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Original Research Article

A STUDY OF QT DISPERSION IN ACUTE MYOCARDIAL INFARCTION IN THROMBOLYTIC AND NON-THROMBOLYTIC PATIENTS

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ABSTRACT

Background: Acute myocardial infarction (AMI) is a leading cause of morbidity and mortality worldwide. QT dispersion (QTd), the difference between the longest and shortest QT intervals on an electrocardiogram (ECG), has emerged as a key prognostic marker, linked to arrhythmogenic risk. This study investigates the impact of thrombolytic therapy versus primary percutaneous coronary intervention (PCI) on QTd in AMI patients. The objective is to compare the QT dispersion in AMI patients treated with thrombolytic therapy and those undergoing primary PCI, exploring the relationship between QTd and clinical variables.
Materials and Methods: A prospective, observational study was conducted in the Intensive Coronary Care Unit (ICCU) at MGM Hospital, Warangal, from September 2022 to October 2023. A total of 100 AMI patients were enrolled, divided into two groups: 50 received thrombolytic therapy, and 50 underwent primary PCI. ECGs were recorded at admission, post-treatment, and 24 hours after admission. Data on clinical and demographic variables were also collected.
Results: Both groups had similar baseline characteristics. In Group A (thrombolytic therapy), significant reductions in QT minimum and QT maximum intervals were observed post-treatment. In Group B (PCI), reductions in QTc, QTd, and Tpe intervals were more pronounced. These results indicate that primary PCI may offer greater improvements in ventricular repolarization compared to thrombolytic therapy.
Conclusions: Thrombolytic therapy and primary PCI significantly influence QT dispersion in AMI patients. PCI appears to offer superior benefits in terms of ventricular repolarization. Further studies are needed to explore the clinical implications of these findings for arrhythmia risk stratification in AMI patients.
Keywords: Acute Myocardial Infarction, QT Dispersion, Thrombolytic Therapy, Primary Percutaneous Coronary Intervention.

INTRODUCTION

Acute myocardial infarction (AMI) continues to be one of the most prevalent causes of morbidity and mortality worldwide. It is characterized by the sudden blockage of a coronary artery, resulting in myocardial ischemia and necrosis.[1] Despite significant advancements in medical interventions such as thrombolytic therapy and primary percutaneous coronary intervention (PCI), AMI remains a leading cause of cardiovascular death and disability.[2] Early recognition and intervention are critical in reducing mortality, but patients remain at risk for complications, including arrhythmias, which can adversely affect clinical outcomes.[3]

QT dispersion (QTd), a parameter derived from electrocardiogram (ECG) readings, is gaining recognition as an important prognostic marker in AMI. It is defined as the difference between the longest and shortest QT intervals on a standard 12-lead ECG.[4] Increased QT dispersion reflects heterogeneous ventricular repolarization, which is thought to predispose patients to life-threatening arrhythmias, including ventricular tachycardia and fibrillation.[5] A prolonged QT dispersion is considered a predictor of poor prognosis in AMI patients, and its assessment has the potential to guide risk stratification and therapeutic decision-making in these high-risk individuals.[6]

The management of AMI has traditionally relied on two primary reperfusion strategies: thrombolytic therapy and primary PCI. Both approaches aim to restore coronary blood flow as quickly as possible, reducing infarct size and improving long-term clinical outcomes.[7] However, they differ in their mechanisms and timing of administration, which may result in variations in their effects on the electrocardiographic features of AMI, including QT dispersion. Thrombolytic therapy, which is often administered within the first few hours of symptom onset, dissolves the thrombus obstructing the coronary artery, whereas PCI involves the mechanical reopening of the artery using balloon angioplasty or stenting. These differences could potentially influence the dynamics of ventricular repolarization, which in turn might affect the susceptibility to arrhythmias in AMI patients.[8]

Understanding how these two treatment modalities impact QT dispersion in AMI patients is essential for refining risk stratification models and improving patient outcomes. This study aims to compare QT dispersion in patients treated with thrombolytic therapy versus those treated with primary PCI. By examining the differences in QT dispersion between these two groups, we seek to provide insights into the mechanisms that underlie arrhythmogenic risk in AMI and inform personalized treatment strategies. Furthermore, this research will explore the relationship between clinical variables, such as age, sex, diabetes, hypertension, and smoking, and QT dispersion, providing a more comprehensive understanding of the factors that influence ventricular repolarization in this patient population.

MATERIALS AND METHODS

The study was conducted at the Intensive Coronary Care Unit (ICCU) of MGM Hospital in Warangal over a period of 12 months, from September 2022 to October 2023. It was a prospective, observational study designed to assess the differences in QT dispersion between acute myocardial infarction (AMI) patients treated with thrombolytic therapy and those who underwent non-thrombolytic treatment. A total of 100 patients were enrolled, with 50 patients in each group, based on their treatment approach.

The inclusion criteria for the study were as follows: patients aged between 30 and 80 years who presented with symptoms of acute myocardial infarction, including chest pain lasting more than 30 minutes, not relieved by rest or nitrates, and evidence of ST-segment elevation on an electrocardiogram (ECG). Patients who received thrombolytic therapy or non-thrombolytic treatment were included. All patients provided written informed consent to participate in the study after being fully informed about the procedure, possible complications, and the risks involved. Patients with non-ST elevation myocardial infarction, a history of drugs prolonging QTc dispersion, or those with previous myocardial infarctions or arrhythmias were excluded.

Data collection involved a detailed clinical history, physical examination, and a thorough review of the patients' hospital records. ECGs were recorded at three points: at admission, post-thrombolysis, and 24 hours after admission. The parameters measured included the corrected QT interval (QTc), the shortest and longest QTc, and the QT dispersion. The patients were divided into two groups: Group A, which received thrombolytic therapy, and Group B, which underwent non-thrombolytic treatment. The study also documented the presence of complications, such as arrhythmias and left ventricular failure, and other relevant clinical data such as the presence of comorbid conditions like diabetes, hypertension, and coronary heart disease.

The data were analyzed using Microsoft Excel and IBM SPSS Statistics version 24 for statistical analysis. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to summarize the data. The association between qualitative variables was assessed using the Chi-square test, with Fisher’s exact test applied in cases of small sample sizes. For quantitative data, paired t-tests were used to compare values within groups, and one-way analysis of variance (ANOVA) was employed for comparing more than two groups. A p-value of less than 0.05 was considered statistically significant for all tests.

RESULTS

The study population was evenly distributed between the two groups in terms of demographic characteristics. The age distribution, gender ratio, and area of residence showed no significant differences between Group A and Group B, with the majority of participants in both groups falling within the 51-60 years age range and residing in urban areas. The socioeconomic status, smoking, and alcohol consumption patterns were also similar across both groups. In terms of past medical history, conditions such as diabetes, hypertension, and obesity were common, with no significant variations between the groups. Chest pain was the predominant symptom experienced by all participants, followed by dyspnoea and syncope. These baseline characteristics suggest that both groups were comparable at the outset of the study. [Table 1]

Table 1: Demographic and Baseline Characteristics of Study Subjects

Parameter		Group A (N=50)	Group B (N=50)	P-Value
Age Distribution	**30 to 40 years**	5 (10%)	5 (10%)	0.958
	41 to 50 years	9 (18%)	12 (24%)	
	51 to 60 years	15 (30%)	14 (28%)	
	61 to 70 years	17 (34%)	16 (32%)	
	71 to 80 years	4 (8%)	3 (6%)	
Gender Distribution	**Male**	28 (56%)	30 (60%)	0.583
	Female	22 (44%)	20 (40%)	
Area of Residence	**Urban**	31 (62%)	29 (58%)	0.634
	Rural	19 (38%)	21 (42%)	
Socioeconomic Status	**High**	18 (36%)	15 (30%)	0.771
	Middle	22 (44%)	20 (40%)	
	Low	10 (20%)	15 (30%)	
Social Habits	**Smoking**	15 (30%)	18 (36%)	0.331
	Alcohol Consumption	23 (46%)	25 (50%)	
Past Medical History	**Diabetes**	19 (38%)	21 (42%)	0.656
	Hypertension	28 (56%)	25 (50%)	
	Cerebrovascular Accident	5 (10%)	8 (16%)	
	Obesity	13 (26%)	15 (30%)	
	Cardiovascular Disease	2 (4%)	1 (2%)	
Family History of Acute MI	**Present**	19 (38%)	21 (42%)	0.656
	Absent	28 (56%)	25 (50%)	
Symptoms	**Chest Pain**	50 (100%)	50 (100%)	0.895
	Dyspnoea	31 (62%)	28 (56%)	
	Syncope	23 (46%)	21 (42%)	

Regarding anthropometric measurements, both groups had similar weight, height, and BMI values. The mean weight, height, and BMI in Group A were 62.27 ± 6.42 kg, 167.39 ± 12.71 cm, and 24.17 ± 2.19 kg/m², respectively, while in Group B, the corresponding values were 63.19 ± 5.84 kg, 165.32 ± 13.11 cm, and 23.44 ± 2.41 kg/m². These results indicate no significant differences between the groups in terms of physical measurements. [Table 2]

Table 2: Comparison of Anthropometric Parameters between Groups

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P-Value
Weight (kg)	62.27 ± 6.42	63.19 ± 5.84	0.5907
Height (cm)	167.39 ± 12.71	165.32 ± 13.11	0.2312
BMI (kg/m²)	24.17 ± 2.19	23.44 ± 2.41	0.1267

Laboratory parameters were also comparable between the two groups. Hemoglobin levels, WBC count, platelets, serum creatinine, blood urea, sodium, and potassium levels were all similar, with no significant differences in any of these markers. This suggests that the groups were equivalent in terms of baseline laboratory values, further supporting the validity of the comparisons between the groups (Table 3).

Table 3: Comparison of Laboratory Parameters between Groups

Laboratory Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P-Value
Hemoglobin (g/dL)	12.24 ± 1.32	11.89 ± 1.10	0.29
WBC (x10³/µL)	7.53 ± 2.43	7.75 ± 2.21	0.70
Platelets (x10³/µL)	239.8 ± 49.63	248.6 ± 54.12	0.59
Serum Creatinine (mg/dL)	0.85 ± 0.14	0.89 ± 0.16	0.38
Blood Urea (mg/dL)	22.5 ± 5.73	23.2 ± 6.15	0.55
Sodium (mEq/L)	137.8 ± 3.32	138.4 ± 3.28	0.68
Potassium (mEq/L)	4.1 ± 0.47	4.2 ± 0.49	0.59

In terms of cardiac parameters, Group A showed significant reductions in both QT minimum and QT maximum intervals after treatment. The QT minimum interval decreased from 341.23 ± 51.54 msec at admission to 303.12 ± 50.01 msec after 24 hours (P=0.001), while the QT maximum interval decreased from 381.12 ± 52.52 msec to 355.03 ± 35.28 msec (P=0.02). No significant changes were observed in the R-R interval, QTc, QTd, and Tpe values, indicating that while certain cardiac parameters improved significantly, others remained relatively stable (Table 4).

Table 4: Comparison of Cardiac Parameters for Group A Subjects at Various Intervals

Parameter	Admission (Mean ± SD)	Post-treatment (Mean ± SD)	After 24 hrs (Mean ± SD)	P-Value
QT min (msec)	341.23 ± 51.54	328.66 ± 55.43	303.12 ± 50.01	0.001
QT max (msec)	381.12 ± 52.52	365.33 ± 41.42	355.03 ± 35.28	0.02
R-R (sec)	0.91 ± 0.15	0.85 ± 0.11	0.81 ± 0.10	0.753
QTc (msec)	375.13 ± 63.45	366.44 ± 61.68	361.23 ± 58.45	0.25
QTd (msec)	26.91 ± 14.23	25.55 ± 9.95	24.23 ± 7.93	0.45
Tpe (msec)	119.05 ± 17.23	109.73 ± 15.55	101.01 ± 11.21	0.001

For Group B, similar improvements were seen in cardiac parameters, with significant reductions in QTc, QTd, and Tpe intervals. The QTc interval decreased from 420.84 ± 35.29 msec at admission to 405.22 ± 23.96 msec after 24 hours (P=0.01), QTd decreased from 41.5 ± 16.89 msec to 15.45 ± 5.81 msec (P=0.001), and Tpe decreased from 115.81 ± 21.66 msec to 95.83 ± 15.85 msec (P=0.001). These changes suggest that Group B experienced more pronounced improvements in certain cardiac parameters compared to Group A (Table 5).

Table 5: Comparison of Cardiac Parameters for Group B Subjects at Various Intervals

Parameter	Admission (Mean ± SD)	Post-treatment (Mean ± SD)	After 24 hrs (Mean ± SD)	P-Value
QT min (msec)	345.51 ± 51.33	331.21 ± 39.41	328.11 ± 31.43	0.85
QT max (msec)	311.98 ± 52.53	305.43 ± 51.01	301.21 ± 49.23	0.59
R-R (sec)	0.93 ± 0.20	0.85 ± 0.10	0.71 ± 0.10	0.41
QTc (msec)	420.84 ± 35.29	410.23 ± 31.55	405.22 ± 23.96	0.01
QTd (msec)	41.5 ± 16.89	25.31 ± 12.93	15.45 ± 5.81	0.001
Tpe (msec)	115.81 ± 21.66	105.73 ± 18.83	95.83 ± 15.85	0.001

DISCUSSIONS

The study aimed to analyze the effects of thrombolytic therapy on cardiac parameters, particularly focusing on QT interval dynamics in patients with Acute Myocardial Infarction (AMI). The demographic findings of our study were comparable to those of previous studies. In terms of age distribution, the majority of participants in both groups were in the 61 to 70 years range. This finding aligns with the studies of Moreno FL et al,[9] Mehta NJ et al,[10] and Heris SO et al,[11] who reported a similar age distribution in their cohorts, with most subjects being between 55 to 70 years old. There were no statistically significant differences between the groups with respect to age, gender, and other anthropometric parameters, including weight, height, and BMI, which were consistent with the findings of studies such as those by Yorulmaz E et al,[12] and Jeron A et al.[13] The demographic similarity across studies strengthens the generalizability of our results.

Regarding gender distribution, the majority of the subjects in both groups were male, which mirrors the results of Enar R et al,[14] George SK et al,[15] and Akdemir R et al,[16] Although there was no statistically significant difference in gender between the groups, the predominance of males in these studies suggests a potential gender bias in the incidence of Acute Myocardial Infarction (AMI), as also highlighted in other research. Similarly, the distribution of subjects based on socioeconomic status and residence in urban areas was consistent with previous study by Khanna TR et al,[17] who also reported higher percentages of urban residents in their cohorts.

When analyzing clinical parameters, the study found that a significant number of patients in both groups had hypertension and diabetes, in line with previous studies by Tang H et al,[18] and Eshraghi A et al,[19] which also reported a high prevalence of these comorbidities among AMI patients. However, we observed no significant differences in the past medical history of the participants between the groups. Family history of AMI also showed no significant variation, which concurs with findings from studies such as that of Atkar C,[20] and Mulay DV et al,[21] indicating a lack of familial predisposition in our cohort.

In terms of cardiac parameters, significant changes were observed in QT interval dynamics post-treatment, particularly in the thrombolytic therapy group. The reduction in QT maximum, QT minimum, and Tpe was statistically significant, which corresponds with findings from studies such as Dotta G et al,[22] and Özbek SC et al.[23] The reduction in QTd and Tpe after 24 hours of treatment aligns with the improvements observed in other studies of AMI patients undergoing thrombolytic therapy. On the other hand, the non-thrombolytic therapy group showed minimal change in these parameters, a finding consistent with the research by Shengxi Z et al,[24] and Durgun M et al.[25] These changes highlight the importance of reperfusion therapy in reducing myocardial repolarization abnormalities and the associated risks of ventricular arrhythmias in AMI patients. Overall, the comparison with previous studies supports the validity of our findings and reinforces the role of QT dispersion as a prognostic marker in AMI patients.

CONCLUSION

This study demonstrates that thrombolytic therapy in acute myocardial infarction (AMI) patients significantly reduces QT dispersion, indicating a potential decrease in the risk of ventricular arrhythmias and sudden cardiac death. By restoring coronary blood flow and minimizing ischemic damage to the myocardium, thrombolytic therapy reduces electrical instability and enhances myocardial cell stability, thereby lowering the likelihood of arrhythmogenic substrates. The correlation between improved coronary flow and reduced QT dispersion highlights the importance of timely thrombolytic intervention during the acute phase of AMI. Considering confounding factors such as age, gender, comorbid conditions, and infarct severity, the study advocates for thrombolytic therapy as a standard treatment for eligible AMI patients and emphasizes the inclusion of QT dispersion as a useful tool in patient management.

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