Original Article

Association between on Admission Serum NT-pro BNP and ST-segment Resolution in Patients with Acute ST Elevated Myocardial Infarction undergoing Primary Percutaneous Coronary Intervention

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Abstract

Introduction: Post-percutaneous coronary interv2ntion (PCI) assessment of ST-segment resolution (STR) serves as a vital indicator of perfusion at heart micro vessels in patients with ST-segment elevation myocardial infarction (STEMI). NT-pro BNP emerges as a significant biomarker, aiding in risk stratification and prognostication in acute coronary syndrome. The aim of the study objective was to find out association between on admission N-terminal pro-B-type natriuretic peptide (NT-pro BNP) and ST-segment resolution and predicting about reperfusion before primary PCI.

Methods: This cross-sectional analytical study was carried out at national Heart Foundation Hospital & Research Institute (NHFH&RI) for one year from May 2023 to April 2024 involving 104 patients with STEMI who met the inclusion and exclusion criteria. A digital 12-lead ECG was recorded at admission and 60 minutes after primary PCI and blood samples were collected for NT-pro BNP. ST segment resolution ≥50% was considered as successful reperfusion and categorized as Group I, whereas STR<50% was considered failed reperfusion and categorized as Group II.

Results: Result revealed that maximum patient was in 51-60years age group (38.4%) and male predominant (86.5%). Diabetes mellitus (68.96%), hypertension (86.20%) and dyslipidemia (86.20%) were more in Group II. The mean (±SEM) NT-pro BNP level In Group I and group II was 385±53.47pg/ml and 6727±1286.39pg/ml respectively. Notably, NT-pro-BNP ≥688pg/ml showed highest Youden Index with sensitivity of 86.2%, specificity of 85.3%, positive predictive value (PPV) of 69.44%, negative predictive value (NPV) of 94.12% and accuracy of 85.58% to predict failed ST resolution.

Conclusions: NT-pro BNP level on admission is an important biomarker to predict ST resolution after Primary PCI.

Key words: STEMI, Primary PCI, NT-pro BNP.

Introduction

Primary percutaneous coronary intervention (PCI) is the preferred reperfusion strategy in patients with STEMI. The success of PCI can be determined electrocardiographically by measuring ST-segment resolution (STR) after procedure and angiographically by evaluating Thrombolysis in Myocardial Infarction (TIMI) flow [1]. However, good epicardial blood flow does not necessarily imply adequate perfusion at the myocyte level. That is why monitoring STR after successful primary PCI is probably the most convenient method to assess if appropriate perfusion is achieved in the heart micro vessels, because STR reflects the physiology of myocytes, which are the final target of coronary blood flow [2]. Recent studies have shown that STR is an important prognostic indicator for late revascularization, recurrence rate of myocardial infarction, but does not predict long-term mortality in patients with STEMI undergoing primary PCI [3].

In acute coronary syndrome, both BNP and NT-pro BNP were elevated but NT-pro BNP might be a better diagnostic biomarker than BNP [4]. Higher levels of NT-pro BNP level were associated with greater LV end-diastolic volume, a greater LV end-systolic volume, lower LVEF, a larger infarct

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size, and a larger number of transmural segments [5]. In patients with acute myocardial infarction, this biomarker level on admission were independently associated with extent, severity, and complexity of coronary atherosclerosis as assessed by SYNTAX score [6]. Baseline NT-pro BNP may identify low risk patients who underwent primary PCI and eligible for discharge within 48-72 hours [7]. Not only that, NT-pro BNP had value in patients with STEMI who underwent primary PCI in predicting 1month major adverse cardiovascular events (MACEs) [8]. The level of NT-pro BNP was significantly higher in those with no-reflow phenomenon (Ayhan et al., 2013) and significantly lower in those with ST segment resolution compared with the counterpart who underwent primary PCI [9]. NT-pro BNP is a valuable tool for predicting prognosis in these patients. The aim of the study was to find out association between on admission NT-pro BNP and ST-segment resolution after one hour of primary PCI.

Materials and Methods

This cross-sectional analytical study was carried out at the Department of Cardiology of National Heart Foundation Hospital and Research Institute (NHFH & RI) from May 2023 to April 2024(one year). For this study, the sample size was calculated by using Cochran's formula considering 95% level of significance and 5% precision level (marginal error). The calculated sample size was 104. All STEMI patients who underwent primary PCI were included in this study. patients with STEMI who refused to primary PCI; patients with STEMI delayed arrival (>12 hours); patients with STEMI with cardiogenic shock and acute left ventricular failure and patients with STEMI with known hepatic and renal impairment were excluded from the study.

Particulars of the patient, targeted history were taken, and detailed clinical examinations were performed and recorded in a pre-designed structured questionnaire. Demographic data such as age, sex, and BMI by measuring weight and height were recorded. Risk factor profiles including smoking, hypertension, diabetes, dyslipidemia, and family history of premature coronary artery disease were noted.

According to the Western Pacific Region Office of WHO recommendation among South Asians, obesity was defined as BMI > 25.0 kg/m2 [10]. Primary PCI was defined as emergent PCI with balloon, stent, or others approved device, performed on infarct related artery (IRA) without previous fibrinolytic treatment [11]. A digital 12-lead ECG was recorded at a speed of 25 mm/s and a voltage of 10 mm/mV was obtained for all patients on admission (Preprocedural ECG) and 60 min after primary PCI (post procedural ECG). A single lead with maximum ST segment elevation was measured. ST segment resolution was measured after 60 min of primary PCI. ST segment resolution <50% after one hour (01) of primary PCI was considered as failed reperfusion, whereas STR≥50% was regarded as successful reperfusion. NT-pro BNP was measured on admission. Coronary angiography and PCI were performed according to standard practice. Informed written consent was taken from each

patient before enrollment. The study protocol was approved by ethics review committee of NHFH&RI.

The data obtained from the study were analyzed, and the significance of differences was estimated using statistical methods. Continuous variables with normal distribution were expressed as mean value ± standard deviation and compared using unpaired Student's t-test. Continuous variables with non-normal distribution were compared using the Mann-Whitney U test. Categorical variables were compared using the Chi-square test. Correlation analysis was performed to adjust for potential confounders in predicting the relation between NT-pro BNP level and STR. Receiver operating characteristics (ROC) curve was used to derive the optimum cutoff value of the NT-pro BNP level for prediction of poor ST resolution. A probability (p) value of ≤0.05 was considered significant, while p > 0.05 was considered insignificant. Statistical analysis was carried out using SPSS 22.

Results

Total 104 participants were selected after considering inclusion and exclusion criteria. The mean age of the patients (n=104) was 54.30 ±11.77 years. The maximum patient age group was between 51-60 years (38.4%). Among the study population, 86.5% (90) were male and 13.5% (14) were female. About 57.69% patients had diabetes mellitus (DM), 65.4% patients had hypertension (HTN), 76.69% patients had dyslipidemia, 62.5% patients had history of smoking, 33.6% patients were obese, and 32.7% patients had family history of coronary artery disease. The base line and clinical characteristics of the patients were presented in table 1. Regarding location of STEMI, 48.07% of cases diagnosed as inferior myocardial infarction (MI), 46.2% as anterior (anteroseptal, anterior, ext. anterior) MI and others (lateral, postrerior) MI 5.7%.

Table 1: Baseline and clinical characteristics of the patients (n-104)

Variables	Mean±SD/n (%)
Age (Mean±SD) year	54.30 ±11.77
Age category	
• <40 years	10(09.6%)
• 40-50 years	33(31.7%)
• 51-60 years	40(38.4%)
• >60 years	21(20.1%)
Gender	
• Male	90(86.5%)
• Female	14(13.5%)
Risk factors	
HTN	68(65.4%)
DM	60(57.7%)
Dyslipidemia	80(76.6%)
Obesity	35(33.6%)
Family history of CAD	34(32.7%)
Smoking	
• Smoker	45(43.2%)
• Ex-smoker	20(19.2%)
Location of myocardial infarction	
Inferior MI	50(48.07%)
Anterior MI	48(46.2%)
Others	06(5.7%)

SD: standard deviation; DM: diabetes mellitus; HTN: hypertension; CAD: coronary artery disease; MI: myocardial infarction.

Table 2 showing laboratory variables of among the study population. The mean (±SD) value of hemoglobin was 13.12 ±1.50%. Mean (±SD) serum creatinine was 1.20 ±0.16 mg/dl. Regarding fasting lipid profile, mean (±SD) of total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), triglyceride (TG) were 219.47 ±48.32 mg/dl, 39.01 ± 5.02 mg/dl, 106.58 ±21.14 mg/dl, 155.30 ± 51.58 mg/dl respectively. Mean (±SEM) value of NT-proBNP was 2153.86 ±453.61pg/ml. The mean (±SD) left ventricular ejection fraction (LVEF) was 48.39 ± 5.68 %.

Table2: Distribution of biochemical variables and LVEF among the patients (n=104)

Variables	Mean±SD
Hb%	13.12±1.50
WBC(/mm^3)	12632.692±3258.40
Serum creatinine (mg/dl)	1.20±0.16
Total cholesterol (mg/dl)	219.47±48.32
TG (mg/dl)	155.30±51.58
LDL (mg/dl)	106.58±21.14
HDL (mg/dl)	39.01±5.02
RBS (mmol/L)	11.57±4.21
HbA1C (%)	7.90±6.70
Troponin I (ng/ml)	37.71±18.47
NT pro BNP (pg/ml)(Mean±SEM)	2153.86±453.61
SGPT (U/L)	45.91±12.04
LVEF(%)	48.39±5.68

SD: standard deviation; LVEF: left ventricular ejection fraction; WBC: white blood cell; TG: triglyceride; LDL: low density lipoprotein; HDL: high density lipoprotein; RBS: random blood sugar; NT pro BNP: N-terminal pro-B-type natriuretic peptide; SEM: standard error of the mean; SGPT: serum glutamate pyruvate transaminase.

Table 3: Angiographic findings of the study population (n=104)

Variables	Frequency	Percentage (%)
Angiographic findings		
Presence of multivessel stenosis	32	30.8
Vessels involved		
LAD	65	62.5
RCA	54	51.9
LCX	22	21.2
LM	01	01.0
TIMI flow (post PCI)		
TIMI 2	09	08.7
TIMI 3	95	91.3
	Mean±SD	
Symptom onset to hospitalization (hrs)	6.66±2.80	
Door to wire crossing (min)	75.50±10.50	

LAD: left anterior descending; RCA: right coronary artery; LCX: left circumflex; LM: left main; TIMI: thrombolysis in myocardial infarction; PCI: percutaneous coronary intervention; SD: standard deviation; hrs: hours; min: minute.

The angiographic findings (Table 3) of the study reveal that 30.8% (32 patients) had multivessel stenosis. Among the vessels involved, the left anterior descending artery (LAD) was most frequently affected (62.5%). Regarding Thrombolysis in Myocardial Infarction (TIMI) flow grades, 91.3% of patients achieved TIMI 3 flow, indicating complete perfusion, while 8.7% had TIMI 2 flow, indicating partial perfusion. The average time from symptom onset to hospitalization was mean (±SD) 6.66±2.80hrs, and the average door to wire crossing time was mean (±SD)75.50±10.50min, highlighting the efficiency and promptness of the intervention process.
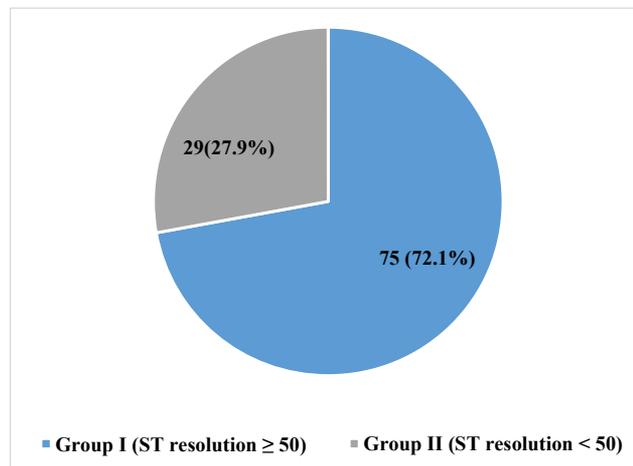

Figure 1: ST-resolution of the study population (n=104)

Among the study population, 72.1% (75) had successful ST-resolution and 27.9% (29) had failed ST-resolution (Figure 1).

In group II diabetes mellitus 68.96%, hypertension 86.2%, and dyslipidemia 86.20% were present and statistically significant evidenced by p-values of 0.032, 0.006, and 0.002, respectively. However, smoking status, family history of coronary artery disease (CAD), and obesity do not show significant differences between the two groups.

Table 4: Distribution of risk factors between two groups (n=104)

Risk Factors	Group I (n=75)	Group II (n=29)	p-value
	Frequency (%)	Frequency (%)	
Diabetes Mellitus	40 (53.33)	20 (68.96)	[c]0.032[s]
Hypertension	43 (57.3)	25 (86.2)	[c]0.006[s]
Dyslipidemia	55 (73.33)	25 (86.20)	[c]0.002[s]
Smoking status			
• Smoker	47 (62.7)	18 (62.1)	[c]0.879[ns]
Family H/O CAD	28 (37.3)	6 (20.7)	[c]0.105[ns]
BMI (kg/m^2)			
• Obese (>25)	25(33.3)	10 (34.4)	[c]0.105[ns]

H/O: history of; CAD: coronary artery disease; BMI: body mass index; c = chi-square test ns = non-significant; s = significant

Across different parameters including hemoglobin percentage, serum creatinine, lipid profile (Total cholesterol, HDL, LDL, TG), SGPT, hemoglobin A1C, and troponin I level, no significant differences are observed between the two ST-resolution groups (Table 5). Only LVEF was statistically different (p <0.001) in two groups.

Table 5: Biochemical and LVEF findings between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Mean±SD	Mean±SD	
Hb%	13.17±1.55	13.00±1.40	^{t}0.609^{ns}
Serum creatinine (mg/dl)	1.21±0.15	1.19±0.19	^{t}0.632^{ns}
Total cholesterol (mg/dl)	221.72±47.94	213.65±49.67	^{t}0.448^{ns}
TG (mg/dl)	155.28±48.53	155.37±59.69	^{t}0.993^{ns}
LDL (mg/dl)	106.02±19.09	108.03±26.03	^{t}0.666^{ns}
HDL (mg/dl)	39.32±5.39	38.24±3.88	^{t}0.329^{ns}
SGPT (U/L)	46.50±12.61	44.37±10.46	^{t}0.422^{ns}
HbA1C (%)	7.12±1.81	7.83±1.97	^{u}0.088^{ns}
Troponin I (ng/ml)	37.10±19.41	39.28±15.98	^{u}0.406^{ns}
LVEF	50.84±3.80	42.06±4.82	$<^t$0.001^s

SD: standard deviation; TG: triglyceride; LDL: low density lipoprotein; HDL: high density lipoprotein; SGPT: serum glutamate pyruvate transaminase; LVEF: left ventricular ejection fraction. t = unpaired t-test; u = Mann-Whitney U-test; ns = non-significant; s = significant

NT pro BNP levels between Group I (n=75) and Group II (n=29) demonstrates a significant difference (Table 6). In Group I, the mean ±SEM NT pro BNP level is notably lower at 385.41±53.47 whereas in Group II, the mean NT pro BNP level is substantially higher at 6727±1286.39, with a p-value of less than 0.001.

Table 6: NT pro BNP level between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Mean±SEM	Mean±SEM	
NT pro BNP (pg/ml)	385.41±53.47	6727.43±1286.39	$<^u$0.001^s

NT pro BNP: N-terminal pro-B-type natriuretic peptide; SEM: standard error of the mean; u = Mann-Whitney U-test; s = significant

The Spearman's rank correlation analysis between NT-pro BNP and ST-resolution (Figure 2) showing a moderate negative correlation coefficient of -0.514, indicating that as NT pro BNP levels increase, ST-resolution tends to decrease. The value is (p<0.001) meaning this correlation is statistically significant.
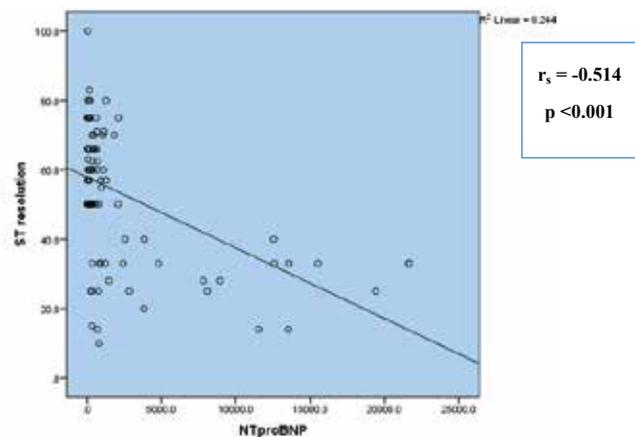

Figure 2: Correlation of NT pro BNP with ST-resolution (n=104); NT pro BNP: N-terminal pro-B-type natriuretic peptide

The comparison of variables between Group I and Group II reveals significant differences (Table 7). In Group I, 24% of patients had multivessel stenosis, whereas in Group II, this percentage was notably higher at 48.3% (p = 0.016). Additionally, the mean time from symptom onset to hospitalization was in Group II mean ±SD (10.96±0.82) with a p-value of less than 0.001. The door to wire crossing time was in Group II mean ±SD 90.50±10.55 with a p-value of less than 0.001.

Table 7: Angiographic findings between two groups (n=104)

Variables	Group I (n=75)	Group II (n=29)	p-value
	Frequency (%)	Frequency (%)	
Presence of multivessel stenosis	18 (24)	14 (48.3)	^{c}0.016^s
	Mean ±SD	Mean ±SD	
Symptom onset to hospitalization (hrs)	5±0.82	10.96±0.82	$<^t$0.001^s
Door to wire crossing (min)	60.20±10.50	90.50±10.55	$<^t$0.001^s

SD: standard deviation; hrs: hours; min: minute; c = chi-square test; t = unpaired t-test ns = non-significant; s = significant

Receiver operating characteristics (ROC) analysis (Figure 3) of NT-pro BNP level on admission to predict ST segment resolution yielded an area under curve (AUC) value of 0.920 (95% CI 0.864-0.975) demonstrating statistically significant result (p <0.05).
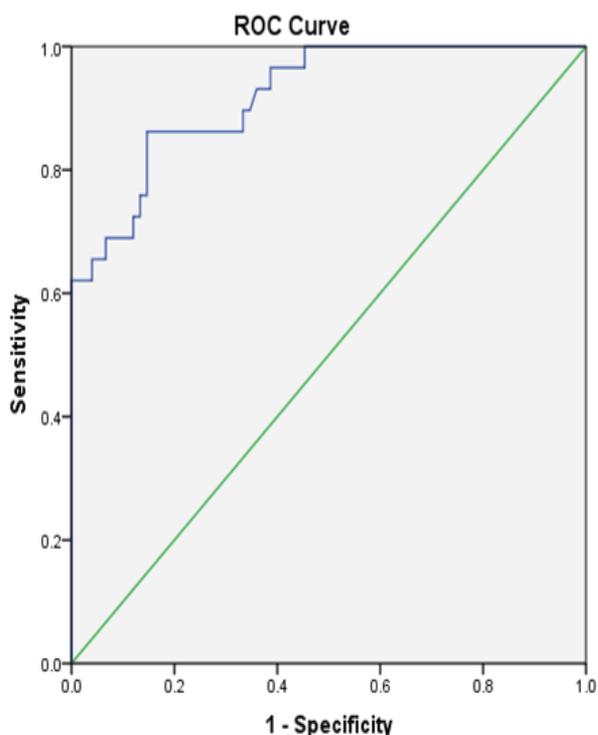
Area	Std. Error	p value	95% Confidence Interval	
			Lower	Upper
.920	.028	<0.001	.864	.975

Figure 3: ROC analysis for cut-off value of NT-pro BNP; ROC: Receiver operating characteristics; NT pro BNP: N-terminal pro- B-type natriuretic peptide

A cut-off value of ≥688 showed the highest Youden index (0.715) with 86.2% sensitivity and 85.3% specificity (Table 8).

Table 8: Determination of cut off value with Youden index

Cutoff value	Sensitivity	Specificity	Youden index (j=sen+spe-1)
≥672	0.862	0.827	0.689
≥680	0.862	0.840	0.702
≥688	0.862	0.853	0.715
≥745.50	0.828	0.853	0.681
≥810	0.793	0.853	0.646

Sensitivity 86.21% and specificity 85.33% found from the derived cutoff value can predict poor ST resolution with about 85.58% accuracy (Table 9).

Table 9: Sensitivity, specificity, PPV, NPV and accuracy gained by the derived cutoff of NT pro BNP with 95% confidence interval for predicting ST-segment resolution

Statistic	Value	(95% Confidence Interval)
Sensitivity	86.21%	68.34% to 96.11%
Specificity	85.33%	75.27% to 92.44%
PPV	69.44%	56.37% to 79.99%
NPV	94.12%	86.50% to 97.56%
Accuracy	85.58%	77.33% to 91.70%

PPV=Positive Predictive Value; NPV=Negative Predictive Value; NT pro BNP: N-terminal pro-B-type natriuretic peptide.

Notably, NT-proBNP along with diabetes mellitus, hypertension, dyslipidemia, presence of multivessel stenosis, and LVEF demonstrate statistically significant associations with ST-segment resolution, with p-values less than 0.05 (Table 10).

Table 10: Univariate analysis of the factors predictive for ST-segment resolution

Factors	OR	95% CI		p value
		Lower	Upper	
Diabetes Mellitus	2.596	1.074	6.273	0.034
Hypertension	4.651	1.472	14.695	0.009
Dyslipidemia	3.951	1.579	9.885	0.003
NT-pro -BNP	1.998	0.997	2.999	<0.001
Presence of multivessel stenosis (>50%)	2.956	1.201	7.275	0.018
LVEF (%)	1.496	1.296	1.727	<0.001

OR: odds ratio; CI: confidence interval; NT pro BNP: N-terminal pro-B-type natriuretic peptide; LVEF: left ventricular ejection fraction.

Discussion
In this present study, the mean age was 54.30 ± 11.77years. The maximum patient age group was between 51-60 years (38.4%). Almost similar findings were observed by previous studies: mean age 53.1±12.6 years and maximum patient age group between 51-60 years (37.5%) [12] & mean age 52.7±10.4 years [13]. South Asians have multiple risk factors that pose potentially atherogenic condition. It may be due to altered metabolic condition, frequent infection, inflammation, constant stress and narrowness of the arteries. CAD most probably occurs in relatively early age groups in our country. Among the study population, male was 86.5% & female was 13.5% which was consistent with another study- 87.7% male and 12.3% female [14].

Patients arriving at the hospital after a prolonged duration of chest pain (10±0.82hours) and door to wire crossing time (90.50±10.55 min) were more likely to have failed STR compared to those who got early medical attention (5±0.82 hours) and door to wire crossing time (60.20±10.50 min).This finding was similar to study conducted by Park et al. [2] where symptom to door time (133±94min) and door to balloon time (81±51min) was higher in the group of incomplete STR. Individuals with diabetes mellitus (68.96%), hypertension(86.2%) & dyslipidemia (86%) demonstrated a higher in Group II (p<0.05). Study conducted by Park et al. [2] also revealed hypertension, diabetes mellitus, and hyperlipidemia had a higher association with incomplete STR. Shavadia et al. [15] showed diabetes mellitus was more associated with failed STR. In this study, among the Group-I, 62.7% of patients were current smoker while 62.1% patients of Group-II were current smoker and after comparing the data of two groups, p value was not significant (p value =0.879). Blomet al. [16] showed smoking is more associated with failed reperfusion which didn't match with this study.

In this study, among the study population 72.1% underwent ≥50% ST segment resolution & 27.9% underwent <50% ST segment resolution. Study conducted by Lorgis et al. [17] found 73% participants having ≥50% ST segment resolution & 27% underwent <50% ST segment resolution& the obtained result was parallel to this study. Peng et al. [9] stated that a total of 202 patients (92.7 %) showed STR at 180 min after primary PCI. Conversely, 16 patients (7.3 %) failed to show STR (non-STR) which didn't match with this study.

Across different parameters including Hemoglobin percentage, Serum creatinine, Serum Glutamic Pyruvic Transaminase, Hemoglobin A1C, and Troponin I level, no significant differences are observed between the two ST-resolution groups.

Notably, a higher (50±.84%) LVEF was significantly associated with Group-I and lower (42.06±4.82) in Group-II. In support of our findings, Park et al. [2] also showed significant association of LVEF with failed STR (43±19) which is similar to this study. In this study, presence of multivessel stenosis is more (48.3%) in Group-II but Woo et al. [18] showed there is almost same in both complete and incomplete STR group.

On admission NT-pro BNP level in Group-I mean ±SEM (385.41±53.47pg/ml) and Group-II (6727.43±1286.39pg/ml) levels demonstrate a significant difference (p < 0.001), implying a potential association with ST segment resolution percentages in cardiovascular health assessment. Our finding was similar with Peng et al. [9] as they also found higher NT-pro BNP concentrations in non-STR group (4476.2 ± 1784.9 pg/ml vs. 2,505.6 ± 1,638.4 pg/ml; p < 0.005).

ROC analysis of NT-pro BNP level on admission to predict ST segment resolution yielded an AUC value of 0.920 (95% CI 0.864-0.975) demonstrating statistically significant result (p <0.05). A cut-off value of ≥ 688 pg/ml showed the highest Youden index (0.715) with sensitivity of 86.21%, specificity of 85.33%, positive predictive value (PPV) of 69.44%, negative predictive value (NPV) of 94.12%, and an overall accuracy of 85.58%. A study by Peng et al. [9] found 81.2% sensitivity and 65.8% specificity with cut off value of NT-pro BNP ≥2563.6pg/ml.

Verouden et al. [19] also found elevated NT-pro BNP levels (>608 ng/L) emerged as the strongest predictor of incomplete ST-segment recovery (adjusted odds ratio 2.6, 95% confidence interval 1.6 to 4.1; p <0.001) compared to other biomarkers and clinical predictors which is similar to this study.

Fabris et al. [20] found patients with STR< 70% had higher NT-pro BNP values compared to patients with complete STR (> 70%) [Mean ±SD 375.2 ±1021.7 vs 1007.4 ±2842.3, Median (IQR) 111.7 (58.4-280.0) vs 168.0 (62.3-601.3), P < .001]. At multivariate logistic regression analysis, independent predictors associated with higher risk of poor myocardial reperfusion (STR< 70%) were: NT-pro BNP (OR 1.17, 95%CI 1.04-1.31, P = .009).

A study aimed to examine the association between five serum biomarkers, collected before emergency coronary angiography, and immediate ST-segment recovery in patients undergoing primary PCI for ST-segment elevation myocardial infarction (STEMI). The biomarkers measured were N-terminal pro-brain natriuretic peptide (NT-pro-BNP), cardiac troponin T, creatinine kinase-MB fraction, high-sensitivity C-reactive protein, and serum creatinine, with blood samples drawn through the arterial sheath at the start of PCI. Incomplete ST-segment recovery was defined as <50%. Among the 662 STEMI patients included, 338 (51%) had incomplete ST-segment recovery. Elevated NT-pro-BNP levels (>608 ng/L) emerged as the strongest predictor of incomplete ST-segment recovery (adjusted odds ratio 2.6, 95% confidence interval 1.6 to 4.1; p <0.001) compared to other biomarkers and clinical predictors [19].

Limitations of the Study
There were some limiting factors which might have an effect on the results: i) The study was conducted in a single center; 2) Purposive sampling was done instead of random sampling and iii) Reliance on single measurements of NT-pro BNP and ST-segment resolution at admission may overlook dynamic changes over time.

Conclusion
The present study showed that on admission serum NT-pro BNP level has significant association with ST-segment

resolution among patients of STEMI following primary PCI. Thus, measurement of NT-pro BNP level on admission may be considered as an essential parameter of predicting successful revascularization before primary PCI. Large scale, multicenter study should be considered to establish temporal relationships between serum NT-pro-BNP levels and ST-segment resolution over time and outcome of primary PCI.

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