The Relationship between Red Blood Cell Distribution Width and Coronary Artery Lesion Severity In Acute Myocardial Infarction Patients with Non-Elevation of ST-Segment (IMA-NEST) at Haji Adam Malik Hospital

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ARTICLE INFO	ABSTRACT
	Introduction: Red cell distribution width (RDW), a measure of erythrocyte size variability, is associated with acute inflammation. Elevated RDW predicts adverse outcomes in cardiovascular diseases like acute myocardial infarction. This study investigated the relationship between RDW and coronary lesion severity, assessed by the SYNTAX Score, in patients with non-ST-elevation acute coronary syndrome (NSTE-ACS) undergoing coronary angiography. **Methods**: This retrospective analytical study included NSTE-ACS patients who underwent coronary angiography at H. Adam Malik General Hospital Medan. Baseline characteristics, laboratory parameters (including RDW), and angiography results were collected. The association between RDW and SYNTAX Score was analyzed. ROC/AUC curve analysis assessed RDW's predictive ability for coronary lesion severity, determining sensitivity and specificity. **Results**: In 160 patients, RDW was significantly associated with SYNTAX Score ($p<0.001$). TIMI score, GRACE score, and number of involved arteries also correlated with lesion severity. **Conclusion**: RDW is a promising predictor of coronary lesion severity in NSTE-ACS patients undergoing coronary angiography.
Keywords	Red cell distribution width, Acute coronary syndrome, Coronary lesion severity, SYNTAX Score, NSTE-ACS.

INTRODUCTION

Atherosclerosis that causes plaque, stenosis and obstruction is known as coronary artery disease (CAD), which is one of the common causes of morbidity and mortality globally. Approximately 17.9 million people die from cerebrovascular disease, accounting for 32% of total global mortality and 85% of these are caused by ischaemic coronary heart disease and stroke.[1,2] There were 151 cases of SCA at Dradjat Prawiranegara Hospital, Serang analysed during 2014. The number of patients with unstable angina was 27 people, IMA-NEST was 29 people, and IMA-EST was 95 people (63%).[3] Similarly, in North Sumatra, the diagnosis of coronary heart disease (CHD) was estimated at 0.5% (44,9698) in 2013.[4]

Diagnosis of cardiovascular disease (CVD) currently relies mainly on clinical assessment, imaging manifestations, and some biochemical parameters, but indices that can be used routinely in the clinic are relatively limited.[5] The gold standard for the diagnosis and selection of CAD therapy methods is invasive conventional coronary angiography, which outlines the severity and complexity of CAD.[6] The ideal diagnostic marker should be highly specific and sensitive, rapidly available, inexpensive, and non-invasive.

Clinicians have endeavoured for many years to find such biomarkers to aid early preventive identification, intervention, and therapy to prevent cardiovascular adverse events.[5,6]

One candidate is the red blood cell distribution width (RDW), which is obtained from a standardised complete blood count (CBC). RDW is a numerical value of the size of circulating erythrocytes.[7] RDW is a simple measure of red blood cell size heterogeneity, which is calculated by dividing the standard deviation (SD) of erythrocyte volume by the mean corpuscular volume (MCV) (i.e., RDW = SD/MCV x 100). Although the result can be expressed as an absolute value (i.e., RDW-SD) or as a percentage (i.e., RDW-%), percentages are more widely used in routine laboratory practice. There is no universal reference range that can be used for RDW measurement, as RDW values are generally instrument-dependent and the range of physiological values can vary between a minimum of 11% and a maximum of 15%.[8]

RDW assessment is quick, easy, inexpensive, requires no specialised skills or instrumentation, therefore, its assessment can be performed in almost any clinical laboratory performing routine or urgent testing.[8] In addition, RDW has been found to be a novel prognostic biomarker in patients with coronary artery disease (CAD).[6] Numerous studies have reported that elevated RDW levels are significantly associated with poor prognosis in heart failure, stable coronary heart disease (CAD), old myocardial infarction and acute coronary syndrome (ACS).[1,7] RDW is an easily available effective marker to assess the severity of coronary artery disease and helps in risk stratification of CAD patients for further complications.[1]

METHODS

This study is a retrospective observational analytical study with a cross sectional design to assess the relationship between the width of red blood cell distribution and the severity of coronary artery lesions in patients with acute myocardial infarction with ST Segment Non-Elevation (IMA-NEST).

Sampling was conducted at Haji Adam Malik Hospital Medan from December 2023 to June 2024. Inclusion criteria in this study were patients with acute myocardial infarction with Non-Elevation of ST Segment (IMA-NEST) who sought treatment at the Hajj Adam Malik Hospital Medan, patients had complete clinical data and supporting examinations in medical records and were willing to be research subjects by signing informed consent. Patients with no history of coronary artery disease, cardiogenic shock and heart failure.

Patients with renal disease (or serum creatinine levels >1.5 mg/dl), patients with anaemia, patients with clinical evidence of active infection, active cancer, haematological proliferative disease, patients with active or chronic inflammation or autoimmune disease, patients with pregnancy, patients with a recent history of blood transfusion, and patients with severe arrhythmia were included in the exclusion criteria.

Before the study began, the researcher requested ethical clearance from the Standing Committee for Research Ethics Assessment of the Faculty of Medicine, University of North Sumatra. Each individual who was included in the research sample made an informed consent letter signed by the participant and the researcher. All samples of this study were patients with acute myocardial infarction with Non-Elevation of ST Segment (IMA-NEST) treated at the Hajj Adam Malik Hospital Medan who met the inclusion and exclusion criteria. Diagnosis of acute myocardial infarction with Non-Elevation of ST Segment (IMA-NEST) was made based on ESC and PERKI guidelines. Sample collection used the quota method (consecutive sampling) where each subject who met the inclusion criteria was sampled until the total number of samples was at least 40 samples.

The study subjects were all patients with acute myocardial infarction with ST-segment non-elevation (IMA-NEST) and signed the informed consent. Baseline data, subject identity (age, gender), electrocardiogram/ECG examination (non ST segment elevation), and angiographic examination (coronary artery lesions) were fully documented. SYNTAX score was then calculated. Then all the data obtained will be subjected to data processing, analysis, and hypothesis testing, which has been determined using SPSS ver 19.

Bivariate analysis used the chi square test if the data were normally distributed, or the Fisher exact test if the data were not normally distributed. For samples that proved significant in the bivariate analysis test, they

were entered into the multivariate test with logistic regression. Statistical data analysis using computer statistical tools, p value <0.05 was said to be statistically significant. To determine the cut off value of red blood cell distribution width (RDW) on cardiovascular event rate and severity of coronary artery lesions, ROC (Receiver operating curve) analysis was performed which will be presented in the form of a curve, AUC (Area Under Curve) value, cut off point value, sensitivity, specificity, positive predictive value and negative predictive value.

RESULTS

Table 1. Characteristics Subject Study.

Characteristics	N (%)
Type Sex	
• Man	120 (75)
• Woman	40 (25)
Age (Median (Min-max) (years)	61 (36 – 81)
weight (Median (Min-max) (kg)	67.5 (45 - 103)
Height (Median (Min-max) (cm)	163.5 (116 – 180)
BMI (Median (Min-max) (kg/m ^{2})	25.39 (16.53 – 44.44)
Hemoglobin (Mean ± SD) (gr/dL)	38.49 ± 2.184
Hematocrit (Median (Min-max))	39.9 (4.03 – 55.9)
Leukocytes (Median (Min-max) (x 10^3 µL)	10.23 (2.64 – 32.21)
Platelets (Median (Min-max) (x 10^3 µL)	244.5 (8.59 – 552)
RDW (Median (Min-max) (%)	13.2 (10 – 19.1)
Sodium (Median (Min-max) (mEq /L)	144 (3.2 – 158)
Potassium (Median (Min-max) (mEq /L)	4.1 (2.72 – 14.4)
Chloride (Median (Min-max) (mEq /L)	105 (9 – 116)
SYNTAX (Median (Min-max)	24.25 (2 – 59.5)
TIMI (Median (Min-max))	3 (1-7)
GRACE (Mean ± SD)	108.07 ± 28.22
CRUSADE (Median (Min – max)	37 (6 – 134)
Smoker	
• Yes	105 (65.5)
• No	55 (34.4)
Dyslipidemia	
• Yes	41 (25.6)
• No	119 (74.4)
Hypertension	
• Yes	109 (68.1)
• No	51 (31.9)
DM	
• Yes	70 (43.8)
• No	90 (56.3)
Arteries involved	
• *Left main artery*	56 (35)
• *Left anterior descending artery*	146 (91.3)
• *Left circumflex artery*	126 (78.8)
• *Right coronary artery*	139 (86.9)
Death	
• Yes	17 (10.6)
• No	143 (89.4)

Noted: *Chi Square Test, ** Anova Test

From the table above, it can be seen that TIMI score, GRACE, RDW, and involved arteries have a significant relationship with the severity of coronary artery lesions in patients with Acute Myocardial Infarction with Non-Elevation of ST Segment (IMA-NEST) (Table 1).

Table 2. Connection between wide distribution cell blood red with level severity lesion arteries coronary disease in patients infarction myocardium I with Non- ST Segment Elevation (IMA-NEST).

SYNTAX Score	RDW		N (%)	P value
	≤ 14 %	> 14%		
≤ 22	62	8	70	
> 22	45	45	90	< 0.001*
Total	107	53	160	

Noted: * *Chi Square Test*

In this study, there was a significant relationship between the width of red blood cell distribution and the severity of coronary artery lesions in acute myocardial infarction patients with Non-Elevation ST Segment with a p value of <0.001 (Table 2)

Table 3. Predictors of Severity Level Lesion Arteries Coronary in Patients Infarction Myocardium I with Non- ST Segment Elevation .

Characteristics	OR	p value *
THYME	1,170	0.401
GRACE	1,003	0.733
RDW	7,750	0,000

Noted: *logistic regression test

In table 3. shows that RDW, left circumflex artery, and right coronary artery affect the severity of coronary artery lesions in patients with acute myocardial infarction with non-ST segment elevation (IMA-NEST) (p value <0.005).

DISCUSSION

In this study, there is a significant relationship between the distribution width of red blood cells and the severity of coronary artery lesions in acute myocardial infarction patients with Non-Elevation of ST Segment. From the results of the logistic regression test that the Red Blood Cell Distribution Width has a Sig value of 0.000, it is concluded that RDW affects the severity of Coronary artery lesions in patients with acute myocardial infarction with Non-Elevation Segment ST (IMA-NEST).

Hamza et al in 2021 showing that there is a positive association between high levels of red blood cell distribution width and the severity of coronary artery disease in patients. The study also showed that high RDW levels correlated with high SYNTAX scores.6 This study is in line with Sahin et al. who found that the RDW level of patients was significantly higher in the high SYNTAX group (15.2±1.8 vs. 14.2±1.2, p<0.001). There was a significant and positive correlation between RDW level and SX score (r=0.460, p<0.001).[7] This is in line with Azab et al that RDW is an independent predictor of long-term mortality from all causes in NSTEMI patients.[8]

Research conducted by Ahmed et al in 2020 that a total of 130 patients were enrolled in their study. Patients were divided into high (n=89) and low (n=41) SYNTAX groups. The high SYNTAX group was defined as patients with scores in the third tertile (SYNTAX score, SX score ≥ 33) while the low SNTAX score group was defined as patients with scores in the lower 2 tertiles (SYNTAX score, SX score < 33). The high RDW group was defined as patients with RDW values >16% and the low RDW group as patients with RDW values <16%. Analyses showed that the mean RDW score correlated with the mean SYNTAX score in both groups. The RDW level was significantly higher in patients with high SYNTAX score compared to patients with low SYNTAX score (16.2±1.8 vs 14.2±1.2, p<0.001). There was a significant positive correlation between the mean RDW score and the mean SYNTAX score (r=0.831, p<0.001). This reflects the utility of RDW as a non-invasive and readily available laboratory test to determine the severity and complexity of coronary disease in NSTEMI patients.

In this study, an AUC of 0.82% was obtained with a p value (<0.001) indicating that the width of the red blood cell distribution can well predict the severity of coronary artery lesions in patients with acute

myocardial infarction with non-elevation of the ST segment (IMA-NEST) with a cut off of 13.35, sensitivity of 68.9%, specificity of 84.3%, PPV 50% and NPV 88.6%. This is in line with Sahin et al obtaining ROC curves of RDW level on admission used to predict high SYNTAX scores. RDW level >14.25% measured on admission had a sensitivity of 66% and specificity of 64% in predicting high SYNTAX score. Independent predictors of all-cause mortality in the study population were demonstrated by Cox regression analysis. SYNTAX score (hazard ratio, HR 1.04, 95% CI 1.00-1.08, p=0.019), age (HR 1.04, 95% CI 1.01-1.06, p=0.003) and LVEF (HR 0.95, 95% CI 0.92-0.98, p<0.001) were independent predictors of all-cause mortality in patients with NSTEMI. They showed a positive association between high RDW levels and severity of coronary artery disease in patients with NSTEMI. They also showed that a high RDW level on admission correlated with a high SYNTAX score.[7-12]

DECLARATIONS
None

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