QT INTERVAL PROLONGATION IN PATIENTS OF ACUTE ST ELEVATION MYOCARDIAL INFARCTION

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ABSTRACT:
Objective: To determine the frequency of QT interval prolongation in patients of acute ST elevation myocardial infarction (MI).

Patients and methods: This Cross sectional survey was conducted at the Department of Cardiology, Punjab Institute of Cardiology Lahore, from May to November 2009. A total of 660 cases were recruited for this study. The QT interval was measured manually from Leads II and V5, three QT intervals were measured from each lead and averaged. Where the U wave was prominent in these leads the dip or notch between T and U was taken as the end of T wave. Upper limit of QT was taken (0.44sec) in male and (0.46sec) in females. Frequency of QT prolongation was observed in patients during the early 24 hours in hospital stay.

Results: The mean age of the patients was 54.9±11.9 years, mean age of the male patients was 55.3±12 years and female patients was 54.5±12.1 years. There were 524(79.4%) male patients and 136 (20.6%) female patients. There were 222(33.6%) patients with diabetes mellitus, 424(64.2%) patients had hypertension, 344(52.1%) patients were smokers, 60(9.1%) patients had hyperlipidemia and 86(13%) patients had family history of IHD. Overall 358(54.2%) patients were thrombolysed and 302(45.8%) patients were not thrombolysed. Distribution of electrolytes revealed that 152(23%) patients had below normal potassium, 36(5.5%) patients had below normal calcium and 362(54.8%) patients had below normal magnesium level. QT prolongation was observed in 450(68.2%) patients while 210(31.8%) patients had normal QT interval. In patients who were having prolonged QT 60(11.4%) were male and 36(26.4%) were female.

Conclusion: QTc prolongation occurred in a significant number of patients with ST elevation MI in first 24 hours.

Key words: Acute myocardial infarction; ST elevation myocardial infarction; QT interval prolongation; Coronary artery disease.

INTRODUCTION
Acute myocardial infarction (AMI) is by far the most important form of ischemic heart disease (IHD) and alone is the leading cause of death in the United States. About 1.5 million individuals in the United States suffer an acute MI annually and approximately one third of them die. At least 250,000 people a year die of acute MI before they reach the hospital, cause of death in majority is ventricular fibrillation.1,2

The QTc interval prolongs in 81% patients with early transmural ischemia as defined by clinically accepted criteria of transmural ischemic / myocardial infarction i.e. (ST depression or ST elevation >1 mm). It has been described as earliest ECG abnormality.3-4 The multiple etiologies of the prolonged QT interval are electrolyte imbalance, drugs, ischemic heart disease and congenital disorders.5 Patients with acute myocardial infarction are at a higher risk of sustaining malignant ventricular arrhythmias if QT interval is prolonged. Ventricular tachycardia and ventricular fibrillation are life threatening ventricular arrhythmias encountered in peri-myocardial infarction period in patients with acute myocardial infarction.5

A plethora of literature is available for QT prolongation, the consensus of which ideally recommends (>0.42-0.44 seconds) for men, and (>0.45-0.46 seconds) for women.6

Association has been observed between QTc duration and mortality after acute myocardial...
infarction for both total and cardiovascular events including sudden deaths. At multifactorial analysis QTc > 0.44 seconds appears to be an independent predictor of risk of total and cardiac mortality in patients with acute myocardial infarction. A close correlation has also been observed between the presence of severe ventricular arrhythmias and heart rate variability (HRV), late ventricular potentials (LVP) and dispersion of QT intervals. Patients with life threatening arrhythmias are also characterized by the presence of late ventricular potentials and changes of standard deviation of RR interval and total QRS duration.

Prolongation of the corrected QT (QTc) interval is an independent risk factor in patients with unstable angina and acute ischemic changes. Of the 21 patients (38%) who reached the primary endpoint, 17 (81%) had QTc prolongation. Binary logistic regression analysis showed that QTc prolongation was an independent predictor of the combined endpoint. The study showed that QTc prolongation is an independent predictor of cardiovascular risk in patients with non-ST-segment elevation acute coronary syndrome but without acute ischemic changes on admission ECG.

Decisions regarding reperfusion strategies in patients with acute myocardial infarction rely largely on the presence of ST-segment elevation (STE) in the ECG, consequently with significant limitations. Studies of the “ischemic cascade” show that ST-segment changes occur well after the onset of wall motion abnormalities. The QTc interval prolongs in 100% of patients with early transmural ischemia. When compared with clinically accepted indexes of transmural ischemia, it is the earliest ECG abnormality.

The rationale of this study was to keenly observe the patients with STEMI who were liable to develop QT interval prolongation as these patients had an increased risk of developing malignant ventricular arrhythmias i.e. (ventricular tachycardia and ventricular fibrillation) and death in early hours of myocardial infarction, these patients were observed for QT interval prolongation leading to arrhythmias and for the timely management of these arrhythmias and for improving outcome after STEMI. This study was designed to determine the frequency of QT interval prolongation in patients of acute ST elevation myocardial infarction.

MATERIAL AND METHODS

This cross sectional survey was conducted at the Department of Cardiology, Punjab Institute of Cardiology Lahore, from May to November 2009.

The collected sample size was 660 cases with 3% margin of error, 95% confidence level taking expected percentage of QT interval prolongation in acute myocardial infarction i.e. 81%.

Purposive non-probability sampling was utilized.

Patients of both genders with age range of 25 to 85 years and diagnosed cases of ST elevation myocardial infarction with clinical, electrocardiographic and biochemical parameters of acute myocardial infarction were included.

Patients with prolonged QTc with causes other than acute ST elevation myocardial infarction. Patients with bundle branch block (BBB), heart blocks and with heart failure were excluded.

ST-Elevation myocardial infarction defined electrocardiographically as ST-segment elevation >0.2 mv in at least two contiguous chest leads or >0.1 mv in at least two contiguous limb leads. Confirmation of diagnosis of MI with rise of biomarkers.

QT interval was defined as an interval measured on ECG from the start of Q wave to the end of T wave. Prolonged QTc (>0.44 seconds in male and >0.46 seconds in female).

A total of 660 cases were recruited from the inpatients department of Punjab Institute of Cardiology Lahore. Written consent was taken from all the patients before recruiting the study. The QT interval was measured manually from Leads II and V5. Three QT intervals were measured from each lead and averaged. Where the U wave was prominent in these leads the dip or notch between T and U was taken as the end of T wave. Bazett’s formula was used for correcting QT, Upper limit of QT was taken as (0.44sec) in males and (0.46sec) in females. Frequency of QT prolongation was observed in patients during the early 24 hours in hospital stay.

The effect modifiers (thrombolysis electrolytes, diabetes mellitus, HTN, smoking, hyperlipidemia, family history of IHD) were addressed by stratification. All this information was collected through a specially designed proforma.

STATISTICAL ANALYSIS

The collected data was entered into SPSS version 12 for Windows. The qualitative variables like sex, risk factors, QT wave prolongation were expressed as frequencies and percentages. The quantitative variables like age were presented as mean and standard deviation.

RESULTS

The mean age of the patients was 54.9 ± 11.9 years, mean age of the male patients was 56.2 ± 1
years and female patients was 54.5±12.1 years. Mean age of the study population was 54.9±11.9 years. Study population was further divided into groups according to age in order to assess the impact of age on the population as a whole. There were lesser number of patients in extremes of age as there were 28(4.2%) patients in age group 25-35 years and also in 76-85 years. Similar number of patients were present in age range of 36-65 years. (Table 1)

There were 222(33.6%) patients with diabetes mellitus, 424(64.2%) were hypertensives, 344(52.1%) were smokers, 60(9.1%) patients had dyslipidemia and 86(13%) patients had family history of ischemic heart disease. (Table 2)

Normal Potassium level was observed in 508(76.9%) patients while 152(23%) patients had below normal potassium level. Normal calcium level was observed in 624(94.5%) patients while 36(5.5%) patients had below normal calcium level. Normal Magnesium level was observed in 298(45.2%) patients while 362(54.8%) patients had below normal Magnesium level.

QT prolongation was observed in 450 patients while 210 patients had normal QT interval. In order to study the effect of various variables on QT prolongation the study population was divided into prolonged QT interval and normal QT interval and study parameters were compared in the two groups. More patients 172(38.2%) with diabetes had QT prolongation as compared to 50(23.8%) diabetics with normal QT interval. In prolonged QT interval group 312(69.3%) patients were hypertensive as compared to 112(53.3%) patients in the normal QT interval group. Lesser number of smokers were present in the prolonged QT interval group as compared to normal QT interval group. In prolonged QT interval group hyperlipidemia and family history of ischemic heart disease were also more frequent in patients with prolonged QT interval as compared to patients with normal QT interval. (Table 4) Patients with prolonged QT interval were less frequently thrombolysed 224(49.8%) patients as compared to patients with normal QT interval 134(63.8%) patients. More patients 112(24.9%) in prolonged QT interval had below normal potassium level as compared to 40(19%) patients with normal potassium level. Similar number of patients were observed in prolonged QT and normal QT level with below normal and normal calcium level. Below normal magnesium level was observed in 252(56%) patients in prolonged QT interval group as compared to 110(52.4%) patients with normal QT interval. Similar number of patients with normal magnesium level were present in prolonged QT interval and normal QT interval.

DISCUSSION

Acute myocardial infarction is by far the most important form of ischemic heart disease and alone is the leading cause of death in the United States. About 1.5 million individuals in the United States suffer an acute MI annually and approximately one third of them die. At least 250,000 people a year die of acute MI before they reach the hospital.\textsuperscript{2}

The QTc interval prolongs in 81% patients with early transmural ischemia as defined by clinically accepted criteria of transmural myocardial infarction i.e. (ST depression or ST elevation >1mm). It
has been described as earliest ECG abnormality.\textsuperscript{3,4} The multiple etiologies of the prolonged QT interval are electrolyte imbalance, drugs, ischemic heart disease and congenital disorders.\textsuperscript{5} Patients with acute myocardial infarction are at a higher risk of sustaining malignant ventricular arrhythmias if QT interval is prolonged. Ventricular tachycardia and ventricular fibrillation are life threatening arrhythmias encountered in peri-myocardial infarction period in patients with acute myocardial infarction.\textsuperscript{5}

A plethora of literature is available for QT prolongation the consensus of which ideally recommends (>0.42-0.44 seconds) for men, and (>0.45-0.46 seconds) for women.\textsuperscript{6} Association has been observed between QTc duration and mortality after acute myocardial infarction for both total and cardiovascular events including sudden deaths.\textsuperscript{7} At multifactorial analysis QTc >0.44 seconds appears to be an independent predictor of risk of total and cardiac mortality in patients with acute myocardial infarction.\textsuperscript{7} A close correlation has also been observed between the presence of severe ventricular arrhythmias and heart rate variability (HRV), late ventricular potentials (LVP) and dispersion of QT intervals(QTd). Patients with life threatening arrhythmias are also characterized by the presence of lat ventricular potentials and changes of standard deviation of RR interval and total QRS duration.\textsuperscript{8}

Prolongation of the corrected QT interval is an independent risk factor in patients with unstable angina and acute ischemic changes. Of the 21 patients (38%) who reached the primary endpoint, 17 (81%) had QTc prolongation.\textsuperscript{4}

In our study, the mean age of the patients was 54.9±11.9 years. As compared with the study of Yi et al\textsuperscript{10} the mean age of the patients was 54.5±8.9 years, which is comparable with our study. In another study of Gadaleta et al\textsuperscript{4} the mean age of the patients was 57.4 years, which is also comparable with our study.

In our study there were 79.4% male patients and 20.6% female patients. As compared with the study of Gadaleta et al\textsuperscript{4} there were 81% male patients and 19% female patients, which is comparable with our study.

In our study 33.6% patients had diabetes mellitus. As compared with the study of Gadaleta et al\textsuperscript{4} there were 66.7% patients having hypertension in group A and 76.5% in group B, which is comparable with our study.

In our study the frequency of QT interval prolongation in patients with acute ST elevation myocardial infarction was 68.2%. As compared with the study of Gadaleta et al\textsuperscript{4} prolongation of the corrected QT interval was observed in 81% patients, which is comparable with our study.

Studies of the “ischemic cascade” show that ST-segment changes occur well after the onset of wall motion abnormalities. The QTc interval prolongs in 100% of patients with early transmural ischemia.\textsuperscript{9} While in our study the frequency of QT interval prolongation in patients of acute ST elevation myocardial infarction QT was in 68.2% patients, which is also comparable with the above study.

In another study conducted by van den Bergh et al\textsuperscript{11} the frequency of QT interval prolongation was observed in 68.2% patients. While in our study the frequency of QT interval prolongation in patients of acute ST elevation myocardial infarction QT was similar to the above study.

CONCLUSION

QTc prolongation occurred in a significant number of patients with ST elevation MI in first 24 hours.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Prolonged QTn=460</th>
<th>Normal QT n=210</th>
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<tbody>
<tr>
<td>Diabetes Mellitus</td>
<td>172 (38.2%)</td>
<td>30 (23.8%)</td>
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<tr>
<td>Hypertension</td>
<td>312 (69.3%)</td>
<td>112 (53.3%)</td>
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<tr>
<td>Smoking</td>
<td>220 (48.8%)</td>
<td>24 (9.9%)</td>
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<tr>
<td>Arterial Hypertension</td>
<td>48 (10.2%)</td>
<td>14 (6.6%)</td>
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<tr>
<td>Family History</td>
<td>68 (15.1%)</td>
<td>10 (8.6%)</td>
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<tr>
<td>Thrombolytics given</td>
<td>224 (49.8%)</td>
<td>154 (63.8%)</td>
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<tr>
<th>Potassium</th>
<th>Below normal</th>
<th>Normal</th>
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<tr>
<td>112 (24.9%)</td>
<td>17 (19%)</td>
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<tr>
<td>338 (75.1%)</td>
<td>170 (80.9%)</td>
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<th>Calcium</th>
<th>Below normal</th>
<th>Normal</th>
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<tr>
<td>24 (5.3%)</td>
<td>12 (5.7%)</td>
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<tr>
<td>426 (94.7%)</td>
<td>198 (94.3%)</td>
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<table>
<thead>
<tr>
<th>Magnesium</th>
<th>Below normal</th>
<th>Normal</th>
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<tbody>
<tr>
<td>252 (56%)</td>
<td>110 (52.4%)</td>
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<tr>
<td>198 (44%)</td>
<td>100 (47.6%)</td>
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REFERENCES


