.4%
QTd (peak)	86.1%	56.7%	87%	54.8%	79.4%
QTc	90.1%	23.3%	81.8%	47.6%	74.8%

Figure 2: A: Roc curve of QT, corrected QT and QT dispersion for prediction of CAD patients from normal**.** B: Roc curve of corrected QT and QT dispersion for differentiation between obstructive and non-obstructive CAD cases

Discussion

Numerous studies advocated the use of QT interval (QTI) variations in response to exercise-induced ischemia rather than ST-segment changes to improve the diagnostic performance of stress ECG. Using QTI for diagnosis of ischemia can be explained as Ischemia produced by exercise produces variation in ventricular repolarization. QT dispersion (QTd) is one of the QTI metrics that is used more often than the others [(13)]

This work reported non-significant difference between normal, obstructive and non-obstructive groups regarding age and hyperlipidemia but there was significantly higher percentage of male patients, smokers, diabetics, and hypertensive between normal and obstructive patients. Generally, these results could be interpreted as men of middle age are more prone to cardiovascular risk than the same aged female because of female sex hormone cardiac protection effect [(14)], and Smoking exposure causes heart disease by several processes, involving vasoconstriction, inflammation, decreased oxygen delivery and clot formation. In addition to directly harming coronary arteries, oxidised low-density lipoprotein increases and high-density lipoprotein levels decrease (that eliminates cholesterol buildup in the arteries), hence causing elevation in fatty deposits (plaque) at the site of the arterial damage [(15)]. some similar results were found as they revealed higher rate of male, smokers, diabetics & hypertensives among obstructive CAD patients but they are different regarding age and dyslipidemia as they were significant [(9)]. Another study [(6)] found dissimilar results as it reported that age, gender distribution, hypertension, dyslipidemia and smoking were similar in both CAD and control groups.

Family history showed a significant increased rate in obstructive than non-obstructive and normal groups. These results are in line with those who documented the association between family history of CAD and acute coronary syndrome (ACS) in chest pain patients [16], also, in Multi-Ethnic Study of Atherosclerosis (MESA) it was noted that there was an association between family history of premature coronary heart disease and the presence of any coronary artery calcification, as well as advanced coronary artery calcification [17]. But on the opposite side, another study [9] documented a non-significant relation of family history with severity of CAD.

BMI was significantly increased from normal to non-obstructive CAD with highest value in obstructive CAD patients, that result is parallel to Khan et al, 2018 [18] who reported that obesity was related with a considerably higher risk of cardiovascular mortality and morbidity in comparison to a normal BMI.
Numerous studies have demonstrated that the obesity is an independent risk factor for cardiovascular diseases. This risk added to the relationship between obesity and hypertension, dyslipidaemias, diabetes mellitus, and sleep apnea syndrome, all of which have been shown to increase the prevalence of cardiovascular diseases, increased the risk of cardiovascular disease [19].

Our results revealed non-significant changes in heart rate at beginning and peak with significantly higher heart rate in CAD groups than in normal group, this indicates delay in heart rate recovery in patients with CAD, in agreement with those results, a study showed significant delay in heart rate recovery time in diabetic patients with positive stress ECG test for myocardial induced ischemia [20]. Also, another showed similar duration of exercise, resting, and peak heart rate between CAD and control groups [6].

Current study findings documented that basal QT interval showed non-significant differences between studied groups but measurement at peak and recovery was increasing significantly from normal group to non-obstructive and Obstructive CADs, also QTc (Bazett formula) was significantly increased with the increasing obstruction, this is in line with the study [6] that revealed a significantly higher QT interval and Bazett formula QTc (at max exercise) among CAD patients than control, and non-significant difference of QT interval and QTc at rest between both groups. Also, another study [9] reported significantly higher QTc among obstructive CAD patients than non-obstructive CAD
This work revealed that QT dispersion at rest had significantly lower value in normal group than both non obstructive and obstructive CAD groups and also a significantly lower QT dispersion was present in non-obstructive than obstructive CAD groups. Coincident results presented in study [11] that revealed that QT dispersion at rest and at peak of stress ECG were considerably higher in ischemic cases than normal perfusion group.

In the current work, correlation analysis reported positive correlation between Gensini score (degree of coronary obstruction) and QT interval (at beginning, at peak & at recovery), corrected QT, QT dispersion at peak. This is in agreement with the result found by [11] who found a positive association between QT dispersion difference and cardiac defect size**,** also another study [21] that also showed that a strongly positive association exists between QTc dispersion and SYNTAX score (degree of coronary occlusion).

Also, various studies reported the association between QTc dispersion and CAD severity [22, 23 & 24] Nevertheless, these investigations assessed the severity of CAD utilizing distinct grading methods, including vessel score, Friesinger score, and Leaman score, but the study [25] assessed extent and severity of ischemia by diffuse score and Gensini score. and showed highly significant correlation with QT dispersion.

QT dispersion was not associated to gender, age, obesity, DM, smoking or ischemic heart disease family history. But a correlation existed between QTc dispersion and serum creatinine, which is in agreement with our results that reported non-significant correlation between QT dispersion (at peak) among ischemic patients and age, sex, smoking, BMI but recorded significant positive correlation with systolic BP, Diastolic BP [21]. Moreover, another study [25] found no association between QTc dispersion and each of age, sex, smoking, DM and gave significant association with hypertension

For prediction of obstructive patients, ROC curve analysis revealed that QT dispersion at cutoff point 39 had sensitivity 86.1% and specificity 56.7%, this is coincident with the study [8] that documented a sensitivity of QT dispersion for prediction of critical CAD was 90% and specificity 53% at a cutoff point 37.

Corrected QT revealed sensitivity 90.1%, specificity 23.3% at cutoff point 337.85 ms (AUC 0.48, 95% CI 0.37 – 0.60). similar results were explored in study [8] that reported higher validity of QTc at recovery (cut off point 404 msec sensitivity 90.9% & specificity 46%)

Conclusion

Stress ECG test had a benefit of being non-invasive low-cost test, it is proven that considering QT prolongation and dispersion for detection of obstructive CAD patients improved the accuracy of this technique

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To cite this article: Hany H. Ebaid, Hesham Rashid, Mohamed A. Tabl, Mohamed A. Mahmoud. Correlation between QT Interval Prolongation or Dispersion in Positive Exercise ECG Patients and Severity of Coronary Artery Disease. BMFJ XXX, DOI: 10.21608/bmfj.2023.187365.1746