# ST Segment Depression in 12 lead ECG and Severity of Coronary Artery Disease in Non-ST segment elevation Acute Coronary Syndrome

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***Key words:*** *Acute coronary syndrome, unstable angina, non ST segment elevation acute coronary syndrome, coronary artery disease.*

**Abstract**

***Background:*** *Patients of non-ST segment elevation acute coronary syndrome (NSTE ACS) is a large group who gets admitted in coronary care units. 12-lead electrocardiogram (ECG) provides the simple available and earliest objective information for risk stratification of NSTEACS. We tried to find out the association between magnitude of ST segment depression and angiographic severity in NSTE ACS patients.*

***Methods:*** *This cross sectional study was carried out in patients with NSTE ACS patients admitted into and underwent coronary angiography. A total number of 105 consecutive patients were included in this study. ST segment depression was measured and categorized according to magnitude of ST segment depression into three groups as Group I: No (<1mm) ST segment depression, Group II: 1-2 mm ( e"1 to <2mm) ST segment depression and Group III: e" 2 mm ST segment depression. Cumulative sum of ST segment depression and number of leads in ST segment depression also measured in all ECG leads. Angiographic severity was assessed by vessel score and Friesinger index. Significant CAD was considered if Friesinger index was e" 5. Magnitude of ST segment depression was correlated with angiographic severity of coronary artery disease.*

***Results:*** *According to 'Friesinger index' 56(53.33%) patients had significant CAD and 49(46.66%) patients had insignificant CAD. Magnitude of ST segment depression found to have significant relationship with severity of coronary artery disease (p<0.001). Number of leads in ST segment depression also revealed positive correlation (r = 0.446; p<0.001). Positive correlation was also found between sum of the ST segment depression and Vessel score (r= 0.435; p<0.001).*

***Conclusion:*** *Magnitude of ST segment depression is positively correlated with the angiographic severity of coronary artery disease in non- ST segment elevation acute coronary syndrome.*

***(Cardiovasc. j. 2017; 9(2): 116-121)***

## Introduction:

Coronary heart disease (CHD) is a major cause of mortality globally and this health problem is reaching epidemic in both developed, as well as, in developing countries.[1] It will be the leading cause of disability worldwide by the year 2020.[2] Non-ST segment elevation acute coronary syndrome (NSTE ACS) accounts for approximately 2-2.5 million hospital admission annually worldwide.[3] MA Siddique has explained that multiple cardiovascular risk factors along with ignorance about risk factors as a cause of recent increases of occurrence of unstable angina in Bangladesh.[4] Rapid risk stratification is crucial for appropriate management of this group of patient. Prognostic value of ST segment deviation (both elevation and depression) was studied in the Thrombolysis In Myocardial Ischemia (TIMI) III registry by Cannon CP 1997.[5] Specifically prognostic value of ST segment depression in coronary artery diseases was assessed by various studies.[6-13]

Kaul et al. found that a categorical quantification of the amount and distribution of ST segment depression can identify a gradient of risk independent of clinical variables.[10] This study has shown that patient with ST segment depression of ≥2mm in two contiguous leads was approximately six times (odds ratio 5.73; 95% CI) more likely to

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die within one year than patients with no ST depression and risk increased to ten folds where e"2mm ST segment depression extends more than one regions. ST segment depression and its association with angiographic severity of coronary artery diseases was assessed in few studies.[14-15]

Patients of NSTE ACS are a large number of admissions to coronary care units where 12-lead electrocardiogram (ECG) provides the simple available and earliest objective information for risk stratification. The qualitative importance of ST segment depression on the baseline ECG in patients of non-ST segment elevation acute coronary syndrome is recognized but quantification of this phenomenon and its correlation with angiographic severity of coronary artery disease is rarely used in the modern era of aggressive pharmacological and interventional therapy, which might be a better independent risk predictor of coronary artery diseases in this group of patents.

**Methods:**

This was a cross sectional study carried out in the department of cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, in the period of January 2011 to May 2011. Sampling population was Patients of non-ST segment elevation acute coronary syndrome who admitted into and underwent coronary angiography in hospital. Total Sample size was 105. Patients admitted into hospital with at least one of the following three criteria: i)Angina occurring at rest (or minimal exertion) and usually lasting >20 minutes (if not interrupted by nitroglycerin administration), ii) Being severe and described as frank pain, and of new onset (i.e., within 2 month), iii) Occurring with a crescendo pattern (i.e., more severe, prolonged, or frequent than previously).patients with i) ST segment elevation in admission ECG or appearance of new ST segment elevation over the course of hospital stay, ii) Ventricular hypertrophy, iii) Bundle branch block, iv) Paced rhythm, v) Wolf-Parkinson-White syndrome, vi) Previous PTCA or CABG cases, vii) Serious co morbid condition like chronic kidney disease or cerebrovascular disease were excluded from the study.

**Study procedure:**

Patients with NSTE ACS admitted into the Department of Cardiology NICVD had been evaluated. Considering inclusion and exclusion criteria patient was selected for the study.12 lead ECG as recorded in the emergency department was analyzed and divided into three groups: Group I: No (<1mm) ST segment depression, Group II:1-2 mm ( ≥1 to <2mm) ST segment depression in two or more contiguous leads Group III: e" 2 mm ST segment depression in two or more contiguous leads. Cumulative sum of ST segment depression and number of leads in ST segment depression was also measured. ST segment shift was measured in all leads at 80 ms after the J point for ST segment depression. ST segment depression was measured at 1-mm intervals, with every fraction rounding to the nearest whole number. The distribution of ST segment depression was examined in three regions anterior (leads V1 to V4), inferior (leads II, III and aVF) and lateral (leads I, aVL, V5 and V6). A particular region was deemed to have ST segment depression if any two contiguous leads comprising the region had ST segment depression.

Angiographic severity of coronary artery disease was assessed by 2 scoring system Vessel score and Friesinger index.[16] According to Friesinger index severity of coronary artery disease was assessed and categorized into two groups:

1) Insignificant CAD (Friesinger index<5).
2) Significant CAD (Friesinger index ≥5).

Magnitude of ST segment depression was compared with angiographic severity.

**Data analysis:**

Data was presented as frequency and percents for categorical variables and as mean with standard deviation for quantitative variables. Categorical variables were analyzed by chi-square test. Quantitative variables were analyzed by t-test or ANOVA. Correlations between magnitude of ST segment depression and angiographic severity was measured by Pearson's correlation test. p value <0.05 was considered as significant. Statistical analysis was performed with SPSS, version 16.0 (SPSS Inc).

**Results:**

In this study total 105 patients were study population. Out of all cases 60(57.1%) was in group I, 20(19.0%) was in group II and rest 25(23.8%) was in group III. Total number of male patient

was 81(77.1%) and female patient was 24(22.9%). Male female ratio was 3.37:1 in the whole study population. There was no significant impact of sex distribution among the three ST segment groups. The mean age was 50.72± years 7.32±7.89years and 53.90±8.31 years in group I,II and III respectively. Maximum frequency was found in the age group of 51-60 years. There was statistically significant (p<0.001) difference in mean age among the three ST segment groups in ANOVA test.

The mean BMI of whole study population was 24.55±3.17 kg/$m^2$. There was no statistically significant difference in mean BMI among the groups. Hypertension was the most common risk factor present in 58(55.2%) patients followed by Smoking in 48(45.7%) and Diabetes mellitus in 36(34.6%). There was no significant difference in traditional risk factors among the three groups.

Distribution of study population according to ST segment depression found that higher the magnitude of ST segment depression higher the Friesinger index and vessel score, which is shown in Table II and III. Friesinger index difference was statistically significant (p<0.001) among three groups in chi-square test (Table III).

**Table-I**

*Baseline clinical variables in the study population (n= 105).*

| Variables | Group I | Group II | Group III | p value |
|---|---|---|---|---|
| Distribution of population | 60(57.1%) | 20(19.0%) | 25(23.8%) | |
| Age | 50.72±7.0 | 53.90±8.31 | 52.90±89 | NS |
| Sex (Male) | 44(73.3%) | 17(85%) | 20(80%) | NS |
| Risk factors: | | | | |
| Smoking | 27(45%) | 9(45%) | 12(45.7%) | NS |
| Hypertension | 32(53.3%) | 11(55%) | 15(60%) | NS |
| Diabetes Mellitus | 22(37.3%) | 5(25%) | 9(36%) | NS |
| Positive F/H of CAD | 12(23.0%) | 2(11.1%) | 6(27.3%) | NS |
| Dyslipidemia | 18(62.0%) | 5(83.3%) | 2(18.1%) | NS |
| BMI | 24.96±3.45 | 23.85±2.38 | 24.55±3.17 | NS |
| Pulse | 81.52±12.09 | 82.95±10.03 | 82.87±13.14 | NS |
| SBP | 121.81±16.05 | 127.37±21.62 | 128.4±25.11 | NS |
| DBP | 81.12±9.95 | 79.74±9.04 | 81.57±10.80 | NS |
| LVEF | 60.38±10.75 | 60.19±7.78 | 59.51±9.95 | NS |
| Sum of ST segment depression | 0 | 3.95±1.98 | 9.28±3.69 | <0.001$^S$ |
| Num. of leads in ST depression | 0 | 3.55±1.46 | 4.92±1.77 | <0.001$^S$ |
| Vessel score | 0.88±0.99 | 1.40±1.18 | 2.04±1.06 | <0.001$^S$ |
| Friesinger index | 3.98±4.38 | 6.25±4.55 | 8.92±3.85 | <0.001$^S$ |

S= Significant, NS= Not significant, p value derived from appropriate statistical analysis

**Table-II**

*Distribution of patients according to Friesinger index (n=105).*

| Friesinger index | Group I (n=60) | Group II (n=20) | Group III (n=25) | Total | p value |
|---|---|---|---|---|---|
| 0-4 | 37(61.7%) | 8(40.0%) | 4(16%) | 49(46.7%) | (p<0.001) |
| 5-10 | 18(30.0%) | 7(35.0%) | 11(44%) | 36(34.3%) | |
| 11-15 | 5(8.3%) | 5(25.0%) | 10(40%) | 20(19.0%) | |

$^{\#}$p value derived from chi square test

**Table-III**

*Distribution of patients according to vessel score (n=105).*

| Vessel score | Group (n=60) | Group II(n=20) | Group III (n=25) | Total |
|---|---|---|---|---|
| 0 | 29(48.3%) | 6(30.0%) | 4(16.0%) | 39(37.1%) |
| 1 | 13(21.6%) | 5(25.0%) | 1(4.0%) | 19(18.1%) |
| 2 | 14(23.3%) | 4(20.0%) | 10(40.0%) | 28(26.6%) |
| 3 | 4(6.6%) | 5(25.0%) | 10(40.0%) | 19(18.1%) |

**Table-IV**

*ST segment depression and severity of CAD according to Friesinger index (n=105).*

| Significant CAD | GroupI(n=60) | Group II(n=20) | Group III (n=25) | Total | p value |
|---|---|---|---|---|---|
| Present(FIe"5) | 23(38.3%) | 12(60.0%) | 21(84.0%) | 56(53.3%) | (p<0.001) |
| Absent(FI<5) | 37(61.7%) | 8(40.0%) | 4(16.0%) | 49(46.6%) | |

m p value derived from chi square test.
Friesinger index (FI) e"5= Significant CAD Friesinger index (FI) <5= Insignificant CAD

Significant CAD was found in 38.3% cases in Group I, 60% in Group II and 84% in Group III which found incremental rate of significant CAD proportional to magnitude of ST segment depression. Cumulative sum of the ST segment depression (r= 0.435; p<0.001) and number of leads in ST segment depression (r = 0.446; p<0.001) both found positive correlation with Vessel score which means that higher the total burden of ST segment depression higher the severity of coronary disease.

Similarly cumulative sum of the ST segment depression (r= 0.446; p<0.001) and number of leads in ST segment depression (r = 0.453; p<0.001) also revealed positive correlation with Friesinger index which means that higher the total burden of ST segment depression higher the severity of coronary disease.

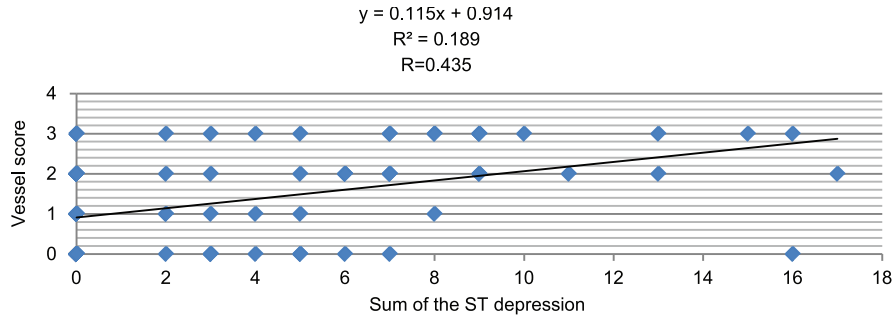


**Fig.-1:** *The scatter diagram shows significant positive correlation (r=0.435) between Vessel score and sum of ST segment depression in the study patients. (n=105)*

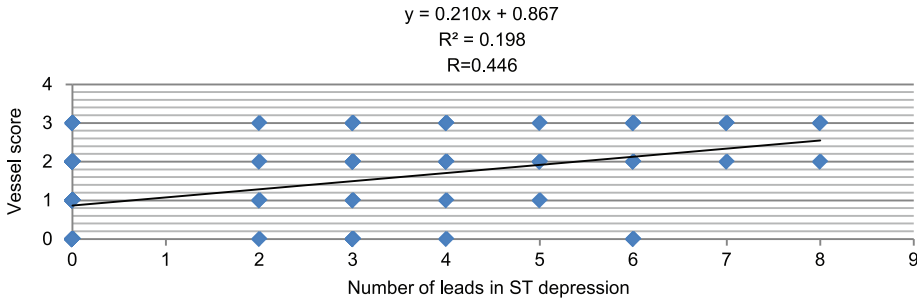


**Fig.-2:** *The scatter diagram shows significant positive correlation (r=0.446) between Vessel score and number of leads in ST segment depression in the study patients. (n=105*

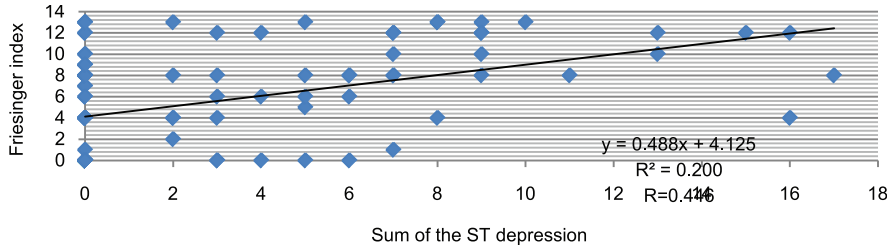


**Fig.-3:** *The scatter diagram shows significant (r=0.446) between Friesinger index and sum of ST segment depression in the study patients. (n=105)*

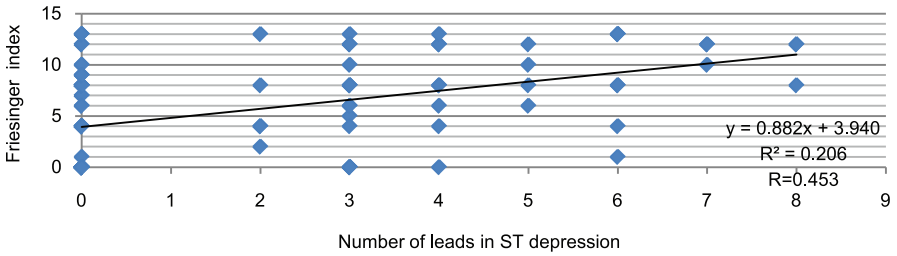


**Fig.-4:** *The scatter diagram shows significant positive correlation (r=0.453) between Friesinger index and number of leads in ST segment depression in the study patients. (n=105)*

**Discussion:**

The most important finding of this study is that higher the magnitude of ST segment depression higher the severity of coronary artery disease. It is remarkable that the magnitude of ST segment depression in NSTE ACS is assessed hear in three different way such as qualitative ST segment depression (No ST depression, 1-2 mm ST depression and ≥2 mm ST segment depression ), cumulative sum of ST segment depression and number of leads in ST segment depression.

Correlation study found that cumulative sum of ST segment depression and number of leads in ST segment depression both are positively correlated with angiographic severity of coronary artery disease according to Friesinger index and vessel score.

José A et al. found that that the presence, magnitude and extent of ST segment depression were associated with an increased mortality.[8] ST segment depression in two or more lateral leads was associated with (odds ratio 3.5, 95 % CI: 1.2 to 10.6) significantly increased mortality. Qualitative analysis of ST segment depression and its impact on the outcome of coronary artery disease found that ≥2 mm ST segment depression was 6 times more likely to die within one year than patients with no ST segment depression.[10]. Kaul et al. found that quantitative ST segment depression and cardiac troponin T are complimentary in assessing risk among ACS patients and both should be employed to determine prognosis and assist in medical decision making.[10] Khan found that in hospital complications, in terms of mortality, acute LVF, significant arrhythmias, cardiogenic shock and STEMI was more in ≥2mm ST segment depression group in comparison to less severe ST segment depression groups.[12]

Ullah et al.[15] found angiographic correlation with lateral (I,avL,$V_5$, $V_6$) ST segment depression, Yuri B et al.[17] found angiographic correlation with isolated anterior ST segment depression, but present study found angiographic correlation with ST segment depression of any region in 12 lead admission ECG.

Savonitto et al.[18] found that in patients of NSTE ACS the cumulative sum of ST segment depression in all ECG leads was a powerful predictor of all cases mortality at 30 days, independent of clinical variables and correlated with the extent and severity of coronary artery diseases.

This present study which was intended to find out the association between magnitude of ST segment depression and severity of coronary artery diseases

revealed that magnitude of ST segment depression positively correlates with the angiographic severity of coronary artery diseases in non- ST segment elevation acute coronary syndrome patients.

**Conclusion:**

Magnitude of ST segment depression found significantly correlated with severity of coronary artery disease. Cumulative sum of ST segment depression and number of leads in ST segment depression also found significantly correlated with severity of coronary artery disease. This may provide a very simple and effective base line predictor of severity of coronary artery disease in the patients of non ST segment elevation acute coronary artery syndrome.

**Conflict of Interest - None.**

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