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# Clinical implication of ST segment depression in II, III, aVF in patient with Anterior Wall myocardial infarction

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***Abstract:*** **Anterior wall myocardial infarction (MI) is a varieties of MI which involves the anterior most part of the heart and part of the ventricular septum. The diagnosis is aided by 12 lead ECG showing ST-elevation in leads V1-V6, I and aVL; major vessels involved is left anterior descending artery. Aim: The aim of this study is to determine ECG parameters, assess the role of ST-segment depression in the leads II, III, aVF to locate the culprit artery accurately as compared to Coronary Angiography (CAG) in anterior wall MI. Methods: A retrospective study was done from January 2018 to December 2018 by taking the clinical records of the 151 patients having Anterior wall MI, admitted and underwent CAG in the Department of Cardiology, First Hospital of Jilin University. Results: There were 112 male and 39 female patients. Among the included patients, 106 were smokers. Proximal stenosis was found in 11 male patients and 10 in female patients. Middle & distal stenosis was found in 101 male patients and 29 female patients. Among the assessed patients, the result suggested that gender was the influencing factor. It was observed that the male patient had anterior wall MI than that of the female patients. Conclusion: Coronary Angiogram is the gold standard investigation for diagnosing area of stenosis in spite of having normal ECG's. Hence, patients who are clinically presenting with symptoms of MI and having normal ECG findings have to be further evaluated to rule out AWMI and to decrease morbidity and mortality.**

**Keywords: Anterior Wall Myocardial Infarction, Coronary Angiogram, Creatine kinase, ECG, STEMI, Troponin.**

## 1. INTRODUCTION

Coronary heart disease occurs mainly because of atherosclerosis of coronary arteries that are supplying heart and the Myocardial Infarction is its usual presentation. Globally as estimated by World Health Organization (WHO) that in 2004, 12.2% of worldwide deaths were from ischemic heart disease with it being the leading cause of death in high- or middle-income countries. Where as in low socio economic countries the leading cause of mortality is lower respiratory tract infections followed by ischemic heart diseases **(1).**

Worldwide, more than 3 million people have ST- segment elevated MI (STEMIs) and 4 million have Non ST-elevated MI (NSTEMIs) per year **(2).** STEMIs occur about twice as often in men as women **(3).** In developing nations like India, China, Korea most common cause for mortality is Ischemic Heart Disease (IHD) and in India, a developing nation, IHD had become the leading cause of death by 2004, accounting for approximately 1.46 million deaths (14% of total deaths) and deaths due to IHD were expected to double during 1985–2015 **(4).** The most common cause of a myocardial infarction is the rupture of an atherosclerotic plaque inside an artery supplying heart muscle **(5,6).**

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Heart is a pulsatile beating organ which is majorly supplied by three coronary arteries namely Right Coronary artery, Left Anterior Descending artery & Left Circumflex artery. Anterior wall of heart is chiefly supplied by Left Anterior Descending artery & Anterior wall myocardial infarction (AWMI) occurs due to the blockade of this artery. The characteristic involvement of the anterior part of the heart and the ventricular septum is seen in AWMI.12 lead ECG shows ST elevation in leads V1-V6, I and aVL, elevation and depression significantly seen in chest lead V3 and in lead III respectively.

When a patient has an anterior-wall MI, indicative changes seen in leads V1 through V4 and the reciprocal changes in lateral leads I and aVL and inferior leads II, III, and aVF. In leads V1 through V4, the normal R-wave progression is lost. Muscle damage is severe if there is more proximal lesion. Anterior-wall MIs can be categorized as anteroseptal, anterolateral, true anterior, and extensive anterior infarcts. Anteroseptal infarcts involve the anterior part of the intraventricular septum and produce changes in leads V1 through V3. Left coronary artery is supplying anterolateral aspect of the heart and its occlusion can be seen on 12 lead ECG with characteristic changes in leads V5, V6, I, aVL. Neither interventricular septum nor lateral walls are involved in a true anterior MI **(7).**

## 2. AIM OF THE STUDY

The aim of the study is to determine the culprit artery in the case of anterior wall myocardial infarction with electrocardiogram and to compare with coronary angiogram to know the lesion of stenosis in culprit artery. The major objectives are

- To determine the ECG parameters

- To assess the role of ST segment depression in the leads II, III, aVF

- To locate the culprit artery accurately as compared to Coronary Angiography

## 3. METHODS AND METHODOLOGY

**Design:**

A hospital based retrospective study was done in this study.

**Setting:**

This study was carried out Department of Cardiology, First Hospital of Jilin University, Changchun, China.

**Subjects:**

We analyzed 151 patients with anterior wall MI, admitted and underwent coronary angiography in the Department of cardiology, First Hospital of Jilin University from January 1$^{st}$ 2018 to December 31$^{st}$, 2018. Only 151 patients (112 males and 39 females) met our inclusion criteria.

**Inclusion Criteria**

1. Patients of more than 35years (both gender).
2. Patients with chest pain for more than or equal to 30 minutes before hospital admission.
3. Patients with elevated Troponin I levels.
4. Patients with co-morbid conditions like Hypertension, Diabetes & smoking.
5. Patients without ST elevations in Lead II, III, aVF of ECG's or Normal ECG's.

**Exclusion criteria**

1. Patients with previous history of Myocardial Infarction.
2. Patients with ST elevations in Lead II, III, aVF of ECG at the time of admission.
3. Patients who had undergone previous coronary bypass artery grafting or percutaneous coronary interventions prior to current hospital admission.
4. Patients with significant stenosis in both LAD and RCA or triple vessel disease.

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**Statistical Analysis**

The statistical analysis was performed using SPSS 21. Data are expressed as mean +- SD for continuous variables and as percentages for categorical variables. Categorical variables were compared using Chi square test. Analysis of variance was used to calculate the p values for continuous variables. Difference was considered statistically significant at $P$ <0.05.

## 4. RESULTS

We assessed 151 patients with a diagnosis of anterior wall myocardial infarction. After evaluating all the demographical, clinical, past medical, and investigation (Troponin I, EF, ECG, coronary angiography) records, all 151 patients were included for further analysis.

**Group 1: Proximal VS. Middle, Distal**

There were 112 (74.17%) male patients and 39 (25.82%) female patients. The major risk factor was hypertension in 67 (44.37%) patients, diabetes mellitus in 25 (16.55%) patients. Among the included patients, 106 (70.19%) patients were smokers.

Furthermore, the mean age of patients who had proximal stenosis in coronary angiogram was 61.47 years where as mean age of patients who had middle & distal stenosis in coronary angiogram was 59.76 years. Proximal stenosis was found in 11（52.4%）male patient and 10（47.6%）in female patients. Middle and distal stenosis was found in 101（77.7%）male patients and 29（22.3%）female patients. The mean value of troponin I in patient with proximal stenosis was 109.21±84.11 and in patient with middle and distal stenosis was 96.38±78.77. Additionally, mean EF in proximal stenosis was 53 with a range of 45-56 and for middle as well as distal stenosis was 51 with a range of 44-56.

Among the assessed patient there was no statistically significant difference in the age ($P$=0.511), troponin I (P=0.494), EF ($P$=0.972), lead II-depression ($P$=0.390), lead III-depression ($P$=0.390), and lead aVF ($P$=0.390) in terms of proximal and middle or distal stenosis. However, the result suggested that gender was the influencing factor ($P$< 0.05). It was observed that the male patients had anterior wall MI than that of the female patients. ($P$=0.014) (Table 1).

**Compare factors:** Age, Gender, Hypertension, Diabetes, Smoking, Troponin I, EF, Lead II, Lead III, Lead aVF.

**Table 1: Proximal VS. Middle, Distal group**

| Factor | Proximal（n=21） | Middle & Distal（n=130） | Statistical magnitude | $P$-value |
|---|---|---|---|---|
| Age | 61.47±9.84 | 59.746±11.34 | 0.659 | 0.511 |
| Gender | | | | |
| Male | 11（52.4） | 101（77.7） | 6.046 | 0.014 |
| Female | 10（47.6） | 29（22.3） | | |
| Hypertension | 12（57.1） | 55（42.3） | 1.612 | 0.204 |
| Diabetes | 4（19.0） | 21（16.2） | 0.110 | 0.741 |
| Smoking | 15（71.4） | 91（86.1） | 0.018 | 0.894 |
| Troponin I | 109.21±84.11 | 96.38±78.77 | 0.685 | 0.494 |
| EF | 53（45-56） | 51（44-56） | -0.035 | 0.972 |
| II-D | 2（9.5） | 22（16.9） | 0.740 | 0.390 |
| III-D | 2（9.5） | 22（16.9） | 0.740 | 0.390 |
| aVF-D | 2（9.5） | 22（16.9） | 0.740 | 0.390 |

**Table 2: Depression VS No Depression**

| Factor | Groups | | Statistical magnitude | $P$-value |
|---|---|---|---|---|
| | Depression（n=24） | No depression（n=127） | | |
| Troponin I | 87.05（24.23-148.51） | 97.31(19.41-163.01) | -0.130 | 0.897 |
| EF | 50(42-54) | 51(45-56) | -1.071 | 0.284 |

**Group2: Depression VS No Depression**

Furthermore, ST-segment depression was observed in 24 (15.89%) patient and there was no depression in 127 (84.10%) patients. However, there was no significant difference between the troponin I (*P*=0.897) and EF (*P*=0.284) in term of changes in ST-segment (Table 2).

## 5. DISCUSSION

Acute myocardial infarction (AMI) is a medical emergency and among the principal reason for mortality as well as morbidity globally. Subsequently, there is left ventricular remodeling after the initial attack of MI which is an arrhythmic complication and is usually linked with post MI heart failure as well as the long-standing prognosis of MI **(8,9,10).** The complication of MI includes electrical complications (tachyarrhythmia, brad arrhythmias, bundle branch blocks (BBB)), mechanical complication (mitral regurgitation (MR), cardiogenic shock, true ventricular aneurysm), Ischemic complications (post-infarction angina pectoris), inflammatory (peri-infraction pericarditis, Dressler syndrome), as well as embolic complications (Mural thrombus, systemic embolism) **(11,12,13,14).**

The ECG concludes the AMI by observing the electrical signals in the heart as well as injury to blood supply to the myocardium and remains the crucial tools for the diagnosis, localization as well as prognosis evaluation of AMI. Other general laboratory investigation done includes troponin I and creatine kinase (CK-MB) **(15).** The major role of ECG is to differentiate the types of MI depending upon the shape of tracing. ST-segment in the ECG which is higher than the baseline is known as ST-segment elevation myocardial infarction (STEMI) and need prompt aggressive management **(16).** Furthermore, non-invasive CT scan and coronary angiography are the radiological investigation done in patients with MI **(17).**

Anterior wall MI is a varieties of MI which involves the anterior most part of the heart as well as part of the ventricular septum. The diagnosis is aided by 12 lead ECG showing ST elevation in leads V1-V6, I as well as aVL. There is maximum elevation in V3 and maximum depression in lead III. It can be categorized into anteroseptal, anterolateral, true anterior and extensive anterior infarcts. The major vessels involving in anterior MI is left anterior descending artery (LAD). Thus, the presumptive prediction of a culprit vessels based on electrocardiography is of clinical importance. However, there are very few documentation of the accuracy of electrocardiographic ST-segment in recognizing the location of injury or ischemia during infarction **(18,19).**

The present study evaluates the ECG parameters, assess the role of ST segment depression in the leads II, III, aVF to locate the culprit artery (LAD) accurately as compared to Coronary Angiography and other parameters like Troponin I, and Ejection Fraction (EF) in anterior wall myocardial infarction. In our study, we evaluated 151 patients with anterior wall myocardial infarction. Regarding the risk factor, we find that in 44.37% patients (n= 67) had hypertension (HTN), 16.5% patients (n= 25) had diabetes mellitus (DM), 70.19% patients (n= 106) had history of smoking. Hypertension, diabetes mellitus and smoking were the major risk factor in our patients. In an study conducted in Iranian patient by Elham Hakki Kazazi et al. had revealed that among the patient with anterior wall MI the major risk factor were hypertension, Diabetes mellitus, smoking and hyperlipidemia in 43.9%, 28.3%, 19.2% and 58.3% respectively **(20).**

Based on the coronary angiography our study had revealed that 21 (13.9%) patients had stenosis in proximal area of LAD and 130 (86.09%) patients had stenosis in middle and distal area of LAD. Hence, coronary angiography is the gold standard investigation for diagnosing area of stenosis in spite of having normal ECG's. Furthermore, the present study had demonstrated that ST-segment depression in two or more leads was found only in 24 patients (15.9%). However, Fuchs et al. in their study found that 82 patients had ST-segment depression; whereas only 47 patients (57%) with anterior wall MI had ST-segment depression in two or more than two leads **(21).** Hence, ST-segment alone doesn't precisely reveal the location of ischemia or damage, possibly for the reason that ST-segment depression arises often mutually as a principal change due to sub endocardial ischemia or infarction as well as a consequent "reciprocal" changes. Additionally, we found that in patient with ST-depression troponin I and ejection fraction (EF) was less than that of the patient with non ST-depression. Though, it was not statistically significant.

There are numerous limitations in this study that need to be deliberated while interpreting the clinical implications of our findings. Firstly, this remained a single center observational study with a comparatively small sample size. As well as being a retrospective study it had very high changes of bias in the study. Secondly, there is no proper follow up and

documentation of the complication like re-infarction, post infarction angina, arrhythmias as well as mortality in our study. Hence, larger prospective trials with more sample size are required in order to support these finding.

## 6. CONCLUSION

In conclusion, ST- segment depression is not evident in 12 lead ECG in every patient with anterior wall MI. Coronary Angiogram is the gold standard investigation for diagnosing area of stenosis in spite of having normal ECG's. Hence, patients who are clinically presenting with symptoms of MI and having normal ECG findings have to be further evaluated to rule out AWMI and to decrease morbidity and mortality. Regarding the risk factors hypertension, and diabetes mellitus patient was found to have greater chances of having AWMI. The AWMI was found higher in smoking population than the non-smokers.

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