JKBMS, Vol.4, No.2, P.85-90, 2018 https://doi.org/10.56056/amj.2018.66

# Coronary Artery Lesions during Coronary Angiography in Acute ST-Segment Elevation Myocardial Infarction with and without Reciprocal Changes

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## Abstract

**Background and objectives:** ST segment elevation myocardial infarction is one of the most common causes of death worldwide. This study tries to clarify the role of reciprocal changes in the possibility of having more than one coronary artery occlusion. **Methods:** The study is a prospective case control study and the data are collected from January 2017 till January 2018. The total number of participants in this study was 144 cases of acute ST segment elevation myocardial infarction randomly taken from emergency department of cardiac center in Erbil city. All of them underwent coronary angiography, comparison of coronary artery finding made between those with reciprocal changes on electrocardiography 72 cases and the others without reciprocal changes 72 cases. Chi-square test was used for data analysis and interpretation. **Results:** The mean age of participants were 57.5 years. 35 out of 144 were female and 109 out of 144 were male. Out of 72 case with reciprocal ST segment depression 63 (87.5%) had more than one blood vessel with critical lesion, while 9 out of 72 (12.5%) had single blood vessel with critical lesion. On the other hand 40% of patients without reciprocal ST depression had more than one artery involved and the remainder 60% had single blood vessel involved and this difference was statistically significant. **Conclusions:** Reciprocal ST segment depression in acute ST segment elevation myocardial infarction signifies the presence of multiple vessel occlusion rather than simple electrical phenomenon.

**Keywords** ST segment elevation myocardial infarction; Coronary angiography; Reciprocal ST segment depression.

## Introduction

Acute coronary syndrome (ACS) classified into three conditions: unstable angina, acute ST segment elevation myocardial infarction (STEMI) and non STEMI[1-3]. The definition of myocardial infarction (MI) shifts to more sensitive biomarkers of myocardial injury which have important implications for epidemiologic study, public policy, and clinical trials[4]. The universal definition of MI is evidence of myocardial necrosis in a clinical setting consistent with acute myocardial ischemia[5,6]. MI rises sharply in both men and women with increasing age, and racial differences exist and the proportion of patients with ACS events who have STEMI varies in across observational studies—from 29% to 47% of patients admitted with ACS generally. STEMI has higher mortality than stable coronary artery disease[2,7]. The right and left coronary arteries, arise behind the right and left cusps of the aortic valve, respectively. The left coronary artery, which divides into anterior descending and the circumflex branches, supplies the left ventricle and atrium. The right coronary artery is dominant in 50% of individuals, and the left coronary artery is dominant in another 20%, and co-dominancy seen in 30%[8]. Coronary artery disease is almost always due to atheromatous narrowing and subsequent occlusion of the vessel (Early atheroma is present from young adulthood onwards while mature plaque where they proliferate and change their phenotype to form a fibrous capsule around the lipid core)[9]. When coupled with reduced coronary flow reserve, as occurs with obstruction of coronary arteries or abnormalities of the coronary microcirculation, an imbalance in myocardial ATP production relative to demand may occur, and the resulting ischemia can worsen or cause heart failure[10]. After evaluation of modifiable and non-modifiable risk factors[11]. Mains symptoms are chest pain and breathlessness, while physical signs are pallor, sweating and tachycardia and hypotension[12]. STEMI

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pain may simulate that of acute pericarditis, pleural pain, musculoskeletal pain and esophageal spasm[13]. Inflammatory markers used for risk stratification include C-reactive protein, triglyceride, serum cholesterol, high density lipoprotein, low density lipoprotein[14]. Clinically, cardiac risk include non-modifiable and modifiable risk factors and better assessed when combined[15]. ECG findings of STEMI include elevation of ST segment or new left bundle branch block on ECG[16]. Elevation of ST segment may involve many leads, which may correlates with a higher mortality[17]. The most common indication for emergency coronary angiography is acute unstable angina and acute MI[18], with no absolute contraindications[19]. The relative contraindications include decompensated congestive heart failure, renal insufficiency, bacteremia, acute stroke, gastrointestinal bleeding, uncorrected electrolyte abnormalities and contrast allergy[18].

The aim of this study was to clarify the role of reciprocal ST segment changes in the possibility of having more than one artery occlusion.

## Patients and Methods

This is a prospective case control study (all cases randomly taken) on acute STEMI (144 in total), half of the cases with reciprocal ST segment depression (RSTD) and the other half with no RSTD, comparison between both groups made on the bases of findings of severity of coronary artery diseases during coronary angiography. In this study, the data taken from 144 cases recorded as having acute STEMI, and taken from the start of January 2017 subsequently till the start of January 2018, mostly were referral patients and all have been revised and admitted by specialist of internal medicine or directly by cardiologist from outpatient department of the same hospital. The article had been ethically approved by the scientific and ethical committee of Hawler Medical University and acceptance for participation in current study taken verbally from all participants, and those who refused to participate were excluded.

All patients had previous ECG at the time that they are reached the hospital. coronary angiography performed through right femoral artery approach in majority of the cases, with right radial artery approach in few cases especially when femoral approach is not possible, adequate sterilization of the skin overlying the vessel is done, with iodine then local infiltration with lidocaine (2%) with 10-15 ml done, seldinger and femoral sheath set and then Judkin left(JL) and Judkin right (JR) type of cardiac catheter used with guide wire and contrast material of about 50 ml is used for every case, the contrast material injected into both coronary arteries directly through cardiac catheters and the monitoring and evaluation of coronary vessel made by x-ray machine, the whole procedure is taking about 20-30 minute in average, then proceeding to intervention of blocked vessel accordingly. the report of coronary artery lesion written after good discussion between two expert cardiologist. All Patients with Acute STEMI underwent coronary angiography. Exclusion criteria: STEMI refusing cardiac catheterization, chest pain of more than 24 hours and cardiogenic shock. p-value level of $\theta$.05 was taken as significant.

## Results

In this case control study, the total 144 patients were studied with mean age of 57.5 (±10 years). All of them underwent coronary angiography. In regard to the baseline demographic & clinical characteristics, the patient characteristics with regard to, age, diabetes mellitus and smoking status showed no significant statistical difference (p-value of 0.030, 0.030, 0.71, 0.35 respectively). Regarding hypertension and gender our study showed statistically significant difference in two subgroups with p-value of 0.004, 0.030 respectively as shown in Table 1.

**Table (1):** Basal characteristics of patients

| Characteristics | | Reciprocal Depression | | Total | p-value |
|---|---|---|---|---|---|
| | | No Reciprocal change | Reciprocal Depression | | |
| Gender | Female | 12 | 23 | 35 | 0.03 |
| | Male | 60 | 49 | 109 | |
| Age groups | 20-39 | 6 | 2 | 8 | 0.303 |
| | 40-59 | 31 | 36 | 67 | |
| | 60-80 | 35 | 34 | 69 | |
| Hypertension History | No HTN | 53 | 36 | 89 | 0.004 |
| | HTN | 19 | 36 | 55 | |
| Diabetic history | No DM | 54 | 48 | 102 | 0.71 |
| | DM | 18 | 24 | 42 | |
| Smoking history | Non Smoker | 43 | 50 | 92 | 0.112 |
| | Smoker | 30 | 22 | 52 | |

The result of the comparison of group of patients having STEMI with RSTD with group of patients having STEMI without RSTD showed significant increase in incidence of concomitant significant coronary artery occlusion in non-culprit coronary artery during angiographic estimation of both groups with p-value of 0.002 (as shown in table 2). In comparison of relation of culprit blood vessel which (one of LAD or LCX or RCA) is responsible about the clinical presentation at the same time in accordance to presence or absence of RSTD, with p-value of near to 0.035(as shown in Table 2).

**Table (2):** Coronary angiographic finding according to Reciprocal Depression.

| Findings | | Reciprocal Depression | | Total | p-value |
|---|---|---|---|---|---|
| | | No Reciprocal change | Reciprocal Depression | | |
| Number of Vessels affected | Single | 28 | 9 | 37 | 0.002 |
| | Two | 17 | 29 | 46 | |
| | Three | 26 | 31 | 57 | |
| | Four | 1 | 3 | 4 | |
| | Total | 72 | 72 | 144 | |
| Culprit Vessel | LAD | 49 | 34 | 83 | 0.035 |
| | LCX | 4 | 4 | 8 | |
| | RCA | 19 | 34 | 53 | |
| | Total | 72 | 72 | 144 | |

Those patients who had inferior STEMI with reciprocal depression of chest leads having lesion in RCA carried concomitant non critical lesions in other blood vessel or vessels. While those with inferior STEMI having no RSTD had lesion or lesions apart from the culprit lesion responsible about acute STEMI with p-value of 0.00013 by Fisher›s Exact Test as shown in Table 4. In the group of patients with anterior STEMI with RSTD in non-anterior leads having lesion or lesions in LAD artery showed non- significant incidence of concomitant artery occlusion in non-culprit artery than the group of patients with anterior STEMI without RSTD with p-value of 0.307 as shown in Table 3.

**Table (3):** Cross tabulation showing the relationship between Number of Vessel according to Reciprocal depression in Inferior and Anterior STEMI.

| Number of Vessel | | Reciprocal Changes | | Total | p-value |
|---|---|---|---|---|---|
| | | No reciprocal change | Reciprocal depression | | |
| Inferior STEMI | Single | 11 | 3 | 14 | 0.0001 |
| | Two | 2 | 14 | 16 | |
| | Three | 7 | 15 | 22 | |
| | Four | 0 | 1 | 1 | |
| | Total | 20 | 33 | 53 | |
| Anterior STEMI | Single | 5 | 2 | 7 | 0.5 |
| | Two | 4 | 8 | 12 | |
| | Three | 4 | 7 | 11 | |
| | Four | 0 | 1 | 1 | |
| | Total | 13 | 18 | 31 | |

## Discussion

Till now the role of RSTD in acute STEMI not well identified, whether it is an indicator of multi-vessel disease or it is just an electrical phenomenon[20-23]. Evaluation of basic characteristics of the patients participated in this study showed gender effect on the study, with significant p-value of 0.03, which may be due to small number of female patients in the taken sample, however when random multi-stage sampling, taken the p-value showed no significance. In comparison of different age groups no significant age effect observed (p-value of 0.3). In subgroup of patients according to presence of hypertension (HTN), significant effect of HTN seen with p-value of 0.004, with 89 were non hypertensive and 55 were hypertensive, in which the effect remained after taking multistage sampling of equal numbers of in both subgroups. Diabetes versus non diabetics showed no effect with p-value of 0.7 in current study. The smokers versus never smoked participants showed no effect of smoking on RSTD significance. The comparison of group of patients having acute STEMI with RSTD with group of patients having acute STEMI without RSTD showed increased number of concomitant significant coronary artery occlusion in non-culprit coronary artery, with p-value of 0.002. In evaluation of relation between culprit blood vessel and significance of RSTD, there was significant difference when the culprit blood vessel responsible about acute STEMI, were due to LAD, RCA,LCX or Multivessel, with p-value of 0.035, with significant number of patients presenting with inferior STEMI having more than one vessel affected. When we take the subgroup of patients who have Acute STEMI in inferior wall, totally are 53 in number, significant difference between those with RSTD and those with RSTD observed, but no significant relation observed in other anatomical location of MI on ECG. The results of this study is very similar to the study made by Nour in which his study sample was 200 patients in total, (44% females and 56% males), with mean age was 51.8 ± 15.6 years, concluding that RSTD in acute STEMI was associated with greater extent of coronary artery involvement with p-value of <0.001[20].

Another similar study to current study by Kidambi et-al, claims that "RSTD appear to be a marker of increased ischemic myocardium at risk and indicate the potential for increased salvage with emergency revascularization and RSTD showed no relationship to infarct size, which may be remote concomitant ischemia at different arterial vessel of non-culprit site"[24].

On the other hand Ferguson in his study concluded a different result from this study that RSTD in acute STEMI not predict ischemia or the extent of coronary artery disease in the arteries and it represents a benign electrical phenomenon, 11 out of 23 patients had acute STEMI about 48 %, of whom had RSTD there was no statistically significant increase in incidence of multivessel coronary artery lesion in neither groups, but rather they correlated the extent of coronary artery disease to the mean degree of ST-segment elevation from the infarcting wall, however

he concluded the incidence of multivessel disease to be greater in patients with RSTD than in those without such RSTD in respect to average S-T elevation irrespective to the RSTD (2.8 ± 0.4 versus 1.9 ± 0.3 mm, p-value of 0.06)[21].

In another non-concordant study to our current study in which Vaidya in his clinical randomized study(2017), with 53 patient sample size (smaller size number than current study ) with acute STEMI, comparing ECG and coronary angiography claims that RSTD may represent subendocardial distant ischemia from the primary coronary artery in only 14% of the study sample, while an electrical phenomenon in 77%, rather than ischemia at distance from impaired collateral circulation with p-value of 0.004, and the study did not give possibility for concomitant non total non- culprit coronary artery lesion responsible about non STEMI in these patient[25].

## Conclusions

Simply we can conclude from this study that RSTD in acute STEMI is an indicator of severity of the coronary artery disease on coronary angiography in the form of more than one artery involvement, while those without RSTD have only single coronary artery lesion on coronary angiograph.

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