Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2024 (27 Aug);38.98. https://doi.org/10.47176/mjiri.38.98

Evaluation of the Relationship between QT Dispersion in ECG and Response to Primary PCI in Patients with Acute Myocardial Infarction

Mir Mohammad Sadra Ghods Hosseini[1], Samira Dodangeh[2], Hamid Reza Javadi[2], Alireza Razaghi[3], Majid Haji Karimi[2]*

Received: 27 Dec 2023 Published: 27 Aug 2024

Abstract

Background: St-elevation myocardial infarction (STEMI) is a serious condition that occurs when the blood flow to one or more coronary arteries is blocked, leading to damage or death of the heart muscle (myocardial injury or necrosis). The present study aimed to compare QTc and QTd intervals in patients with STEMI before and 90 minutes after treatment in Booali Sina Hospital, Qazvin, Iran.

Methods: The present study is an analytical cross-sectional study. Between March 2021 and 2022, 107 patients administered to Booali Sina Hospital, Qazvin, Iran, due to STEMI who underwent primary PCI were enrolled in the study. Data including age, sex, height and weight, disease history, QTc interval before and 90 minutes after treatment, QTd before and 90 minutes after treatment and Ejection fraction values were extracted from the patient's files. Then, the relationship between change in QT and QTd after treatment with response to treatment based on ST Resolution was evaluated. SPSS 20.0 statistical program was used for the statistical analysis. All values are given as mean± standard deviation (SD). A p-value of less than 0.05 was considered as significant.

Results: The observed mean difference in investigated variables of patients, including age, height, weight, and BMI, was not statistically significant between the two groups (response to treatment and non-response to treatment (P > 0.05). Findings demonstrated that the mean QTd 1 in the response to the treatment group was higher compared to the non-response to the treatment group, and this difference was not statistically significant (P = 0.337). It is remarkable that the mean QTd 2 in the response to treatment group was statistically significantly lower than the non-response to treatment group (P = 0.002).

Conclusion: We showed that QTd in the studied patients after primary angioplasty reduced significantly compared to the QTd before the treatment, so the QTd can be considered as a noninvasive measure of the response to the treatment in patients with STEMI.

Keywords: Acute coronary syndrome, ST-segment elevation, Primary percutaneous coronary intervention, QT dispersion

Conflicts of Interest: *None declared*
Funding: *None*

Cite this article as: Ghods Hosseini MMS, Dodangeh S, Javadi HR, Razaghi A, Haji Karimi M. Evaluation of the Relationship between QT Dispersion in ECG and Response to Primary PCI in Patients with Acute Myocardial Infarction. *Med J Islam Repub Iran.* 2024 (27 Aug);38:98. https://doi.org/10.47176/mjiri.38.98

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death globally, posing a significant threat to public health. The most common manifestation of CVDs is acute myocardial infarction (AMI), which occurs when the coronary arteries become blocked, either completely or partially, due to coronary artery disease. This blockage prevents blood from reaching the heart muscle, leading to potentially life-threatening consequences. Therefore, ischemic reperfusion is the most important treatment for patients with ST-elevation myocardial infarction (STEMI)

Corresponding author: Dr Majid Haji Karimi, m.hajikarimi@qums.ac.ir

1. Clinical Research Development Unit, Qods Hospital, Qazvin University of Medical Sciences, Qazvin, Iran
2. Clinical Research Development Unit, Booalisina Hospital, Qazvin University of Medical Sciences, Qazvin, Iran
3. Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran

↑What is "already known" in this topic:
Primary PCI is the essential treatment for patients with STEMI. The recommended method for evaluation of response to treatment is ST resolution in ECG after primary PCI. It is clear that QT changes by ischemic event before and after primary PCI.

→What this article adds:
We tried to find the change in the QT and QTd after primary PCI in patients with STEMI based on the response or no response to primary PCI.

Our research revealed that QTd decreased in patients who respond to Primary PCI, so it can be a marker for response to treatment.

(1, 2). Fibrinolysis, which involves the administration of fibrinolytic drugs such as streptokinase and primary percutaneous coronary intervention (PCI) are two treatment options that aim to restore blood flow to ischemic tissues. (3). In patients with STEMI, ST-segment resolution (STR%) and myocardial blush grade (MBG) are the primary reperfusion parameters that have been shown to be crucial in determining the prognosis of these patients (4-7).

In addition, QT interval dispersion (QTd) on electrocardiogram (ECG) is an important diagnostic criterion to evaluate the heterogeneity of ventricular repolarization in patients with STEMI, providing valuable information about the risk of arrhythmias and cardiac mortality(8). QTd is the difference between the longest and shortest QT intervals measured on a 12-lead ECG (9). The QT interval represents the time from ventricular depolarization to repolarization in the ECG.Furthermore, these arrhythmic events can be followed by sudden death, implying that a prolonged QT interval is a significant cardiovascular risk factor (10-13). AMI has been shown to increase the variability in the process of repolarization (repolarization heterogeneity) (13), and the QTc interval begins to shorten following successful reperfusion (14-16). There is a lack of research on the changes in the QTc in the early period after revascularization following an AMI.

A study by Roukema et al. found a direct relationship between the QTd and the presence of MI. So, according to the study, ischemia increases the time it takes for the heart muscle to recover from an electrical impulse (repolarization time), which in turn leads to a prolongation of the QT interval on an ECG (17). So, according to previous studies, it has been found that, specifically, the QTd is significantly higher in patients with coronary artery stenosis when measured immediately after exercise testing (>50%). (18). According to Alasti et al.'s 2010 study, the researchers investigated the effect of Percutaneous Coronary Intervention (PCI) on QT dispersion in 96 patients. They took ECG recordings from the patients before PCI (pre-procedure) and 24 hours after PCI (post-procedure). The researchers calculated various ECG parameters, including Duration of QRS, QT interval, QT dispersion, Modified QT dispersion, JT interval (a measure of the time it takes for the heart to recover from an electrical impulse), Modified JT dispersion (a modified measure of JT dispersion). The results showed a clear difference between the pre-procedure and post-procedure ECG recordings in terms of Duration of QRS, Modified QT dispersion and Modified JT dispersion (19). This suggests that PCI had a significant effect on these ECG parameters, which may be related to changes in the electrical activity of the heart or the recovery process after PCI.

Because it is very important to evaluate the effectiveness of revascularization therapy in patients with MI in order to guide the subsequent management and evaluate the prognosis (20). Our study aimed to compare QTc and QTd intervals in patients with STEMI before and 90 minutes after therapeutic intervention in Booali Sina Hospital, Qazvin, Iran.

Methods

The present study is an analytical cross-sectional study. Between March 2021 and March 2022, 107 patients administered to Booali Sina Hospital, Qazvin, Iran, due to STEMI who underwent primary PCI, were enrolled in the study.

All patient information was collected and recorded using the medical files. The combination of acute anginal chest pain and ST elevation on an ECG was used to diagnose STEMI. The sample size based on Harris et al.'s study (21) was obtained from 55 samples, with a 95% confidence interval and the test power of 80%, and for the average QT interval with the values of 32.1+33.6 and 50.86+36.1.

The inclusion and exclusion criteria of the study were as follows: patients diagnosed with STEMI who were candidates for primary PCI were considered as inclusion criteria. Exclusion criteria also include patients diagnosed with MI without ST-segment elevation, having a previous history of STEMI, taking drugs that prolong the QT interval (such as antiarrhythmic drugs type III, IA, IC (such as amiodarone, flecainide) macrolides, methadone), patients with a history of kidney failure or heart failure, having electrolyte disorders that affect the QT interval.

Data including demographic data (age, sex), anthropometry (height and weight), disease history, QTc (QT corrected) interval before and 90 minutes after treatment (which named QTc 1 interval, QTc 2 interval) and QTd (QT dispersion) before and 90 minutes after treatment (which named QTd 1 and QTd 2), and Ejection fraction (EF) values after treatment was extracted and recorded from the patient's files.

In the present study using two criteria for response to treatment: the first is one is the percent decrease **in** ST-segment elevation after primary PCI and the second one is the TIMI FLOW score after primary angioplasty. If the reduction of the ST segment is more than 50%, it means a successful response to the treatment, and if the reduction of the segment is less than 50%, it means no response to the treatment (22). Another measure of response to treatment is the TIMI Flow score after angioplasty in angiography films, which is divided into 4 groups based on the angiographic evidence of patients: TIMI Flow 0 means no blood flow after occlusion; TIMI Flow 1 means penetration of blood flow through the occlusion without establishing blood flow after the occlusion; TIMI Flow 2 means relative establishment of blood flow; and TIMI Flow 3 means complete establishment of blood flow (23). We did not use the TIMI score to divide patients into response and non-response to treatment groups but we used this criterion just for comparing to the ECG criterion for response and non-response to treatment.

Then, the patients were divided into 2 groups by the response to primary angioplasty based on a decrease of more than 50% ST elevation in ECG.

Patients who had more than 50% ST elevation resolution in ECG 90 min after primary angioplasty were put in response to the treatment group, and other patients who did not meet these criteria were considered as non-response to treatment.

The QTc interval is considered prolonged if it is greater than 440 ms in men and 460 ms in women (24). To determine the QT interval in the ECG of the patients, the beginning of the Q wave to the end of the T wave was measured in all leads, and the highest QT value measured was corrected and recorded using Hodges formula: QTC = QT + 1.75 (heart rate – 60). Then, the QTd value was calculated as the difference between the lowest measured QTc interval and the highest QTc interval in the ECG. Normal QTd is between 10-71 and values above 100 are considered completely abnormal QTd (25).

The statistical analysis was performed using SPSS 20.0 software.The results are presented as mean ± standard deviation (SD). To compare the mean values of continuous variables between the two groups, the t-test and the chi-square tests were used. The level of significance was set at 0.05, which means that any p-value less than 0.05 is considered statistically significant.

Results

In this study, 107 patients admitted to Booali Hospital with the diagnosis of STEMI who underwent primary angioplasty were investigated. The mean age of study participants who did not respond to treatment was 57.94 ± 7.60 years, and those who responded to treatment were 57.82 ± 2.22 years. Out of 107 studied patients, 11 women (10.28%) and 96 men (89.71%), 3 women (27.3%) and 15 (15.6%) men did not respond to treatment. According to the data analysis, there was no significant relationship between the response treatment and the gender of the studied patients (P = 0.391). In addition, the observed mean difference in investigated variables of patients including age, height, weight, and BMI, was not statistically significant between the two groups ($P > 0.05$) (Table 1).

The mean QTc 1 interval in the response to the treatment group was lower compared to the non-response to treatment group, and this difference was not significant (P = 0.442). Although the mean QTc 2 interval in the non-response to treatment group was lower compared to the response to treatment group, this observed mean difference was not significant (P = 0.698). In addition, the mean QTd 1 in response to the treatment group was higher compared to the non-response to treatment group, whereas this difference was not significant (P = 0.337). It is remarkable that the mean QTd 2 in response to treatment group was statistically significantly lower than the non-response to treatment group (P = 0.002) (Table 2).

It was also found that the mean EF after primary PCI was higher in patients who responded to treatment compared to patients who did not respond to treatment, and this mean difference was not significant (P = 0.615). The findings showed that all patients with TIMI Flow grade 1 and 6 out of 42 patients with a TIMI Flow grade 2 did not respond to treatment. Whereas all patients with a TIMI Flow grade 3 responded to treatment. As Table 3 depicts, a significant difference was found between TIMI Flow and response to treatment (P = 0.001).

The results of the study showed that 10 of 61 (16.4%) patients with anterior MI did not respond to treatment, and 8 out of 44 (18.2%) patients with inferior MI did not respond to treatment. However, both patients with lateral infarction responded to the treatment. Overall, findings showed that there is no significant relationship between the location of MI and the response to the treatment (P = 0.790) (Table 4).

Among the studied patients, 39 (36.4%) patients with hypertension (HTN), 25 (23.4%) patients with diabetes mellitus (DM), 13 (12.1%) patients with dyslipidemia (DLP), 7, 7 and 3 patients respectively, didn't respond to treatment. As Table 4 depicts, no significant difference was found am between the mentioned underlying diseases and the response to treatment (P = 0.505, P = 0.080, and 0.456, respectively).

Discussion

The present study found that QTc decreases after treat-

Table 1. Comparison of mean demographic characteristics of patients in response to treatment based on ST Resolution

Variable	ST Resolution	Number of patients	Mean ± SD	*P*-value
Age	< 50%	18	57.94 ± 7.60	0.960
	> 50%	89	57.83 ± 12.22	
Height	< 50%	18	171.06 ± 6.16	0.077
	> 50%	89	173.84 ± 6.00	
Weight	< 50%	18	80.06 ± 10.90	0.562
	> 50%	89	81.54 ± 9.65	
BMI	< 50%	18	27.22 ± 2.18	0.592
	> 50%	89	26.91 ± 2.24	

> 50%: successful response to treatment; < 50%: no response to treatment

Table 2. Comparison of mean QTC, QTD, and EF in response to treatment based on ST Resolution

Variable	ST Resolution		*P*-value
	<50% Mean (SD)	>50% Mean (SD)	
QTc 1	419.30 ± 36.37	411 .28 ± 40.85	0.442
QTc 2	402.77 ± 33.14	406.71 ± 10.09	0.698
QTd 1	87.08 ± 24.91	97.66 ± 21.96	0.337
QTd 2	106.73 ± 32.65	83.11 ± 27.98	0.002*
EF	37.50 ± 8.95	38.60 ± 8.29	0.615

QTc 1 interval: QTc interval before treatment; QTc 2 interval: QTc interval 90 minutes after treatment; QTd 1: QT d interval before treatment; QTd 2: QTd 90 minutes after treatment

> 50%: successful response to treatment; < 50%: no response to treatment

EF: Ejection Fraction

[DOI: 10.47176/mjiri.38.98]

Table 3. Comparison of frequency and percentage of TIMI flow grade response to treatment based on ST Resolution

TIMI flow grade		ST Resolution		*P*-value
		<50% Freq.(%)	>50% Freq.(%)	
	Grade 1	12 (100)	0	0.001*
	Grade 2	6 (14.3)	36 (85.7)	
	Grade 3	0	53 (100)	

> 50%: successful response to treatment; < 50%: no response to treatment

Table 4. Comparison of frequency and percentage of infarct location and underlying diseases of patients in response to treatment based on ST Resolution

Variable		ST Resolution		*P*-value
		<50% Freq (%)	>50% Freq (%)	
Region of MI	Anterior	10 (16.4)	51 (83.6)	0.790
	Inferior	8 (18.2)	36 (81.8)	
	Lateral	0	2 (100)	
HTN	No	11 (16.2)	57 (83.8)	0.505
	Yes	7 (17.9)	32 (82.1)	
DM	No	11 (13.4)	71 (86.6)	0.080
	Yes	7 (28.0)	18 (72.0)	
DLP	No	15 (16.0)	79 (84.0)	0.456
	Yes	3 (23.1.7	10 (76.9)	

AMI: Acute myocardial infarction; HTN: Hypertension; DM: Diabetes Mellitus; DLP: Dyslipidemia

ment in both groups (response to treatment and non-response to treatment) but without statistical significance. Specifically, QT dispersion before treatment was lower in the non-response to treatment group compared to the response to treatment group, but after the treatment, there is a significant reduction in response to treatment group compared to the non-response to treatment group. Therefore, our data provide that QT Dispersion changes can be considered in patients with STEMI as a measure of response rate to treatment.

QTd is described as the difference between the longest (QTmax) and shortest QT interval (QTmin) with standard 12-lead surface ECG recordings of the patients, which is proposed as a marker of ventricular repolarization inhomogeneity (26). According to Gokhan et al.'s study (8) QT prolongation in the ECG represents a non-uniform and delayed repolarization recovery in regions of infarction or ischemia. During ischemia, the underlying fundamental mechanism elevates extracellular potassium levels, causing anoxia and acidosis. In addition to QT prolongation, these conditions (myocardial infarction, cardiomyopathy, and arrhythmias) can also cause other electrical changes in the heart cells, including reduction in membrane excitability, shortening of action potential duration, and prolongation of recovery of excitability following an action potential (27, 28).

Worldwide, primary angioplasty has been suggested as the best reperfusion strategy for most patients with AMI when it can be performed within less than 90 (120) min after first medical contact because it ensures reperfusion of the infarct-related coronary artery more than 90% (29).

Previous studies have reported that QTd increases in the early phase of STEMI and decreases significantly after successful recanalization of the infarct-related artery (27, 28). Based on our observations, we demonstrated a significant reduction of QTd, which reflects homogeneous myocardial repolarization and could help to reduce the mortality rate in the subjects.

In accordance with these reports, our data demonstrated a significant reduction in QTd in response to treatment group compared to non-response to treatment group. Ali et al. demonstrated similar findings (reduction in QTd) after rheolytic thrombectomy in AMI (30). QTd after MI is characterized by the size of the scar and myocardial viability. In line with the present research, Lopes et al. (31) found that thrombolytic therapy significantly reduced QTd in patients with STEMI who underwent successful thrombolysis. The QTd was significantly shorter compared to those who did not receive thrombolytic therapy. In addition, Ornek et al. (32) and Mulay et al. (33) reported that QTd decreases significantly after successful recanalization of the infarct-related artery in the 1st week of admission.

Increased QT dispersion values reflect larger amounts of scarred tissue in the infarct region, whereas low QT dispersion values present a substantial amount of viable myocardium (34). The present study focused on STEMI patients with achievement of TIMI flow grades I, II, and III. Establishing the patency of the infarct-related artery by primary angioplasty can help to restore blood flow to the affected area of the heart, reducing the risk of regional myocardial ischemia, thereby causing complete STR (STR >50%) in patients. The findings of the study showed that TIMI flow grades III were associated with STR >50% values compared to TIMI flow grades 0 and I, II. Thus, the degree of ST resolution reduction is influenced by the reperfusion status of the infarcted artery.

Moreover, there were no significant differences between the location of MI and underlying diseases (HTN, DM, and DLP) and response to therapy in patients with STEMI in included patients of the present study.

The present study had limitations, such as a relatively small sample size, so the findings could be confirmed by further studies in larger groups. In addition, as the ECG tests were done 90 minutes after the treatment, it is possible that the reduction of QTd may require more time, so it is suggested that these tests be performed in the patient's

[DOI: 10.47176/mjiri.38.98]

ECG at longer intervals.

Conclusion

We showed that QTd in the studied patients after angioplasty reduced significantly compared to the QTd before the treatment, so the QTd can be considered as a noninvasive measure of the response to the treatment in patients with STEMI.

Acknowledgments: The authors thank the staff of Booali Sina Hospital, Qazvin, Iran for their help in preparing this paper. The authors are grateful to the colleagues and patients of the endocrine and cardiac clinics who helped with the project and Mr. Mostafa Sargol.

Authors' Contributions

Majid Hajikarimi conceived and designed the study protocol; Mir Mohammad Sadra Ghods Hosseini contributed to data collection and execution of experimental tests; Alireza Razaghi performed statistical analysis; Samira Dodangeh wrote the manuscript draft and also contributed to the creation of the tables; Hamid Reza Javadi contributed to the critical revision of the article.

Ethical Considerations

This research was designed with the approval of the Research Ethics Committee of Qazvin University of Medical Sciences, Iran, with the number IR.QUMS.REC.1399.531.

Acknowledgment

The authors would like to express their gratitude to the colleagues and patients of the endocrine and cardiac clinics who assisted with the project, as well as to Mr. Mostafa Sargol. In addition, the authors would like to thank the Clinical Research Development Unit, Qods Hospital, Qazvin University of Medical Sciences, Qazvin, Iran.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Vesterinen P. Electrocardiographic repolarization variables in detecting myocardial infarction and ischemic injury: From body surface potential mapping to a single lead. Helsingin yliopisto Helsingfors universitet University of Helsinki; 2007.
2. Akbari H, Asadikaram G, Vakili S, Masoumi M. Atorvastatin and losartan may upregulate renalase activity in hypertension but not coronary artery diseases: the role of gene polymorphism. J Cell Biochem. 2019;120(6):9159-71.
3. Helal AM, Shaheen SM, Elhammady WA, Ahmed MI, Abdel-Hakim AS, Allam LE. Primary PCI versus pharmacoinvasive strategy for ST elevation myocardial infarction. Int J Cardiol Heart Vasc. 2018 Dec;21:87–93.
4. McLaughlin MG, Stone GW, Aymong E, Gardner G, Mehran R, Lansky AJ, et al. Prognostic utility of comparative methods for assessment of ST-segment resolution after primary angioplasty for acute myocardial infarction: the Controlled Abciximab and Device Investigation to Lower Late Angioplasty Complications (CADILLAC) trial. J Am Coll Cardiol. 2004;44(6):1215-23.
5. Spitaleri G, Brugaletta S, Scalone G, Moscarella E, Ortega-Paz L, Pernigotti A, et al. Role of ST-segment resolution in patients with ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention (from the 5-Year outcomes of the EXAMINATION [Evaluation of the Xience-V Stent in Acute Myocardial Infarction] Trial). Am J Cardiol. 2018;121(9):1039-45.
6. Henriques JP, Zijlstra F, van 't Hof AW, de Boer MJ, Dambrink JHE, Gosselink M, et al. Angiographic assessment of reperfusion in acute myocardial infarction by myocardial blush grade. Circulation. 2003;107(16):2115-9.
7. Poli A, Fetiveau R, Vandoni P, del Rosso G, D'Urbano M, Seveso G, et al. Integrated analysis of myocardial blush and ST-segment elevation recovery after successful primary angioplasty: real-time grading of microvascular reperfusion and prediction of early and late recovery of left ventricular function. Circulation. 2002;106(3):313-8.
8. Yosefian S, Farshidi H, Sobahni M, Rahimi S. QT-Dispersion as a potential marker in prognosis of acute myocardial infarction. Hormozgan Medical Journal. 2009;12(4):223-30.
9. Giedrimiene D, Giri S, Giedrimas A, Kiernan F, Kluger J. Effects of ischemia on repolarization in patients with single and multivessel coronary disease. Pacing Clin Electrophysiol. 2003;26(1p2):390-3.
10. Straus SM, Kors JA, De Bruin ML, van der Hooft CS, Hofman A, Heeringa J, et al. Prolonged QTc interval and risk of sudden cardiac death in a population of older adults. J Am Coll Cardiol. 2006;47(2):362-7.
11. Beinart R, Zhang Y, Lima JA, Bluemke DA, Soliman EZ, Heckbert SR, et al. The QT interval is associated with incident cardiovascular events: the MESA study. J Am Coll Cardiol. 2014;64(20):2111-9.
12. Schwartz P, Wolf S. QT interval prolongation as predictor of sudden death in patients with myocardial infarction. Circulation. 1978;57(6):1074-7.
13. Peters RW, Byington RP, Barker A, Yusuf S, Group11a BS. Prognostic value of prolonged ventricular repolarization following myocardial infarction: the BHAT experience. J Clin Epidemiol. 1990;43(2):167-72.
14. Bonnemeier H, Hartmann F, Wiegand UK, Bode F, Katus HA, Richardt G. Course and prognostic implications of QT interval and QT interval variability after primary coronary angioplasty in acute myocardial infarction. J Am Coll Cardiol. 2001;37(1):44-50.
15. Alici G, Sahin M, Ozkan B, Acar G, Acar RD, Yazicioglu MV, et al. The comparison in reduction of QT dispersion after primary percutaneous coronary intervention according to existence of thrombectomy in ST-segment elevation myocardial infarction. Clin Cardiol. 2013;36(5):276-9.
16. Galluzzo A, Gallo C, Battaglia A, Frea S, Canavosio FG, Botta M, et al. Prolonged QT interval in ST-elevation myocardial infarction: predictors and prognostic value in medium-term follow-up. J Cardiovasc Med. 2016;17(6):440-5.
17. Bonow RO, Mann DL, Zipes DP, Libby P. Braunwald's heart disease e-book: A textbook of cardiovascular medicine. Elsevier Health Sciences; 2011 Feb 25.
18. Jensen BT, Abildstrom SZ, Larroude CE, Agner E, Torp-Pedersen C, Nyvad O, et al. QT dynamics in risk stratification after myocardial infarction. Heart Rhythm. 2005;2(4):357-64.
19. Alasti M, Adel MH, Torfi E, Noorizadeh M, Bahadoram S, Moghaddam MA, et al. QT dispersion: does it change after percutaneous coronary intervention? J Tehran Heart Cent. 2011;6(1):19.
20. Guaricci AI, Carità P, Lorenzoni V, Casavecchia G, Rabbat M, Ieva R, et al. QT-interval evaluation in primary percutaneous coronary intervention of ST-segment elevation myocardial infarction for prediction of myocardial salvage index. PLoS One. 2018;13(2):e0192220.
21. Dotta G, Fonseca FAH, Izar MCdO, Souza MTd, Moreira FT, Pinheiro LFM, et al. Regional QT interval dispersion as an early predictor of reperfusion in patients with acute myocardial infarction after fibrinolytic therapy. Arq Bras Cardiol. 2018 Dec 17;112(1):20-9.
22. Kim BG, Cho SW, Ha JH, Ahn HS, Lee HY, Kim GS, Byun YS, Rhee KJ, Nah JC, Kim BO. Relationship between the ST-Segment Resolution and Microvascular Dysfunction in Patients Who Underwent Primary Percutaneous Coronary Intervention. Cardiol Res Pract. 2019; 2019(1):8695065.
23. Sarkar A, Grigg W, Lee J. TIMI grade flow In: StatPearls. Treasure Island (FL). StatPearls Publishing; 2021.
24. Trialists FT. Indications for fibrinolytic therapy in suspected acute myocardial infarction: collaborative overview of early mortality and major morbidity results from all randomised trials of more than 1000 patients. Lancet. 1994;343(8893):311-22.
25. Malik M, Batchvarov VN. Measurement, interpretation and clinical potential of QT dispersion. J Am Coll Cardiol. 2000;36(6):1749-66.

26. Sahu P, Lim P, Rana B, Struthers A. QT dispersion in medicine: electrophysiological holy grail or fool's gold? QJM. 2000;93(7):425-31.
27. Moreno FL, Villanueva T, Karagounis LA, Anderson JL. Reduction in QT interval dispersion by successful thrombolytic therapy in acute myocardial infarction. TEAM-2 Study Investigators. Circulation. 1994;90(1):94-100.
28. Karagounis LA, Anderson JL, Moreno FL, Sorensen SG, Investigators T-. Multivariate associates of QT dispersion in patients with acute myocardial infarction: primacy of patency status of the infarct-related artery. Am Heart J. 1998;135(6):1027-35.
29. Silber S, Albertsson P, Avilés FF, Camici PG, Colombo A, Hamm C, et al. Guidelines for percutaneous coronary interventions: the Task Force for Percutaneous Coronary Interventions of the European Society of Cardiology. Eur Heart J. 2005;26(8):804-47.
30. Ali A, Malik FS, Dinshaw H, Jenkins JS, Collins T, White CJ, et al. Reduction in QT dispersion with rheolytic thrombectomy in acute myocardial infarction: Evidence of electrial stability with reperfusion therapy. Catheter cardiovasc interv. 2001;52(1):56-8.
31. Lopes NHM, Grupi C, Dina CH, de Gois AF, Hajjar LA, Ayub B, et al. QT interval dispersion analysis in acute myocardial infarction patients: coronary reperfusion effect. Arq Bras Cardiol. 2006;87:91-8.
32. Ornek E, Duran M, Ornek D, Demirçelik B, Murat S, Kurtul A, et al. The effect of thrombolytic therapy on QT dispersion in acute myocardial infarction and its role in the prediction of reperfusion arrhythmias. Niger J Clin Pract. 2014;17(2):183-7.
33. Mulay DV, Quadri SM. QT dispersion and early arrhythmic risk in acute myocardial infarction. Indian Heart J. 2004;56(6):636-41.
34. Schneider CA, Voth E, Baer FM, Horst M, Wagner R, Sechtem U. QT dispersion is determined by the extent of viable myocardium in patients with chronic Q-wave myocardial infarction. Circulation. 1997 Dec 2;96(11):3913-20.

[DOI: 10.47176/mjiri.38.98]