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ASSOCIATION BETWEEN TERMINAL QRS DISTORSION WITH GRACE SCORE IN ACUTE STEMI PATIENT IN HAJI ADAM MALIK HOSPITAL, MEDAN

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Abstract

Background: Amount of 17.9 million people died from cardiovascular disease in 2016, half were caused by acute myocardial infarct. Terminal QRS distortion is showing the degree of ischemia in patients with severe STEMI. Risk stratification of the current ACS is carried out using the GRACE score as a validated predictor.

Objective: The study objective is to determine the association between terminal QRS distortion in STEMI patients and the GRACE score, also to identify the risk of death through an ECG examination.

Methods: The study involved STEMI patients who were hospitalized at Haji Adam Malik Hospital from May 2019 to March 2020. The first group was STEMI with terminal QRS distortion, and another group was without distortion. The association between terminal QRS distortion and independent parameters of GRACE score were observed, and monitoring was carried out for the next six months. The Kaplan-Meier curve performed survival analysis.

Results: From 60 STEMI patients, 45 patients (75%) with ST-elevation anterior and 26 (43.3%) patients with terminal QRS distortion (first group). It had a significant statistically GRACE score (130.92 ± 38.209, $p = 0.001$), compared to those without distortion. The GRACE score parameters to terminal QRS distortion were significantly associated ($p < 0.05$). The first group also had poor clinical outcomes (Hazard Ratio 3,596; CI 95%) and the highest mortality rate over six months of follow-up.

Conclusion: The association between terminal QRS distortion and the GRACE might be considered as a potential tool for risk stratification in STEMI patients.

Introduction

Around 17.9 million people died due to cardiovascular disease in 2016; almost 31% of deaths globally, which half of the death is due to Acute Myocardial Infarction (AMI) (WHO 2017). The prevalence of coronary heart disease in Asian countries includes 1/3 of the population worldwide (Gomar et al.2016, Jayaraj et al.2018). Data in 2014, the highest cause of death in Indonesia after stroke is coronary heart disease, it was 12.9% of the total population, with 30% being patients with acute STEMI (Kemenkes RI 2017). The Global Registry of Acute Coronary Events (GRACE) study in 2001 showed that the acute STEMI incidence was 27% of all acute myocardial infarction patients (Eagle et al.2014)

The mortality rate during acute STEMI treatment is still high. Some of the factors that influence include age, heart rate frequency, history of diabetes, impaired kidney function, left ventricular dysfunction (heart failure to cardiogenic shock), history of cardiac arrest, and history of ventricular arrhythmias (Medina et al.2018, Garcia et al.2017, McNamara et al.2016).

Terminal QRS distortion is the presence of a J point elevation of more than 50% of the R wave height in leads with a qR configuration and or loss of S waves in leads with an Rs configuration. Birnbaum hypothesized that the absence of terminal QRS distortion on the ECG of acute STEMI patients is a sign of myocardial protection due to persistent perfusion (through collateral circulation or incomplete or intermittent arterial occlusion) or the result of ischemic preconditioning, or a result of drug administration (Garcia et al.2017, Ahsan et al.2018).

Risk stratification of the current ACS is carried out using the GRACE score as a validated predictor (Wan et al.2014). The GRACE score can also be used to estimate the mortality rate in patients with ACS at 6 and 36 months (Alnasser et al.2015).

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In this study, the authors tried to see whether there was an association between terminal QRS distortion in acute STEMI patients and the GRACE score system at the Haji Adam Malik Central General Hospital (RSUP) to identify early the risk of death through an ECG.

Methods

Study Population

The data were taken from acute STEMI patients who were treated at RSUP Haji Adam Malik between May 2019 until March 2020, with a consecutive sampling method. The study involved 60 acute STEMI patients who were willing to be contacted and interviewed via telephone or face to face. Acute STEMI patients with ECG images that can interfere with ST-segment assessment (such as bundle branch block, Wolff-Parkinson-White syndrome, or pacemaker rhythm), with a history of Coronary Artery Bypass Surgery (CABG) or Percutaneous Coronary Intervention (PCI) in previous hospitals, and incomplete/unreadable ECG results were excluded from the study.

ECG and GRACE Score evaluation

This study is a retrospective cohort study. An ECG was carried out for the diagnosis of acute STEMI; the first group was the patient group with terminal QRS distortion and the second group without terminal QRS distortion. GRACE scores were calculated for both groups. Furthermore, the association between terminal QRS distortion and the independent parameters of the GRACE score (based on age, heart rate, systolic blood pressure, creatinine, KILLIP classification, Troponin I, ST-segment elevation on the ECG on admission, and cardiac arrest at admission) were observed and 6 months of monitoring were carried out.

Statistical analysis

The data were analyzed using SPSS version 23. QRS distortion data as a categorical variable and GRACE score as a numeric variable. The bivariate analysis used unpaired t-test or Mann Whitney test on numerical variables, while for categorical variables using the Chi-square or Fisher test. Then a multivariate analysis will be carried out using logistic regression. Statistical data analysis using SPSS version 23 software, p-value <0.05 is said to be statistically significant.

Results

Acute STEMI patients who underwent treatment at RSUP Haji Adam Malik in the period May 2019 to March 2020 found a total of 60 patients with terminal QRS distortion and without terminal QRS distortion have met the inclusion and exclusion criteria, consisting of 53 patients (88.3%) male and seven patients (11.7%) were women with mean age 56 years. Distribution of risk factors owned by study subjects, median and median heart rate, blood pressure, acute STEMI incidence rate, ECG images with terminal QRS distortion, GRACE score, laboratory parameters (CKMB, Troponin I, leucocytes), and mortality due to acute STEMI during the treatments are presented in **table 1**.

Table 1. Baseline Characteristics

Characteristics	**N=60**
Sex	
Male	53 (88.3%)
Female	7 (11.7%)
Age (year)	56 (36-77)
Risk Factors	
Hypertension	32 (53.3%)
Diabetes Mellitus	32 (53.3%)
Dyslipidemia	44 (73.3%)
Smoking	50 (83.3%)
Clinical Parameters	
Heart rate (x/minute)	84 (60–115)
Systolic Blood Pressure (mmHg)	119.17 ± 21.26
Diastolic Blood Pressure (mmHg)	76.67 ± 14.46
GRACE Score	113.38 ± 33.49
Killip Class	
I	42 (70.0%)

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II	16 (26.7%)
III	0 (0 %)
IV	2 (3.3%)
ECG	
ST Elevation (acute STEMI)	
Anterior	45 (75.0%)
Non-Anterior	15 (25.0%)
Distorsion of QRS Terminal	
Yes	26 (43.3%)
No	34 (56.7%)
Laboratorium Parameters	
Hb	13.8 (11-18)
Leucocyte	11,790 (6,010-20,550)
Ureum	30.53 ± 12.27
Creatinin	1.02 ± 0.31
LDL	134 (33-287)
HDL	43.55 ± 14.72
TG	161 (57-318)
CKMB	148.70 ± 122.11
Troponin I	9.45 ± 8.16
Ejection Fraction	42 (25-66)
Coronary Angiography	
MVD	35 (58.3%)
1VD	25 (41.7%)
Intervention	
PCI	29 (48.3%)
Primary PCI	17 (28.3%)
CABG	1 (1.7%)
Conservative	13 (21.7%)
Hospital death incidence	16 (26.7%)
Arrest	8 (13.3%)
Acute Heart Failure	13 (21.7%)
Heart Block	2 (3.3%)
Ventricle Arrhythmias	9 (15.0%)
Cardiogenic Shock	7 (11.7%)
Mayor Cardiovascular Event	33 (55%)

The results of this study showed that patients with terminal QRS distortion had a higher GRACE score (130.92 ± 38.209) with p = 0.001, and of the eight independent parameters of the GRACE score (i.e. age, HR, systolic blood pressure, creatinine, heart failure (Killip class), Troponin I, ST-segment deviation, and cardiac arrest) associated with the presence of terminal QRS distortion had a significant association (p <0.05) (Table 2), except for ST-segment deviation because all acute STEMI patients had ST-segment deviations. Statistically there was no difference between the two groups.

This study also found a statistically significant association between clinical outcomes and patients with terminal QRS distortion (p <0.05) (Table 3), they are significant with hospital death, acute heart failure, cardiac arrest, and major cardiovascular events (MCVE) during the period of stay at the hospital.

The author found that the anterior location of the infarct was the most significant parameter for terminal QRS distortion with an Odds Ratio of 25.020 (2.587-242.005, 95% CI, p = 0.005). Another parameter that was also statistically significant was that the group of patients with reduced EF had an Odds Ratio of 4,117 (1,099-15,427, 95% CI, p = 0.036) and the group of leukocytosis patients had an Odds Ratio of 3.903 (1,062-14,352, 95% CI, p = 0.040).

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Table 2. Association between Terminal QRS Distortion and GRACE Parameters

Variables	QRS distortion (+) N=26	QRS distortion (-) N=34	*p-value*
Age	58.58 ± 9.183	53.62 ± 8.098	**0.030**[*]
HR	87.81 ± 13.703	80.65 ± 9.257	**0.027**[*]
SBP (mmHg)	112.31 ± 21.782	124.41 ± 19.57	**0.028**[*]
Creatinin	1.115 (0.62-1.84)	0.910 (0.38-1.37)	**0.030**[#]
Heart failure, Killip ≥ II, n (%)	14 (53.8)	28 (82.4)	**0.035**[+]
Troponin I	11.27 (0.1-32)	4.51 (0.54-19.26)	**0.027**[#]
ST-segment deviation (%)	100	100	1[$]
Arrest, n (%)	7 (26.9)	1 (2.9)	**0.016**[$]
GRACE score	130.92 ± 38.209	99.97 ± 21.707	**0.001**[+]

[*]Uji T-Independent, [#]Uji Mann_whitney, [+]Uji Chi-Square, [$]Uji Fisher's. Bold is the significant p-value.

Table 3. The outcome of patients with terminal QRS distortion

Outcomes	QRS Distortion(+) N=26	QRS distortion (-) N=34	*p-value*
Hospital death	11 (42.3)	5 (14.7)	**0.036**[+]
Acute heart failure, n(%)	10 (38.5)	3 (8.8)	**0.014**[+]
Heart Block, n(%)	1 (3.8)	1 (2.6)	1.000[+]
Ventricle Arrhythmias	6 (23.1)	3 (8.8)	0.157[+]
Cardiogenis shock, n(%)	4 (15.4)	3 (8.8)	0.454[$]
Arrest, n(%)	7 (26.9)	1 (2.9)	**0.016**[$]
Mayor cardiovascular event, n(%)	20 (76.9)	13 (38.2)	**0.004**[+]

[+]Uji Chi-Square, [$]Uji Fisher's. Bold is the significant p-value.

The death rate in the hospital was 11 people (42.3%) in the terminal QRS distortion group and five people (14.7%) in the terminal QRS distortion group (p = 0.036). Meanwhile, the mortality rate after six months of monitoring was six people (40%) in the terminal QRS distortion group and four people (13.8%) without the terminal QRS distortion group. Statistically, the difference in event-free survival in the two groups was different with a significance level of p = 0.032. Based on the survival analysis between groups with terminal QRS distortion and without terminal QRS distortion, the hazard ratio (HR) was 3.596 (CI 95%) as the picture below (Fig.1).

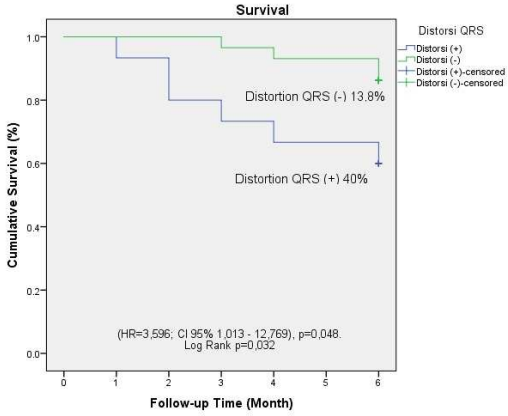

Fig.1. Kaplan-Meier curve (at six months of follow-up, Terminal QRS distortion group has six deaths, and 20 surviving patients. The QRS distortion (-) group has four deaths and 30 surviving patients

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Discussion

Risk stratification in patients with STEMI is generally performed using multiple risk scores based on clinical presentation and evidence of left ventricular dysfunction. Electrocardiography (ECG) has a role in diagnosing and determining prognosis in acute myocardial infarction. Assessment of the morphology of QRS waves on the ECG of patients with STEMI can be done to predict mortality during admission (Mulay 2013).

Parameters that can be used to assess a patient's prognosis include anterior infarction, cardiogenic shock, high CKMB and creatinine levels, Killip class and GRACE score (Hou et al 2017). The results of this study were significant and statistically significant ($p < 0.05$) in patients with distortion. QRS terminal for several measuring variables, namely age ($p = 0.030$), SBP ($p = 0.028$), DBP ($p = 0.009$), HR ($p = 0.027$), IM Location - Anterior ($p = 0.011$), Ejection Fraction ($p = 0.011$), Leukocytes ($p = 0.028$), Creatinine ($p = 0.030$), Troponin I ($p = 0.027$), EF Group - Reduced EF ($p = 0.008$), GRACE score ($p = 0.001$), death in hospital ($p = 0.036$,) acute heart failure ($p = 0.014$) and cardiac arrest ($p = 0.016$).

The mean GRACE score was 130.92 ± 38.209 in the group with terminal QRS distortion and 99.97 ± 21.707 in the group without terminal QRS distortion with $p = 0.001$. Patients who had terminal QRS distortion had higher GRACE scores compared to those without terminal QRS distortion. According to Hassel, in the inferior acute STEMI patient, terminal QRS distortion on the admission ECG was associated with larger infarct size and a tendency to have a lower left ventricular ejection fraction. Myocardial infarction lesion in the anterior was the most significant parameter to the incidence of terminal QRS distortion having an Odds Ratio of 25.020 (2.587-242.005, 95% CI, $p = 0.005$) (Hassel et al.2016).

In this study, the association between terminal QRS distortion and the incidence of leukocytosis was found with an Odds Ratio of 3.903 (1.062-14.352, 95% CI, $p = 0.040$). Yuksel hypothesized that the increased neutrophil-lymphocyte ratio in acute STEMI patients was related to the degree of ECG ischemia at admission, assuming it was due to an adequate perfusion mechanism at the level of microvascular integrity (Yuksel et al.2014).

Statistically, the difference in event-free survival of the two groups was different with a significance level of $p = 0.032$. Based on the survival analysis between groups with QRS distortion and without QRS distortion, the hazard ratio (HR) was 3.596. The Kaplan Meier curve shows that terminal QRS distortion is a robust prognostic indicator in predicting mortality during follow-up six months after discharge from the hospital.

Studies have shown that patients with grade 3 of ischemia seen on the ECG at admission are associated with poorer prognosis during admission, inadequate fibrinolytic response, higher mortality even after primary PCI, and larger infarct size (Tanriverdi 2015). The study by Sejersten stated that the 30-day mortality rate of acute STEMI patients with terminal QRS distortion was higher than those without terminal QRS distortion on the ECG at admission (9.7% vs 4.8%, p-value <0.001) (Sejersten et al. 2006). Terminal QRS distortion should be added as a tool for risk stratification in acute STEMI patients (Prasitlumkun et al.2019). Furthermore, Tang's study found that the GRACE score could accurately predict long-term mortality and differentiate between long-term survivors (up to 4 years) in all ACS patients (n=1143) (Tang et al.2007).

Conclusion

There is an association between terminal QRS distortion and GRACE score at RSUP Haji Adam Malik which was found on the independent parameters of the GRACE score, namely age, HR, SBP, creatinine, heart failure (Killip class), Troponin I, and cardiac arrest in the group with terminal QRS distortion ($p < 0.05$). The mortality rate for acute STEMI patients with terminal QRS distortion was higher than those without terminal QRS distortion during the six months of monitoring at RSUP Haji Adam Malik. So that terminal QRS distortion can be added as a tool for risk stratification in acute STEMI patients.

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