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Correlation between Right Ventricular Function with Revascularization Time and 30-day Mortality in ST-Elevation Myocardial Infarction Patients Underwent Right Coronary Artery Intervention

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Abstracts: Right ventricular (RV) function provides strong prognostic information in patients treated with primary percutaneous coronary intervention (PCI) due to myocardial infarction. Longitudinal RV systolic function can be assessed by the measurement of the tricuspid annular plane systolic excursion (TAPSE). This study aimed to evaluate the correlation between TAPSE and revascularization time with 30-day mortality using TIMI risk score in patients presenting STEMI who underwent revascularization of right coronary artery (RCA). This was a descriptive amd analytical study. Data were collected from iSTEMI Registry database which consisted of 49 STEMI patients undergoing PCI in RCA and TAPSE measurement at Prof. Dr. R. D. Kandou General Hospital from October 3rd, 2018 to July 28th, 2019. Echocardiographic examination was done within 48 hours of hospitalization. A descriptive analysis and bivariate correlation with Spearman's rho were applied between given variables. P-value of <0.05 was considered to be statistically significant. The results showed that the mean age of the patients was 57.92 10.345 years old and 79.2% were male. The mean TAPSE measurement was 18.51 mm +/- 3.63 mm. The median revascularization time was 357.5 minutes while median TIMI score was 4. Shorter treatment time (p=0.708) and lower TIMI score (p=0.923) were not associated with better right ventricular function measured with TAPSE in patients undergoing RCA intervention. In conclusion, right ventricular function is not associated with revascularization time and thirty days mortality in patients presenting with ST-elevation acute myocardial infarction involving right coronary artery.
Keywords: tricuspid annular plane systolic excursion; revascularization time; right coronary artery; ST-elevation myocardial infarction

INTRODUCTION

Right ventricular (RV) function provides strong prognostic information in patients treated with primary percutaneous coronary intervention (PCI) for myocardial infarction. In post-AMI patients, the relevance of right ventricular (RV) function is poorly defined. Major complications and in hospital mortality are well correlated with the involvement of RV function during inferior AMI.[1] Right ventricular systolic function can be assessed by the measurement of the tricuspid annular plane systolic excursion (TAPSE). As a surrogate marker for RV systolic function, TAPSE reflects the longitudinal shortening of the right ventricle.[2]

Mortality has been associated with increased door-to-treatment time in acute coronary syndrome.[3-5] Longer reperfusion time is associated with increased area of infarction and also myocardial function. In ST elevation myocardial infarction patient, TIMI risk score can predicted risk for 30 days of mortality. The multivariable model used variables that captured the majority prognostic information in TIMI risk score for STEMI. In men and women, smoker and nonsmokers, this risk score was stable over multiple points.

Furthermore, a large external data in STEMI patients has been performed well with the TIMI risk score.[6]

In patients who undergo primary percutaneous coronary intervention (PCI), however, the clinical relevance of RV dysfunction in that currently growing population of post-AMI patients is unknown. Therefore, the aim of the current study was to investigate the relationship between RV function measured by TAPSE with time to revascularization and 30 days of mortality in patients treated with primary PCI. In addition to traditional measurements that are recommended to quantify RV function with 2D-echocardiography.

METHODS

This study aimed to evaluate the correlation between TAPSE with revascularization time and 30-day mortality using TIMI risk score in patients presenting STEMI who underwent revascularization of right coronary artery (RCA). This is a single-centre cross sectional study conducted at the Department of Cardiology and Vascular Medicine, Prof. Dr. R. D. Kandou Hospital, Manado, Indonesia. Data were collected from iSTEMI registry database which consisted of 49 STEMI patients undergoing PCI in RCA and TAPSE measurement at Prof. Dr. R. D. Kandou General Hospital from October 3rd, 2018 to July 28th, 2019. Revascularization was referred to percutaneous coronary intervention (PCI).

Inclusion criteria were as follows: patients with ST-elevation myocardial infarction and patients undergo PCI with right coronary artery (RCA) as culprit vessel. Exclusion criteria were as follows: failed to revascularization, patients with history of right ventricular (RV) dysfunction, patients with poor echo window whom TAPSE measurement is under optimal, and TIMI risk score could not be obtained.

In echocardiography, images were obtained with patients in the left lateral decubitus position using a commercially available system. Data acquisition was performed at a depth of 16 cm in the parasternal and apical views using a 3.5-MHz transducer. During breath-hold, M-mode and 2D images were obtained and three consecutive beats were saved in cineloop format. Tricuspid annular plane systolic excursion (TAPSE) was measured in the RV free wall. In the 4-chamber view, the M-mode cursor was placed through the tricuspid annulus in such a way that the annulus moved along the M-mode cursor and the total displacement of the RV base from end-diastole to end-systole was measured.

Tabel 1. TIMI risk score for ST-elevation myocardial infarction

TIMI Risk Score for ST-Elevation Myocardial Infarction	Points
Age 65-74/>75 (years)	2/3 points
Systolic Blood Pressure <100	3 points
Heart Rate >100	2 points
Killip class II-IV	2 points
Anterior STE or LBBB	1 point
Diabetes, h/o hypertension or h/o angina	1 point
Weight <67 kg	1 point
Time to treatment >4 hours	1 point

Note: Adapted from "TIMI risk score for ST-Elevation myocardial infarction: a convenient, bedside, clinical score for risk assessment at presentation: An intravenous nPA for treatment of infarcting myocardium early II trial substudy," by Morrow et al. Circulation. 2000;102(17):2036.[7]

We used validated TIMI score for STEMI in this study (Table 1). Data were collected with anamnesis, physical examination and other supporting examinations.

Statistical analysis was conducted using the Statistical Product and Service Solutions (SPSS) version 23. The target for sample size was derived from the formula for Spearman test. The TAPSE and time to reperfusion were numerical data that were tested using the Spearman test. P-values <0.05 were considered as statistically significant. Moreover, the TAPSE and 30 days mortality TIMI risk score were numerical data that were tested using the Spearman test. P-values <0.05 were considered as statistically significant.

RESULTS

Table 2 showed the baseline characteristics of patients in this study. The mean age of the patients was 57.92±10.345 years old and 79.2% were male. The median TAPSE mea-

surement was 18.51 mm ±3.63 mm. The median revascularization time was 357.5 minutes while median TIMI score was 4. Shorter treatment time (p= 0.708) and lower TIMI Score (p = 0.923) were not associated with better RV function measured with TAPSE in patients undergoing RCA intervention.

Table 2. Baseline characteristics of patients

Parameters	N	Percentage	Mean ± SD	Median (Q1;Q3)
Age, years			57.92 ± 10.345	
Male sex	38	79.2%		
Body weight, kg				65 (60;73)
Body height, cm				165 (158.5;169)
BMI, kg m			25.396 ± 3.8853	
SBP, mmHg			122.458 ± 28.921	
DBP, mmHg			76.563 ± 20.2924	
HR			73.208 ± 19.383	
Killip classification				
I	34	70.8%		
II	10	20.8%		
III	0	0.0%		
IV	4	8.3%		
Diabetes	15	31.3%		
Hypertension	27	56.3%		
Dyslipidemia	18	37.5%		
Current smoker	17	35.4%		
Heart failure	1	2.1%		
Stroke	1	2.1%		
PAD	1	2.1%		
Previous PCI	4	8.3%		
Previous CABG	0	0.0%		
History of premature CVD in family	3	6.3%		
Hemoglobin, g/dL			13.88 ± 1.61	
Hematocrit			41.43 ± 4.91	
Leukocyte, /mcL			12377.27 ± 3114.44	
Total cholesterol, g/dL				179 (140;209)
HDL-C, g/dL				35 (29;41)
LDL-C, g/dL			115.26± 42.38	
TG, g/dL				116 (94;145)
Serum uric acid, mg/dL			7.047 ± 2.2619	
Serum ureum, mg/dL				29 (24.25;41,5)
Serum sodium, mEq/dL				137 (133;139)
Serum potassium, mEq/dL				4.1 (3.69;4.4)
CK-MB, U/L				53 (28;133.5)
TnT, ng/L				100 (0;439.75)
LVEF			47.63 ± 12.02	
TAPSE, mm			18.51 ± 3.63	
TIMI score				4 (2;6)
Revascularization time (minutes)				357.5 (204.5;2498.5)

DISCUSSION

Despite evaluation of left chamber functional parameters, assessment of right chamber function has become increasingly popular and important in recent decades. The problem of visualization of the whole right ventricle, inconsistency in the analysis of RV parameters, and poor understanding of the impact of RV function on prognosis make the late adoption and integration of right ventricular (RV) function into a complete evaluation of cardiac function are difficult.[8]

Echocardiography has a high threshold for detecting right-sided myocardial dysfunction, and its increasing availability and fidelity has made it a rising diagnostic modality in a variety of settings such as the emergency department and the operating room. For detection of right ventricular infarction echocardiography have the sensitivity and specificity as high as 82% and 93%, respectively. Signs include right ventricular wall dyskinesia/ hypokinesia, paradoxical septal motion, tricuspid regurgitation, and pulmonary regurgitation. Other measurements such as TAPSE are currently being evaluated and may indicate a poor prognosis.[9]

RV systolic functions can be assessed with parameters such as RIMP, TAPSE, 2D RV FAC, 2D RV ejection fraction (EF), three-dimensional (3D) RV EF, tissue Doppler-derived tricuspid lateral annular systolic velocity, and longitudinal strain and strain rate. TAPSE is known to be well correlated with parameters of RV global systolic function, such as radionuclide-derived RV EF, 2D RV FAC, and 2D RV EF.[10]

With the introduction of reperfusion therapy and aggressive efforts to modify risk factors, the prognosis of patients with ischemic heart disease has improved markedly. The rate of cardiovascular events after myocardial infarction has decreased to approximately 5% over a period of two years as compared with the 20% to 30% reported in the prethrombolytic era. New risk markers can significantly improve survival of patients who are at high risk despite reperfusion therapy that others have demonstrated for the identification of subgroups of patients at greater risk.[11]

Right ventricular (RV) dysfunction is a powerful risk marker after acute myocardial infarction (MI). Reliable data on RV damage using cardiac magnetic resonance imaging (MRI) are scarce.[12] The association between right ventricular functional parameters and STEMI[12-16] was previously examined. Morbidity and mortality are well known to be associated with right ventricular (RV) involvement after an acute myocardial infarction (MI).[17] In 50% to 80% postmortem and animal studies, RV involvement in acute MI has been reported but is frequently underestimated in the clinical setting owing to the diagnostic limitations of the electrocardiogram (ECG) and echocardiography. However in this study, we found that right ventricular function measured by TAPSE was not associated with TIMI score as predicted score for 30 days mortality of STEMI patients.

Current guidelines recommend rapid reperfusion in patients with acute STEMI to reduce infarct size. Mortality and improved myocardial recovery were demonstrated in experimental dan clinical data in patient with shorter reperfusion times. Primary percutaneous coronary intervention (PPCI) has been the preferred treatment of choice for STEMI for two decades. The original concept of "Door-to-Balloon" (DTB) time has evolved over time, first to "Door-to-Reperfusion" (DTR) time, and most recently to "First Medical Contact to Device" (FMC-device) time Unfortunately, logistics can prevent some patients from receiving this treatment.[18,19]

In STEMI patient, many studies showed that reperfusion therapy especially primary PCI restores the right ventricular systolic function.[20] However in this study, we found that right ventricular function was not associated with time to reperfusion. One study in patients with right ventricular dysfunction after NSTE-ACS found that TAPSE and RIMP value of these patients were not significantly different before and after a succesful PCI.[21] This maybe associated with myocardial stunning after an acute myocardial infarction. RV dysfunction is reversible in most patients and permanent RV ischemic injury is very uncommon four months after acute MI treated with primary PCI.[12] Serial

echocardiography may needed to measure the recovery of myocardial infarction during a success revascularization.

CONCLUSION

Tricuspid annular plane systolic excursion is not correlated with revascularization time and 30-day mortality in patients presenting with ST-elevation acute myocardial infarction involving right coronary artery.

Data Availability

Available on reasonable request

Conflict of Interests

There was no conflict of interest to be declared.

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