CARDIAC RISK ASSESSMENT IN ACUTE ST ELEVATION MYOCARDIAL INFARCTION PATIENTS THROUGH BASELINE AND POST REPERFUSION FRONTAL PLANE QRS-T ANGLES

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ABSTRACT

Background: Acute ST segment elevation myocardial infarction (STEMI) is still associated with increased risk of death. Novel ECG parameters have recently emerged to identify high risk patients in acute STEMI.

Aim of the study: The aim of this study to evaluate the prognostic importance of baseline and postprocedural f(QRS-T) angles in patients with acute STEMI. In addition, the clinical usefulness of baseline and postprocedural f(QRS-T) angles for predicting reperfusion success in patients who received thrombolytic therapy will be investigated.

Patients and methods: This wasa cross sectional study. We recorded 74 patients with acute STEMI who were admitted to CCU in Cardiology department at Zagazig University Hospitals in the period from September 2019 to April 2020. A 12 lead ECGs were recorded for all patients at hospital admission, immediately after PCI and 90 min after thrombolytic treatment.

Results: In our study, ST segment resolution and postprocedural f(QRS-T) were significantly higher in thrombolytic group compared to PCI group, however baseline f(QRS-T) was higher in thrombolytic group compared to PCI group but without statistical significance. No significant difference found between the two groups regarding in-hospital mortality. Age, LVEF, and baseline and postprocedural f(QRS-T) angle were found to be independent predictors for in hospital mortality. Regarding MACE, Death was the most event occur and new ischemia was the least event occur. This was significantly related to age, BMI, DM, HTN, smoking, hypercholesterolemia, three vessels disease, LVEF, baseline f(QRS-T), postprocedural f(QRS-T) and ST segment resolution. Baseline f(QRS-T) at cutoff point 92.8 and post-procedural f(QRS-T) at cutoff point 88.6 have a significant area under the curve with sensitivity 68%, 81% and specificity 75%, 84.7% respectively for predicting in-hospital mortality.

Conclusion: f(QRS-T) angle is an inexpensive, noninvasive and easily detectable parameter on 12 lead ECG. In this study, we have shown that postprocedural f(QRS-T) angle has higher prognostic importance than baseline f(QRS-T) angle for predicting high risk patients in acute STEMI.

Keywords: Acute ST segment elevation myocardial infarction (STEMI), Frontal Plane QRS-T Angles.

I. INTRODUCTION:

Acute ST segment elevation myocardial infarction (STEMI) is still associated with increased risk of death and recurrent (MACE) despite considerable progress in therapy options (1).

Therefore, early risk stratification in patients with acute STEMI is very important for determining their optimal management (2).
To date, several electrocardiographic (ECG) parameters have been used for stratifying patients on hospital admission. However, novel ECG parameters have recently emerged to identify high risk patients in acute STEMI (3).

One of these novel ECG parameters is the frontal plane QRS-T angle Frontal plane QRS-T \[\theta(QRS-T)\] angle which defined as the angle between the directions of ventricular depolarization (QRS axis) and repolarization (T axis), was described as a novel marker of ventricular repolarization heterogeneity (4).

In our study we investigated the association of both baseline \(\theta(QRS-T)\) and postprocedural \(\theta(QRS-T)\) angles with poor prognostic events in patients with acute STEMI undergoing revascularization therapy (pPCI + thrombolytic therapy, TT) (5).

II. PATIENTS AND METHODS:

2.1. The current study was conducted as a cross sectional study. We recorded 72 patients with acute STEMI who were admitted to CCU in Cardiology department at Zagazig University Hospitals in the period from September 2019 to April 2020 after obtaining the approval of the institutional review board (IRB) of Zagazig University. This study included patients with age more than 18 years old, who were admitted/referred to our hospital with acute STEMI. In this study we went to treat patients with (pPCI or thrombolytic therapy) in our CCU at Cardiology department in Zagzig University.

2.2. A consent form approved by the committee of human rights in research in Zagazig University was obtained from each participant before the study initiation.

2.3. In this study, we included patient who had symptoms of acute myocardial infarction, and ECG was done to all patients over 18 years old presented with first attack of acute STEMI, reperfusion therapy was done to all of them, and ECG was done to all patients after the reperfusion.

2.4. All patients with pacemaker rhythm, previous treated with CABG, interventricular or intraventricular conduction disturbance in the ECGs including RBBB and LBBB, and patients taking medications that affect QT interval have been excluded from the study.

2.5. All Patients were subjected to the following:

- Preoperative:
  - Complete history taking: including
  - Demographic data: age and gender, Diabetic or not, Hypertensive or not, Smoker or not and the Site of MI
  - QRS-T angle (baseline and post procedural)
  - Main symptoms:
    - Dyspnea, Orthopnea, lower limb edema, Ascites, Hepat congestion and GIT symptoms
  - Medical history
  - Preoperative medications.
  - History of other non-cardiac or pulmonary diseases.
  - Full clinical examination: including
  - General examination and Cardiac examination
  - Pre-operative investigation in the form of:
    - Laboratory: routine full laboratory investigations.
A 12 lead ECGs were recorded for all patients at hospital admission, immediately after pPCI and 90 min after thrombolytic treatment.

ECG recordings were taken using a 0.16–100 Hz filter range, 25 mm/s speed, and 10 mm/mV height. All of the ECG recordings were analyzed by two independent physicians.

The f(QRS-T) angle was calculated as absolute difference between frontal plane QRS axis and frontal plane T axis.

If the angle exceeds 180°, it was calculated by subtracting from 360° (6, 7 and 8).

Baseline f(QRS-T) angle was defined as the angle which measured from the first ECG at the time of hospital admission.

Post-procedural f(QRS-T) angle was defined according to the treatment strategy as follows:

the angle which measured post-PCI from the ECG after treated with pPCI.

the angle which measured from the ECG taken 90 min after onset of therapy in patients treated with TT.

ST segment resolution (STR) was calculated as the baseline sum of ST segment elevation minus the sum of ST segment elevation at the end of reperfusion therapy (9).

Successful thrombolysis was defined as ≥50% decrease in ST elevation and the loss of chest pain after TT. Failed thrombolysis was defined as <50% decrease in ST elevation after TT (9).

2.3 Coronary angiography

The PCI procedures were performed according to standard clinical protocols via the femoral route. Standard left and right Judkins diagnostic and guiding left or right catheters were used in all procedures. All angiographic data of patients were assessed from the catheterization laboratory records and evaluated by two independent interventional cardiologists. The angiographically critical lesion was defined as the presence of ≥50% stenosis in the left main coronary artery and ≥70% in the other major epicardial coronary arteries. Each culprit lesion in the epicardial coronary artery was classified as proximal, mid, and distal according to the definition by American College of Cardiology and American Heart Association (9).

"F QRS-T angle"

Approach to compute QRS-T angle, which uses leads aVF, V2, V5 and V6. This approach includes several steps.

First, “net” values of QRS complex amplitudes are calculated in each of aVF, V2, V5 and V6 leads as $QRS_{net} = R_{amp} - |S/QS_{amp}|$.

“Net” values of the T wave are calculated by measuring positive and negative T wave amplitudes, accordingly: $T_{net} = (+)T_{amp} - |(-)T_{amp}|$.

Then, magnitudes of QRS and T are calculated according to equations:

$QRS_{sm} = [(QRS_{net}V6)^2 + (QRS_{net}aVF)^2 + (QRS_{net}V2)^2]^{1/2}$

And $T_{sm} = [(T_{net}V5)^2 + (T_{net}aVF)^2 + (T_{net}V2)^2]^{1/2}$.

Finally, F QRS-T angle (FQRS-T angle) is calculated as following:

$F \text{ QRS-T angle} =$

$((QRS_{net}V6 \times T_{net}V5) + (QRS_{net}aVF \times T_{net}aVF) + (QRS_{net}V2 \times T_{net}V2))$
\((\text{QRS}_{sm} \times T_{sm})\)

(6.7 and 8).

2.6. Statistical analysis:

After collecting and verifying the data, it was edited on a personal computer. Then, the statistical analyses were performed using IBM Statistical Package for Social Science (SPSS) statistical software version 20.0 (IBM Inc., Armonk, NY, USA) to obtain the final results. The used tests were: “t” test; for quantitative values, data were expressed as the means ± standard deviation, medians with ranges or proportions. The Chi-square (X2) test; for qualitative values, data were expressed as proportion. The statistical difference was considered significant if \(P\) value was \(\leq 0.05\) and highly significant when \(P\) value \(\leq 0.01\).

III. RESULTS:

Concerning demographic data, we found no significant difference between the two studied groups (Table 1).

Concerning ECG characteristics tests between the two studied groups, we found there is significant difference found between the two groups regarding ST segment resolution and postprocedural \((\text{QRS}-\text{T})\) angle. Thus, ST segment resolution and postprocedural \((\text{QRS}-\text{T})\) were significantly higher in thrombolytic group compared to PCI group, however baseline \((\text{QRS}-\text{T})\) was higher in thrombolytic group compared to PCI group but without statistical significance (Table 2).

Concerning outcome and in-hospital mortality between the two studied groups, we found that regarding thrombolytic therapy group, 29.6% of the patients were reported MACE and, meanwhile in PCI group 22.2% of patients were reported MACE with no significant difference between the groups. Regarding in-hospital mortality, we found 7.4% in PCI group and 11.1% in TT group without statistically significant difference found between the two groups (Table 3).

Concerning Multivariate logistic regression analysis to determine the independent predictors of in hospital mortality, we found that Age, LVEF, and baseline and postprocedural \((\text{QRS}-\text{T})\) angle were found to be independent predictors for in-hospital mortality (Table 4).

From other point of view, we decided to study the difference between patients who developed MACE and non-MACE patient. We found that there was significant difference found between patients regarding age, BMI, DM, HTN, smoking, hypercholesterolemia, three vessels disease, LVEF, baseline \((\text{QRS}-\text{T})\), postprocedural \((\text{QRS}-\text{T})\) and ST segment resolution. They were significantly higher in MACE patients except for LVEF and ST segment resolution were lower in MACE patients (Table 5).

Baseline \((\text{QRS}-\text{T})\) at cutoff point 92.8 and post-procedural \((\text{QRS}-\text{T})\) at cutoff point 88.6 had a significant area under the curve with sensitivity 68%, 81% and specificity 75%, 84.7% respectively for predicting in-hospital mortality (Table 6).

### Table (1): Demographic characteristics between studied groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group I PCI (n=27)</th>
<th>Group II Thrombolytic (n=27)</th>
<th>(t/\chi^2)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td>0.84</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Mean± SD</td>
<td>57.9±13.4</td>
<td>59.9±11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>20 (74.1%)</td>
<td>0.81</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>7 (25.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>Mean± SD</td>
<td>26.23±2.74</td>
<td>0.96</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td></td>
<td>26.97±3.59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table (2): ECG characteristics tests between the two studied groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group I PCI (n=27)</th>
<th>Group II Thrombolytic (n=27)</th>
<th>MW</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST segment resolution (%)</td>
<td>54.1±38.7</td>
<td>63.1±26.3</td>
<td>4.376</td>
<td>.01</td>
</tr>
<tr>
<td>Mean± SD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Baseline \(f(QRS-T) (\degree)\)
\[\text{Mean} \pm \text{SD}\]
78.8 ± 50.3
84.3 ± 45.7
1.616 .187

Postprocedural \(f(QRS-T) (\degree)\)
\[\text{Mean} \pm \text{SD}\]
62.1 ± 49.4
71.5 ± 46.2
5.491 .009

**Table (3):** Outcome and in-hospital mortality between the two studied groups.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group I PCI (n=27)</th>
<th>Group II Thrombolytic (n=27)</th>
<th>(\chi^2)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACE</td>
<td>6</td>
<td>22.2</td>
<td>8</td>
<td>29.6</td>
</tr>
<tr>
<td>Non-MACE</td>
<td>21</td>
<td>77.8</td>
<td>19</td>
<td>70.4</td>
</tr>
<tr>
<td><strong>In-hospital mortality</strong></td>
<td>2</td>
<td>7.4</td>
<td>3</td>
<td>11.1</td>
</tr>
</tbody>
</table>

**Table (4):** Multivariate logistic regression analysis to determine the independent predictors of in-hospital mortality

<table>
<thead>
<tr>
<th>Variables</th>
<th>OR</th>
<th>S.E.</th>
<th>Sig.</th>
<th>95% Confidence Interval for OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.063</td>
<td>.152</td>
<td>.001*</td>
<td>1.021 - 1.122</td>
</tr>
<tr>
<td>Female</td>
<td>2.264</td>
<td>.089</td>
<td>.164</td>
<td>1.649 - 4.164</td>
</tr>
<tr>
<td>LVEF</td>
<td>.913</td>
<td>.062</td>
<td>.003</td>
<td>.716 - .943</td>
</tr>
<tr>
<td>ST resolution</td>
<td>1.012</td>
<td>.161</td>
<td>.216</td>
<td>.816 - 1.035</td>
</tr>
<tr>
<td>Baseline (f(QRS-T))</td>
<td>2.233</td>
<td>.046</td>
<td>.046</td>
<td>1.495 - 3.642</td>
</tr>
<tr>
<td>Pp (f(QRS-T))</td>
<td>3.641</td>
<td>.072</td>
<td>.021</td>
<td>1.326 - 7.161</td>
</tr>
<tr>
<td>Three vessels disease</td>
<td>2.014</td>
<td>.018</td>
<td>.096</td>
<td>.730 - 3.193</td>
</tr>
</tbody>
</table>

**Table (5):** Patients’ characteristics according to MACE.

<table>
<thead>
<tr>
<th>Variables</th>
<th>MACE  (n=14)</th>
<th>Non-MACE (n=40)</th>
<th>(t / \chi^2)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>62.26 ± 12.19</td>
<td>56.15 ± 13.74</td>
<td>4.12</td>
<td>.001</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>10 (71.4%)</td>
<td>28 (70%)</td>
<td>.011</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>4 (28.6%)</td>
<td>12 (30%)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>29.21 ± 4.41</td>
<td>25.26 ± 6.12</td>
<td>2.22</td>
<td>.031</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>8 (57.1%)</td>
<td>8 (20%)</td>
<td>6.86</td>
<td>.009</td>
</tr>
<tr>
<td>Hypertension</td>
<td>10 (71.4%)</td>
<td>14 (35%)</td>
<td>5.57</td>
<td>.018</td>
</tr>
<tr>
<td>Smoking</td>
<td>14 (100%)</td>
<td>25 (62.5%)</td>
<td>7.27</td>
<td>.007</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>13 (92.8%)</td>
<td>10 (25%)</td>
<td>19.5</td>
<td>.000</td>
</tr>
<tr>
<td>Three vessels disease</td>
<td>7 (50%)</td>
<td>3 (7.5%)</td>
<td>12.4</td>
<td>.001</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>40.47 ± 7.53</td>
<td>47.21 ± 8.32</td>
<td>2.67</td>
<td>.010</td>
</tr>
<tr>
<td>Baseline (f(QRS-T)) (%)</td>
<td>96.4 ± 34.66</td>
<td>78.73 ± 40.27</td>
<td>2.13</td>
<td>.035</td>
</tr>
<tr>
<td>Postprocedural (f(QRS-T)) (%)</td>
<td>94.1 ± 40.92</td>
<td>71.43 ± 43.52</td>
<td>3.72</td>
<td>.004</td>
</tr>
<tr>
<td>ST segment resolution (%)</td>
<td>54.22 ± 29.74</td>
<td>76.41 ± 25.67</td>
<td>2.67</td>
<td>.010</td>
</tr>
</tbody>
</table>

**Table 6:** Analysis of baseline \(f(QRS-T)\) angle and postprocedural \(f(QRS-T)\) angle for predicting in-hospital mortality

<table>
<thead>
<tr>
<th></th>
<th>Cutoff</th>
<th>AUC</th>
<th>S.E.</th>
<th>Sig.</th>
<th>95% C.I.</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (f(QRS-T))</td>
<td>92.8</td>
<td>.838</td>
<td>.059</td>
<td>.0</td>
<td>1.723 - 4.953</td>
<td>68%</td>
<td>81%</td>
</tr>
<tr>
<td>Post-procedural (f(QRS-T))</td>
<td>88.6</td>
<td>.928</td>
<td>.034</td>
<td>.0</td>
<td>1.861 - 6.995</td>
<td>75%</td>
<td>84.7%</td>
</tr>
</tbody>
</table>
Acute ST-segment elevation myocardial infarction (STEMI) still has a high mortality rate despite the fact that primary percutaneous coronary intervention (PCI) reduces cardiovascular death and is regarded as the recommended revascularization strategy (10).

Although improved in-hospital treatment of acute coronary syndromes (ACS) and subsequent secondary prevention has led to a reduction in the number of overall cardiovascular deaths, sudden cardiac death (SCD) remains a major health problem (11).

Despite major advances in the management of myocardial infarction (MI), electrocardiography (ECG) remains as one of the most diagnostic tools used in the early determination of patient status and optimal treatment strategy. There is proof of the use of ST segment changes in effective triage, and early revascularisation of patients with acute ST segment elevation MI (STEMI) (12).

Several electrocardiogram (ECG) parameters have been utilized to determine high-risk patients during an acute STEMI. Frontal QRS-T (fQRST) angle is one of these parameters, which describe the absolute value of difference between the QRS axis and the T-wave axis on an electrocardiogram (ECG). QRS and T-wave axes are usually found in the automatic reports of ECG devices. Therefore, its measurement is simply done by extracting the QRS axis from T-wave axis. fQRST angle indicates heterogeneity between depolarization (QRS) and repolarization (T-wave) of the myocardium (8).

The frontal QRS-T angle (QRSTa) was first described as the absolute value of the difference between ventricular depolarization (QRS axis) and repolarization (T axis) as a novel marker of myocardial depolarization and repolarization heterogeneity (7).

QRSTa abnormalities reflect the electrical instability of ventricular myocardium and predict adverse cardiovascular outcomes and total mortality, especially in patients with CAD (13).

An abnormal fQRST angle has been observed to be related to increased cardiovascular mortality. It is associated with prognosis in patients with acute coronary syndromes (ACS) (6).

F(QRS-T) angle has a prognostic value in ACS in the different populations, a wide f (QRS-T)angle (>90°) is a good discriminator of long-term mortality in patients with left ventricular systolic dysfunction after an acute myocardial infarction (4).

Regarding Concerning ECG characteristics tests between the two studied groups, We found There is significant difference found between the two groups regarding mean ST segment resolution % (54.1 ± 38.7) in Group I and (63.1 ± 26.3) in Group II , and postprocedural f(QRS-T °) , 62.1 ± 49.4 in Group I and 71.5 ± 46.2 in Group II .

Thus, ST segment resolution and postprocedural f(QRS-T) were significantly higher in thrombolytic group compared to PCI group, however baseline f(QRS-T) was higher in thrombolytic group compared to PCI group but without statistical significance.
In the study of (1), STR was significantly higher in TT group than in pPCI group, which is consistent with our results, while there was no difference regarding postprocedural f(QRS-T) angles.

In the study of (14), pre-and post-procedural fQRST angle was higher in patients with SYNTAX II score N 21.9 and residual SYNTAX N8, respectively. Where the included that fQRST angle is an independent predictor of coronary atherosclerotic burden in STEMI patients.

Concerning outcome and in-hospital mortality between the two studied groups, we found that regarding thrombolytic therapy group, 29.6% of the patients were reported MACE and, meanwhile in PCI group 22.2% of patients were reported MACE with no significant difference between the groups. Regarding in-hospital mortality, we found 7.4% in PCI group and 11.1% in TT group without statistically significant difference found between the two groups. Concerning major adverse cardiac events distributions, we found that Death was the most event occur and new ischemia was the least event occur.

From other point of view, we decided to study the difference between patients who developed MACE and non-MACE patient. we found that There is significant difference found between the two groups regarding age, BMI, DM, HTN, smoking, hypercholesterolemia, three vessels disease, LVEF, baseline f(QRS-T), postprocedural f(QRS-T) and ST segment resolution. They were significantly higher in MACE patients except for LVEF and ST segment resolution were lower in MACE patients.

Concerning Multivariate logistic regression analysis to determine the independent predictors of in hospital mortality: we found that Age, LVEF, and baseline and postprocedural f(QRS-T) angle were found to be independent predictors for in hospital mortality. Also, there is significant difference found between the two groups regarding DM, HTN, smoking, hypercholesterolemia, baseline f(QRS-T), postprocedural f(QRS-T) and ST segment resolution regarding failure of reperfusion.

Regarding ROC curve analysis of baseline f(QRS-T) angle and postprocedural f(QRS-T) angle for predicting in-hospital mortality. Baseline f(QRS-T) at cutoff point 92.8 and post-procedural f(QRS-T) at cutoff point 88.6 have a significant area under the curve with sensitivity 68%, 81% and specificity 75%, 84.7% respectively for predicting in-hospital mortality. There is significant difference found between the two groups regarding DM, HTN, smoking, hypercholesterolemia, LVEF and ST segment resolution that they were significantly higher in patients with Baseline f(QRS-T) >92.8° except for LVEF was significantly lower.

Concerning Correlation between baseline & postprocedural f(QRS-T) and other parameters,We found a significant positive correlation between baseline f(QRS-T) with number of diseases arteries, CK-MB, troponin T, besides a significant negative correlation with LVEF and ST segment resolution in all patients group.

While we found a significant positive correlation between Postprocedural f(QRS-T) with age, CK-MB, troponin T, besides a significant negative correlation with LVEF and ST segment resolution in all patients group.

Several studies have shown that ECG measures of depolarization and repolarization can be used to determine short- and long-term prognosis after ACS (15).

FQRST calculates the vector dispersion between myocardial depolarization and repolarization. In other words, a wide QRS-T angle reflects structural aberrancies affecting the regional pathophysiological changes in ionic channels which affects the sequence of repolarization, in turn, increasing arrhythmogenicity and susceptibility for MACE due to malignant ventricular arrhythmias. This correlation between FQRST and SCD is noted across a wide range of cardiac dysfunction, including, CHF, ACS, stable coronary artery disease, hypertrophic cardiomyopathy as well as in seemingly normal cardiac structure and function (16).

In the study of (11), They demonstrated that QRS-T angle improved prediction of MACE following ACS in addition to traditional cardiac risk factors. Hence, FQRST serves as a useful surrogate for damaged/jeopardized myocardium at risk, thereby, predicting STEMI mortality, as confirmed in our study.

In the study of (4), showed that f(QRS-T) angle >90° is an independent predictor of long-term mortality in acute STEMI patients. Similar to this study, (1). we also found that patients with baseline f(QRS-T) angle ≥95.6° had significantly higher in hospital mortality rate. These results suggest that acute STEMI patients with the higher baseline f(QRS-T) angle have a higher cardiac risk.
In the study of (14), they concluded that pre-and post-procedural fQRS-T angle was higher in patients with SYNTAX II score N 21.9 and residual SYNTAX N8, respectively. The cut-off levels for fQRS-T angle established according to ROC analysis in terms of SYNTAX, SYNTAX II, and residual SYNTAX were found to be 91°, 76.5°, and 79.5° respectively. In multivariante analysis, fQRS-T angle, infarct-related artery, and age were independent predictors of intermediate-high SYNTAX score. They concluded that fQRS-T angle is an independent predictor of ACS burden and mortality in STEMI patients. the cut-off values of fQRS-T angle for SYNTAX, SYNTAX II and residual SYNTAX scores were determined to be 91°, 76.5°, and 79.5°, respectively.

The relationship between fQRS-T angle and the severity of CAD has been investigated previously. In the study of (17) they showed that the prevalence of 2 or 3 vessel CAD was significantly higher in patients with fQRS-T angle ≥ 90. Also (1) showed that a higher number of three-vessel disease was observed in STEMI patients presenting with baseline fQRS-T angle ≥95.6. in our study as previously mentioned as We found a significant positive correlation between baseline f(QRS-T) with number of diseases arteries.

Other studies also analysed the relation between fQRS-T angle and long-term mortality from ACS. (18) reported that With regard to MACE and two years mortality was observed to be lower in patients with fQRS-Tangle ≤ 38° in contrast to that in patients with an fQRS-T angle ≥ 104°.

V. CONCLUSION:

From all the mentioned data we can conclude that, f(QRS-T) angle is an inexpensive, noninvasive and easily detectable parameter on 12 lead ECG. In this study, we have shown that postprocedural f(QRS-T) angle has higher prognostic importance than baseline f(QRS-T) angle for predicting high risk patients in acute STEMI. In addition, baseline f(QRS-T) angle can be used as a simple tool to determine failed reperfusion in acute STEMI patients receiving TT. Therefore, we think that the evaluation of f(QRS-T) angle on surface ECG during acute STEMI may be an acceptable noninvasive electrocardiographic marker for cardiac risk assessment in future.

Conflict of Interest: No conflict of interest.

REFERENCES
