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RESEARCH PAPER

Comparison of in Hospital Outcome of Patients with and without Distorted Terminal Portion of QRS Complex on Initial Electrocardiogram in ST Segment Elevation Myocardial Infarction with GRACE Scoring Assessment

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Abstract

Distorted terminal portion of QRS complex on initial electrocardiogram in ST segment elevation myocardial infarction is a strong predictor of in hospital adverse outcome This observational prospective study was carried out in the department of cardiology, BSMMU, Dhaka from July 2014 to June 2015 to analyse admission ECG in patients of STEMI based on terminal portion of QRS complex and find out inhospital death, heart failure, cardiogenic shock and recurrent myocardial infarction, with GRACE scoring assessment. Total 60 patients with STEMI (age 54.33±10.37, 55M/5/F) were included in this study after analysing the selection criteria. We defined two ECG groups according to absence of distortion of terminal QRS (Group-I) and presence of distorted terminal QRS (Group-II) in two or more adjacent leads. Group-II further divided into pattern-A – J point originating at ≥50% of height of R wave in leads with qR configuration and pattern B- S wave is absent in leads with RS configuration. Global Registry of Acute Coronary Events (GRACE) risk score was evaluated and compared in between two groups. Out of 60 patients of STEMI, 30 patients had distortion of QRS complex. There were 7 deaths, 16 heart failure, 3 cardigenic shock and no recurrent myocardial infarction. Hospital mortality and heart failure were found to be significantly higher in distorted QRS group (1 vs. 6 patients p=0.04; 4 vs. 12 patients p=0.02; respectively), cardiogenic shock of both groups did not show significant difference (0 vs. 3 patients p=0.075). Multiple logistic regression analysis using hospital mortality as dependable variable and all studied risk factors were independent variables, QRS distortion on admission ECG and Killip class were only variable found to be statistically significant (OR=7.25, p value < 0.05 ; OR=16.25, p value < 0.05 respectively). GRACE risk score was significantly high in distorted QRS group and low in without QRS distorted group (6 vs 15 patients p=0.014; 6 vs 16 patients p=0.007; respectively). Intermediate GRACE score did not show any statistically significant difference between two groups (p=0.77). Careful analysis of ECG which is simple, cheap, universally available bed side investigation may offer important prognostic information in patients with STEMI and would help in deciding which patients should go urgent myocardial revascularization procedure. Assessment of GRACE risk scoring is strongly encourage in everyday clinical practice as it provides reliable identification of STEMI patients who are at high risk of death.

Keywords: STEMI, Distorted QRS, Death, Heart failure, Cardiogenic shock, GRACE risk score.

Introduction

For a long time the 12-lead electrocardiogram (ECG) is considered an essential part of the diagnosis and initial evaluation of patients with chest pain.

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It is important to appreciate that the ECG provides information about a totally different aspect of pathophysiology in acute myocardial infarction than does the coronary angiogram. Coronary angiography identifies vessel anatomy whereas the ECG reflects the physiology of the myocardium during acute ischaemia.[1] Coronary angiography remains the "gold standard for identifying the infarct related artery, the ECG remains the gold standard for identifying the presence and location of acute myocardial infarction.[1]

Early risk stratification of patients presenting with STEMI is commonly done using various risk scores based primarily on the clinical presentation and evidence of left ventricular failure. Risk assessment needs to be done shortly after admission, when only the history, physical examination and the ECG are available.[2,3] The role of ECG in diagnosis and prognostication of AMI is well established.[2] In the early 1970s, it was found by epicardial and precordial mapping that the magnitude of ST segment elevation is a reflection of the extent of myocardial injury.[3] As a result, ST segment elevation was used to define subsets of patients who can benefit most from early thrombolysis[4] and even monitor the effects of reperfusion therapy.[5] However, the magnitude of ST elevation is influenced not only by the extent and severity of the ischemia, but also by variation of the shape and size of the chest and by localization of infarction and some author observed that, on admission ECG, presence of distortion of the terminal portion of the QRS complex was associated with larger infarct size and increased mortality.[6]

STEMI patients have several risk scoring system to identify the higher risk individual.[7] GRACE risk score is one of them and done by clinical parameters. It is an accurate tool for predicting the mortality in patients with STEMI at least in short and medium term than others risk scoring system.[7] The European society of cardiology (ESC) recommends the GRACE risk score as the preferred tool for inhospital and long term risk stratification. [8]

The purpose of this study was to analyse admission ECG in patients of STEMI based on terminal portion of QRS complex and find out inhospital death, heart failure, cardiogenic shock and recurrent myocardial infarction. The Global Registry of Acute Coronary Events (GRACE) score is used to determine the probability of in hospital death in patients with STEMI and compare this risk score in patients with and without distorted terminal QRS on initial ECG.

Materials and Methods

This observational prospective study was conducted in BSMMU during the period of July 2014 to June 2015. We studied 60 patients of STEMI admitted within 12 hours of onset of chest pain which lasted for at least 30 minutes and receiving thrombolytic therapy. STEMI was diagnosed when ECG showing ST elevation of 1 mm or more in two or more consecutive leads often with reciprocal ST depression in the contralateral leads, except in leads V2-V3 where ≥2 mm of ST elevation in men with age ≥40 years, ≥2.5mm men with age <40 years and ≥1.5 mm in women were required for accurate diagnosis [9] with positive T waves in leads with ST segment elevation with increase in cardiac enzymes. Among them those patients who received streptokinase 1.5 million units infusion over a period of 1 hour was included in the study. The patients fulfilling exclusion criteria were excluded. Clinical assessment was done and various risk factors was noted. Standard medications like antiplatelets, beta blockers, ACEI/ARBS and statins as per the direction of the treating physician. Time from onset of chest pain and administration of thrombolytic therapy was recorded.

Terminal portion of the QRS complex in two or more consecutive leads were analysed by 3 experienced physicians and in case of uncertain ECG classification, two other physicians were consulted. The investigators analyzing ECGs were blinded to clinical data of the patients. Anterior localization and number of leads with ST segment elevation were analyzed. The patients were classified into two ECG pattern groups, group I and group II. Group II was divided into A & B pattern.

Group I: Those with tall symmetric T waves and ST elevation in two or more adjacent leads without major changes in the configuration of the terminal portion of the QRS complex.

Group II: Those with tall symmetric T waves and ST elevation and distortion of the terminal portion of the QRS complex in two or more adjacent leads.

Pattern A: The height of the R wave and J point were measured. Emergence of the J point at or above the lower half of the R wave (≥50% of the R wave amplitude as measured from isoelectric line) in leads with qR configuration (Fig. 1).

Pattern B: Absence of S waves in leads with Rs configuration (leads without Q waves) (Fig. 2)

All the patients were evaluated during inhospital period. Heart failure was assessed by Killip class classification.

GRACE score was assessed for each patient by using the appropriate number of points for each of the eight prognostic variables. These variables are Killip class, heart rate, systolic blood pressure, age, presence or absence of cardiac arrest at admission,

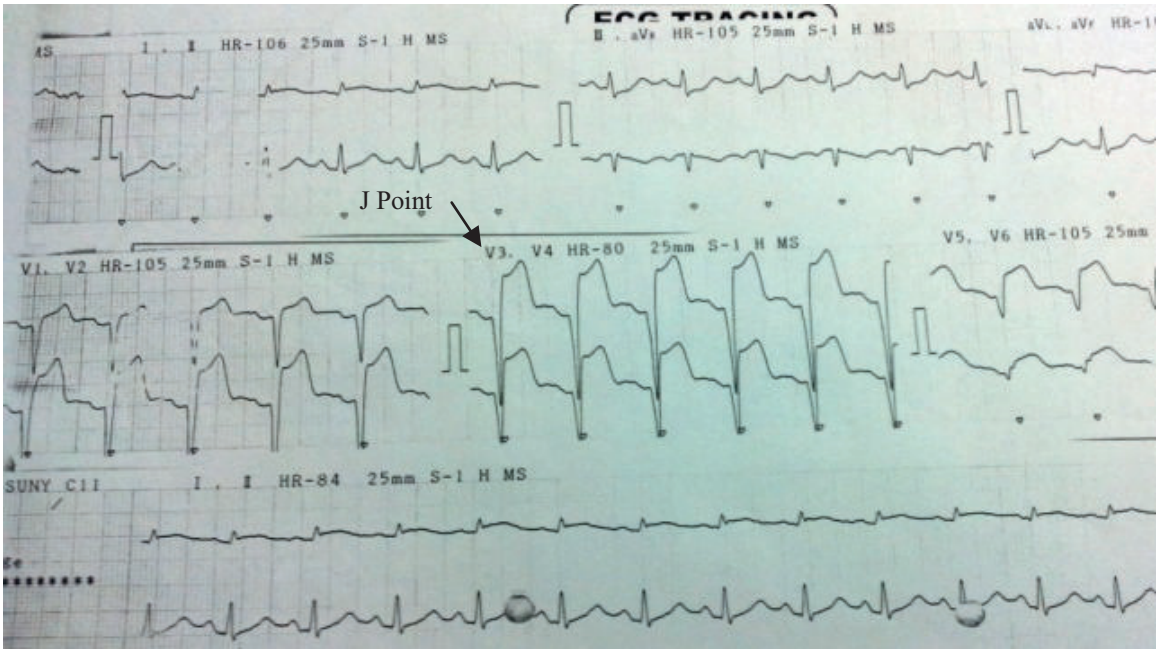

Figure 1: Mr. X, 45 years admitted in BSMMU. ECG showing acute STEMI extensive anterior, J point emergence more than 50% of the R wave amplitude in leads V1-V6, 1 and aVL in Leads with qR configuration, pattern A, and GRACE score-320.

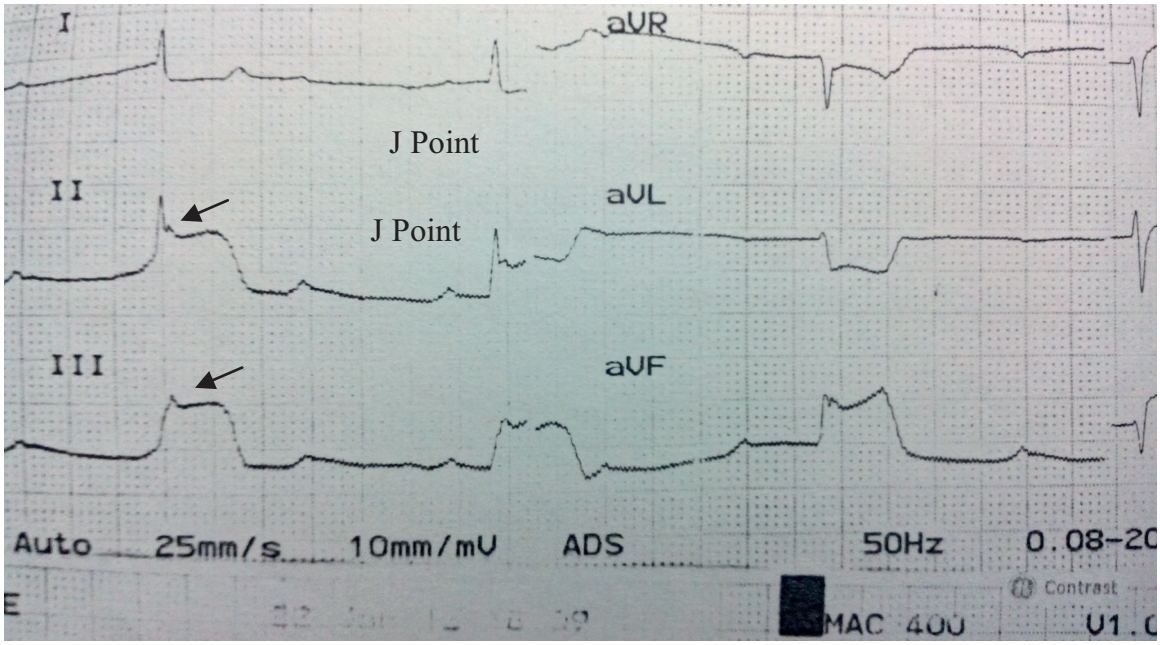

Figure 2: Mr. X, 55 years admitted in BSMMU. ECG showing acute STEMI inferior and complete heart block, absence of S wave in leads II, III and aVF in Leads with Rs configuration, pattern B, and GRACE score- 282.

presence or absence of elevated cardiac biomarkers, ST segment deviation and serum creatinine level. The final score between 0 and 372.[10] For this analysis we defined high risk of inhospital death as a likelihood of >8% and low risk of death was defined as likelihood of <3% that correspond to GREAC score >172,141-172, <141 as high, intermediate and low score respectively.[10]

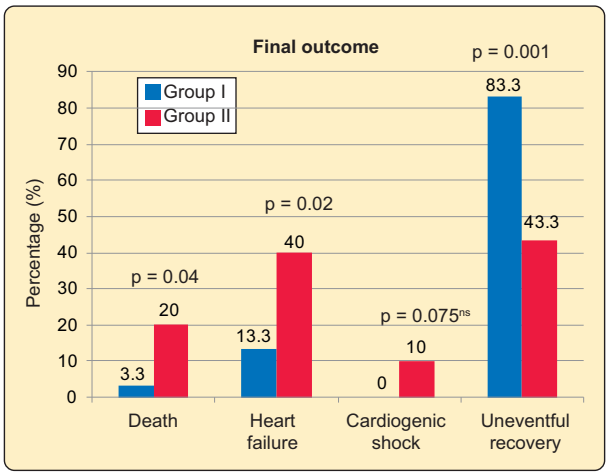

Figure 3: Percentage of patients developed death, heart failure, cardiogenic shock and uneventful recovery (n=60).

Ethical clearance was taken from the institutional ethical committee of BSMMU. Collected data was cleaned, edited and analyzed with help of software SPSS version 20. *p* value <0.05 was considered to be significant.

Results

Results of the study was analyzed by comparison of in hospital outcome including death, heart failure, cardiogenic shock, recurrent MI and GRACE score between group I (patients without QRS distortion) and group II (patients with QRS distortion). Baseline clinical data and investigation findings were also observed. Mean age of the study subjects was 55 years, 54.33±10.37 in Group I and 57.03±11.91 in Group II. There were no statistically significant difference in risk factors and door to needle time in between two groups (Table I).

Regarding inhospital outcome, death and heart failure were significantly higher in group II (1 vs. 6 patients p=0.04; 4 vs. 12 patients p=0.02; respectively), cardiogenic shock of both groups did not show significant difference (0vs. 3 patients p=0.075) but there was no recurrent MI in two groups (Figure 4).

GRACE risk score was significantly high in distorted QRS group and low in without QRS distorted group (6 vs 15 patients p=0.014; 6 vs 16 patients p=0.007; respectively). Intermediate GRACE score did not show any statistically significant difference between two groups (p=0.77). Among study population 7 patients died due to cardiogenic shock (2), acute left ventricular failure (2) and arrhythmias (3). Out of 7, 6 patients had higher GRACE score (>172). Among the 60 patients Killip >2 were 16 patients, 2 died from distorted QRS group (p< 0.05). Multiple logistic regression analysis showed that the distorted QRS on initial ECG and Killip class ³II were independent predictor of heart failure and in hospital mortality (Table II).

Table I: Showing characteristics of 60 patients of STEMI without QRS distortion (Group I) and QRS distortion (Group II) on admission EGG

Characteristics	Group-I (n=30)	Group-II(n=30)	*p* value
Age (mean)	54.33±10.37	57.03±11.91	0.353[115]
Sex (Male)	28(93.3%)	27(90.0%)	0.640[115]
HTN	9(63.3%)	13(43.3%)	0.121[ns]
DM	14(46.7%)	20(66.7%)	0.118[ns]
Smoking	16(53.3%)	17(56.7%)	0.795 [ns]
Dyslipidemia	13(43.3%)	15(50.0%)	*om*[m]
Time to thrombolysis (mean±SD) hrs	3.9±L13	4.5±1.27	0.06[tls]
Hear rate (≥100/min)	4(13.3%)	8(26.7%)	0.795 [ns]
Killip class (≥II)	4(13.3%)	12(46.7%)	0.019*
Location of AMI (Anterior)	15(50.0%)	16(53.3%)	0.796 [ns]
Number of leads with ST segment elevation (>5)	13(43.3%)	16(53.3%)	0.438[ns]

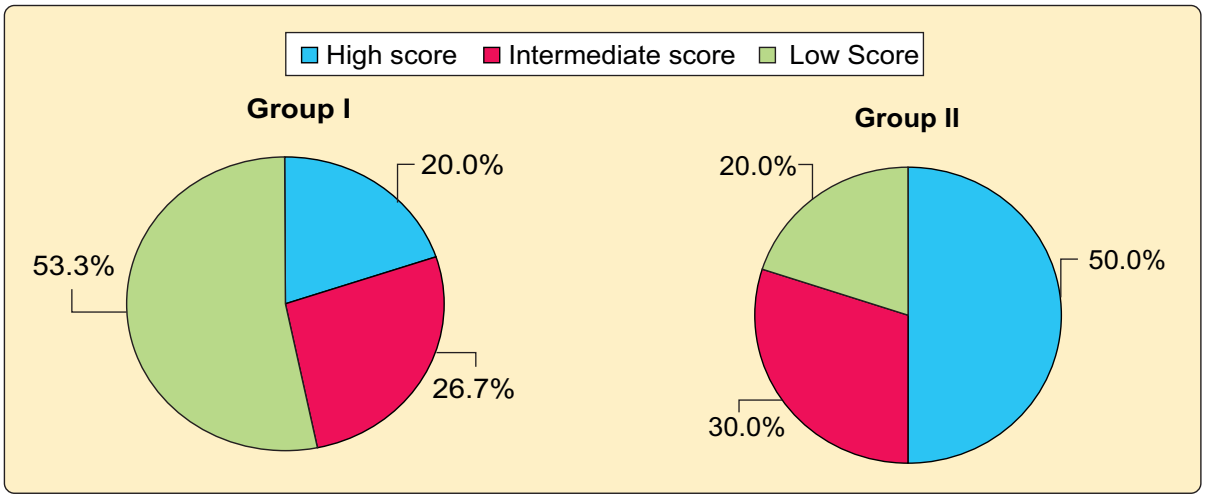

Figure 4: Distribution of risk strata according to GRACE score.

Table II: Showing multiple logistic regression analysis using hospital mortality as dependable variables (n=60).

Variables	Odds ratio	95% CI		*p* value
		Lower	Upper	
Age:<60 vs ≥60	0267	0.038	1.85	0.181
Sex: Malevs Female	2.143	_	_	0.96
HTN: Yes/No	2.857	0.415	19.65	0286
DM:Ys/No	1.500	0.238	9.465	0.666
Smoking: Yes/No	0.333	0.31	3.579	0.364
Time to thrombolysis ≥4 hrs: Yes vs No	3.750	0.540	26.05	0.181
Hearrate: ≥100vs<100	1.600	0.202	12.69	0.656
Killip class: ≥II vsl	16.25	1.774	148.84	0.006*
Location of AMI: Ant. vs Inf.	5.00	0.704	35.49	0.108
≥5 leads with ST elevation: Yes vs No	0.667	0.106	4.21	0.666
QRS distortion: Yes/No	7.25	0.76	17125	0.04*

Discussion

Coronary artery disease (CAD) is an increasingly important medical and public health problem, and is the leading cause of mortality in Bangladesh. Like other South Asians, Bangladeshis are unduly prone to develop CAD, which is often premature in onset, follows a rapidly progressive course. An ECG, a source of decisive data that may obtain within 10 minutes after arrival of patients with a history of chest discomfort consistent with acute coronary syndrome.[11] The role of ECG in diagnosis and prognostication of acute myocardial infarction is well established. In acute MI who might benefit from reperfusion therapy either by mechanical or pharmacological can be identified with this cost effective, easily available and bedside diagnostic tool. Therefore, this prospective study tried to determine the inhospital death, heart failure, cardiogenic shock and recurrent MI by interpretating the ECG and GRACE scoring of the study population; comparing the patients with STEMI with or without distorted terminal portion of QRS complex in ECG on admission.

The extent of myocardial infarction can also be estimated by Echocardiography, radionuclide ventriculography, myocardial perfusion scintigraphy, and magnetic resonance imaging (MRI). [12] Positron emission tomography and X-Ray computed tomography (CT) are less common.[13] But the imaging methods such as Echo and radionuclide ventriculography increases delay in starting treatment

and can neither measure the severity of ischemia nor differentiate between viable myocardium and already infracted myocardium.[12] Although single photon emission computed tomography (SPECT) with 99 mTc sestamibi can quantify residual flow to infarct area and the size of the area at risk and allow the viable myocytes to be imaged but this methods are also time consuming, expensive, technically demanding and not easily available. [12,13]

The purkinji system is less sensitive to ischemia than the contracting myocardial cells. Distortion in the terminal portion of the QRS to occur when more severe degree of ischemia that would injure the purkinji system. Distortion of the QRS is caused by alteration in the conduction velocity of the activation wave in the purkinji fibers as it travels through the ischemic region. The delayed conduction decreases the degree of cancellation and, by so doing, increase the amplitude of the R wave and causes loss of the S wave.[14,15]

A total number of 60 patients (30 patients in each group) with STEMI, out of them 55 patients were male and mean age was 55 years, 54.33±10.37 in Group I and 57.03±11.91 in Group II. There were no statistically significant difference in risk factors and door to needle time in between two groups.

The mean door to needle time was 3.9±1.13 hrs and 4.5±1.27 hrs in group I and group II respectively. These parameter did not show statistically significant difference between two groups (p value > 0.05 for these parameters) that also similar to other studies.[12,16] Time interval between onset of chest pain and thrombolysis is an important factor for outcome of the patients.

Birnbaum et al.[14] found time interval to be significant when thrombolysis to be performed ≥2 hrs and was associated with increase inhospital mortality only among patients with QRS distortion and not in patients without QRS distortion, patients who were treated within 2 hrs of onset of symptoms there was no difference in mortality between two groups.

Our patient's Killip class ≥II 4 and 12 patients respectively in group I and group II. These parameters showed the higher Killip class in group II (p value < 0.05) which was observed by various study[14,16]. They stated that higher the Killip class indicate larger area of myocardial necrosis and higher incidence of heart failure and increase mortality.

Regarding the ECG findings of these patients population only the QRS distortion were significant, location of anterior MI, number of leads with ST elevation in group I and group II did not showed any significant difference. In present study ST segment elevation in ≥5 leads in group I and group II 13 and 16 patients respectively (p value > 0.05 for these parameters). These findings agreed with other study.[12] Terminal portion of QRS distortion on admission was a better predictor of final infarct size than number ST segment elevation. Patients with 8 or 9 of out of 12 leads showing ST segment elevation have three or four times of mortality of those with only 2 or 3 leads demonstrating ST segment elevation.[17] Birnbaum et al.[14] stated that the number of leads with ST elevation and sum of the ST elevation had only mild correlation with myocardial dysfunction but no correlation with severity of dysfunction. Severity of ischemia correlate with the degree of distorted QRS complex.

GRACE risk scoring of the study population was done and divided into high, intermediate and low risk as > 172, 141-172, <141 respectively on the basis of probability of inhospital death > 8% consider as high risk and <3% as low risk. GRACE risk score was significantly high in distorted QRS group and low in without QRS distorted group (6 vs 15 patients p=0.014; 6 vs 16 patients p=0.007; respectively). Intermediate GRACE score did not show any statistically significant difference between two groups (p=0.77) [10] as the predictor of GRACE score higher killip class and low systolic blood pressure were more in group II.

Regarding final outcome of the study population, death was 1 and 6 patients respectively in group I and group II. Heart failure was 4 without QRS distortion group and 12 in distorted QRS group. These parameters showed difference were significant between two groups (p value < 0.05 for these parameters) and similar pattern had also been found among many other studies[14,16] Patients with distorted QRS complex had absence of collateral blood flow, larger area of myocardial necrosis and difficult to salvage the jeopardized myocardium even after reperfusion therapy. So this group of patients had more tendency to develop heart failure and death.

Among study population 7 patients died due to cardiogenic shock (2), acute left ventricular failure (2) and arrhythmias (3). Out of 7, 6 patients had higher GRACE score (>172).

In multivariate analysis where hospital mortality was dependent variables and all the other baseline characteristics such as age, gender, HTN, DM, smoking, time to thrombolysis, heart rate, Killip class, location of acute MI, ≥5 leads with ST elevation, initial ECG pattern were independent variables where Killip class and initial ECG pattern were only significantly associated with hospital mortality (*p* value >0.05). The odds ratio were more than one in gender, HTN, DM, time to thrombolysis, heart rate, location of acute MI. Results of current study had similarity with other study.[12,16] It indicates that the distorted QRS on ECG and Killip class were independent predictor of inhospital mortality and heart failure.

The morphology of QRS suggest the grade of ischemia, absence of distorted QRS indicate grade 2 ischemia and presence of distortion of QRS complex in acute MI indicate grade 3 ischemia that was predictive of more extensive myocardial involvement and greater severity of regional dysfunction.[18] It concluded that the careful analysis of ECG which is simple, cheap, universally available, bed side investigation may offer important prognostic information in patients with STEMI. The distortion of the terminal portion of QRS appears as an independent predictor for development of death and heart failure; GREAC score is also significantly higher in patients having distorted QRS. That would help in deciding which patients should go for intensive care unit admission, early aggressive myocardial revascularization procedures or urgent referral to higher centers even if much time has elapsed from onset of symptom.

Conflict of Interest: There was no conflict of interest.

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