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Relationship Between P Wave Peak Time in Leads II And V1 with Syntax Scores to Measure Severity of Coronary Lessions on Non-ST Segment Elevation Acute Myocardial Infarction Patients in Adam Malik Hospital Medan

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Abstract:-

Introduction: Non-ST Segment Elevation Acute Myocardial Infarction (NSTEMI) is one of the spectrums of Acute Coronary Syndrome (ACS) with a high mortality rate. Patients with NSTEMI require early risk stratification to define invasive strategy. Electrocardiography (ECG) has been proven useful for detecting cardiac abnormalities due to ACS. One of the ECG parameters used is the P wave peak time. The severity of myocardial ischemia or infarction is determined by the lesion of coronary artery and can be measured based on the SYNTAX score. This study aimed to determine the relationship between the P wave peak time and the SYNTAX score.

Method: This is a cross-sectional study of NSTEMI patients who underwent angiography at the Adam Malik Hospital from July 2020 to June 2021. Measurements of P wave peak time on ECG were made in leads II and V1. The SYNTAX score was calculated based on the results of the angiography. Bivariate analysis was conducted to assess the correlation between the two variables. Then, ROC analysis was performed to assess the wave peak time as a predictor of coronary lesion severity.

Result: Total subjects were 60 NSTEMI patients consist of 37 (61.66%) patients with severe coronary lesions (SYNTAX score < 23) and 23 (38.33%) patients with non-severe coronary lesions (SYNTAX score ≥ 23). There is a moderate positive correlation between the P wave peak time and the SYNTAX score in lead II (r = 0.449; p < 0.001) and in lead V1 (r = 0.405; p = 0.001). Based on ROC analysis, the P wave peak time can predict the severity of coronary lesions with AUC = 0.71 in lead II and AUC = 0.68 in lead V1.

Conclusion: The P wave peak time on the ECG has a correlation with the SYNTAX score and can predict the severity of coronary lesions in NSTEMI patients.

Keywords:- *NSTEMI, P Wave, SYNTAX Score, Coronary Lesion.*

I. INTRODUCTION

Cardiovascular disease is a group of disorders of the heart and blood vessels. According to *the World Health Organization* (WHO), this disease is the leading cause of death worldwide, with more than any other cause each year. It is estimated that around 17.9 million people died from cardiovascular disease in 2016. This number represents 31% of all global deaths. From this percentage, 85% of deaths were caused by heart attacks due to coronary heart disease and stroke (WHO, 2019).

Acute Coronary Syndrome (ACS) which is part of CHD is a major cardiovascular problem because it causes high hospitalization rates and high mortality rates (Irmalita *et al* , 2015, 2018). ACS is a life-threatening condition and can occur suddenly in patients with atherosclerotic coronary artery disease. This syndrome consists of a range of conditions ranging from unstable angina pectoris (APTS) to widespread acute myocardial infarction (AMI), which is *irreversible necrosis of heart muscle* (Rhee *et al* , 2015; Wilder *et al* , 2016) . The occurrence of ACS is caused by an acute disturbance of coronary blood flow, both partial and total, to the myocardium. ACS consists of unstable angina pectoris (APTS), ST segment elevation non-acute myocardial infarction (IMANEST), and ST segment elevation acute myocardial infarction (IMAEST) (Kim *et al* , 2013).

IMANEST which is one part of SKA is different in each n countries. The Euro Heart Survey, a study based in 25 countries, showed an IMANEST incidence of 58% with a mortality during hospitalization of 2.8% (Hasdai *et al* , 2002). Meanwhile, based on the CRUSADE (Can Rapid Risk Stratification of Unstable Angina Patients Suppress ADverse Outcomes with Early Implementation of the ACC/AHA Guidelines) registry, the mortality rate during treatment at IMANEST is 4.2% (Widimsky *et al* , 2007). Even higher mortality rates are shown from the *Global Registry of Acute Coronary Events* (GRACE) study, which is 5% during treatment and increases after 6 months of treatment, reaching 6.2%-7.3% (Fox *et al* , 2002; Widimsky *et al* , 2007). Terkelsen *et al* (2005) showed the 1-year mortality rate in IMANEST patients was 30.5% with a more advanced age

presentation and many comorbidities, such as diabetes mellitus.

Patients with AMI without ST segment elevation (IMANEST) should undergo early risk stratification to identify the need for an early invasive strategy. Electrocardiogram (ECG) has proven useful in stratifying the risk of various heart disorders because it is inexpensive, non-invasive, can be performed quickly and results are also quickly obtained. Electrical activity in the atria , which can be measured by P waves on the ECG, although a well-known method, is re-emerging as a parameter used in ACS patients as the ECG continues to develop at this time (Cagdas *et al* ., 2017).

Changes in P wave duration indicate abnormalities in the timing of both interatrial and intraatrial atrial depolarization. Previous studies have suggested a change in P wave duration in patients with ischemic heart disease but have not shown an association with the severity of coronary artery lesions (Burak *et al* , 2019a). The relationship between coronary heart disease and P wave parameters on the ECG is based on 2 things, including the presence of ischemia or fibrotic tissue in the atria itself which can interfere with conduction activity in the atria, and the presence of impaired systolic or diastolic function caused by ischemia in the ventricles can also have an effect. increased ventricular filling pressures, especially the left ventricle. As a consequence of the increase in left ventricular filling load is an increase in pressure and volume in the atria which has an impact on prolonging the time of atrial depolarization (Alexander, 2017).

Depolarization activity in the atria can be assessed by several parameters such as *P wave dispersion*, *P wave terminal force* and *P wave peak time* . The peak time of the P wave is measured from the start of the P wave to the peak (highest point) of the P wave in leads II and V1 and is calculated by calculating the average of 3 successive P waves. In leads with a biphasic P wave morphology, the peak time is measured from the beginning of the P wave to the lowest point (nadir) on the negative deflection of the wave. The full duration of the P wave is said to be elongated if it is more than 120 ms (Bayam *et al* , 2019).

The SYNTAX score (SYNergy between percutaneous coronary intervention with TAXus and cardiac surgery) is a scoring system that was developed comprehensively to describe the complexity of coronary arteries from angiographic results . The SYNTAX score was created taking into account the number of lesions and their functional consequences, location, and complexity . A higher SYNTAX score indicates a more complex disease and a poorer prognosis. This score helps make a decision whether to perform *Coronary Artery Bypass Surgery* (CABG) or *Percutaneous Coronary Intervention* (PCI) . In patients with low (0-22) and intermediate (23-32) SYNTAX scores, the clinical outcome was nearly the same between PCI and CABG. However, in patients with a SYNTAX score of more than 32, the clinical outcome was better with CABG at 12 months. The SYNTAX score has also been shown to be a predictor of medium-term outcome after PCI in patients with blockage of all 3 coronary arteries and can be used to help select a revascularization strategy in patients with blockage of all three coronary arteries (Sianos et *al* ., 2005; Erdoan et *al* . , 2003). 2020) .

Taking into account the incidence of acute coronary syndromes, especially IMANEST, as well as the need for appropriate decisions in determining the invasive strategy to be carried out, this study aimed to find a relationship between the peak time of the P wave and the severity of coronary lesions as the main mechanism of IMANEST, with consideration of the ECG examination is non-invasive examination which is quite easy and has been routinely performed.

II. RESEARCH METHODS

➢ *Research design*

This study is a descriptive analytic study with a *cross sectional study design*, namely by assessing the relationship (correlation) between the peak time of the P wave and the severity of coronary lesions in IMANEST patients. The peak time of the P wave was calculated in units of time (ms) from the ECG, while the severity of the coronary lesion was assessed by the SYNTAX score after the patient underwent coronary angiography.

➢ *Research Time and Place*

The study was conducted on patients with non-ST-segment elevation acute myocardial infarction (IMANEST) who were treated at Adam Malik Hospital Medan from July 2020 to June 2021.

➢ *Inclusion Criteria*

- Patients with clinical and supportive examinations as IMANEST (clinical, ECG and cardiac biomarkers)
- IMANEST patients who are willing to undergo coronary angiography

➢ *Exclusion Criteria*

- Patients with congenital heart disease
- Patients with valvular heart disease
- Patients with atrial rhythm disturbances (Atrial Fibrillation, Atrial Flutter, Atrial Tachycardia)
- Patients with atrioventricular conduction obstruction
- Patients with kidney disorders
- Patients with incomplete medical record data, and an ECG that is difficult to assess
- IMANEST patients with insignificant angiography

➢ *How it Works and Research Flow*

Before starting the research, the researcher asked for information on *ethical clearance* from the Permanent Committee for Assessing Research Ethics, Faculty of Medicine, University of North Sumatra. Each individual who is included in the research sample must have an *informed consent letter* signed which must be signed by both the participant and the researcher.

All samples of this study were patients diagnosed with IMANEST on guard duty and daily work duties and undergoing treatment at H. Adam Malik Hospital, Medan. Researchers conducted examinations on patients, in the form of ECG, electrocardiography, chest X-ray, and blood laboratories to diagnose disease. All data is recorded completely.

An ECG assessment using the *Bionet Cardiotouch* 3000 tool, a speed of 25 mm/s and an amplitude scale of 10 mV/mm was performed when entering the Emergency Room (IGD). The peak time of the P wave from the electrocardiogram is measured in leads II and V1 in ms, and will be further validated by a consultant cardiologist . Angiography was performed in the catheterization laboratory of H. Adam Malik Hospital, Medan. Calculation of the SYNTAX score as a measure of the severity of coronary artery lesions will be assessed using the SYNTAX score using the application at http://www.syntaxscore.com/calculator/start.htm . For the purposes of data processing, the results of the calculation of the SYNTAX score will be grouped into 2 groups, namely the group with the SYNTAX score < 23 and the SYNTAX score 23.

Laboratory examinations are carried out when the patient enters the ER through the Hospital Clinical Pathology laboratory. Haji Adam Malik Medan. Blood samples for diagnosis were taken when the patient was admitted to the hospital, except for tests for lipid profile and fasting blood sugar, which were taken after the patient had fasted for about 8 hours. The results of the examination are recorded. Optimal and standardized medical therapy is provided to all patients during treatment. The selection of reperfusion measures is carried out according to the clinical assessment of the respective doctors in charge.

➢ *Processing and analysis of data*

Statistical data processing and analysis using the SPSS application. Bivariate analysis using *Chi-square test* and bivariate for numerical data with *independent T-test*. The variable is considered significant if the p value < 0.05. Multivariate test of categorical independent variables with categorical dependent variable tested by logistic regression. The level of accuracy of the independent variable in predicting the occurrence of the dependent variable was analyzed using the *Receiving Operator Curve* (ROC) curve so as to produce the *cut off point* , sensitivity and specificity of the independent variable.

III. RESEARCH RESULT

➢ *Research Characteristics*

This research was conducted at the Department of Cardiology and Vascular Medicine, RS. H. Adam Malik from July 2020 to June 2021 by collecting samples from looking at the medical records of IMANEST patients during treatment at the Cardiac Special Emergency Service Unit (UPK2J), Cardiovascular Intensive Care (CVCU), and inpatient treatment (RIC). The number of samples was 60 people who met the inclusion criteria and exclusion criteria so that they could be included in the study.

From the total number of samples included in the study, data were collected from the clinical condition of the patient at the time of admission, the results of laboratory examinations, and electrocardiography and coronary angiography examinations.

➢ *Characteristics of Research Subjects*

The number of subjects in this study were 60 people, consisting of 47 men (78.3%) and 13 women (21.7%) with an average age of 55.78 ±8.73 years. Data that are normally distributed are presented in the form of a mean with a standard deviation while data that are not normally distributed are presented in the form of a median with minimum and maximum values.

Based on the risk factors possessed by the research subjects, the risk factor for diabetes mellitus was the most risk factor, namely 47 people (78.3%), followed by a history of smoking 43 people (71.7%) and the last is a history of hypertension 31 people (51.7%). Based on the hemodynamic parameters of the study subjects, the median systolic blood pressure was 130 (90 - 200) mmHg and the median diastolic blood pressure was 80 (60 - 110) mmHg.

The electrocardiographic parameters showed the mean time of the peak of the P wave in lead II was 62.78 ±6.28 ms while the average time of the peak of the P wave in lead VI was 58.62 ±6.06 ms. For echocardiographic parameters, the mean left ventricular ejection fraction was 46.92 ±9.76% and the left atrial volume index average was 35.75 ±10.71 ml/m ^{2} . From the results of angiography, 50 (83.3%) subjects with multiple coronary lesions and the remaining 10 (16.7%) subjects with single coronary lesions, with a mean SYNTAX score of 24.46 ±10.49.

Table 4.1. Basic Characteristics of Research Subjects

Characteristics	
Gender	
Man	47 (78.3%)
Woman	13 (21.7%)
Age (years)	55.78 ±8.73
Risk factor	
History of Hypertension	31 (51.7%)
DM history	47 (78.3%)
Smoking History	43 (71.7%)
Hemodynamic Parameters	
Systolic BP (mmHg)	130 (90 - 200)
Diastolic BP (mmHg)	80 (60 - 110)
Laboratory Parameters	
Hemoglobin (g/dL)	13.3 (9.6 - 17.7)
Leukocytes (/ µL)	10,880 (4,670 – 20,310)
Trombosit (10^3/µL)	245.5 (157 – 563)
Ureum (mg/dL)	30 (11 – 90)
Creatinin (mg/dL)	1 (0.54 – 4.04)
Glucose (mg/dL)	119.5 (69 – 517)
Troponin I (ng/mL)	1.71 (0.05 – 26.2)
CKMB (U/L)	51.5 (11 – 480)
Cholesterol Total (mg/dL)	188.88 ± 40.67
Trigliserida (mg/dL)	148 (73 – 347)

HDL (mg/dL)	35 (20 – 57)
LDL (mg/dL)	133.77 ± 39.31
Score GRACE	106.90 ± 24.44
Parameter Electrocardiography	
PWPT lead II (ms)	62.78 ± 6.28
PWPT lead V1 (ms)	58.62 ± 6.06
Parameter Electrocardiography	
LVEF (%)	46.92 ± 9.76
LAVi (ml/m^2)	35.75 ± 10.71
Parameter Angiography	
Single Vessel	10 (16.7%)
Multi Vessels	50 (83.3%)
SYNTAX Score	24.46 ±10.49

The results of the measurement of the peak time of the P wave on the ECG and the SYNTAX score from the angiography are numerical data, so to minimize bias during the measurement, 2 measurements were made by experienced observers (Cardiologist or Interventional Cardiologist). Furthermore, the assessment of intraobserver reliability is carried out using *the test-retest correlation coefficient* . By ensuring a good value of intraobserver reliability, it is hoped that bias on the part of the researcher will be minimal. Bias on the part of the instrument is beyond the control of the researcher.

Table 4.2. *Test-retest Correlation* on Intraobserver Reliability Test

Variable	*p value*	Correlation Coefficient (r)	N
PWPT lead II	<0.001	0.92	60
PWPT lead V1	<0.001	0.90	60
SYNTAX Score	<0.001	0.98	60

The results of *the test-retest correlation coefficient* , both the peak time of P waves in leads II and V1 on the ECG and the SYNTAX score on angiography performed with the Pearson correlation test, show *p-value* < 0.05 and correlation coefficient (r) > 0.7 so that the measurement results are *reliable* .

- *Bivariate Analysis of Research Subjects on Severity of Coronary Lesions*

Bivariate analysis with *T-Independent* Test, *Mann-Whitney* Test, *Chi-Square* Test, and *Fisher's Test* This study was conducted to determine whether there was a significant relationship or difference between the characteristics of the study subjects based on the severity of coronary lesions. A SYNTAX score of ≥23 was classified as *Severe CAD* in 37 (61.66%) people and a SYNTAX score <23 was grouped as *Non-Severe CAD* in 23 (38.33%) people.

From the bivariate analysis, it was found that there were statistically significant differences in characteristics (p < 0.05) in several parameters, namely history of diabetes mellitus, peak time of the P wave in lead II and lead V1, left ventricular ejection fraction, left atrial volume index, number of coronary lesions and SYNTAX score.

Table 4. 3 . Bivariate Analysis of Research Subject Characteristics on Coronary Lesion Severity

Characteristics	***Severe CAD* n = 37 (61.66%)**	***Non-Severe CAD* n = 23 (38.33%)**	***p value***
Gender			
Man	30 (63.8%)	17 (36.2%)	0.535 [2]
Woman	7 (53.8%)	6 (46.2%)	
Age (years)	56.54 ±9.40	54.57 ±7.56	0.375 [3]
Risk factor			
Hypertension	21 (67.7%)	10 (32.3%)	0.462 [1]
DM	33 (70.2%)	14 (29.8%)	**0.021** [2]
Smoke	30 (69.8%)	13 (30.2%)	0.079 [1]
hemodynamics			
Systolic BP (mmHg)	130 (90 – 190)	130 (100 – 200)	0.878 [4]
Diastolic BP (mmHg)	80 (60 – 110)	70 (60 – 110)	0.554 [4]
Laboratory			
Hemoglobin (g/dL)	13.3 (9.9 – 15.4)	13.8 (9.6 – 17.7)	0.994 [4]
Leukocytes (/ µL)	8,990 (4,670 – 20,310)	11,580 (5,740 – 16,340)	0.199 [4]
Platelets (10 ^{3} / µL)	245 (157 – 432)	274 (198 – 563)	0.632 [4]
Urea (mg/dL)	33 (13 – 86)	26 (11 – 90)	0.446[4]
Creatinin (mg/dL)	1 (0.64 – 4.04)	0.89 (0.54 – 2.24)	0.915[4]
Glucose (mg/dL)	123 (69 – 332)	115 (69 – 517)	0.298[4]
Troponin I (ng/mL)	2.3 (0.2 – 17.6)	1.5 (0.05 – 26.20)	0.054[4]
CKMB (U/L)	58 (11 – 480)	47 (14 – 134)	0.361[4]
Cholesterol Total (mg/dL)	189 ± 46.72	188.7 ± 29.41	0.978[3]
Triglycerides (mg/dL)	139 (73 – 305)	154 (92 – 347)	0.119 [4]
HDL (mg/dL)	35 (20 – 54)	35 (25 – 57)	0.659 [4]
LDL (mg/dL)	132 ±41.86	135 ±35.61	0.727 [3]
GRACE Score	109.51 ±25.52	102.70 ±22.49	0.284 [3]
Electrocardiography			

PWPT lead II (ms)	64.54 ±6.00	59.96 ±5.764	**0.005**[3]
PWPT lead V1 (ms)	60.14 ± 5.77	56.17 ± 5.82	**0.013**[3]
Electrocardiography			
LVEF (%)	43.62 ± 9.46	52.22 ± 7.78	**0.001**[3]
LAVi (ml/m^2)	40.18 ± 9.92	28.61 ± 7.78	**<0.001**[3]
Angiography			
Single Vessel	1 (10%)	9 (90%)	**<0.001**[1]
Multi Vessels	36 (72%)	14 (28%)	
SYNTAX Score	30.92 ±7.07	14.06 ±5.52	**<0.001**[3]

[1] Chi-Square [2] Fisher Exact [3] T-independent
[4] Mann-Whitney

➢ *Correlation Analysis of P Wave Peak Time in Leads II and V1 with SYNTAX Score*

To determine the correlation of the peak time of P waves in leads II and V1 with echocardiographic parameters (left ventricular ejection fraction and left atrial volume index) and angiography (SYNTAX score) *Pearson correlation analysis was performed* with normally distributed data. The results obtained are significant results with a positive correlation between the peak time of the P wave in lead II with a SYNTAX score (r = 0.449; *p value* < 0.001) and the peak time of the P wave in lead V1 with a SYNTAX score (r = 0.405; *p value* = 0.001), with a moderate correlation strength . Similar results were obtained between the peak time of the P wave in leads II and V1 with the left ventricular ejection fraction and left atrial volume index. Where for the left ventricular ejection fraction, a negative correlation was obtained with a weak correlation strength for lead II (r = -0.366; *p value* = 0.004) and very weak for lead V1 (r = -0.289; *p value* = 0.025). For the left atrial volume index, a positive correlation was obtained with a strong correlation strength both in lead II (r = 0.680; *p value* < 0.001) and in lead V1 (r = 0.673; *p value* < 0.001).

Table 4.4. Correlation Analysis of P Wave Peak Time in Leads II and V1 with Echocardiographic Parameters and Coronary Lesion Severity

Variable	Correlation Test	LVEF	LAVi	SYNTAX Score
PWPT lead II	p value	0.004	<0.001	<0.001
	r	-0.366	0.680	0.449
PWPT lead V1	p value	0.025	<0.001	0.001
	r	-0.289	0.673	0.405

Subsequently, a linear regression analysis was performed between the peak times of the P waves in leads II and V1 with the SYNTAX score to obtain the similarities between the two parameters, both for leads II and V1.

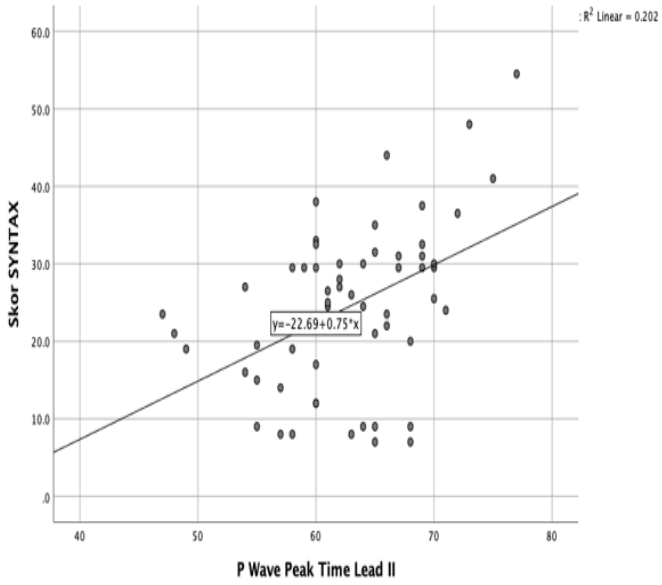

Fig 4.1. Linear Graph between the Peak Time of P-Wave in Lead II and the SYNTAX Skor Score

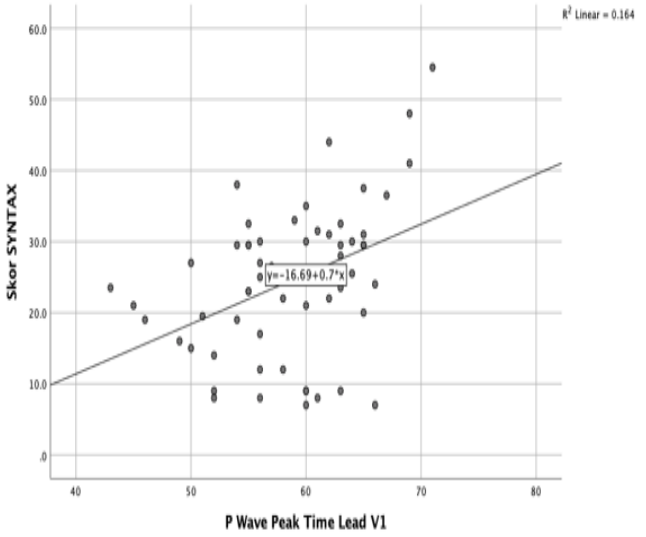

Fig 4.2. Linear Graph between the Peak Time of P-Wave in Lead V1 and the SYNTAX . Score

The result of the equation obtained for lead II is the SYNTAX score = 0.75*PWPT lead II – 22.69 and for lead V1 is the SYNTAX score = 0.7*PWPT lead V1 – 16.69.

➢ *ROC Analysis of P Wave Peak Time in Leads II and V1 on Coronary Lesion Severity*

ROC analysis was performed to assess the accuracy of the timing of the P wave peaks in both lead II and in lead V1 in predicting the severity of coronary lesions. The severity of coronary lesions was classified as severe *CAD* (SYNTAX score ≥23) and *non-severe CAD* (SYNTAX score < 23). The results obtained that *the area under the curve (AUC)* from lead II is 71.6% and lead V1 is 68.6%. The *AUC value* in lead II is moderate while the *AUC value* in lead V1 is still weak.

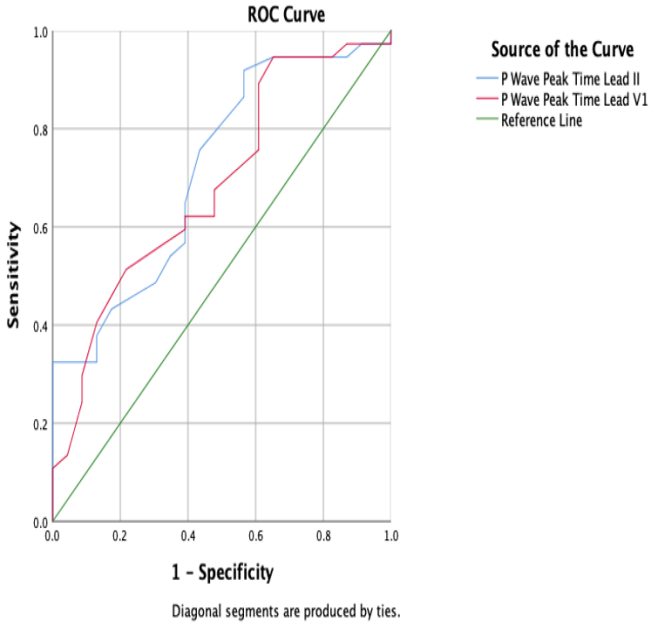

Fig 4.3. ROC Analysis of P Wave Peak Time in Leads II and V1 on Coronary

➢ *Lesion Severity*

cut *off* time for the peak of the P wave in lead II is 61.5 ms with a sensitivity of 64.9% and a specificity of 60.9%. The cutoff time for the peak of the P wave in lead V1 is 58.5 ms with a sensitivity of 62.2% and a specificity of 60.9%.

Table 4.5. Cut-*off* Time of P-Wave Peaks in Leads II and V1 on Coronary Lesion Severity

Parameter	AUC	p value	Cut off	Sensitivity	Specificity
PWPT lead II	71.6 %	0.005	61.5	64.9%	60.9%
PWPT lead V1	68.6 %	0.016	58.5	62.2%	60.9%

IV. DISCUSSION

This study is a cross-sectional study of patients with IMANEST at the Haji Adam Malik Central General Hospital conducted from July 2020 to June 2021. This study aimed to assess the relationship or correlation between the peak time of the P wave and the severity or severity of coronary lesions. The severity of coronary lesions was measured based on a long-standing score, namely the SYNTAX score (*The Synergy between PCI with Taxus and Cardiac Surgery*), so that the relationship obtained was in the form of a correlation.

Patients with non-ST-segment elevation acute myocardial infarction (IMANEST) should be risk stratified immediately to identify the need for an early invasive strategy. Electrocardiogram (ECG) has proven useful in stratifying the risk of various heart disorders because it is inexpensive, non-invasive, can be performed quickly and results are also quickly obtained. Electrical activity in the atria , which can be measured by means of P waves on the ECG, can be investigated as a parameter used to predict the severity or severity of coronary lesions in IMANEST patients (Cagdas *et al* , 2017).

The GRACE score (*Global Registry for Acute Coronary Events*) obtained in this study showed a higher mean in the group with *severe CAD* (109.51 ±25.52) when compared to the *non-severe CAD group* (102.70).± 22.49). However, the differences obtained were not statistically different (p = 0.248). A significant difference was stated by Rahmaini, *et al* (2019) where the mean GRACE score in the group with a SYNTAX score of ≥23 was higher than the group with a SYNTAX score of < 23 (p = 0.001). This discrepancy may be due to population differences with previous studies, where the previous study involved patients with both IMANEST and APTS, while the population in this study was only patients with IMANEST.

In this study, there was a significant difference between the peak time of the P wave and the severity of coronary lesions. The peak time of the P wave was measured in the limb leads, namely lead II and the precordial leads, namely lead V1. The peak time of the P wave in lead II was statistically different between the SYNTAX score < 23 group and the SYNTAX ≥23 score group with p = 0.005. The same thing was also found in lead V1 where the difference obtained was quite statistically significant with p value = 0.013. Based on a study conducted by Burak (2019), the peak time of the P wave in both lead II and lead V1 had a significant difference between the two groups with differences in the severity of coronary lesions where the peak time of the P wave became larger or longer along with the severity of the lesions in the vessels. coronary blood. The same thing was also obtained by a study conducted by Bayam *et al* (2019) with a p value = 0.003. The mechanism underlying the prolongation of the peak P wave time in the group with more severe coronary lesions was related to the presence of fibrotic scars due to ischemia in the atria and due to impaired systolic and diastolic function in the ventricles that increased ventricular filling pressures.

To determine the relationship between the peak time of P waves in leads II and V1 with the severity of coronary lesions using the SYNTAX score, the researchers conducted a correlation test and the correlation coefficients obtained were r = 0.449 for lead II and r = 0.405 for lead V1. This correlation value is a positive correlation, meaning that the higher the peak time value of the P wave, the higher the SYNTAX score, and this correlation value is classified as a correlation with moderate strength (0.4 ≤r < 0.6). Research from Burak *et al* (2019) found a correlation value of r = 0.412 in lead II and r = 0.252 in lead V1. The correlation value in lead V2 is lower than in lead II but still shows a significant relationship.

The relationship between the peak time of the P wave was also tested with echocardiographic parameters, namely left ventricular ejection fraction and left atrial volume index. The results obtained in this study for the relationship between the peak time of the P wave and the left ventricular ejection fraction were p = 0.004 and r = -0.366 in lead II and p = 0.025

and r = -0.289 in lead V1. Meanwhile, the relationship between the peak time of the P wave and the left atrial volume index is p < 0.001 and r = 0.680 in lead II and p < 0.001 and r = 0.673 in lead V1. Another study conducted by Burak *et al* (2018) also obtained significant results between the peak time of the P wave and an increase in filling pressure in the left ventricle with a p value of < 0.001. Chang (2019) stated that the peak time of the P wave which describes the electrical conductivity in the atria is influenced by the pressure in the atria, where the increase in pressure in the atria due to increased pressure in the ventricles will prolong the conduction time in the atria.

To assess the ability of the P wave peak time to predict the severity of coronary lesions, the study performed an ROC analysis. From the results of the ROC analysis, *the area under the curve* for lead II is 71.6% and for lead V1 is 68.6%. The AUC value is classified as weak to moderate. Previous research conducted by Burak (2019) found that the AUC value in lead II was 70.8% and 61.7% in lead V1. Research from Bayam *et al* (2019) found that the AUC value for the mean peak time of P waves in leads II and V1 was 66.3%. Cagdas *et al* (2017) also conducted a study to assess the peak time of the P wave in predicting the incidence of *no-reflow* in the acute coronary syndrome population undergoing primary IKP, and obtained an AUC of 77.8%. A recent study conducted by Alasga *et al* (2021) tried to assess the relationship between the peak time of the P wave and the severity of coronary lesions in a population with diabetes mellitus with acute coronary syndromes, which resulted in AUC in lead II of 74% and in lead V1 of 66%. From several studies that have been carried out, it was found that the peak time of the P wave can predict the severity of coronary lesions, but the AUC results obtained show that lead II is better at predicting the severity of coronary lesions than lead V1. However, the ability to predict the severity of coronary lesions by both leads has not yet reached the level of a strong relationship. However, the peak time of the P wave in both leads II and V1 can be considered in predicting the severity of coronary lesions, considering that electrocardiography is a diagnostic modality that is quite simple, affordable, and easy to perform.

V. CONCLUSION

- The mean peak time of the P wave of IMANEST patients in this study in lead II was 62.78 ±6.28 ms and in lead V1 was 58.62 ±6.06 ms .
- The mean SYNTAX score of IMANEST patients in this study was 24.46 ±10.49
- There is a relationship between the peak time of the P wave and the severity or severity of coronary lesions based on the SYNTAX score both in lead II (p < 0.001) and in lead V1 (p = 0.001) with a positive direction of correlation and moderate strength of correlation (0.4 ≤r < 0.6)
- The peak time of the P wave can predict the severity of coronary lesions based on the SYNTAX score moderately in lead II (AUC = 71.6%) and weakly in lead V1 (AUC = 68.6%)

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