


## Prognostic Value of Tricuspid Annular Plane Systolic Excursion (TAPSE), Right Ventricular Fractional Area Changes (RV FAC) and Pulses Tissue Doppler S' Wave (PTD S') at 30 Days after Care of Acute Miocardial Infarction Patients in Haji Adam Malik Hospital Medan

Fadli Ilhami<sup>1\*</sup>, Ali Nafiah Nasution<sup>2</sup>, Cut Aryfa Andra<sup>2</sup>

<sup>1</sup> Cardiology and Vascular Resident, Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia / Haji Adam Malik General Hospital, Medan, Indonesia

<sup>2</sup> Cardiologist, Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia / Haji Adam Malik General Hospital, Medan, Indonesia

\*Corresponding Author: Fadli Ilhami, E-mail: [ilhamifadli27@gmail.com](mailto:ilhamifadli27@gmail.com) 

### ARTICLE INFO

#### Article history:

Received  
3 March 2023

Accepted  
31 May 2023

Manuscript ID:  
JSOCMED-030423-25-5

Checked for Plagiarism: Yes

Language Editor:  
Rebecca

Editor-Chief:  
Prof. Aznan Lelo, PhD

### Keywords

### ABSTRACT

**Introduction:** Echocardiography is a reliable and simple method of hemodynamic monitoring that can be used on every IMA patient. Tricuspid Annular Plane Systolic Excursion (TAPSE), Right Ventricular Fractional Area Changes (RV FAC), and Pulses Tissue Doppler S' Wave (PTD S') are the three main parameters of ventricular electrocardiography. The purpose of this study is to understand the reliability of the right ventricle function prognostic indicators TAPSE, PTD S', and RV FAC with regard to the MACE at 30 days following the occurrence of the AMI in RSUP H. Adam Malik Medan

**Method:** This study is an ambispective observational analytic study with sampling carried out at one time (cross-sectional study) on 88 AMI patients at the HAM Hospital who were treated from March 2022 to June 2022 and performed echocardiography in the first 24 hours and measured TAPSE, PTD S' and RV FAC. And followed for 30 days to see the MACE in patients. Bivariate test was conducted to assess the correlation between variables. To determine which independent variables were more effective at predicting MACE, a multivariate logistic regression test was then run. The effectiveness of the independent factors in predicting MACE was also assessed using ROC analysis.

**Results:** The total subjects were 88 AMI patients consisting of 39 (44.3%) patients who experienced MACE and 49 (55.6%) patients who didn't. The prognostic values of TAPSE, PTDS' and RV FAC on MACE at 30 days were related by bivariate analysis with P Value 0.001 but only PTD S' showed logistic regression results that were consistent with P Value < 0.001. Based on ROC analysis obtained by PTD S' can predict MACE with AUC = 0.894

**Conclusion:** Echocardiographic measurement PTD S' has a good prognostic value to predict MACE within 30 days in AMI patients.

Tricuspid Annular Plane Systolic Excursion, Right Ventricular Fractional Area Changes, Pulses Tissue Doppler S' Wave, Acute Miocardial Infarction

**How to cite:** Ilhami F, Nasution AN, Andra CA. Prognostic Value of Tricuspid Annular Plane Systolic Excursion (TAPSE), Right Ventricular Fractional Area Changes (RV FAC) and Pulses Tissue Doppler S' Wave (PTD S') at 30 Days after Care of Acute Miocardial Infarction Patients in Haji Adam Malik Hospital Medan. *Journal of Society Medicine*. 2023; 2(5): 176-182. DOI: <https://doi.org/10.47353/jsocmed.v2i5.65>

## INTRODUCTION

Seven of the ten leading causes of death globally in 2019 were non-communicable diseases and the world's biggest killer was ischaemic heart disease, responsible for 16% of the world's total deaths since 2000. The largest increase in deaths due to this disease increased by more than 2 million to 8.9 million deaths in 2019.[1]

Based on the results of Basic Health Research (RISKESDAS) in Indonesia in 2018, the most common cardiovascular disease is coronary heart disease (CHD), which is around 1.5% where the highest incidence is found at the age of 65-74 years (3.6%) followed by the age group above 75 years (3.2%).[2]

Acute Myocardial Infarction (IMA) is a life-threatening heart disease condition that can occur suddenly in patients with coronary artery atherosclerosis.[3] The occurrence of IMA is caused by either partial coronary blood flow disturbance called Acute Myocardial Infarction without ST segment Elevation (IMANEST) or total flow disturbance to the myocardium acutely called Acute Myocardial Infarction with ST segment Elevation (IMAEST). Both can cause irreversible necrosis of the heart muscle.[3]

IMA can cause right ventricular dysfunction problems due to extensive cardiomyocyte damage, resulting in right ventricular infarction or due to inter-ventricular interactions, namely the left ventricle affecting the right ventricle. This can lead to haemodynamic instability.[4]

This haemodynamic instability is what causes major cardiovascular events to often occur in IMAEST patients with right ventricular infarction, including increasing the morbidity of length of stay, mortality, and rehospitalisation in less than 30 days after IMAEST.[4] This condition causes IMA patients, both IMANEST and IMAEST, to be admitted to the Intensive Cardiac Care Unit (ICCU) for monitoring.[5,6]

Echocardiography is a haemodynamic monitoring modality that is routinely performed in the ICCU and emergency room in all IMA patients. Emergency echocardiography may also be indicated in patients with cardiogenic shock and/or haemodynamic instability or suspected complications without delaying angiography. Echocardiography is used routinely to assess resting left ventricular and right ventricular function, detect mechanical complications post AMI, and rule out mechanical LV thrombus.[5] Infarct localisation and assessment of infarct extent can all be obtained by echocardiography. In addition, right ventricular dysfunction is easily assessed using several echocardiographic parameters including Tricuspid Annular Plane Systolic Excursion (TAPSE), Right Ventricular Fractional Area Changes (RV FAC) and Pulsed tissue Doppler S wave (RV S') which these methods have established prognostic value.[7,8]

Considering the high incidence of IMA, as well as the need for prognosis data on each patient, then echocardiographic examination is a non-invasive examination that is quite easy and has been routinely performed, this study aims to find the prognostic value between right ventricular function (TAPSE, PTD S' and RV FAC) with major cardiovascular events.

## **METHOD**

This study is an ambispective observational analytic study with sampling conducted at one time (cross-sectional study), namely by assessing the prognostic between TAPSE, PTD S', and RV FAC with KKVm in IMA patients. This study was conducted at the Hospital. H. Adam Malik Medan from March 2022 to June 2022 by collecting samples looking at the medical records of IMA patients at the Cardiovascular Care Unit (CVCU), the initial sample size was 105 patients, 17 patients were excluded with the information that twelve patients did not have echocardiographic data within 24 hours, one patient had a history of previous infarction, one patient had comorbid Covid19, two patients had previous kidney disorders, and one patient with isolated RV infarction, so that the number of samples that met the inclusion criteria and exclusion criteria of 88 people could be included in the study.

From the total number of samples involved in the study, data collection was carried out from clinical conditions and echocardiography. The inclusion criteria of this study were patients with clinical and examination supporting as IMA (clinical, ECG and cardiac biomarkers), IMA patients who underwent echocardiography procedure within the first 24 hours after admission in the hospital. Patients with incomplete medical record data, and echocardiographic data difficult to assess, patients with congenital heart disease, valvular heart disease, dilated cardiomyopathy, pulmonary hypertension, pulmonary embolism, history of myocardial infarction, permanent pacemaker, history of right ventricular infarction, isolated right ventricular infarction, renal abnormalities, and cor pulmonary were included as exclusion criteria.

The study began with identifying medical records of patients admitted to the CVCU of H. Adam Malik Hospital Medan, adjusted to the inclusion and exclusion criteria used in this study. Baseline data such as mean characteristics of age, gender, patient's diagnosis, then the patient will be performed echocardiographic examination at 24 hours from the initial diagnosis especially right ventricular function (TAPSE, RV S, and

RV FAC), and will be followed in the next 30 days to follow up KKvM (heart failure, arrhythmia, recurrent ischaemic, reinfarction and cardiovascular mortality) in patients.

Statistical data processing and analysis using the SPSS application. Bivariate analysis was performed using Chi-square test for categorical data and T-independent test for numerical data. Multivariate analyses were performed on bivariate variables that had p values <0.25 and were theoretically important. The accuracy of the independent variables in predicting the incidence of the dependent variable was analysed using ROC curves resulting in cut off points, sensitivity and specificity of the independent variables.

## RESULT

### Characteristics of the study

This study was conducted at the Hospital. Haji Adam Malik Medan from March 2022 to June 2022 by collecting samples looking at the medical records of IMA patients at the Cardiovascular Care Unit (CVCU), the initial sample size was 105 patients, 17 patients were excluded with the information that twelve patients did not have echocardiographic data within 24 hours, one patient had a history of previous infarction, one patient had comorbid Covid-19, two patients had previous kidney disorders, and one patient with isolated RV infarction, so that the number of samples that met the inclusion criteria and exclusion criteria of 88 people could be included in the study (Table 1).

From the total number of samples involved in the study, data collection was carried out from clinical conditions and echocardiography.

Table 1. Characteristics of the study

Characteristics	
Type Sex	
Man	67 (76.1%)
Woman	21 (23.9%)
Age ( years )	57.22 ±9.61
Factor Risk	
Hypertension	36 (40.9%)
DM	40 (45.5%)
Smoke	50 (56.8%)
Family History	19 (21%)
Hemodynamic Parameters	
Systolic BP (mmHg)	122 (70 – 187)
Heart Rate	85 (50 – 177)
Echocardiographic Parameters	
LVEF (%)	44 ±11.65
E/A	1.14 ±0.47
E/E'	13.27 ±3.71
TAPSE(mm)	17,9 ±3.66
PTD S'	10.7 ±2.9
FAC RVs	35.4% ±5.54
Incident Major Cardiovascular	39 (44.3%%)
Heart Failure	28 (71.79%)
Shock Cardiogenic	8 (20.51%)
Arrhythmia Malignant	7 (17.9%)
Re Infarction	2 (5.12%)
Stroke / Pulmonary Embolism	2 (5.12%)
Mortality cardiovascular	6 (15.38%)

**Bivariate Analysis of Study Subjects on Major Cardiovascular Events within 30 Days**

Bivariate analysis with T-Independent Test, Mann-Whitney Test, Chi-Square Test, and Fisher's Test was performed to determine whether there was a significant relationship or difference between the characteristics of the study subjects based on major cardiovascular events. There were 39 (44.33%) patients who experienced major cardiovascular events within 30 days after acute myocardial infarction and 49 (55.6%) patients who did not experience major cardiovascular events.

Bivariate analysis revealed statistically significant differences ( $p < 0.05$ ) in several parameters such as TAPSE, PTD S', RV FAC, and EF (Table 2).

Table 2. Bivariate Analysis of Subject Characteristics on Major Cardiovascular Events

Characteristics	KKvM n = 39(44.3%)	Non- KKvM n = 49 (55.6%)	p-value
Type Sex			
Man	31 (79.48%)	36 (73.46%)	0.51 <sup>1</sup>
Woman	8 (20.52%)	13 (26.53%)	
Age ( years )	57.48 ±9.9	56.75 ±9.38	0.375 <sup>3</sup>
Factor Risk			
Hypertension	16 (44.4%)	20 (55.5%)	0.462 <sup>1</sup>
DM	24(60%)	16 (40%)	0.007 <sup>1</sup>
Smoke	25 (50%)	25 (50%)	0.079 <sup>1</sup>
Family History	8 (42.1%)	11 (57.89%)	0.523 <sup>1</sup>
Hemodynamic Parameters			
Systolic BP (mmHg)	120 (70 – 190)	125 (90 – 187)	0.001 <sup>4</sup>
Heart Rate	86 (48 – 177)	85 (50 – 121)	0.014 <sup>4</sup>
Echocardiographic Parameters			
LVEF (%)	37.41 ±10.21	49.4 ±9.92	<0.001 <sup>3</sup>
E/E'	13.3 ±3.6	13.1 ±3.7	0.857 <sup>3</sup>
TAPSE(mm)	15.4 ±3.25	20.1 ±2.4	<0.001 <sup>3</sup>
PTD S'	8.6 ±2.09	12.4 ±2.4	<0.001 <sup>3</sup>
FAC RVs	30.97 ±4.79	39.1 ±2.86	<0.001 <sup>3</sup>

<sup>1</sup>Square; <sup>2</sup>Fisher Exact; <sup>3</sup>T-independent; <sup>4</sup>Mann-Whitney

**Multivariate Analysis of TAPSE, PTD S' and RV FAC and EF with KKvM**

To measure how strong TAPSE, PTD S' and RV FAC can be a prognostic function of KKvM within 30 days after IMA, logistic regression analysis was performed. Variables included in the multivariate test were those with a p value <0.25 in the bivariate test that were theoretically important, so TAPSE, PTD S', RV FAC and EF were included in the analysis. The results obtained were significant results for PTDS' parameters with KKvM (p value < 0.001) OR 75 (95% CI) while TAPSE, RV FAC and EF parameters obtained non-significant results (Table 3).

Table 3. Analysis Multivariate PTD S' Logistic Regression to KKvM

Variable	P-value	r
PTD S'	<0.001	75
EF	0.084	2.87
TAPSE	0.999	0
FAC RVs	0.462	3.03

### ROC Analysis of PTDS' on Major Cardiovascular Events

ROC analysis was performed to assess the accuracy of PTDS' in predicting major cardiovascular events within 30 days after acute myocardial infarction. The area under the curve (AUC) of PTDS' was 0.894. The AUC value of PTDS' is classified as good.

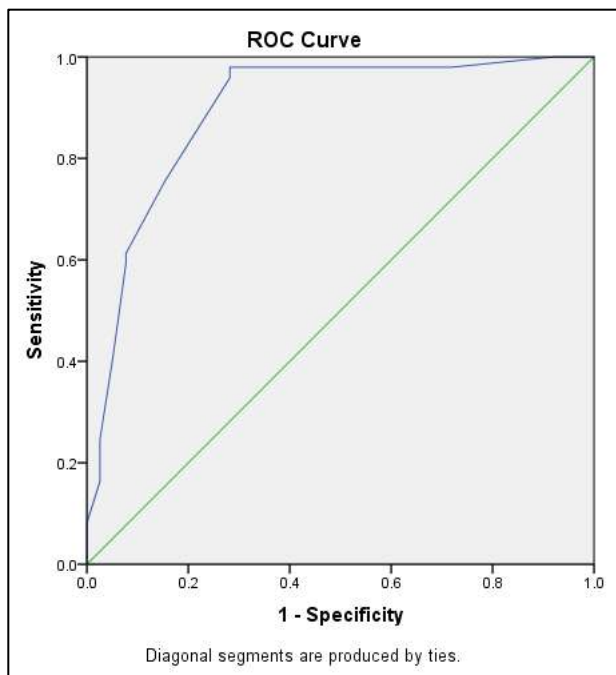


Figure 1. ROC analysis of PTDS' to KKvM in 30 days

The cut off point for PTDS' is 7.75 m/s with a sensitivity of 98% and specificity of 69.2%.

Table 4. Cut off point of PTDS' to KKVM

Parameter	AUC	p-value	cut off	Sensitivity	Specificity
PTDS'	0.894	<0.001	7.75	98%	69.2%

### DISCUSSION

In this study, there was a significant difference between TAPSE and major cardiovascular events. TAPSE parameters measured at the apical four chamber cut and M Mode longitudinal cut were statistically different in the bivariate test between the KKvM group and the Non KKvM group with a p value = <0.001. Similar results were also obtained in the previous study where the TAPSE parameter obtained a statistically significant difference with a p value = <0.001.

Significant difference of PTDS' with major cardiovascular events. The PTDS' parameter measured at the apical four chamber cut and performed Tissue dopler, was statistically different in the bivariate test between the KKvM group and the Non KKvM group with a p value = <0.001. The same thing was found in a previous study conducted by Awad (2020) on PTDS' parameters where the difference obtained was statistically significant with a p value = 0.001.[4]

There was also a significant difference between RV FAC parameters and major cardiovascular events. RV FAC parameters measured at the apical four chamber cut and tracing along the RV during the systolic and diastolic phases, statistically different in the bivariate test between the KKvM group and the Non KKvM group with a p value = <0.001. The same thing was also obtained in the RV FAC parameter in the previous study where the difference obtained was statistically significant with a p value = 0.001.

In this study, there was also a significant difference in EF. EF parameters were performed with the bi plane simpson method of apical four chamber and apical two chamber pieces and then tracing the left ventricle during systolic and diastolic. Statistically, the bivariate test was different between the KKvM group and the Non KKvM group with a p value = 0.001. The same thing was also obtained in a previous study by Awad et al in 2020 where the EF parameter obtained a statistically significant difference with a p value = <0.001.[4]

To determine the strength of the prognostic value of the parameters TAPSE, PTD S' and RV FAC with Major Cardiovascular Events within 30 days, the researchers conducted a multivariate logistic regression test with the results that only the PTD S' parameter remained significant as an independent predictor for the occurrence of KKvM with p value <0.001, OR 75 and IK 95%. This is different from Awad's (2020) study which obtained significant results in all three echocardiographic parameters, namely TAPSE (p value 0.001), RV FAC (p value 0.001), and PTD S' (p value 0.008). This may occur because the number of samples in this study was smaller than the previous study, then the variables included in the multivariate test in this study were only four, namely TAPSE, RV FAC, PTDS' and LV EF, while the previous study added echocardiographic parameters Left Atrial Volume Index (LAVI) and Left Ventricular End Systolic Volume (LV ESV), the comparison variables in the previous multivariate test were more, allowing some predictors to be significant in the multivariate logistic regression test.[4]

To assess the ability of PTD S' in predicting Major Cardiovascular Events, the study conducted ROC analysis. From the results of the ROC analysis, the area under the curve (AUC) for PTD S' was 0.894. The AUC value is classified as very good. Previous research conducted by Awad (2020) obtained the AUC value of PTD S' with the result of 0.783. The ability to predict Major Cardiovascular Events by the PTD S' parameter touches a very good level of relationship so that it can be recommended in predicting the prognosis of Major Cardiovascular Events in Acute Myocardial Infarction patients considering that echocardiographic examination is currently a fairly routine monitoring modality carried out in the first 24 hours after IMA.[4,9]

## **CONCLUSION**

Echocardiographic measurement PTD S' has a good prognostic value to predict MACE within 30 days in AMI patients.

## **DECLARATIONS**

Ethics approval and consent to participate. Permission for this study was obtained from the Ethics Committee of Universitas Sumatera Utara and Haji Adam Malik General Hospital.

## **CONSENT FOR PUBLICATION**

The Authors agree to publication in Journal of Society Medicine.

## **FUNDING**

This research has received no external funding.

## **COMPETING INTERESTS**

None.

## **AUTHORS' CONTRIBUTIONS**

All authors significantly contribute to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting, revising, or critically reviewing the article. Approved the final version to be published, agreed on the journal to be submitted, and agreed to be accountable for all aspects of the work.

## ACKNOWLEDGMENTS

None

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