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# The Relation between Electrocardiogram Damage Rating and Hospitalization Outcome in Myocardial Infarction

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**Background:** Ischemic heart disease is among the most important causes of mortality. Therefore, classification and existing ratings for myocardial damage by electrocardiography can assist predicting the prognosis in these patients.
**Objectives:** Given the importance and high prevalence of cardiovascular disease and myocardial infarction in Iran, we investigated the relation between electrocardiogram damage rating and hospitalization outcome in Myocardial Infarction (MI).
**Patients and Methods:** During a 19 month period, 289 patients with unstable angina and non-ST Elevation MI who had inclusion criteria for entrance to our study were examined. All patients were evaluated by both Sylvester table rating (SSS) and Q-wave score. Other information was collected from their medical files.
**Results:** The mean age of subjects was 60.61 ± 12.27 years, where 172 (59.5%) male and 117 (40.5%) female were included. Twenty three patients (7.96%) died during hospitalization. The difference of pathologic Q wave's frequency and recurrent chest pain among patients who expired and those who survived during hospitalization were statistically significant. Also, the amount of Ejection Fraction (EF) and Q score and SSS were significantly different between expired and survived patients. Further analysis showed that EF has negative correlation with SSS ($P = 0.032$, $r = 0.601$).
**Conclusions:** It seems that usage of ECG rating systems such as SSS at the time of admission, in addition to showing the extent of the conflict in the myocardium, can provide valuable information about prognosis, severity of myocardial damage and ventricular function in hospitalized patients.

*Keywords:* Cardiovascular diseases; Hospitalization; Electrocardiography

## 1. Background

Ischemic Heart Disease (IHD) is one of the most common causes of death and disability in most countries and atherosclerosis is one of the main etiologies of IHD (1). Despite extensive diagnostic and therapeutic advances, still one-third of patients with Myocardial infarction (MI) die. Thus, prevention of the risk factors and prompt treatment in high-risk individuals is of high priority in health care systems (2). Various factors such as age, sex, smoking, hyperlipidemia and hypertension are considered as risk factors for cardiovascular diseases (1, 3-6).

One of the best methods to detect cardiac ischemia is evaluating the patients with electrocardiography (ECG). Twelve-lead ECG is widely used for detecting the extent of the conflict and also tracking patients after cardiac infarction. Some protests, such as a Q wave in the electrocardiogram or a bundle branch block are shown to be associated with more severe myocardial damage (7, 8). Failure to achieve probability of normal ventricular function is very high when the electrocardiogram is normal; however, when there are abnormalities in the electrocardiogram, accurate assessment of ventricular function is more difficult than the normal state. Hence, different classification systems have been presented to electrocardiograms that have the ability to assess myocardial damage, the extent of infarction and ventricular function (9-12). The simplified Sylvester QRS Score (SSS) measures the size of the infarction in a scoring system from 31 points corresponding to 3% of the left ventricular mass. The higher the SSS goes, prognosis of the patients decline (13-15). Research has shown that the existing clas-

**Implication for health policy/practice/research/medical education:**
The manuscript would help Medical practitioners to simply calculate the risk of mortality in MI patients.

sification and scoring such as SSS for myocardial damage by ECG has the ability to predict prognosis as well as short and long-term outcomes of patients after MI (14-17).

## 2. Objectives

Given the importance and high prevalence of cardiovascular diseases and MI (18) and the lack of similar studies on SSS in Iran, we intended to evaluate the relation between electrocardiogram damage rating and hospitalization outcome in MI patients.

## 3. Patients and Methods

### 3.1. Subjects

We conducted an analytical cross-sectional study on 289 patients admitted at CCU and Post-CCU of Boo-Ali Hospital from September 2007 till March 2009, diagnosed with unstable angina or non-ST elevation MI (NSTEMI) with ECG and cardiac enzymes assessments (CK-MB and Troponin). All ECGs which were used for interpretations were obtained in the first hour after emergency ward admissions and were analyzed by the same cardiologist. Patients with self-discharged record, no eventual diagnosis or incomplete hospital information were excluded from the study. Information including age, sex, Body Mass Index (BMI), systolic and diastolic blood pressures and pulse rate, ECG changes at presentation, simplified Sylvester score (SSS) (Table 1) ( 14 , 15 ), Q wave, ejection fraction (EF) and prognosis were extracted. A Q-wave with a time of 40 milliseconds and a height equal to 25% of R wave in two adjacent leads was considered as a pathologic Q and was rated from zero to four depending on the affected areas (Anterior/Inferior/Lateral/Septal) ( 12 ). The researchers adhered to the Helsinki announcement ethic codes; furthermore, the ethics committee of Azad University approved the study protocol. All of patients were anonymously included and the results were published as a whole.

### 3.2. Statistical Analysis

The data were analyzed using SPSS version 14 and expressed as mean ± SD. Student t-test was used to evaluate the significance of differences bIetween mean values of two continuous variables and Mann–Whitney test was used for non-parametric distributions. Chi-square analysis was performed for differences in proportions of categorical variables between two or more groups. ROC analysis was performed to evaluate A and SSS best cut-off points.

## 4. Results

Among a total of 289 patients, 172 (59.5%) were male and 117 (40.5%) were female and average age was 60.61 ± 12.27 years. Mean systolic blood pressure of participants was 123.1 ± 24.77 mmHg and mean diastolic blood pressure was 72.47 ± 10.77 mmHg. Average pulse rate was 77.34 ± 7.69 per minute. Twenty three (7.96%) patients died during hospitalization.

**Table 1.** Scoring According to the Simplified Sylvester QRS Score (SSS)

| ECG[a] Lead | Q[a] Wave duration | R[a] Wave Duration | Waves Ratio | Points | Max |
|---|---|---|---|---|---|
| **I** | > 30 | | | 1 | |
| | | | R:Q < 1 | 1 | 2 |
| **II** | > 30 | | | 2 | |
| | > 40 | | | 1 | 2 |
| **aVL**[a] | > 30 | | | 1 | |
| | | | R:Q < 1 | 1 | 2 |
| **aVF**[a] | > 50 | | | 3 | |
| | > 40 | | | 2 | |
| | > 30 | | | 1 | |
| | | | R:Q < 1 | 2 | |
| | | | R:Q < 2 | 1 | 5 |
| **V1**[a] | Any | | | 1 | |
| | | >50 | | 2 | |
| | | >40 | | 1 | |
| | | | R:Q < 1 | 1 | 4 |
| **V2**[a] | Any | <20 | | 1 | |
| | | >60 | | 2 | |
| | | >50 | | 1 | |
| | | | R:Q < 1.5 | 1 | 4 |
| **V3**[a] | Any | <30 | | 1 | |
| | > 20 | | | 1 | |
| | | | Q:R or R:S[a] < 0.5 | 2 | 2 |
| **V4**[a] | | | Q:R or R:S < 1.5 | 1 | 3 |
| **V5**[a] | > 30 | | | 1 | |
| | | | Q:R or R:S < 1 | 2 | |
| | | | Q:R or R:S < 3 | 1 | 3 |
| **V6**[a] | > 30 | | | 1 | |
| | | | Q:R or R:S < 1 | 2 | |
| | | | Q:R or R:S < 3 | 1 | 3 |

[a] Abbreviations: ECG, Electrocardiography; aVL, automated volt left; aVF, automated volt foot; V1-V6, horizontal chest leads; Q, R and S, the names of waves in ECG.

**Table 2.** The Frequency of ECG (Electrocardiography) Rhythm in the two Groups

| Rhythm | Survived | Expired | P value[a] |
|---|---|---|---|
| **AF[b]** | 20 (6.9) | 3 (13%) | 0.228 |
| **LVH[b]** | 23 (8) | 3 (13%) | 0.348 |
| **PVC[b]** | 33 (11.4) | 4 (17.4) | 0.348 |
| **LAD[b]** | 28 (9.7) | 4 (17.4) | 0.193 |
| **RAD[b]** | 30 (10.4) | 2 (8.7) | 0.782 |
| **RBBB[b]** | 28 (9.7) | 3 (13%) | 0.571 |
| **LBBB[b]** | 27 (9.4) | 2 (8.7) | 0.912 |
| **LVCD[b]** | 30 (10.4) | 2 (8.7) | 0.782 |
| **T invert[b]invert** | 38 (13.1) | 3 (13%) | 0.988 |
| **ST depression[b]depression** | 49 (17) | 6 (26.1) | 0.224 |
| **Q pathologic[b]pathologic** | 39 (13.5) | 16 (96.6%) | 0.016 |

[a] No P value is significant.
[b] Abbreviations: AF, atrial fibrillation; LVH, left ventricular hypertrophy; PVC, premature ventricular contraction; LAD, left axis deviation; RAD, right axis deviation; RBBB; right bundle brach block; LBBB, left bundle brach block; LVCD, left ventricular cavity dilatation; T, ST and Q, names of the waves in electrocardiography.

Mean value of SSS was 1.84 ± 1.66; Q score mean was 0.52 ± 0.2 and EF mean was 50.09% ± 5.56% (Table 3). In terms of local changes in the electrocardiogram, 68 (23.5%) had conflict at the lateral area, 60 (20.8%) at the inferior area, 86 (29.8%) at anterior area and 75 (26%) had conflict at the septal area, which revealed no statistically significant difference between expired and survived patients in electrocardiogram main areas (P = 0.402). Further analysis showed that EF has a correlation with SSS (P = 0.032, r = 0.601) but we found no significant correlation between EF and Q score (P = 0.12, r = 0.420). In ROC analysis, the cut-point for EF (AUC = 0.679, P < 0.001) was 37.5 % (sensitivity = 67.1% and specificity = 62%) and the cut-point for SSS (AUC = 0.701, P < 0.001) was 3.5 (sensitivity = 62.6% and specificity = 90.2%).

**Table 3.** Ejection Fraction (EF), Q Score and Simplified Sylvester QRS Score (SSS) Score in the two Groups, expired and survived patients

| Parameters | Groups status | Mean, % | P value[a] |
|---|---|---|---|
| **EF** | Expired | 41.09 | P < 0.000 |
| | Survived | 50.86 | |
| **Q score** | Expired | 0.15 | P < 0.000 |
| | Survived | 0.74 | |
| **SSS** | Expired | 1.61 | P < 0.000 |
| | Survived | 4.48 | |

[a] No P value is significant.

From the 45 patients (15.6%) who had recurrent chest pain during hospitalization, 12 (52.2%) died. Significant difference was found in recurrent chest pain frequency between expired and survived patients.

In total, except for pathologic Q wave (P = 0.016), there was no statistically significant difference between survived and expired patients in electrocardiogram parameters. Furthermore, there was no statistically significant difference between the two groups in hospitalization duration, weight, BMI, diabetes, hyperlipidemia, smoking and hypertension (P > 0.05).

## 5. Discussion

Our study demonstrated that expired MI patients had significantly higher frequency of pathologic Q wave and recurrent chest pain in comparison with survived patients. However, a multi-centric study by Richardson et al, with review and follow up of 46,000 patients over 13 years demonstrated that any changes in the electrocardiograms can be associated with increased mortality in cardiovascular patients. Furthermore, electrocardiogram changes were associated with higher mortality in antro-septal and lateral MI, but not in inferior MI. However, this difference was not statistically different between the two groups (expired and survived). Such difference in some of our findings with the study of Richardson et al. might have originated from shorter follow up in our study and also our smaller sample size (10).

Patients who died during hospitalization had higher EF, Q score and SSS. Also a negative correlation was found between EF and SSS. Fioretti et al. (16) studied 285 hospitalized patients and found that expired patients had a higher SSS and EF. Although some other researchers have found somewhat similar results, but some inconsistencies are present about the relation between EF and SSS. For example, Ideker et al. (19) emphasized that there is a strong inverse relation between EF and SSS in hospitalized patients, but others emphasized on the presence of a not very strong inverse relation. In our opinion, this inverse correlation was predictable due to the higher myocardial damage in patients with higher SSS score which can result in reduced contractility of the myocardium.

In the study of Richardson et al. (10) a value of five in SSS (with nearly 30% of sensitivity and85% of specificity) and in the study of Fioretti et al. (16) a value of six in SSS (with 64% of sensitivity and 56% of specificity) and 40% for the EF (sensitivity and specificity equal to 64%) had the highest predictive values for mortality. While in our study the cut-point for EF was 37.5 % (sensitivity = 67.1% and specificity = 62%) and the cut-point for SSS was 3.5 (sensitivity = 62.6% and specificity = 90.2%). According to our results, although SSS has not a high sensitivity to predict mortality, but possesses a high specificity (10).

In conclusion, it seems that patients' on-admission electrocardiograms rating may be beneficial in predicting mortality among MI patients, the extent of myocardial damage and ventricular function. However, more multicentric high sample size studies are recommended to confirm these results. Additionally, several other methods for myocardial damage ratings based on electrocardiograms and other myocardial indices can be used to identify the most accurate tool which can be applied in triage room even at small hospitals.

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## Authors' Contribution

Simindokht Moshar, Mehrnoosh Broumandpour, the instructor and hypothesizer of the study. Maryam Mohsenikia, gathering the data, writing the paper and data analysis. Scott Reza Jafarian Kerman, for scientific editing of the paper. Sarvenaz Zavareie, gathering the data and data analysis. Seyyed Mohammad Javad Mirlohi, for translations.

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