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Relationship between Atherogenic Index of Plasma (AIP) and Mayor Cardiovascular Event (MACE) in Patients with Acute Myocardial Infarction (IMA) with Percutaneous Coronary Intervention (PCI) in Haji Adam Malik Hospital

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ABSTRACT

Introduction: Atherogenic index of plasma (AIP) is a new biochemical parameter closely related to lipid metabolism in the body as a risk factor in atherosclerosis and coronary heart disease. This study aimed to determine whether AIP values could be used to predict major cardiovascular events (MACE) in the treatment period of ACS patients undergoing primary percutaneous coronary intervention processes.

Methods: This study was an observational analytical study with retrospective data collection method. Patients who experienced ACS at RSUP Haji Adam Malik Medan and undergo IKP starting from April 2023 will be collected. Basic characteristic data including laboratory parameters and AIP values as well as MACE events were be collected. Data analysis were carried out whether there are differences in AIP values in MACE and Non-MACE patients, and predictive ability will be assessed through ROC/AUC curve analysis, and sensitivity and specificity values will also be obtained.

Results: A total of 69 samples were obtained. A total of 25 patients (36.2%) experienced MACE. The most prevalent MACE in this study was death from all causes as many as 17 patients (24.6%). AIP value can be used as a predictor of MACE events: Death of All Causes (Cut Off value: 0.505; AUC: 0.673; P = 0.033; 95% CI 0.537 – 0.809; Sensitivity 64.7%; Specificity 59.6%), Acute Heart Failure (Cut Off value: 0.502; AUC: 0.695; P = 0.029; 95% CI 0.551 – 0.839; Sensitivity 69.2%; Specificity 60.7%), and Malignant Arrhythmia (Cut Off value: 0.582; AUC: 0.758; P = 0.026; 95% CI 0.578 – 0.938; Sensitivity 71.4%; Specificity 75.8%).

Conclusion: The AIP index can be a good predictor of the incidence of MACE in ACS patients undergoing primary percutaneous coronary intervention.

Keywords

Plasma atherogenic index, Acute coronary syndrome, Primary percutaneous coronary intervention.

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INTRODUCTION

Various indices have been used for the diagnosis and prognosis of cardiovascular disease of which the atherogenic index of plasma (AIP), developed from the logarithmic ratio of triglycerides (TG) to high-density lipoprotein-cholesterol (HDL-C) in molar concentration, is reported as a sensitive marker of lipoprotein profile.[1] Atherogenic lipids are a major risk factor for coronary artery disease. Atherogenic lipids promote the ability of plasma lipids to mediate atherosclerotic plaque formation in coronary arteries.[2]

Elevated AIP is a strong independent predictor of all-cause mortality and cardiovascular disease after coronary revascularisation.[3] Based on the significant positive association between AIP and cholesterol levels, this index was shown to be an alternative and simple marker of plasma atherogenicity. AIP values were

found to be higher in IMA-EST patients who underwent pIKP and died in hospital. The predictive value of AIP was also evaluated in patients with SCA. Cai G et al. showed that AIP was independently associated with the presence and severity of SCA where AIP values were found to increase according to the prevalence of SCA, acute myocardial infarction, unstable angina pectoris, and Gensini score also increased. Qin Z et al. found that AIP was an independent predictor of major cardiovascular and cerebrovascular adverse events, including cardiac death, myocardial infarction, repeat revascularisation and stroke, regardless of clinical presentation.[4]

Coronary artery disease (CAD) is the leading cause of death in the world, with individual prognosis depending on various factors, such as diabetes or the presence of metabolic syndrome.[5] Dyslipidaemia is one of the known risk factors for cardiovascular disease, which is a major cause of morbidity and mortality worldwide. Previous studies revealed that AIP is associated with the risk of several cardiovascular diseases, such as the incidence of ischaemic heart disease, atherosclerosis, coronary artery disease, acute ischaemic stroke, etc.[6] Based on the significant positive association between AIP and cholesterol levels, this index was shown to be an alternative and simple marker of plasma atherogenicity. AIP values were found to be higher in IMA-EST patients who underwent pIKP and died in hospital.[4]

METHODS

This study is an observational analytic study with a retrospective design to assess the relationship between Atherogenic Index of Plasma (AIP) and Major Cardiovascular Adverse event (MACE) in patients undergoing Percutaneous Coronary Intervention (PCI) at Haji Adam Malik Hospital Medan.

Inclusion criteria in this study were patients with a diagnosis of acute myocardial infarction who underwent Percutaneous Coronary Intervention (CCI) and were treated at H Adam Malik Hospital Medan, had complete clinical data and supporting examinations in medical records, and were willing to become research subjects by signing informed consent. Patients with a diagnosis of acute myocardial infarction who were not examined according to research needs, patients with a history of statin therapy, fibrates and other drugs for dyslipidemia management, patients with a history of stroke, patients with a history of IMA-EST/IMA-NEST, and patients with congenital heart defects were included in the exclusion criteria of this study. 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 as a research sample made an informed consent letter signed by the participant and the researcher.

Subjects who became research samples were all patients with a diagnosis of acute myocardial infarction at the Cardiac Centre of Haji Adam Malik Hospital Medan who then received therapy where before the action had been carried out informed consent to patients who met the inclusion criteria. Subject identity data (age, gender, body mass index (BMI), history of hypertension, history of diabetes, history of smoking) and laboratory examination (lipid profile: TC, TG, LDL, HDL). Then the Atherogenic Index of Plasma (AIP) value was calculated. For patients admitted before the study time, the clinical course during treatment and MVC were seen through medical record data. For patients admitted within the study time, observations were made during treatment and accompanied by MACE that occurred for 30 days. Then all the data obtained will be subjected to data processing, analysis, and hypothesis testing, which have been determined using SPSS ver 19.

RESULTS

There are several parameters that are closely related to the incidence of MACE in this study sample. A total of 18 patients (72%) had MACE and had a history of hypertension, 17 patients (38.6%) did not have MACE and had a history of hypertension, 7 patients (28%) had MACE and had a history of hypertension, and 27 patients (61.4%) did not have MACE and did not have a history of hypertension, which was found to be statistically significant (P = 0.016). A total of 10 patients (40%) had MACE and a history of type 2 DM, 8 patients (18.2%) did not have MACE and a history of type 2 DM, 15 patients (60%) had MACE and a history of type 2 DM, and 36 patients (81.8%) did not have MACE and no history of type 2 DM, which was found to be statistically significant (P = 0.047).

Table 1. Data Characteristics of Research Subjects Categorical Data

Characteristic Data	n (69)
Type Sex	
Man	56 (81.2%)
Woman	13 (18.8%)
Syndrome Coroner I	
STEMI	64 (92.7%)
NSTE-ACS	5 (7.3%)
General MACE	
Yes	25 (36.2%)
No	44 (63.8%)
Death All Because	
Yes	17 (24.6%)
No	52 (75.4%)
Fail Heart I	
Yes	13 (18.8%)
No	56 (81.2%)
Shock Cardiogenic	
Yes	9 (13%)
No	60 (87%)
Malina arrhythmia	
Yes	8 (11.6%)
No	61 (88.4%)
Myocardium Infarction Repeated	
Yes	7 (10.1%)
No	62 (89.9%)
Hypertension	
Yes	34 (49.3%)
No	35 (50.7%)
Dyslipidemia	
Yes	63 (91.3%)
No	6 (8.7%)
DM type 2	
Yes	51 (73.9%)
No	18 (21.1%)
Smoke	
Yes	20 (29%)
No	49 (71%)
Menopause	
Yes	63 (91.3%)
No	6 (8.7%)
Catheterization	
CAD1VD	29 (42%)
CAD2VD	15 (21.7%)
CAD3VD	23 (33.3%)
LM disease	5 (7.2%)
CTO	4 (5.8%)
ISR	1 (1.4%)
Non-Significant Lesion	2 (2.9%)

The median age of patients was higher in patients with MVC 61 (44 - 80) while those without MVC 53 (29 - 73), which was statistically significant (P = 0.013). The median TIMI Risk score was higher in patients with MVC 6 (1 - 10) while those without MVC 3 (1 - 7), which was statistically significant (P = 0.0001). The median value of Plasma Atherogenicity Index was higher in patients who had MACE 0.55 (0.12 - 1.32) while those who did not have MACE 0.45 (0.06 - 0.88), which was statistically significant (P = 0.022). The median GRACE score of patients was higher in patients with MVC 127 (83 - 159) while those without MVC 99 (65 - 124), which was statistically significant (P = 0.0001). The median Killip score was higher in patients with MVC 2 (1 - 4) while those without MVC 1 (1 - 2), which was statistically significant (P = 0.0001). The median CRUSADE score of patients was higher in patients with MVC 38 (7 - 59) while those without MVC 25 (1 -

58), which was statistically significant (P = 0.007). The median heart rate was higher among patients with MVC 89 (43 - 127) while those without MVC 78.75 (33 - 118), which was statistically significant (P = 0.005) (Table 2).

Table 2 Subject Data Characteristics Numerical Data Research

Characteristic Data	n (69)
Index Plasma Aterogeneity	0.4975 ± 0.24
GRACE	107.51 ± 22.17
Killip	1 (1 - 4)
CRUSADE	29.09 ± 14.1
BB	68.52 ± 9.73
TB	166 (148 – 175)
Onset of Pain	17 (1 - 120)
Systolic Blood Pressure	130 (80 - 200)
Diastolic Blood Pressure	80 (50 - 129)
Heart Rate	84.01 ± 20.83
Respiratory Rate	20 (18 – 30)
Hemoglobin	13.71 (7 – 19)
Hematocrit	40.69 ± 6.35
Leukocytes	12979.57 (6620 – 26250)
Platelets	262436.32 ± 72537.62
Urea	1.12 (0 – 4)
Creatinine	1.02 (0.4 – 3.63)
Sodium	141 (121 – 154)
Potassium	4.1 ± 0.61
Chloride	104 (90 – 112)
GDP	125 (66 – 424)
GD2PP	146 (86 - 439)
HBA1C	6.2 (4 - 16)
Total cholesterol	177.41 ± 47.52
HDL	38 (21 – 56)
LDL	122.82 ± 45.47
TG	117 (52 – 789)
Troponin I	15 (0.01 – 15)

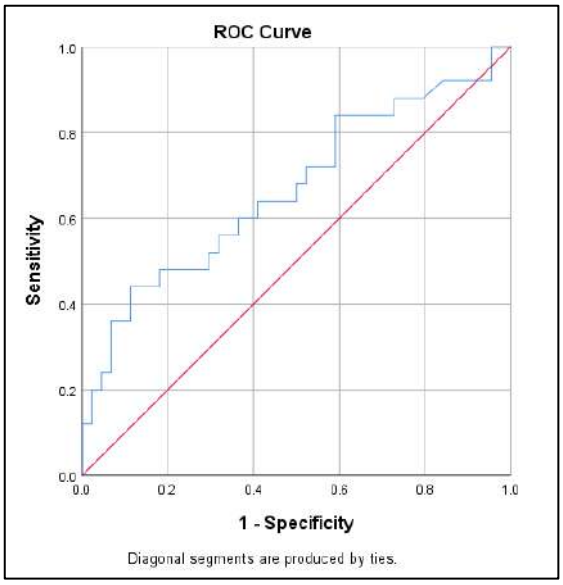

Figure 1. ROC Curve of Plasma Atherogeneity in Common Major Cardiovascular Events (MMEs)

Table 3 Characteristics Subject Study Based on MACE

Characteristic Data	MACE		P value
	Yes	No	
Type Sex			
Man	18 (72%)	38 (86.4%)	0.201**
Woman	7 (28%)	6 (13.6%)	
Hypertension			
Yes	18 (72%)	17 (38.6%)	0.016*
No	7 (28%)	27 (61.4%)	
Dyslipidemia			
Yes	2 (8%)	4 (9.1%)	1,000**
No	23 (92%)	40 (90.9%)	
DM type 2			
Yes	10 (40%)	8 (18.2%)	0.047*
No	15 (60%)	36 (81.8%)	
Smoke			
Yes	18 (72%)	31 (70.5%)	1,000*
No	7 (28%)	13 (29.5%)	
Menopause			
Yes	20 (80%)	43 (97.7%)	0.021*
No	5 (20%)	1 (2.3%)	
Catheterization			
CAD1VD	7 (28%)	23 (52.3%)	
CAD2VD	6 (24%)	8 (18.2%)	0.217**
CAD3VD	7 (28%)	6 (13.6%)	
LM disease	2 (8%)	4 (9.1%)	
CTO	2 (8%)	1 (2.3%)	
ISR	1 (4%)	0 (0%)	
Non-Significant Lesion	0 (0%)	2 (4.5%)	
Age	61 (44 – 80)	53 (29 – 73)	0.013***
Thyme Risk	6 (1 – 10)	3 (1 – 7)	0.0001***
Index Plasma Aterogeneity	0.55 (0.12 – 1.32)	0.45 (0.06 – 0.88)	0.022***
GRACE	127 (83 – 159)	99 (65 – 124)	0.0001***
Killip	2 (1 – 4)	1 (1 – 2)	0.0001***
CRUSADE	38 (7 – 59)	25 (1 – 58)	0.007***
BB	65 (50 – 93)	69 (43 – 89)	0.351***
TB	168 (150 – 175)	165 (148 – 175)	0.522***
Onset of Pain	12 (1 – 96)	18.5 (1 – 120)	0.144***
Systolic Blood Pressure	129 (93 – 200)	130 (80 – 190)	0.461***
Diastolic Blood Pressure	81 (60 – 129)	80 (50 – 101)	0.314***
Heart Rate	89 (43 – 127)	78.75 (33 – 118)	0.005***
Respiratory Rate	20 (18 – 30)	20 (18 – 22)	0.0001***
Hemoglobin	13.4 (9 – 19)	14.1 (7 – 18)	0.168***
Hematocrit	39.94 ± 6.35	41.12 ± 6.39	0.463****
Leukocytes	12590 (6620 – 25010)	11945 (6620 – 26250)	0.708***
Platelets	264000 (133000 – 415000)	252500 (165000 – 556000)	0.871***
Urea	41 (13 – 103)	30 (14 – 76)	0.014***
Creatinine	1.03 (0.57 – 3.63)	1.01 (0.4 – 2.00)	0.553***
Sodium	138 (130 – 149)	141.5 (121 – 154)	0.326***
Potassium	3.8 (3 – 5)	4.1 (3 – 6)	0.015***
Chloride	104 (94 – 107)	104 (90 – 112)	0.659***
GDP	131 (68 – 424)	118.5 (66 – 238)	0.221***
GD2PP	153 (97 – 439)	139.5 (86 – 312)	0.251***
HBA1C	6.7 (5 – 13)	6.2 (4 – 16)	0.271***
Total cholesterol	180 (100 – 315)	177.5 (68 – 249)	0.574***
HDL	38 (21 – 56)	38 (24 – 56)	0.055***
LDL	125 (41 – 286)	120 (3 – 204)	0.817***
TG	138 (55 – 789)	107 (52 – 266)	0.046***
Troponin I	15 (0.01 – 15)	15 (0.01 – 15)	0.658***

Table 4 Analysis Deep Plasma Aterogeneity ROC/AUC Curve Incident Major Cardiovascular (MACE)

MACE parameters	AUC value	P value	95%CI	Cut-Off Value	Sensitivity	Specificity
MACE General	0.667	0.022	0.527 – 0.805	0.505	60%	63.6%

The median value of the patient's breathing rate was higher in patients who experienced MVC 20 (18 - 30) while those who did not experience MVC 20 (18 - 22) was statistically significant (P = 0.0001). The median breath rate was higher in patients with MVC 20 (18 - 30) and those without MVC 20 (18 - 22), which is statistically significant (P = 0.0001). The median ureum value of patients was higher in patients with MVC 41 (13 - 103) while those without MVC 30 (14 - 76), which was statistically significant (P = 0.014). The median potassium value was higher in patients with MVC 3.8 (3 - 5) while those without MVC 4.1 (3 - 6), which was statistically significant (P = 0.015). The median triglyceride value of patients was higher in patients who experienced MACE 138 (55 - 789) while those who did not experience MACE 107 (52 - 266), which is statistically significant (P = 0.046). The complete data is presented in Table 3.

DISCUSSION

In this study, several risk factors were found to be associated with major cardiovascular events in patients with acute coronary syndrome undergoing percutaneous coronary intervention. Hypertension is a factor that is strongly associated with MVC events. Previous studies have shown similar results. A retrospective cohort study investigated the incidence and risk factors of major cardiovascular events (MACE) after 1 year of first documented myocardial infarction (MI) in a multi-ethnic Asian population. Secondary MACE was observed in 231 (14.3%) individuals, including 92 (5.7%) cardiovascular-related deaths. A history of hypertension and diabetes was associated with secondary MACE after adjustment for age, gender, and ethnicity (HR 1.60 [95% CI 1.22-2.12] and 1.46 [95% CI 1.09-1.97], respectively).[7] One registry-based cohort study enrolled consecutive STEMI patients between 2016 and 2019 at Imam-Ali Hospital, Kermanshah, Iran. All patients discharged from inpatient STEMI were followed up for 1 year for MACE, which consisted of all-cause mortality, nonfatal MI, and nonfatal stroke. The study showed that a history of hypertension was higher in MACE, and was a predictor of mortality in the crude model (HR 2.08; 95% CI 1.51 - 2.88 P = <0.001).

In this study, it was also found that diabetes is a risk factor that is closely related to MACE. Previous studies showed that diabetes increased the propensity for major cardiovascular events (MACE) in both groups; age and gender were both independent predictors of MACE in older patients, in STEMI patients aged ⩽ 45 years and those aged > 45 years (OR: 6.4, 95% CI: 1.219-33.593, p= 0.045; OR: 1.802, 95% CI: 1.087-2.985, p = 0.029).[8]

In the current study, there was also a significant association between menopausal conditions and the incidence of MVC. There is no previous study that proves the same, but a previous study mentioned that out of 1875 consecutive postmenopausal patients who underwent coronary angiography (CAG) and were angiographically diagnosed with CAD from January 2011 to December 2013, patients with early menopause had higher SYNTAX scores and multi-vascular disease. Ordinal logistic regression analysis showed that age, hypertension, diabetes, and early menopause exerted independent influence on SYNTAX score. In patients undergoing oophorectomy, early menopause was strongly associated with SYNTAX score.

In the current study, it was also found that triglyceride values were closely associated with MVC events. One study showed elevated Triglyceride levels > 175 mg/dL had a lower unadjusted risk of 1-year major cardiovascular events (MACE) - a composite of myocardial infarction, stroke, and death - compared to low TG levels (8.8% vs 11%, p = 0.05). 0,034).

However, after adjusting for certain clinical factors and lipid profile, elevated TG levels were not associated with lower 1-year MACE (aHR: 1.10 (0.71-1.70), p=0.7).[9] Another study evaluated Triglycerides (TG) and related metabolic indices as predictors for cardiovascular events among patients with acute coronary syndrome (ACS). The risk of MACE increased with higher TG and four TG-derived metabolic indices [TG-

adjusted hazard ratio (HR) = 1.002, 95% CI: 1.001-1.003; TyG index-adjusted HR = 1.736, 95% CI: 1.398-2.156; atherogenic index plasma-adjusted HR = 2.513, 95% CI: 1.562-4.043; TG to high-density lipoprotein cholesterol ratio-adjusted HR = 1.148, 95% CI: 1.048-1.258; and lipoprotein combined index-adjusted HR = 1.009, 95% CI: 1.004-1.014; $P < 0.001$ for all indices]. TG and all four indices significantly improved the predictive ability for MACE in addition to the base model. Among them, the TyG index showed the best ability to predict MACE compared with the other three indices from all three measures ($P < 0.05$ for all comparisons).

CONCLUSION

Plasma atherogenicity index (AIP) values were closely associated and had good predictive value with the incidence of MVC in general in acute coronary syndrome patients undergoing primary percutaneous coronary intervention (AUC value: 0.667; P value = 0.022; Cut off value: 0.505; sensitivity 60%; specificity 63.6%).

DECLARATIONS

This study have been approved by The Health Research Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara and a research permit from Haji Adam Malik Hospital Medan.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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COMPETING INTERESTS

None of the authors present a conflict of interest

AUTHORS' CONTRIBUTIONS

All authors significantly contribute to the work reported, whether in acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting and revising. 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.

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REFERENCES

1. Fu L, Zhou Y, Sun J, Zhu Z, Xing Z, Zhou S, et al. Atherogenic index of plasma is associated with major adverse cardiovascular events in patients with type 2 diabetes mellitus. Cardiovasc Diabetol. 2021; 20: 201.
2. Hartopo AB, Arso IA, Setianto BY. Low Plasma Atherogenic Index Associated with Poor Prognosis in Hospitalized Patients with Acute Myocardial Infarction. Acta Medica Indonesiana - The Indonesian Journal of Internal Medicine. 2016 ; 48(2): 106-114.
3. Qin Z, Zhou K, Li Y, Cheng W, Wang Z, Wang J, Gao F, et al. The atherogenic index of plasma plays an important role in predicting the prognosis of type 2 diabetic subjects undergoing percutaneous coronary intervention: results from an observational cohort study in China. Cardiovasc Diabetol. 2020; 19:23.
4. Kasapkara HA, Erdoğan M. Association between atherogenic index of plasma and in-hospital mortality in patients with STEMI undergoing primary percutaneous coronary intervention. J Health Sci Med. 2023; 6(1): 158-164.
5. Zheng Y, Li C, Yang J, Serry S, Qi Y, Wang W, et al. Atherogenic index of plasma for non-diabetic, coronary artery disease patients after percutaneous coronary intervention: a prospective study of the long-term outcomes in China. Cardiovascular Diabetology. 2022; 21:29

6. Hang F, Chen J, Wang Z, Zheng K, Wu Y. Association between the atherogenic index of plasma and major adverse cardiovascular events among non-diabetic hypertensive older adults. Lipids in Health and Disease. 2022; 21:62
7. Ismail SR, Mohammad MSF, Butterworth AS. Risk Factors of Secondary Cardiovascular Events in a Multi-Ethnic Asian Population with Acute Myocardial Infarction: A Retrospective Cohort Study from Malaysia. J Cardiovasc Dev Dis. 2023; 10 (6): 250.
8. Liang MT, Pang Y, Gao LL, Han LJ, Yao HC. Clinical risk factors and outcomes of young patients with acute ST segment elevation myocardial infarction: a retrospective study. BMC Cardiovasc Disord. 2023; 23(1): 353.
9. Shao QY, Ma XT, Yang ZQ, et al. Prognostic significance of multiple triglycerides-derived metabolic indices in patients with acute coronary syndrome. J Geriatr Cardiol. 2022; 19 (6):456-468.