ejpmr, 2022,9(12), 65-72

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

CORRELATION OF PROLONGED QTC DISPERSION WITH THE SEVERITY OF CORONARY ARTERY DISEASE DETECTED BY SYNTAX SCORE IN PATIENTS WITH NON-ST SEGMENT ELEVATION MYOCARDIAL INFARCTION

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Article Received on 14/10/2022 **Article Revised on 04/11/2022** **Article Accepted on 24/11/2022**

ABSTRACT

Determination of the QT interval dispersion by means of a standard ECGat rest has been widely used for cardiovascular risk assessment during the last 15 years as one of the recent explanations for the development of life threatening ventricular arrhythmias. However, littleis known about the relation between QT dispersion and the severity of coronary artery atherosclerosis as defined by SYNTAX score. The present study was done to assess the correlation between QTc dispersion and these verities of coronary artery disease in acute Non-ST elevation myocardial infarction detected by SYNTAX score. This cross sectional observational study conducted in the NICVD, Dhaka It included 100 patients of Non-STEMI underwent coronary angiography in NICVD. QT dispersion was calculated as the difference between the longest(QT max) and the shortest QT (QTmin) interval recorded by standard 12 lead ECG. The QT interval was corrected by using Bazett's formula (QTc = QT/square root of R-R interval in seconds).Corrected QT dispersion (QTcd) was defined as the difference between the maximum and minimum QTc for a given heart rate. Normal QTcd was 45+_15 ms(chugh,2014),and prolong QTcd was 60ms. The SYNTAX score is calculated by syntax calculator, a new tool to grade the complexity of coronary artery disease.100 participating patients, there were divided into two groups. In Group 1 mean age 48.9 ± 5.8 years and in group-ll mean age was 47.6 ± 8.5years.The mean QTc dispersion was 45 ± 15 ms, while mean SYNTAX score was 19.3 ± 9.3. in group-1 and 11.9 ± 8.6 years There is a strong positive correlation between QTc dispersion and SYNTAX score.QTc dispersion has emerged as a noninvasive measurement for quantifying the degree of myocardial repolarization inhomogeneity. QTc dispersion>60 ms had independent predictive value for the severity of coronary artery disease. The greater the QTc dispersion the higher the number of coronary artery involvement. We observed that there is a positive correlation between prolonged QT dispersion and coronary artery disease severity in terms of syntax score.

KEYWORDS: QTc dispersion; SYNTAX score; Non-STEMI.

INTRODUCTION

Acute coronary syndrome (ACS) is a useful operational term which distinguishes acute myocardial ischemia from stable coronary artery (CAD) disease. Non-ST-segment elevation ACS (NSTE-ACS) comprises unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI). Where as ST elevation MI is due to acute total occlusion, NSTEMI is due to severe obstruction but not total occlusion of culprit coronary artery.

The 12 leads electrocardiogram (ECG) is the most readily available non invasive test by which, in addition of diagnosis, localizing and estimating the size of myocardial infarction can be determined.

Non invasive detection of coronary artery disease is a prime goal for diagnostics in clinical cardiology. QT interval on the surface electrocardiogram (ECG) is a measure of total time of ventricular depolarization and repolarization. Regional differences in ventricular repolarization are reflected as differences in QT intervals in leads corresponding to different part of the myocardium. This heterogeneity is called QT interval dispersion(Doven, et al., 2000). Heterogeneous repolarization may be visible in the 12-lead ECG recording – the refraction time of the action potential is longest in the intraventricular septum and the QT intervals are the longest inantero-septal leads.[1]

Determination of the QT interval dispersion (QTd) by means of a standard ECG at rest has been widely used for cardiovascular risk assessment during the last 15 years as one of the recent explanations for the development of life threatening ventricular arrhythmias is based on the prolongation and dispersion of repolarization between neighboring regions of myocardium.[2]

The SYNTAX (*Syn*ergy between Percutaneous Coronary Intervention with *TAX*US and Cardiac Surgery) score is an angiographic scoring system based on the severity and complexity of coronary lesions. The Syntax score has been shown to be able to predict mortality and morbidity at early and late follow-up in patients irrespective of disease severity in different clinical situations, including ACS.[3]

SYNTAX score was developed as a comprehensive approach for the prospective quantification of coronary lesions with respect to their number, location, and anatomical complexity. This anatomical score was pioneered to aid in decision making in patients with complex coronary artery disease (CAD) allocated to PCI or coronary artery bypass graft (CABG) surgery in the landmark SYNTAX trial.[4]

Originally, the SYNTAX score was designed to grade the complexity of stable coronary artery disease. Higher values of this score, reflecting a more challenging coronary anatomy for the interventional cardiologist.

Therefore, SYNTAX score is a useful tool in choosing an intervention strategy. Although the SYNTAX score is proposed to predict adverse cardiac events in patients with stable coronary disease, its prognostic value is expanding for patients presenting with ACS and non ST elevation MI (NSTEMI).

The aim of the study is to discover the relationship between QT dispersion and severity of coronary artery atherosclerotic diseases as detected by SYNTAX score in patient who suffered NSTEMI.

Previous studies by Chowdhury (2015), Karmakar (2015),Islam (2012), Islam (2014) and Tushar, et al. (2015)conducted in NICVD assessed QTc dispersion correlates with diastolic dysfunction of left ventricle, coronary artery disease severity in myocardial infarction(STEMI) and effect of PCI in angina. But there was no study related to my topic with NSTEMI and SYNTAX score.[5–9]

METHODS

This cross sectional observational study was done in deportment of cardiology, National Institute of Cardiovascular disease, Dhaka from April, 2018 to March, 2019. Sample population was secluded by brief history, Targeted physical examination E.C.G. Troponin-I were don on admission. On the basis of Inclusion & Exclusion criteria of the patient Inclusion criteria. The objective of the study was to find out the relationship between prolog QTc dispersion in the Pt. with NSTEMI with angiographic severity of the CAD A total of 100 patients with NSTEMI who agreed to undergo coronary angiography were included in the study. Coronary angiogram was done during index hospital admission. On the basis QTc dispersion, study subjects were divided into two groups: 50 patients of acute NSTEMI having prolonged QTc dispersion were assessed as group I and 50 patients of NSTEMI patients having normal QTc dispersion were assessed as group II. E.C.G was done in every patient on admission and corrected QT dispersion was measured by Bazett's formula (QTc) = QT/Square roof of RR interval in msec. Normally QTc was 45+15 ms and prolonged QTc dispersion was > 60ms. Than Coronary angiogram was done by conventional method and angiographic Patten and CAD severities assessment was done by visual estimation. SYNTAX score was calculated by 2 independent experienced interventional cardiologist who ware blinded to the identities and clinical information of the patients from baseline diagnostic CAG. The numerical data obtained from the study was analyzed and significance of differences were estimated by using statistical methods. The Statistical Package for Social Sciences version 23 software (SPSS inc., Chicago, Illinois, USA) was used for data analysis. Categorical variables were expressed as percentage and frequency and continuous variables as mean and standard deviation. Continuous variables were compared through the Student's t-test and ANOVA and for the categorical variables the chi-square test were done. To detect association between prolonged QTc dispersion and coronary artery diseases severity (by SYNTAX score) Pearson's correlation test was done. A p- value of less than 0.05 was considered statistically significant.

RESULT

This cross sectional observational study was done at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, during the period from April, 2018 to March, 2019. This study was performed with an aim to find out the relationship between prolonged QTc dispersion in patients with Non ST Segment Elevation Myocardial Infarction with the severity of coronary artery disease. A total of 100 patients with NSTEMI who agreed to

undergo coronary angiography were included in the study. Coronary angiogram was done during index hospital admission. On the basis QTc dispersion, study subjects were divided into two groups: 50 patients of acute NSTEMI having prolonged QTc dispersion were assessed as group I and 50 patients of NSTEMI patients having normal QTc dispersion were assessed as group II.

Table I: Age distribution of the study patients (n=100).

Age in years	Group I (N= 50)		Group II (N=50)		p value
	Number	%	Number	%	
25 – 34	1	2.0	4	8.0	
35 – 44	4	8.0	9	18.0	
45 – 54	34	68.0	25	50.0	
55 - 60	11	22.0	12	24.0	
Mean ± SD (Range)	48.9±5.8 (25-58)		47.6±8.5 (25-64)		0.39^{NS}

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
NS= Not significant (p>0.05)
p value reached from unpaired student t test.

Table 1 describes that total number of 100 patients were studied. The mean age of the studied patients was48.3±7.3 years ranging from 26 to 60years. The mean age of group I was 48.9±5.8 years ranging from 25 to 58 years and the mean age of group II was 47.6±8.58 years ranging from 25 to 64 years. The mean age of group I was higher than group II, but the difference between two groups was not statistically significant (p=0.39). It was found that among the group I, highest percentage were in the range of 45-54 years (68%) followed by 55-60 years (22%), 35-44 years (8%) and lowest in age group of 25-34 years (2%). On the contrary, the same sequence was observed among the group II patients.

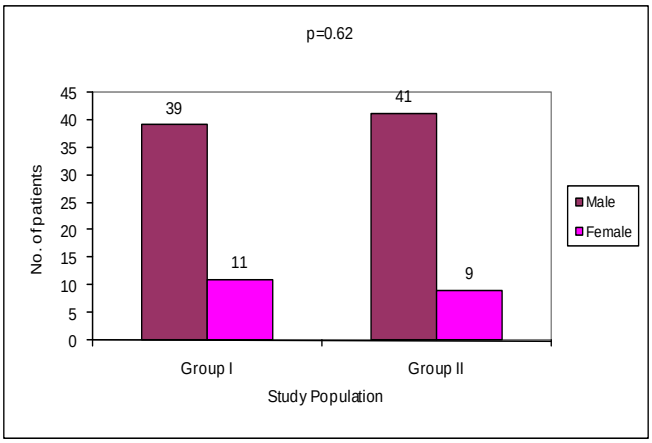

Figure 1: Sex distribution among the study patients.

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
NS= Not significant (p>0.05)
This study was carried out in 100 patients. In group I, 39 (78%) patients were male and 7 (14%) patients were female. In group II, 41 (82%) patients were male and 9 (18%) were female. Male female ratio was 4:1. No significant difference (p=0.62) was found between the groups in terms of sex distribution. P value reached from Chi Square (χ^2) test.

Table II: Risk factors of the study patients (n=100).

Risk Factors	Group I (n= 50)		Group II (n=50)		p value
	Number	%	Number	%	
Smoking					
Yes	35	70.0	28	56.0	0.15^{NS}
No	15	30.0	22	44.0	
Hypertension					
Yes	24	48.0	19	38.0	0.31^{NS}
No	26	52.0	31	62.0	

Diabetes mellitus					
Yes	28	56.0	18	36.0	**0.03**^{S}
No	22	44.0	32	64.0	
Dyslipidaemia					
Yes	24	48.0	7	14.0	**0.001**^{S}
No	26	52.0	43	86.0	
Family H/O of premature CAD					
Yes	36	72.0	29	58.0	0.14^{NS}
No	14	28.0	21	42.0	

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
p value reached from Chi Square test
S= Significant (p<0.05), NS = Not significant (p>0.05)
Table 2 shows among the studied patients, highest percentage had family history of premature CAD (72%) followed by smoking (70%), diabetes mellitus (56%),hypertension and dyslipidaemia (48%) in Group I. On the contrary,highest percentage had family history of premature CAD (58%) followed by smoking (56%), hypertension (38%), diabetes mellitus (36%) and dyslipidaemia (14%)in Group II. Diabetes mellitus anddyslipidaemia were significantly more in group I than ingroup II (p<0.05). The remaining traditional risk factors were observed more in group I than group II but did not reach the level of significance (p>0.05).

Table III: Distribution of the study patients according to clinical examinations (n=100).

Parameters	Group I (n= 50)	Group II (n=50)	P value
	Mean ± SD	Mean ± SD	
Pulse/minute	79.4±4.8 (70-86)	77.1±2.6 (70-80)	0.06 ^{NS}
Systolic blood pressure (mmHg)	130.1±8.5 (120-145)	128.3±8.6 (110-150)	0.30^{NS}
Diastolic blood pressure (mmHg)	81.1±7.1 (60-100)	79.3±5.9 (60-90)	0.17^{NS}

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
p value reached from unpaired student t test
NS = Not significant (p>0.05)
Parenthesis indicates range

Table 3 shows that among the group I patients, the pulse per minute, systolic blood pressure and diastolic blood pressure were 79.4±4.8 per minute, 130.1±8.5 and 81.1±7.1 mmHg respectively. Among group II, the pulse per minute, systolic blood pressure and diastolic blood pressure were 77.1±2.6 per minute, 128.3±8.6 mmHg and79.3±5.9 mmHg respectively. All hemodynamic parameters including pulse, systolic blood pressure and diastolic blood pressure were observed more in group I than group II. But no statistical significant differences were found in pulse/min, systolic blood pressure, diastolic blood pressure between the study groups (p>0.05).

Table IV: Biochemical status of the study patients (n=100).

Biochemical parameters	Group I (n= 50)	Group II (n=50)	p value
	Mean ± SD	Mean ± SD	
RBS (mmol/l)	9.2±2.5	9.1±1.6	0.98^{NS}
S. creatinine (mg/dl)	1.07±0.23	1.04±0.18	0.59^{NS}
Troponin I(ng/dl)	24.0±20.5	21.2±10.5	0.42^{NS}

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
p value reached from unpaired student t test
NS = Not significant (p>0.05)
Table 4 shows biochemical status of the study patients. The mean RBS level was 9.2±2.5 mmol/l in group I and 9.1±1.6 mmol/l in group II and the mean difference was not statistically significant between the two groups (p=0.98).The mean S. creatinine level was 1.07±0.23 mg/dl in group I and 1.04±0.18 mg/dl in group II and the difference between the two groups was statistically insignificant (p=0.59). Troponin I was found 24.0±20.5 ng/dl vs. 21.2±10.5 ng/dl in group I and group II with statistically insignificant difference (p=0.42).

Table V: Mean percent of ejection fraction of study patients (n=100).

Ejection fraction (percent)	Study patients				p value
	Group I (n= 50)		Group II (n=50)		
	Number	%	Number	%	
Moderate LV dysfunction (30-40)	3	6.0	0	0.0	
Mild LV dysfunction (41 – 54)	25	50.0	20	40.0	
Normal LV function (≥ 55)	22	44.0	30	60.0	
Mean ± SD	54.1±6.2		56.5±6.1		0.05^{NS}

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
p value reached from unpaired student t test
NS = Not significant (p<0.05)

Table 5 shows that the mean percent of ejection fraction of the study patients. It was 54.1±6.2% for the patients with group I and 56.5±6.1% for the patients of group II and the mean difference between the two groups was statistically insignificant (p=0.05).

Table VI: Distribution of the study patients according to SYNTAX score (n=100).

SYNTAX Score	Group I (n= 50)		Group II (n=50)		p value
	Number	%	Number	%	
High (≥23)	26	52.0	11	22.0	0.002^{S}
Low (<23)	24	48.0	39	78.0	0.002^{S}
Mean ± SD	19.3±9.3		11.9±8.6		$<0.001^{S}$

Group I: NSTEMI Patients with prolonged QTc dispersion
Group II: NSTEMI Patients with normal QTc dispersion
S=Significant (p<0.05)
p value reached from Chi Square test of categorical approach and unpaired t-test of quantitative approach.

Table 6 shows the SYNTAX score of the study patients. Low SYNTAX score was found (48% vs 78%) in group I and group II respectively with highly significant association (p=0.002). High SYNTAX score was found (52% vs 22%) in group I and group II respectively with highly significant association (p=0.002). Mean SYNTAX score was observed 19.3±9.3 vs. 11.9±8.6 in group I and group II respectively with significant difference (p<0.001).

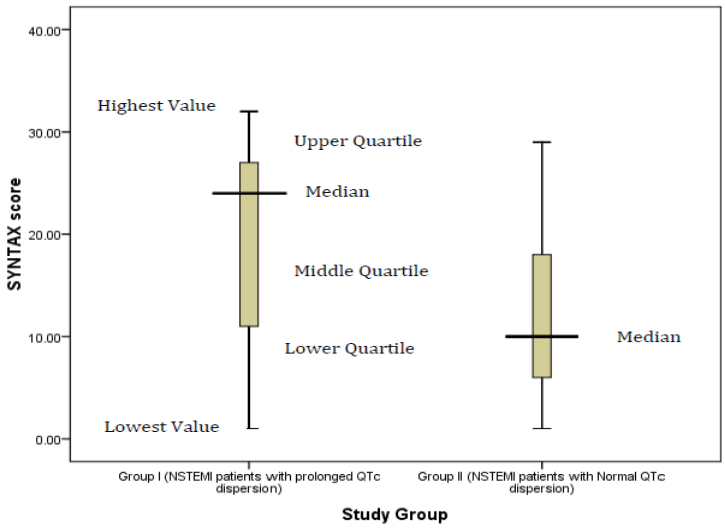

Figure II: Relationship between QTc dispersion and SYNTAX score by Box Plot diagram.

The above diagram showing the median, inter quartile range, highest value of SYNTAX score in group I were found to be higher than group II through the presentation of box plot diagram.

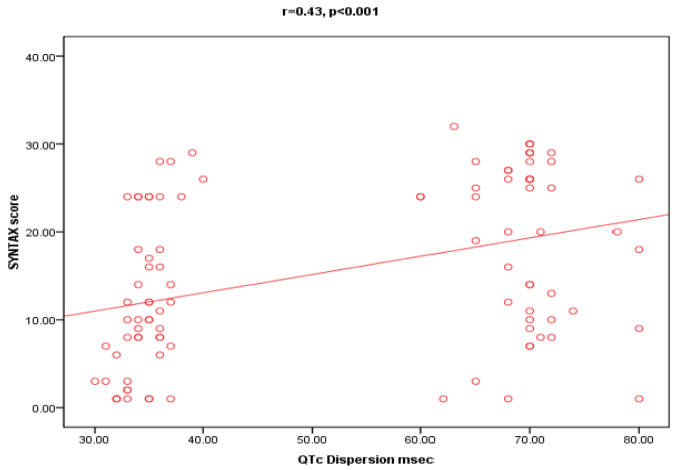

Figure III: Scatter diagram showing correlation between QTc dispersion and SYNTAX score.

The above diagram shows that there is a positive correlation between QTc dispersion and SYNTAX score with correlation coefficient, r=0.43, p<0.001. The diagram depicts that QTc dispersion is increasing as well as SYNTAX score is also increasing accordingly. The p value reached from correlation t-test.

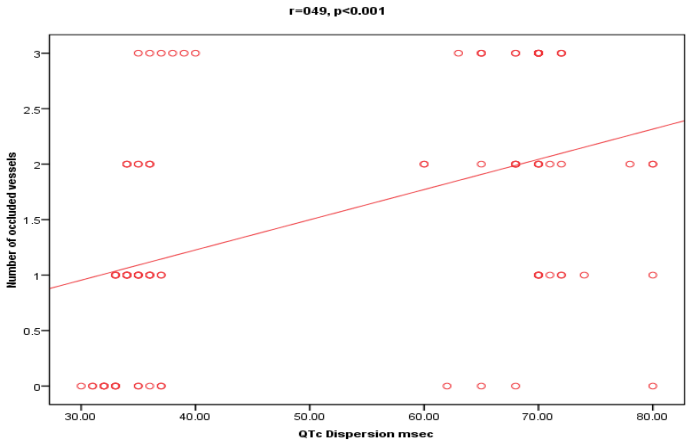

Figure IV: Scatter diagram showing correlation between QTc dispersion and number of occluded vessels.

The above diagram shows that there is a positive correlation between QTc dispersion and SYNTAX score with correlation coefficient, r=0.49, p<0.001. The diagram depicts that QTc dispersion is increasing as well as number of occluded vessels are also increasing accordingly. The p value reached from correlation t-test.

DISCUSSION

This cross sectional observational study was done at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, during the period from April, 2018 to March, 2019. This study was performed with an aim to find out the relationship between prolonged QTc dispersion in patients with Non ST Segment Elevation Myocardial Infarction with the severity of coronary artery disease. A total of 100 patients with NSTEMI who agreed to undergo coronary angiography were included in the study. Coronary angiogram was done during index hospital admission. On the basis QTc dispersion, study subjects were divided into two groups: 50 patients of acute NSTEMI having prolonged QTc dispersion were assessed as group I and 50 patients of NSTEMI patients having normal QTc dispersion were assessed as group II.

The mean age of the patients was 48.9+5.8 years and 47.6+8.5 years in group I and group Irrespectively, which was almost similar between two groups. In the age group of 55-64 years ,maximum frequency was found . Almost similar mean age was observed by Tikiz,et al. and Yilmaz,et al. which are comparable with the present study.15,17 .Uddin 21 found mean age of49.7±11.3 in over all patients of IHD. These small variations of mean age among different study might be due to differences in study design. Hailer et al. found significant difference in mean age between two groups.

There was no statistically significant difference in mean age two between QTc dispersion groups in the current study. In this study it was observed that in patients with QTc dispersion<60 millisecond in group I, 39 (78 %) patients were male and 7(14 %) patients were female. With QTc dispersion.>60millisecond in group II, 41

(82%) patients were male and 9 (18 %) were female. Male female ratio was 4:1.Sexdistribution of the patients in two CAD severity groups revealed significant impact of male sex in severity of CAD. No significant (p>0.05) was found between two groups regarding sex distribution. Hegazy et al. also show no significant difference regarding sex distribution between two groups. Sex distribution of the patients in two groups revealed significant impact of male sex in severity of CAD (P=0.025). Similar male preponderance was found in almost all studies in IHD. Female are less prone to developed IHD in premenopausal age due to protective role of estrogen, moreover smoking as a risk factor of IHD is less common in our country among female, which may explain male predominance of IHD.

The common risk factors for coronary artery disease in the present study showed that, family history of CAD was the highest in Group-I followed by diabetes mellitus (DM), smoking, hypertension, and dyslipidemia. In Group-I smoking family history of CAD. was also the commonest followed by smoking hypertension, diabetes mellitus and dyslipidemia. There was statistically significant of difference between the two groups in terms of diabetes mellitus and dyslipidemia. Smoking habit was found 35 (70%) in group I and 28 (56 %) patients in group II and statistically significant (p<0.05).In group I, 23(46%) patients were hypertensive and in group-II, 28 (56%) patients were hypertensive and statistically insignificant (p>0.05). Diabetes mellitus was found 15 (30%) and 31 (62%) patients with statistically significant (p<0.05) in group I and group II respectively. Dyslipidemia was found 2 (4%) and 19 (38%) patients with statistically significant (p<0.05) in group I and group II respectively. Family history of CAD was found 20 (40%) and 16 (32%) patients with statistically insignificant (p>0.05) in group I and group II respectively.

Coronary angiogram was performed in all study population during index hospital admission. The findings were analyzed by syntax score.33In this study it was observed that the mean syntax score for group I patients was 19.3±9.3 and that of group-II patients was 11.9±8.6 and the mean difference was statistically significant (p<0.001).The mean vessels score was significantly (p<0.001) lower in group II in comparison with group I, indicating more severe coronary artery disease in group II patients. It was found that among group I patients, highest percentage had syntax score 52%. In group II patients, highest percentage had syntax score 22%.There was an association between QTc dispersion and number of vessel involvement. that single occluded vessel was significantly higher in group II than group I (40% vs. 20%, p=0.03). Double occluded vessel had more in group I than group II (32% vs. 16%, p=0.04) with significant association. Triple occluded vessel had also significantly higher in group I than group II (40% vs. 12%, p=0.001).

There was a strong positive correlation with the QTc dispersion and increasing number of vessel involvement (Pearson's correlation coefficient). Patients in group I and II respectively. Syntax score>23 was found 52% patients in-group I and 22% patients in group II. Syntax score <23 was found 24% patient in group I and 78% patients in group II respectively. The mean Syntax score for group I patients was19.3±9.3 and that of group II patients was11.9±8.6. The mean difference was significantly (p<0.05) higher in group II patients. There was a strong positive correlation between the QT dispersion and Syntax coronary angiographic severity score (Pearson's correlation coefficient).

Luz et al. found Friesinger index 0 in 19.0% patients, 1-4 in 17.9% patients, 5 – 10 in 36.1%patients and 11-15 in 27.0% patients. 26Therewas a strong positive correlation between the QTc dispersion and Leaman score (Pearson's correlation coefficient). Bampi et al observed that, Friesinger score 0-4 indicates less extensive disease and Friesinger score e"5 indicates extensive coronary atherosclerosis with extensive coronary artery disease.

CONCLUSION

QTc dispersion has emerged as a noninvasive measurement for quantifying the degree of myocardial repolarization inhomogeneity. QTc dispersion>60 ms had independent predictive value for the severity of coronary artery disease. The greater the QTc dispersion the higher the number of coronary artery involvement. We observed that there is a positive correlation between prolonged QT dispersion and coronary artery disease severity in terms of syntax score.

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