Original Article

In-Hospital Outcome of Patients with ST - T Changes in Non ST Segment Elevation Myocardial Infarction

Md Shahadat Hossain[1], Abu Baqar Md Jamil[2], Alok Chandra Sarker[3], S M Shahidul Haque[4], Mohammad Morshedul Ahsan[5], Md Younus Ali[6], Iftekhar Alam[7]

Abstract

Background: This cross sectional observational study was carried out with an aim to find out in-hospital outcome in patients with ST-T changes in non-ST-segment elevation myocardial infarction (NSTEMI).

Methods: This cross sectional observational study was carried out in the department of cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh from January 2014 to December 2014. A total of 120 patients with NSTEMI were the study population. Patients were divided into two groups on the basis of ST-T changes, 60 patients with ST-T changes were in group I and 60 patients without ST-T changes were in group II.

Result: In this study, the mean age was 54.2 ±14.2 years. Male female ratio was 2.75:1 among the study population. There was no statistically significant difference in mean BMI among the two groups. Smoking was the most common risk factor present (47.5%). Smoking was found significantly more in Group I than patients of group II (p=0.02). Serum troponin I was found significantly raised in group I (42.8±5.5 vs 10.5±8.3, p=0.002). The mean left ventricular ejection fraction (LVEF) of patients in group I was significantly lower than group II (52.1±9.1% vs 61.7±6.9%. p=0.001). Adverse in-hospital outcome was significantly more in group I than group II (48.3% vs 26.7%, p=0.01). Recurrent angina pectoris, STEMI, significant arrhythmia, acute LVF and cardiogenic shock were also more in group I than in group II. In-hospital mortality was noted in group I patients with both ST segment depression and T wave inversion (6.7%). Emergency revascularization was done more commonly in patients of group I (6.7%). The mean duration of hospital stay was statistically significant between the groups (6.24±2.58 vs 4.44±1.71 days. p<0.05)). Multivariate logistic regression analysis revealed that ST-T changes are an independent predictor for developing adverse in-hospital outcome in patients with non-ST-segment elevation myocardial infarction.

Conclusion: The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome in patients with NSTEMI. The ST-segment depression on admission ECG of patients with NSTEMI is associated with higher adverse in hospital outcome and mortality.

Key words: *Non-ST-segment elevation myocardial infarction (NSTEMI), ST-T Changes, Adverse in hospital outcome.*

(Bangladesh Heart Journal 2022; 37(2): 99-106)

1. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh.
2. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh.
3. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh..
4. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh.
5. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh.
6. Assistant Professor, Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh.
7. Assistant Professor, Department of Cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh.

Address of Correspondence: Md Shahadat Hossain[1], Assistant Professor, Department of Cardiology, Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh. Mobile:+88017818401289.

DOI: https://doi.org/10.3329/bhj.v37i2.63133

Copyright © 2017 Bangladesh Cardiac Society. Published by Bangladesh Cardiac Society. This is an Open Access articles published under the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC). This license permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Introduction

Over the last decade, cardiovascular diseases (CVD) have become the single largest cause of death worldwide. Like many high-income countries during the last century, low and middle-income countries are experiencing an alarming increase in the rates of CVD and this change is accelerating[1]. In 2008, age standardized all cause mortality rate in Bangladesh was 1210 per 100,000 population, among them mortality due to non-communicable disease was 702 per 100,000 population[2]. Mortality rate due to cardiovascular and respiratory disease were 421 and 97 per 100,000 populations respectively[3].

The prevalence of coronary heart disease was found to be 3.3 per thousand in 1976 and 17.2 per thousand in 1986 indicating fivefold increase of the disease by ten years[4]. Three small scale population based studies showed average prevalence of ischemic heart disease (IHD) 6.5 per thousand rural population of Bangladesh[5].

Acute coronary syndrome (ACS) is a useful operational term which distinguishes acute myocardial ischemia from stable coronary artery (CAD) disease. Non-ST-segment elevation ACS (NSTE-ACS) comprises unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI). Where as ST elevation MI is due to acute total occlusion, NSTEMI is due to severe obstruction but not total occlusion of culprit coronary artery[6].

In the setting of NSTEMI, macro or micro-vascular coronary flow is diminished enough to produce detectable myocardial necrosis, which presents with elevation of cardiac enzymes[7]. Unstable angina and NSTEMI can be viewed as very closely related clinical conditions with similar presentation but the diagnosis of NSTEMI is established if there is evidence of myocardial necrosis based on elevated cardiac serum markers, such as creatine kinase isoenzyme (CK-MB) , and/or troponin T or I in the absence of ST-segment elevation[8]. NSTEMI constitutes a clinical syndrome subset of the ACS that is usually, but not always, caused by atherosclerotic CAD and is associated with an increased risk of cardiac death and subsequent MI[9]. NSTEMI results from nonocclusive thrombus on pre-existing plaque, dynamic obstruction, progressive mechanical obstruction, inflammation and secondary UA[8].

The incidence of NSTE-ACS, both absolute and relative to STEMI is increasing, probably as a result of demographic changes in the population, including progressively increasing numbers of older persons and higher rates of diabetes mellitus. Approximately two thirds of patients with unstable angina have evidence of myocardial necrosis on the basis of elevated cardiac serum markers, such as cardiac-specific troponin T or I and creatine kinase isoenzyme (CK)-MB and thus have a diagnosis of NSTEMI[8].

The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome in patients with NSTEMI. Cumulative ST-segment deviation of at least one mm on admission ECG identifies patients at risk for subsequent adverse cardiac events[7]. The baseline ECG has an important prognostic value for ACS, as the risk of new or reversible ST-segment depression greater or equal to 0.5 mm has comparable risks to transient ST elevation or new left bundle branch block and increased mortality up to 2 fold. The magnitude of ST-segment deviation and the degree of troponin 1 elevation predicted the likelihood of failure of a conservative strategy, the extent of CAD, and the likelihood of death or MI[7].

In patients with NSTEMI, the study by Barrabes et al showed that ST depression in two lateral leads(I,avl,V5 and V6) was associated with lower LVEF and left main (LM) coronary artery or tripple vessels disease more often than in patients without ST-depression in the lateral leads[10]. Khan et al found that the extent of ST segment depression can predict in-hospital outcome in non-ST-segment elevation acute coronary syndrome[11]. In patients of NSTEMI, the presence of ST segment depression in lateral leads indicates severity of coronary artery disease[12]. Savonitto et al found that in patients with NSTE ACS the sum of ST-segment depression in all ECG leads is a powerful predictor of 30 days mortality independent of clinical variables and correlates with the severity of coronary artery disease[13].

The ECG is an important non-invasive, easy, widely available, inexpensive diagnostic tool that helps rapidly establish a working diagnosis for patients with ischemic symptoms and helps in risk stratification and decision about optimal therapeutic option. The ST-segment depression and T-wave inversion on admission ECG are important predictors of outcome and associated with higher mortality in patients with NSTEMI. In our country there is no such type of study, as such, this study is justified and time worthy.

Methods

This cross sectional observational study was carried out in the department of cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh from January 2014 to December 2014. By means of purposive

sampling total of 120 patients with NSTEMI recruited as study population. Patients were divided into two groups on the basis of ST-T changes, 60 patients with ST-T changes were in group I and 60 patients without ST-T changes were in group II. Patients with STEMI, unstable angina, previous myocardial infarction, previous history of revascularization (PCI or CABG), valvular heart disease, congenital heart disease, cardiomyopathy, bundle branch block pattern or evidence of pre-excitation in ECG, Ventricular hypertrophy and Paced rhythm were excluded from the study.

Detailed history was taken and detailed clinical examination was performed and recorded in predesigned data collection sheet. Routine investigations were done, cardiac troponin-I was measured at least 4 hours after the onset of chest pain. A cardiac troponin-I level of more than 1ng/ml was considered as significant. A 12 lead resting ECG was done at a paper speed of 25 mm/s and 10 mm standardization at admission and every morning and if required. The ST-segment depression was defined as J-point depression e”1 mm followed by a horizontal or down slopping ST segment for at least 0.08 seconds. Degree of ST segment depression was measured in mm. It was measured in that lead where maximum ST segment depression was present. The T-wave inversion was defined as T-wave inversion e”1mm from baseline. It was measured in that lead where maximum T wave inversion was present. Trans-thoracic echocardiography was done by 2D & M-mode and Doppler modalities within 24 hours of hospitalization. Routine follow-up was done everyday to find out any adverse cardiac events till discharge or death.

The study protocol was approved by the Ethical Review Committee of NICVD. Informed consent was taken from each patient or relatives. The Statistical Package for Social Sciences version 16 software (SPSS inc., Chicago, Illinois, USA) was used for data analysis. Categorical variables were expressed as percentage and frequency and continuous variables as mean and standard deviation. Continuous variables were compared through the Student’s t-test and for the categorical variables the chi-square test was done. Multivariate logistic regression analysis was done to identify predictors of in-hospital outcome. A p value of less than 0.05 was considered statistically significant.

Results

All the variables e.g. baseline characteristics and outcome variables were compared between the two groups. In table I comparison between the groups according to age was shown, the mean age was 57.80±14.21 years and 50.53±13.32 years in group I and II respectively, age difference was statistically significant (p=0.005). The sex distribution of the study patients were almost identical in both groups (p=0.41) with male predominance (Figure 1). In table II, considering the risk factors smoking was found significantly more in group I patients (pd”0.02). Table III shows the distribution of the study patients by presenting complaints. All the patients in the study groups presented with chest pain. Shortness of breath was significantly (p=0.04) more in group I.

Table IV shows different parameters of the study population. In haemodynamic evaluation, systolic blood pressure was 130.6±19.4 mmHg and 120.0±15.9 mmHg in group I and II respectively, which was statistically significant (p=0.01). Other clinical parameters were similar between the two groups. There was statistically insignificant difference of mean BMI among the groups. The biochemical investigations findings were higher in group I but were statistically insignificant, except Troponin I level, which was significantly high in group I (p=0.02). Statistically significant difference in ejection fraction was found among the study groups (p=0.001). It was observed that regional wall motion abnormality was significantly higher in group I patients. Table V shows distribution of ST-T changes in ECG in Group I patients (n=60).

Table VI shows the distribution of the study patients by adverse in-hospital outcome. 48.3% patients in group I experienced adverse in-hospital outcome, on the contrary 26.7% of the patients in group II (p=0.01). In group I clinical findings of left ventricular failure and cardiogenic shock were statistically significant. STEMI, arrhythmia, recurrent angina pectoris and in hospital mortality was predominantly higher among group I patients. It was observed that the mean duration of hospital stay was prolonged in group I patients (p<0.05).

Table VII projects the logistic regression analysis of Odds Ratio for characteristics of the subjects likely to develop adverse in-hospital outcome. In univariate analysis, reduced LVEF and ST-T changes were observed as significant predictors for developing adverse in-hospital outcome with OR being 3.10 and 1.88. It was also observed in multivariate analysis, reduced LVEF and ST-T changes were found to be the independent predictors for developing adverse in-hospital outcome with ORs being 2.55, and 1.67. Advance age, smoking and SBP were not observed as independent predictors for developing adverse in-hospital outcome (p>0.05).

Table I

Comparison of the study population according to age (n=120)

Age in years	Group I(n = 60) Number	%	Group II (n = 60) Number	%	P value
<40	4	6.7	10	16.7	
40 – 49	13	21.7	18	30.0	
50 – 59	18	30.0	18	30.0	
60 – 69	12	20.0	8	13.3	
≥70	13	21.7	6	10.0	
Mean±SD	57.80±14.21		50.53±13.32		0.005[s]

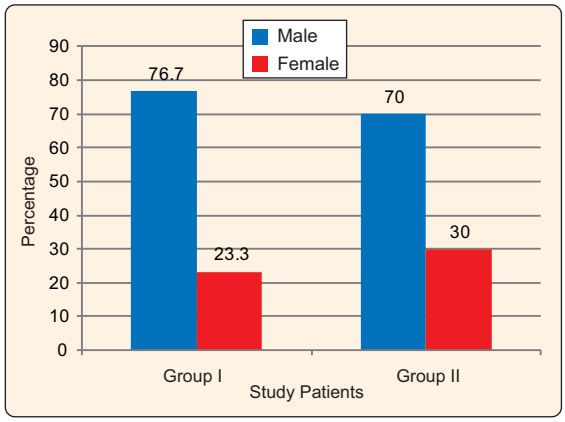

Fig.-1: *Sex distribution among the study patients by bar diagram (n=120)*

Table II

Cardiovascular risk factors in-between the groups (n=120)

Characteristics	Group I Frequency (%)	Group II Frequency (%)	P value
Smoking	35 (58.3%)	22 (36.7%)	0.02[S]
Hypertension	18 (30.0%)	18 (30.0%)	1.00[ns]
Diabetes mellitus	18 (30.0%)	21 (35.0%)	0.56[ns]
Dyslipidaemia	06 (10.0%)	08 (13.3%)	0.56[ns]
Family H/O IHD	06 (10.0%)	06 (10.0%)	1.00[ns]

Table III

Comparison of in between the groups according to presenting complaints of the patients (n = 120)

Complaints	Group I(n = 60)		Group II (n = 60)		P value
	Number	%	Number	%	
Chest pain (Angina)	60	100.0	60	100.0	1.00[ns]
Shortness of breath	14	23.3	06	10.0	0.04[s]
Vomiting	08	13.3	06	10.0	0.57[ns]
Sweating	09	15.0	12	20.0	0.47[ns]
Syncope	05	8.3	02	3.3	0.24[ns]
Palpitation	10	16.7	04	6.7	0.15[ns]

Table IV

Distribution of clinical, biochemical and echocardiography parameters of study population in between the groups (n=120)

Parameters	Group I (n=60) Mean ± SD	Group II (n=60) Mean ± SD	p value
Heart rate (bpm)	81.3±9.3	79.5±14.3	0.11^{ns}
SBP (mm of Hg)	130.6±19.4	120.0±15.9	**0.01^{s}**
DBP (mm of Hg)	84.4±9.1	78.8±8.8	0.34^{ns}
BMI(kg/m^2)	26.67±8.73	23.58±7.72	0.14^{ns}
RBS (mmol/L)	9.8±3.4	9.3±3.6	0.40^{ns}
S. Creatinine (mg/dl)	1.08±0.21	1.03±0.16	0.18^{ns}
Troponin I (ng/ml)	42.8±5.5	10.5±8.3	**0.002^{s}**
Total Cholesterol (mg/dl)	188.9±45.8	185.2±46.9	0.29^{ns}
LDL (mg/dl)	117.3±38.8	110.7±38.9	0.34^{ns}
HDL (mg/dl)	37.8±5.5	39.4±5.8	0.30^{ns}
Triglyceride (mg/dl)	160.5±65.5	158.4±62.3	0.42^{ns}
Echocardiography Parameters			
• EF (%)	52.1 ± 9.1	61.7 ± 6.9	**0.001^{s}**
• RWMA [n, (%)]	15, (25.0%)	5, (8.3%)	**0.01^{s}**

Table V

Distribution of ST-T changes in ECG in Group I patients (n=60)

ECG findings	Number(n)	Percentage (%)
• ST segment depression	22	36.7
• T wave inversion	23	38.3
• ST segment depression and T wave inversion	15	25.0

Table VI

Comparison of patients by adverse in-hospital outcome (n=120)

In-hospital outcome	Group I(n = 60)		Group II (n = 60)		P value
	Number	%	Number	%	
STEMI	05	8.3	01	1.7	0.20^{ns}
Recurrent angina pectoris	08	13.3	03	5.0	0.20^{ns}
Arrhythmias	10	16.7	04	6.7	0.15^{ns}
Acute left ventricular failure	17	28.3	08	13.3	0.04^{s}
Cardiogenic shock	08	13.3	01	1.7	0.02^{s}
Emergency revascularization	04	6.7	03	5.0	1.00^{ns}
Death	04	6.7	00	0.0	0.11^{ns}
Adverse in-hospital outcome	29	48.3	16	26.7	0.01^{s}
Duration of hospital stay(Mean± SD)	6.24±2.58 days		4.44±1.71days		0.02^{s}

Table VII
Factors related to adverse in-hospital outcome

Variables of interest	Univariate analysis			Multivariate analysis		
	OR	95% CI of OR	p value	OR	95% CI of OR	p value
Age (≥50 years)	0.90	0.458-2.104	0.96^{ns}	0.81	0.356-1.824	0.60^{ns}
Smoking	1.68	0.797-3.538	0.17^{ns}	1.55	0.699-3.443	0.28^{ns}
SBP	1.01	0.989-1.031	0.36 ^{ns}	1.00	0.987-1.032	0.42^{ns}
LVEF (<50)	3.10	1.217-7.831	0.006^{s}	2.55	1.016-6.551	0.03^{s}
ST-T changes	1.88	1.181-5.324	0.01^{s}	1.67	1.011 – 4.133	0.02^{s}

Discussion

This cross sectional observational study was carried out with an aim to find out in-hospital outcome in patients with ST-T changes in non-ST-segment elevation myocardial infarction (NSTEMI). The age difference was statistically significant (p≤0.005) among the two groups. The mean age of total study population was 54.2±14.2 years. Khan et al in their study, mean age in non ST segment elevation ACS patients was 57.6±10.1 years[11]. A study done by Ullah et al found mean age of 54.58 years in NSTEMI patients[12]. Uddin et al found mean age of 49.7±11.3 years in patients with IHD[14]. Although results are similar, small variations of mean age among different study may be due to differences in study design. Male patients were predominant among the study population. Similar male preponderance was found in almost all studies in patients with IHD. Male female ratio was 5.9, 4.6 and 4.95 in respectively in studies by Ullah et al and Uddin at al[12, 14].

This study found that smoking was the most common risk factor in study population. Smoking was found significantly more in group I than group II (p≤0.02). Uddin, Khan and Ullah et al had shown smoking as the highest prevalent risk factor in CAD[14,11,12]. Ullah et al in their study found, prevalence of smoking in 81%, hypertension 34%, diabetes mellitus 32%, family history of CAD 20% and dyslipidemia in 9% patients[12].

All the patients of the study group presented with chest pain. Shortness of breath was significantly (p=0.04) more in ST-T changes group (23.3%vs.10%). Vomiting, sweating, syncope and palpitation were also observed in both study group but there was no statistically significant difference (p>0.05).

In hemodynamic evaluation, pulse and diastolic blood pressure did not vary significantly between the two groups. Clinical findings of left ventricular failure were found statistically significant (p=0.04) in patients with ST-T changes group. Ghaffari et al found higher SBP on admission and S3 gallop on heart auscultation during admission[7]. The BMI difference was not statistically significant among two groups. The mean BMI of total study population was 23.6±3.2 kg/m^{2}. Mean BMI of IHD patients was 24.1±4.1 in the study by Uddin et al, which was very similar to present study[14].

In term of biochemical parameters there is no statistically significant difference between two groups except serum troponin I which was found significantly raised in group I (42.8±5.5vs.10.5±8.3 ng/ml, p=0.002). Khan et al found similar observation in their study[11]. In this study, among the ST-T changes group, 23(38.3%) ,22(36.7%),15(25%) patients had significant T wave inversion, ST segment depression and both ST segment depression and T wave inversion respectively. Muller et al found significant ST depression in 38.2% of study population[15].

The mean left ventricular ejection fraction was 52.1 ± 9.1% and 61.7 ±6.9% in group I and group II respectively (p=0.001). Ghaffari et al found that the mean left ventricular ejection fraction (LVEF) of patients with ECG changes were significantly lower than those without ECG changes (p=0.001)[7]. 25% of ST-T changes patients and 8.3% of patients without ST-T changes had regional wall motion abnormality (RWMA). It was observed that RWMA had significantly higher in patients with ST-T changes group than without ST-T changes group (p=0.01).

Adverse in-hospital outcome was observed in 48.3% patients of group I and 26.7% patients of group II. The difference was significant statistically (p=0.01)). In this study, 28.3% patients with ST-T changes developed acute left ventricular failure and it was the most common complication among two groups of patients, followed by arrhythmia (16.7%), recurrent angina pectoris and cardiogenic shock (13.3%) respectively and STEMI

(8.3%). In group I 6.7% patients needed emergency revascularization (PCI) and in group II 5% patients needed emergency revascularization (PCI). None of the two groups required emergency CABG during in-hospital period. In-hospital mortality was 6.7% in group I and none in group II. The incidence of STEMI, recurrent angina pectoris, arrhythmia, emergency revascularization and death were found almost identical with no statistical significant difference (p>0.05). Mueller et al reported mortality rates of 8% in patients with no ECG changes, 19.9% in patients with ST depression and only 5.1% in patients with T wave inversion[15]. Khan and Ullah et al found similar type of complications in their study[11,12]. Barrabes et al showed that ST depression in two lateral leads(I,aVL,V5 and V6) was associated with lower LVEF and left main coronary artery disease or triple vessel disease more often than in patients without ST depression in the lateral leads10. The mean duration of hospital stay was 6.24±2.58 days and 4.44±1.71 days in group I and group II respectively and the mean difference was statistically significant (p<0.05)).

Multivariate logistic regression analysis was done among traditional predictors of adverse in-hospital outcome such as advanced age (e”50 years), smoking, systolic blood pressure, left ventricular ejection fraction and ST-T changes. Among these, ST-T changes and reduced LVEF were found to be the independent predictor for developing adverse in-hospital outcome with ORs being 2.55 and 1.67 and p value<0.05. Most important finding of the present study is that ST-T changes have significant impact on adverse in-hospital outcome in patients with non-ST-segment elevation myocardial infarction.

Conclusion

The ST-T changes in ECG are an important and independent predictor of in-hospital adverse outcome in patients with NSTEMI. ST-T changes could be considered as a good tool for identification of high risk group of NSTEMI. As early optimal medical and intervention treatment has been shown to reduce cardiac events particularly in high risk patients, thus may offer a useful tool to target aggressive medical and interventional therapy to patients for highest risk for ischemic complications.

References

1. Gaziano, T.A., and Gaziano, J.M. Global burden of cardiovascular disease, in R.O. Bonow, D.L. Mann, D.P. Zipes and P. Libby (ed.). Braunwald’s Heart disease: a text book of cardiovascular medicine, St.Louis: Saunders Elsevier,2012, pp.1-20.
2 Health Bulletin, 2013. Dhaka: Directorate General of Health Services.
3 WHO cardiovascular Disease. Factsheet No317, World Health Organization, August11, 2012. Available at:http://www.Who.int/mediacentre/factsheets/fs317/en /index. html [Accessed 06/05/2013].
4 Islam, M.N., Ali, M.A., and Ali, M. Spectrum of Cardiovascular Diseases-The Current Scenario in Bangladesh, Bangladesh Heart Journal, 2004, vol. 19, pp. 1-7.
5 Islam, M.N., Mohibullah, A.K.M., and Majumder, A.A.S. Acute Coronary Syndrome-Guideline for Management, Dhaka: Bangladesh Cardiac Society, 2004, p.4.
6. Wardhan, H., and Bhattacharyya, K. Prognostication of A case of NSTEMI. in P. K. Deb (ed.). cardiology update 2012, Kolkata: Indian Heart House, pp.52-58.
7 Ghaffari,S., Separham, A., and Pourafkari,L. Association of electrocardiographic changes with severity of coronary artery disease and short term outcome in patients with non-ST-segment elevation acute coronary syndromes, Saudi medical journal,2010, vol.31, pp. 400-405.
8 Cannon, C. P., and Braunwald, E. Unstable Angina and Non–ST Elevation Myocardial Infarction, in: R.O. Bonow, D.L. Mann, D.P. Zipes, and P. Libby (ed.). Braunwald’s Heart Disease: A Textbook of Cardiovascular Medicine, Philadelphia: Saunders Elsevier, 2012, pp.1178-1209.
9 Anderson,J.L., Adams, C.D., Antman,E.M., Bridges,C.R., Califf,R.M.,Casey,D.E.Jr., Chavey, W.E.2nd., Fesmire,F.M., Hockman, J.S.,Levin, T.N., Lincoff,A.M.,Peterson,E.D., Theroux,P., Wenger,N.K., and Wright,R.S. 2012 ACCF/AHA Focused Update Incorporated into the ACCF/AHA 2007 Guidelines for the Management of Patients with Unstable Angina/Non-ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, Circulation,2013, vol.127, pp.1-188.
10 Barrabes, J.A., Figueras, J., Moure, C., Cortadellas, J., and Soler-soler, J. Prognostic significance of ST segment depression in lateral leads I, AVL,V5 and V6 on the admission electrocardiogram in patients with a first acute myocardial infarction without ST

segment elevation, Journal of the American College of Cardiology, 2000, vol. 35, pp.1813-1819.

11 Khan, M., Haq, M., Majumder, N., Hossain, M., Rahman, Z., Rahman, M., Akanda, A., & Mohibullah, A. (2012). Extent of ST-Segment Depression Predicts In- Hospital Outcome in Non ST-Segment Elevation Acute Coronary Syndrome. Cardiovascular Journal, 5(1), 62–66. https://doi.org/10.3329/cardio.v5i1.12275

12 Ullah, M., Khalequzzaman, M., Habib, S.M.A., Kar,N., and Islam,M.N. Angiographic correlation of ST segment depression on admission ECG in patients with NSTEMI, Bangladesh heart journal, 2006, vol.21, pp. 72-77.

13 Savonitto, S, Cohen, MG, Politi, A, Hudson, MP, Kong, DF, Huang ,Y, Pieper, KS, Mauri, F, Wagner, GS, Califf, RM, Topol, EJ, and Granger, CB. Extent of ST-segment depression and cardiac events in non-ST-segment elevation acute coronary syndromes, European Heart Journal, 2005, vol. 26, pp, 2106–2113.

14 Uddin, A. N., Majumder, A. A. S., Akanda, M. A. K., Zaman, S., Hossain, M. A., Khan, A. R., Razzaque, M. A., Das, P. R., Islam, M. Z., & Alam, K. A. (2019). Association of Increased Arterial Stiffness with Severity of Coronary Artery Disease in Patients With Non-ST- Segment Elevation Myocardial Infarction. Bangladesh Heart Journal, 34(2), 73–79. https://doi.org/10.3329/bhj.v34i2.44436.

15 Mueller, C., Neumann, F.J., perach, W., Perruchoud, A.P., and Buettner, H.J. Prognostic value of the admission electrocardiogram in patients with unstable angina/non-ST-segment elevation myocardial infarction treated with very early revascularization. American journal of medicine. 2004, vol.117, pp.145-150.