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# Association between Reciprocal Changes and Syntax Score in Patients with ST-Segment Elevation Myocardial Infarction

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**ABSTRACT**

**Background**: The reciprocal change is a surrogate marker of the severity of myocardial infarction (MI). Patients exhibiting this reciprocal change tend to have a larger infarction, poorer left ventricular systolic function, higher incidence of proximal left anterior descending artery (LAD) lesions, multivessel diseases, and worse prognosis.
**Objective:** This study aimed to find the association between reciprocal ST segment changes and syntax score in patients undergoing primary percutaneous coronary intervention (PCI) for ST elevation myocardial infarction (STEMI).
**Patients and methods:** The study included sixty patients who were presented to Emergency Room with STEMI and underwent primary PCI. Echocardiographic evaluation was performed within 24 h of PPCI. We assessed the severity of coronary artery disease (CAD) using syntax and gensini scores.
**Results**: There was significant difference regarding gensini score and syntax score that was higher in with reciprocal change group than without reciprocal change group.
**Conclusion**: We concluded that there is an association between reciprocal ST segment changes and syntax score in patients undergoing primary PCI for ST elevation myocardial infarction.
**Keywords**: STEMI, ECG, Reciprocal changes.

## INTRODUCTION

Acute myocardial infarction (AMI) is one of the leading causes of morbidity and mortality throughout the world [(1)]**.** Acute transmural myocardial infarction induces ST-segment elevation, enlargement of the R wave, and widening of the QRS complex in electrocardiogram (ECG) leads, which are directly related to the ischemic region [(2)]**.**

Moreover, leads not related to the ischemic area can show concurrent reciprocal ST-segment depression. Numerous studies aimed to determine the clinical implications of reciprocal change on ECG. However, the clinical significance of reciprocal change on ECG such as ST-segment depression remote from the infarct site remains controversial, as reflected in a more extensive infarct size or the benign mirror phenomenon [(3)]**.**

The reciprocal change is a surrogate marker of the severity of the disease. Patients exhibiting this reciprocal change tend to have a larger infarction, poorer left ventricular systolic function, higher incidence of proximal left anterior descending artery (LAD) lesions, multivessel diseases, and worse prognosis. Patients in the previously mentioned ECG studies usually receive conservative or thrombolytic therapy, followed by coronary intervention. At present, patients with STEMI usually receive primary PCI [(4)]**.**

Patients with acute STEMI who undergo immediate invasive intervention, the prognostic significance of reciprocal ECG changes is not clear [(5)]**.**

The syntax score (SS) is an anatomic scoring system based on the coronary angiogram that quantitatively characterizes the coronary vasculature withrespect to the number, location, complexity, and functional impact of angiographically obstructive lesions. SS is measured to define the coronaryartery complexity and allows prospective risk stratification of patients undergoing PCI [(6)]**.**

Since admission of ST segment changes in inferior derivations in acute MI occurring secondary to a combination of benign electrical phenomena and myocardial ischemia, we attempted to find the association between these reciprocal changes and anatomical complexity (which will be assessed by syntax score). Therefore, our study aimed to investigate whether reciprocal change in ST-segments is related to markers of CAD severity, as assessed by syntax score in patients undergoing primary percutaneous coronary intervention (PCI) for ST-segment elevation myocardial infarction (STEMI).

## PATIENT AND METHODS

This Cross-sectional observational study was conducted on 60 patients with ST elevation myocardial infarction and underwent primary PCI in Cardiology Department, Faculty of Medicine, Zagazig University during the period from May 2021 to November 2021. Patients were classified according to the presence or absence of reciprocal ECG changes into two groups: group (I): 30 patients with reciprocal change and group (II): 30 patients without reciprocal change.

**Inclusion criteria:** Patients presented with ST elevation myocardial infarction who were eligible for primary PCI. STEMI was defined as symptoms of ischemia associated with ST-segment elevation in



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two contiguous leads (measured at J-point) of ST-segment elevation ≥ 2.5 mm in men younger than 40 years, ≥ 2 mm in men older than 40 years, or ≥ 1.5 mm in women in leads V2-V3 and/or ≥ 1 mm in all other leads in the absence of LVH or LBBB [(7)].

**Exclusion criteria:** Patients with non-STEMI and unstable angina, admission for more than 12 hours after symptom onset and previous myocardial infarction, patients treated with thrombolytics or conservative methods prior to PCI, patients with atrial fibrillation, coronary artery by-pass grafting, LV dilatation, significant valve lesion and electrolyte disturbance.

**All patients were subjected to the following:**

Detailed history, demographic analysis & clinical examination that were recorded including the risk factors for CAD like smoking, dyslipidemia, hypertension, diabetes and family history of CAD. Routine laboratory investigations were done and a standard transthoracic echocardiogram was performed using GE Vivid E9 (Norway) or Philips envisor (Netherlands). All patients presenting within 12 h of onset of symptoms were considered for primary PCI. Severity of CAD was assessed using gensini Score [(8)] and syntax score [(9)].

**Ethical consent:**

**An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

***Statistical analysis***

The collected data were coded, processed and analyzed using SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc., Chicago, IL, USA). Data were tested for normal distribution using Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi^2$) was used to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value ≤ 0.05 was considered significant.

**RESULTS**

Table (1) showed that there was no statistically significant difference between both groups regarding demographic data and risk factors (p > 0.05).

**Table (1):** Demographic data and risk factors of the studied patients.

| Variables | With reciprocal change (n=30) | Without reciprocal change (n=30) | $X^2$ | P value |
|---|---|---|---|---|
| **Age (years)** | 58.90 ± 10.18 | 61.73 ± 12.88 | t= 0.94 | 0.34 |
| **Sex male** | 25 (83.3%) | 27 (90%) | 0.57 | 0.44 |
| **Hypertensive** | 16 (53.3%) | 13 (43.3%) | 0.43 | 0.6 |
| **Diabetic** | 17 (56.6%) | 15 (50%) | 0.6 | 0.26 |
| **Smokers** | 22 (73.3%) | 24 (80%) | 0.54 | 0.37 |

Data are represented by mean ± SD or number (%). Data analyzed using independent t test and chi square test.

Table (2) showed that there was no statistically significant difference between both groups regarding clinical data (p > 0.05).

**Table (2):** Comparison clinical data of studied groups

| Variables | With reciprocal change (n=30) | Without reciprocal change (n=30) | t value | P value |
|---|---|---|---|---|
| **Systolic blood pressure (mmHg)** | 114.66 ± 14.07 | 115 ± 16.5 | 0.08 | 0.93 |
| **Diastolic blood pressure, (mmHg)** | 71.66 ± 11.16 | 69 ± 9.5 | 0.99 | 0.32 |
| **Pulse (bpm)** | 79.4 ± 9.8 | 76.5 ± 13.7 | 0.95 | 0.34 |
| **Symptom to door time (hours)** | 5.67 ± 2.523 | 6.40 ± 1.83 | 1.2 | 0.2 |
| **Killip class** | | | **$X^2$** | |
| **Class 1** | 19 (63.3%) | 12 (40%) | 3.3 | 0.07 |
| **Class 2** | 11 (36.7%) | 18 (60%) | | |

Data are represented by mean ± SD. Data analyzed using independent t test Data are represented as number (%). Data analyzed using chi square test 2X2

Table (3) showed that there was no statistically significant difference between both groups regarding laboratory data except troponin was significantly higher in with reciprocal change group than without reciprocal change group.

**Table (3):** Comparison of laboratory data of studied groups at admission

| Variables | With reciprocal change (n=30) | Without reciprocal change (n=30) | t value | P value |
|---|---|---|---|---|
| **WBCS** | 14.1 ± 2.1 | 13.25 ± 1 | 2 | 0.05 |
| **Hb** | 13.7 ± 1.03 | 13.6 ± 2.4 | 0.2 | 0.83 |
| **Platelets** | 291.5 ± 7.4 | 300.2 ± 8.2 | 0.42 | 0.67 |
| **Cholesterol (mg/dl)** | 212.97 ± 5.1 | 222.06 ± 30.450 | 0.81 | 0.41 |
| **Triglycerides (mg/dl)** | 174.20 ± 8.21 | 186.33 ± 31.303 | 0.76 | 0.44 |
| **HDL (mg/dl)** | 30.78 ± 5.302 | 32.37 ± 5.512 | 1.1 | 0.25 |
| **LDL (mg/dl)** | 119.44 ± 5.42 | 113.36 ± 8.63 | 0.517 | 0.60 |
| **Creatinine (mg/dl)** | 1.06 ± 0.27 | 1.07 ± 0.15 | 0.22 | 0.82 |
| **Troponin (ng/ml)** | 248.03 ± 28.06 | 205.3 ± 31.5 | 5.5 | **<0.001*** |

Data are represented by mean ± SD. Data analyzed using independent t test

Table (4) showed that there was no statistically significant difference between both groups regarding electrocardiographic data.

**Table (4):** Comparison of electrocardiographic data of studied groups

| | Reciprocal (n=30) | Non Reciprocal (n=30) | t value | P value |
|---|---|---|---|---|
| **Q Wave** | | | | |
| **Yes** | 27 (90%) | 24 (80%) | $X^{2}$= 1.176 | 0.27 |
| **No** | 3 (10%) | 6 (20%) | | |
| **Corrected QT interval** | 432.8 ± 18.8 | 420.18 ± 31.6 | 1.89 | 0.06 |
| **Anterior infarction** | 19 (63.3%) | 24 (80%) | $X^{2}$= 2.05 | 0.15 |
| **Inferior infarction** | 11 (36.7%) | 6 (20%) | | |
| **Sum of segments of RC** | 4.46 ± 1.56 | - | - | - |
| **Number of Leads with RC** | 2.33 ± 0.47 | - | - | - |

Data are represented by mean ± SD or number (%). Data analyzed using independent t test and chi square test.

Table (5) showed that there was statistically significant difference between both groups regarding wall motion score index, LVEDD, LVEF and LV mass index while there was no significant difference regarding LVESD.

**Table (5):** Comparison echocardiographic data of studied groups

| Variables | With reciprocal change (n=30) | Without reciprocal change (n=30) | t value | P value |
|---|---|---|---|---|
| **Wall motion score index** | 1.3 (1.2 – 1.4) | 1.25 (1.2 – 1.4) | MW=299.5 | **0.02** |
| **LVEDD** | 52.4 ± 3.6 | 49.06 ± 4.3 | 3.1 | **0.002** |
| **LVESD** | 35.3 ± 2.9 | 34.3 ± 5.4 | 0.9 | 0.35 |
| **LVEF** | 48.2 ± 6.6 | 52.3 ± 3.8 | 2.9 | **0.005** |
| **LV Mass Index** | 118 ± 12 | 96 ± 5 | 9.26 | **0.0001** |

Data represented by mean ± SD are analyzed using independent t test. Data represented as median (25th -75th Percentiles) are analyzed using Mann Whitney test.

Table (6) showed that there was no statistically significant difference between both groups regarding site of lesion while there was significant difference regarding gensini score and syntax score that was higher in with reciprocal change group than without reciprocal change group.

**Table (6):** Comparison angiographic data of studied groups

| Culprit lesion | Reciprocal (n=30) | Non Reciprocal (n=30) | $X^2$ | P value |
|---|---|---|---|---|
| **LAD** | 19 (63.3%) | 24 (80%) | 2.8 | 0.29 |
| **LCX** | 3 (10%) | 3(10%) | | |
| **RCA** | 8(26.7%) | 3 (10%) | | |
| **Use of Aspiration** | 12 (40%) | 8 (26.6%) | 1.2 | 0.27 |
| **Number of Stents** | | | 2.5 | 0.11 |
| **1** | 9 (30%) | 15 (50%) | | |
| **2** | 21 (70%) | 15 (50%) | | |
| **Gensini Score** | 26.4 (5 – 55) | 19.8 (5 – 40) | MW | **<0.001** |
| **SYNTAX score** | 24 (14-35.2) | 16.5 (13.5 – 29.5) | MW | **<0.001** |
| **SYNTAX score** | | | 2.7 | 0.1 |
| **≥33** | 13 (43.3%) | 7 (23.3%) | | |
| **<33** | 17 (56.7%) | 23 (76.7%) | | |

Data represented as number (%) are analyzed using Fischer exact test. Data represented as median ($25^{th}$ -$75^{th}$ Percentiles) are analyzed using Mann Whitney test.

## DISCUSSION

Our results demonstrated that there was no statistically significant difference between both groups regarding demographic data and risk factors. The mean age was 58.90 years for group I and 61.73 years for group II. In agreement with our study**,** **Vaidya** ***et al.*** **[10]** and **Chen** ***et al.*** **[4]** said in their results that there were no significant differences between patients with reciprocal changes and those without, with respect to the demographic profiles and risk factors. Also, **De Luca** ***et al.*** **[11]** showed that there was no significant relationship between STDR and those risk factors. Additionally, **Hwang** ***et al.*** **[12]** demonstrated in his study that a total of 244 patients underwent successful primary PCI. These patients were divided into 2 groups: those with reciprocal change (n = 133) and those without reciprocal change (n = 111). There was no significant difference between both groups regarding age, gender, smoking and hypertension. In disagreement with our study, **Mohamed** ***et al.*** **[13]** said that patients' demographic data were comparable between the groups. Patients with both hypertension and diabetes were more likely to have RC (p=0.05).

Also, these results are different from those of **Michael** ***et al.*** **[14]** who showed a significant relationship between STDR and both risk factors. This discrepancy might be attributed to lack of screening in our study community and different cultural habits between it and the other study community leading to accidental discovery of these diseases on admission.

In the current study, the comparison between 2 groups revealed that there was no statistically significant difference between both groups regarding clinical data. The mean of clinical data of group I (systolic blood pressure (114. 66), diastolic blood pressure (71.66), pulse (79.4), symptom to door time (5.67 hr) and Killip class 1 (63.3%) and class 2 (36.7%)), and group II (systolic blood pressure (115), diastolic blood pressure (69), pulse (76.5), symptom to door time (6.40 hr) and Killip class 1 (40%) and class 2 (60%)).

**Chen** ***et al.*** **[4]** demonstrated that the time of chest pain onset to ED admission did not differ between groups I and II. Furthermore, there was no difference in door-to-balloon times between groups. Although the Killip classification was not significantly different between groups, first SBP and diastolic blood pressure (DBP) measurements were both significantly lower in group I than those in group II (P = .002 and .004, respectively). **Hwang** ***et al.*** **[12]** demonstrated in his study that pain onset to door time and Killip class was not significant between both groups. While, there was significant difference between both groups regarding DBP and HR. In disagreement with our study, **Mohamed** ***et al.*** **[13]** found that patients without RC [Group 2] presented significantly later after symptom onset (9.25 vs 3.83 hours, p= 0.004). **Michael** ***et al.*** **[14]** and **De Luca** ***et al.*** **[11]** showed a significant association between STDR and Killip class on presentation.

In the current study, there was no statistically significant difference between both groups regarding laboratory data except troponin was significantly higher in with reciprocal change (group I) than in without reciprocal change group (group II), indicating ischemia of a larger myocardial mass. In agreement with our study, **Mohamed** ***et al.*** **[13]** demonstrated that comparison of serum laboratory findings were similar except for higher peak troponin T values in patients with RC (7.47 vs 2.90 ng/ml, p=0.04). Also, **Vaidya** ***et al.*** **[10]** and **Chen** ***et al.*** **[4]** demonstrated that upon admission, peak troponin I levels were significantly higher in group I (P = .043). In disagreement with our study, **Shah** ***et al.*** **[15]** carried out a similar study on 261 STEMI patients to detect the effect of STDR (using continuous ECG monitoring for 24 hours) on the in-hospital outcome. Their results showed no significant relationship between STDR and LVEF.

In the present study, there was no statistically significant difference between both groups regarding electrocardiographic data except corrected QT interval was significantly higher in with reciprocal change (432.8) than in without reciprocal change group (420.18), and the other data were as following; anterior infarction in group I (63.3%) and in group II (80%), inferior infarction in group I was 36.7% and in group II was 20%), sum of segments of RC in group I (4.46), and number of Leads with RC in group I (2.33). In **Chen** ***et al.*** **[4]** electrocardiographs revealed that significantly more anterolateral and inferior STEMI occurred in group I (P = .022 and .001, respectively), whereas anterior STEMI was significantly more frequent in group II (P b .001).

In the current study, there was statistically significant difference between both groups regarding wall motion score index (group I (1.3) and group II (1.25)), LVEDD (group I (52.4) and group II (49.06)), LVEF (group I (48.2) and group II (52.3)) and LV mass index (group I (118) and group II (96)), while there was no significant difference regarding LVESD. In agreement with our study, **Zoghi** ***et al.*** **[16]** concluded that those patients presented with RSTD showed a statistically significant lower mean ejection fraction (49% ± 19%) compared to those who presented without such RSTD (52 ± 15%) (P value < 0.001). **Parale** ***et al.*** **[17]** (study on 300 patients of acute myocardial infarction – 180 anterior & 120 inferior) concluded that anterior STEMI patients without reciprocal changes in the inferior leads have a better LVEF & patients with inferior STEMI with ST segment depression in apicolateral leads have higher prevalence of significant LV dysfunction. **Gibelin** ***et al.*** **[18]** found that the persistence of ST segment depression in non-infarcted leads in inferior STEMI for > 48 h was associated with a more severe depression of the left ventricular ejection fraction & that the group presented with RSTD showed a significantly lower EF compared to those presented without RSTD (52.2 ± 6% vs 59.2 ± 7%, P value < 0.005). Also, **Çetin *et al.*** [19] found that left ventricular mass index was significantly higher in reciprocal ST changes group than in non-reciprocal group and is a predictor of reciprocal ST changes. On the grounds of increased LV wall tension, sub endocardial ischemia induced by LVH may cause this electrical phenomenon. Discordant to our results, **Vaidya *et al.*** [10] and **Celik and his colleagues** [20] concluded that there was no statistical significant difference between those patients presented with RSTD & those without RSTD as regards the ejection fraction. In addition, they concluded that RSTD during early phases of inferior infarction is an electrical reflection of primary ST segment elevation in the area of infarction. The discrepancy between their results & ours could result from the difference in the number of studied patients, also the difference in the clinical settings. **Mohamed *et al.*** [13] found that left ventricular systolic pressure, left ventricular end-diastolic pressure and post-PCI LVEF were similar in both groups. In **Chen *et al.*** [4]**,** left ventricular ejection fraction (LVEF) data were obtained using echocardiography at a mean of 6.6 days from 144 patients (87.3%) because some patients died before a formal echocardiography could be performed. For these 144 patients, there were no significant differences between groups I and II with respect to LVEF.

In the current study, the mean syntax score was significantly higher in group I (24) than in group II (16.5). This comes in agreement with **Hatamnejad *et al.*** [21] who showed that there was a strength of association between high SYNTAX score occurrence in reciprocal changes.

## CONCLUSION

We concluded that there is an association between reciprocal ST segment changes and syntax score in patients undergoing primary PCI for ST elevation myocardial infarction.

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