POLISH HEART JOURNAL

Kardiologia Polska
The Official Peer-reviewed Journal of the Polish Cardiac Society since 1957

Online first
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ISSN 0022–9032 e-ISSN 1897–4279

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Article type: Clinical vignette

Received: March 24, 2024

Accepted: May 23, 2024

Early publication date: May 29, 2024

Multi-inflammatory index as a novel predictor of new-onset atrial fibrillation after off-pump coronary artery bypass grafting

Short title: Multi-inflammatory index for AF after off-pump CABG

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WHAT'S NEW?

Multi-inflammatory index (MII) is a newly developed index group composed of several inflammatory indexes including neutrophil/lymphocyte ratio, platelet/lymphocyte ratio and systemic immune-inflammation index, combinating with C-reactive protein. The prognostic and/or predictive capacity of MII has been recently examined in various patient groups such as cardiovascular diseases, metastatic colorectal cancer, COVID-19, degenerated intervertebral disc and erectile dysfunction. However, to the best of our knowledge, there is no study examining the possible relationship between MII and atrial fibrillation (AF) in the literature. Therefore, in this study, we aimed to examine whether there was a possible predictive

relationship between MIIs and postoperative new-onset AF in patients undergoing off-pump coronary artery bypass grafting, and revealed for the first time in the literature that all MIIs predicted new-onset AF after off-pump coronary artery bypass grafting.

ABSTRACT

Background: To our knowledge, a possible predictive relationship of multi-inflammatory index (MII) with new-onset atrial fibrillation (AF) after off-pump coronary artery bypass grafting (CABG) has not yet been studied in the literature.

Aims: To investigate whether MII is a novel group of hematological markers for predicting postoperative new-onset AF in patients undergoing off-pump CABG.

Methods: A total of 427 patients undergoing isolated off-pump CABG between October 2021 and December 2023 were enrolled to this retrospective observational cohort study, and divided into two groups; as AF group (n = 108) and non-AF group (n = 319). The groups were compared in terms of patients' baseline clinical characteristics, laboratory parameters, operative and postoperative data.

Results: The median values of age, length of hospital stay, platelet, neutrophil, C-reactive protein, systemic immune-inflammation index, MII-1, MII-2 and MII-3 were detected to be significantly greater in AF group compared to non-AF group in univariate analyses. In multiple explanatory variable logistic regression analysis, MII-1, MII-2 and MII-3 were determined to be significant hematological variables, and thereby these indexes were considered as the independent predictors of postoperative new-onset AF. Receiver operating characteristic curve analyses showed that for predicting of postoperative new-onset AF, MII-1 of 22.47 constituted the cut-off value with 62.0% sensitivity and 57.0% specificity, MII-2 of 141.77 constituted the cut-off value with 43.5% sensitivity and 76.8% specificity, and MII-3 of 5669 constituted the cut-off value with 63.8% sensitivity and 58.3% specificity.

Conclusion: The present study demonstrated for the first time in the literature that all MIIs predicted new-onset AF after off-pump CABG.

Key words: atrial fibrillation, coronary artery bypass grafting, multi-inflammatory index, off-pump, predictor

INTRODUCTION

Atrial fibrillation (AF) is one of the most important and widespread complications following coronary artery bypass grafting (CABG) with an incidence of 10% to 40% [1–3]. It has been shown that new-onset AF after CABG is linked to significant morbidity, mortality, prolonged hospital stay and increased health care costs [4, 5]. For decreasing the increased morbidity, mortality, hospital stay and health costs, it is critical for identifying the patients at high risk for postoperative new-onset AF and thus taking the appropriate procedures to prevent it. Therefore, for these goals, readily accessible, reliable and affordable biomarkers that can be used in routine clinical practice are needed.

Even though it is known that a wide variety of etiologic factors such as surgical trauma, extracorporeal circulation, electrolyte imbalance and hypoxia are implicated in the pathogenesis of postoperative atrial fibrillation (POAF), electropathophysiological molecular mechanisms of POAF are less well known. Nonetheless, inflammation is one of the pathophysiological factors known to contribute to the development of AF [6–8]. Many inflammatory indicators such as C-reactive protein (CRP), white blood cell (WBC), and interleukins (ILs), have been thoroughly investigated regarding POAF [9]. Moreover, various inflammatory parameters derived from a simple complete blood count (CBC) analysis such as neutrophil/lymphocyte ratio (NLR) [10, 11], platelet/lymphocyte ratio (PLR) [11], and systemic immune-inflammation index (SII) [12–14] have been recently studied as possible predictive indicators of POAF after CABG.

Multi-inflammatory index (MII) is a novel created index group consisting of a combination of several hematological inflammatory indexes such as NLR, PLR and SII, with CRP. This novel index group, including MII-1, MII-2 and MII-3, was firstly studied in patients with metastatic colorectal cancer, and all MII indexes were found as useful prognostic biomarkers of metastatic colorectal cancer [15]. Afterwards, the prognostic and/or predictive abilities of MII were also studied in many different diseases such as acute coronary syndrome (ACS) [16], acute ischemic stroke (AIS) [17], pulmonary embolism (PE) [18], and critically ill COVID-19 patients [19]. On the other hand, to the best of our knowledge, there is no study investigating the possible relationship between MII and AF in the literature. Therefore, we hypothesized that MII, a novel inflammatory indicator, could be a predictor of new-onset AF following off-pump CABG, and this study was designed to examine whether there was a possible predictive relationship between MII and POAF in patients undergoing off-pump CABG. In addition, other possible predictors and postoperative outcomes of new-onset AF following off-pump CABG were also examined in the study.

METHODS

Ethical considerations

The study protocol was approved by the institutional scientific researches ethics committee. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consents were taken from all patients after giving detailed information about the surgery and postoperative period.

Study population and design

This was a retrospective observational cohort study conducted in patients undergoing isolated off-pump CABG between October 2021 and December 2023. A total of 427 patients with available medical records were included in the study, and were divided into two groups according to the development of postoperative new-onset AF; as AF group (n = 108) and non-AF group (n = 319). Preoperative basic demographic features, comorbidities and laboratory parameters, operative data, and postoperative results and complications of the patients were screened, recorded for the analysis, and then compared between the groups. Therefore, the predictors as well as postoperative outcomes of new-onset AF after off-pump CABG were identified. Exclusion criteria were as follows: A history of previous paroxysmal, persistent or permanent AF, conventional on-pump CABG, emergency surgery, reoperative surgery, and concomitant surgery such as carotid endarterectomy and cardiac valve surgery.

Surgical procedure

All patients were operated through median sternotomy under general anesthesia. Internal thoracic artery, great saphenous vein and radial artery were the most commonly used bypass grafts. Unfractionated heparin at a dose of 200 IU/kg was administered intravenously with targeting for an activated clotting time of more than 300 seconds. During the distal anastomoses, an octopus tissue stabilizer was used to ensure the appropriate position on beating heart, a bulldog clamp accompanied by an air blowing to provide the bloodless area, and an intracoronary shunt to maintain the myocardial perfusion when necessary. During the proximal anastomoses, an aortic side-biting clamp was used to provide the bloodless area and appropriate position on ascending aorta. Distal anastomoses were performed with either 7/0 or 8/0 propylene sutures while proximal anastomoses with either 6/0 or 7/0. “No-touch aorta” procedure was performed in cases with severe calcific or porcelain aorta. Protamine infusion with a rate of 1/1 was administered intravenously to neutralize the effect of unfractionated heparin after the completion of all anastomoses.

Postoperative rhythm monitoring

Continuous electrocardiogram (ECG) monitoring was provided to all patients for the first 48 hours after the surgery. Standard 12-lead ECGs were taken every day for the remaining days till discharge in order to evaluate heart rhythms of patients. Additionally, radial pulse was palpated at least once every four hours in order to evaluate the heart rate and dysrhythmias. In the event of tachycardia, palpitations, or a suspicion of an abnormal heart rhythm, a second 12-lead ECG was taken and examined. The diagnosis of new-onset AF was made with the presence of uneven RR intervals and lack of P waves on the ECG.

Laboratory analysis

After peripheral venous blood samples were collected before the surgical procedure, the samples were put into sterile tubes with a set quantity of anticoagulant and then transported to the laboratory for the analysis. An automatic CBC analysis device (Beckman Coulter Inc., CA, US) was used in order to detect the values of preoperative CBC test parameters. CBC parameters included in the study were as follows: hemoglobin, hematocrit, mean corpuscular volume, red cell distribution width (RDW), WBC, platelet (PLT), neutrophil (NEU), lymphocyte (LYM), mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit, as well as NLR, PLR, and SII. Moreover, MII-1, MII-2, and MII-3 were also included in the analysis with the addition of CRP.

We used the following formulas in the study:

NLR = NEU / LYM; PLR = PLT / LYM; and SII = PLT × NEU / LYM.

MII-1 = NLR × CRP; MII-2 = PLR × CRP; and MII-3 = SII × CRP

Statistical analysis

Shapiro–Wilk test was used to evaluate the normality of variables. Continuous variables were presented as median (min.–max.) values while categorical variables were expressed as number (percentages). Continues variables were analyzed using the Mann–Whitney U test while categorical variables were analyzed using the χ^2 test. Multiple explanatory variable logistic regression analysis was conducted to determine the independent predictors of POAF. Receiver-operating characteristic (ROC) curve analyses were conducted to determine the cut-off values of selected variables with sensitivity and specificity rates, via logistic regression, for POAF from area under curve. ROC curve analysis was performed using “Optimal Cutpoints” library of R software [20]. The R software was used to perform the statistical analyses (R Core Team, 2021) [21]. A *P*-value <0.05 were regarded as statistically significant for all analyses.

RESULTS

This study included 108 patients with POAF (74 males and 34 females) and 319 patients without POAF (231 males and 88 females), and POAF incidence was calculated as 25.3%. Patients with POAF were significantly older than those without POAF, and the median ages were 67 and 63 years for AF group and non-AF group, respectively ($P = 0.003$). No significant differences were detected in terms of the other clinical features and comorbid conditions between the groups (Table 1). As laboratory parameters of the patients were compared between the groups, the median values of PLT, NEU, SII, CRP, MII-1, MII-2 and MII-3 in AF group were detected to be significantly greater than those in non-AF group (Table 2). As intraoperative data, postoperative outcomes and complications of the patients were considered, only the median value of length of hospital stay in AF group was detected to be significantly greater than in non-AF group. There were no significant differences with regards to the other intraoperative and postoperative variables between the both groups (Table 3).

After identifying the significant risk factors in univariate analyses, the multiple explanatory variable logistic regression analysis was conducted to determine the independent predictors of POAF by adjusting for significant variables. According to the multiple explanatory variable logistic regression analysis; age, MII-1, MII-2 and MII-3 were detected to be independent predictors of POAF (Table 4).

ROC curve analyses revealed that for predicting POAF development, age of 64 constituted the cut-off value with 67.6% sensitivity and 53.6% specificity, MII-1 of 22.47 constituted the cut-off value with 62.0% sensitivity and 57.0% specificity, MII-2 of 141.77 constituted the cut-off value with 43.5% sensitivity and 76.8% specificity, and MII-3 of 5669 constituted the cut-off value with 63.8% sensitivity and 58.3% specificity (Table 5). ROC curves of these determined independent predictors of POAF were presented in Figure 1.

DISCUSSION

The present study demonstrated that patients with new-onset POAF were significantly older and had longer length of hospital stay compared to patients without new-onset POAF. Among laboratory parameters, PLT, NEU, SII, CRP, MII-1, MII-2 and MII-3 values in AF group were significantly greater than those in non-AF group, according to the univariate analysis. However, in the multiple explanatory variable logistic regression analysis, PLT, NEU, SII and CRP lost the statistical significance, and only MII-1, MII-2 and MII-3 became significant and thereby were considered as the relevant predictive indices for new-onset POAF. The most interesting

finding of our study was that all these MII indexes independently predicted new-onset POAF following off-pump CABG, for the first time in the literature.

Identifying the predictors of new-onset AF after heart surgery is essential because it makes it possible to create preventative strategies and provide the required early intervention. Even though a large number of different predictors of new-onset POAF have been reported in various studies, advanced age is the most well-known predictor which has been detected in most studies in the literature [1–5]. As previously documented in numerous studies, our study also verified that advanced age was a significant and independent predictor of new-onset POAF.

Studies examining hematological indices derived from the basic blood tests to predict new-onset POAF following heart surgery have raised in last years, and these hematological indices have gained increasing popularity in the relevant subject. Because these tests are low-cost, reliable, fast and easily accessible. In fact, many hematological indices obtained from the CBC analysis, such as PLT, RDW, MPV, WBC, NLR, PLR and SII, have been studied in a large number of different studies, and the predictive values of these indices for new-onset POAF have been demonstrated. However, these different studies have been often revealed inconsistent and inconclusive results due to the fact that there exist several reasons such as methodological differences, heterogeneity of patient selection and potential bias. In a systematic review and meta-analysis study including a total of 6098 patients from 22 studies, the predictive roles of hematological indices for new-onset POAF were investigated after isolated CABG, valve surgery or combined procedures. Preoperative PLT, RDW, MPV, WBC and NLR, as well as postoperative WBC and NLR were reported to be significant hematological indices associated with POAF in the study [22]. In our study, we found that preoperative PLT, NEU, SII and CRP were significant markers in the univariate analysis; however, in the logistic regression model, these mentioned indices did not reach statistical significance and were not considered as significant predictive markers for new-onset AF after off-pump CABG.

Among the hematological indices derived from the CBC test, SII is one of the relatively novel and recently most frequently studied markers that has been shown to have predictive and/or prognostic value in various cardiovascular diseases [23]. SII consists of the combination of three inflammatory peripheral cell counts (platelets, neutrophils and lymphocytes), with a formula (SII = PLT × NLR), and reflects simultaneous inflammatory and immune status of patients. Considering the role of inflammatory and immune mechanisms in the pathogenesis of AF, it was thought that SII might have a predictive value in the development of AF, and studies investigating the relationship between SII and AF were designed based on this hypothesis. In a recent study involving a total of 622 patients diagnosed with ACS, the relationship between SII

and new-onset AF was investigated. Thirty-five (5.6%) of these patients developed new-onset AF during a two-year follow-up period, and consisted of the study group. In the study, SII was detected to significantly increase in the study group compared to the control group, and the multivariate logistic regression analysis revealed that SII was an independent predictor of new-onset AF in patients with ACS [24]. In another study, Bağcı et al. [25] examined whether SII predicted new-onset AF after ST-elevation MI, and revealed the predictive ability of SII for new-onset AF in patients with ST-elevation MI. The authors concluded that SII could be used as an independent predictor of new-onset AF after ST-elevation MI. In addition, the predictive role of SII for new-onset POAF in patients undergoing CABG was also investigated in several recent studies. Yilmaz et al. [12] and Uğuz et al. [13] demonstrated the predictive value of SII for new-onset POAF in on-pump CABG patients while Topal et al. [14] demonstrated this in off-pump CABG patients. Moreover, a systematic review and meta-analysis study evaluating SII for predicting POAF after cardiac surgery has just been published. In this recent paper, a total of 3245 patients from 8 studies were included (6 studies involved CABG, 1 encompassed mitral valve surgery, and another 1 on various cardiac procedures). The study indicated that elevated SII was significantly associated with an increased risk for POAF after cardiac surgery, highlighting its utility as a predictive biomarker [26]. In our study, even though SII was detected as a significant variable in the univariate analysis, in the logistic regression analysis model it could not remain among the significant variables and dropped from the model at the last stage of the analysis. Therefore, even though the odds ratio of SII were very close to 1, we could not accept SII as a significant and independent marker in the prediction of POAF. In fact, if MIIs, which we thought to be stronger indexes (e.g., MII-3 = SII × CRP), had not been included in the logistic regression analysis, SII would probably not have fallen out of the model and would have been detected as a significant and independent predictor of POAF.

MII is a newly developed index group composed of several inflammatory indexes including NLR, PLR and SII, combinating with CRP. MII was firstly described by Casadei Gardini et al. [15], and its prognostic capacity was evaluated on patients with metastatic colorectal cancer undergoing first-line chemotherapy. The authors consequently reported that all MII indexes were useful prognostic markers in this patient population. Afterwards, the prognostic and/or predictive capacity of MII was investigated in different patient groups such as cardiovascular disorders, COVID-19, degenerated intervertebral disc and erectile dysfunction. Gozdas et al. [19] studied the effects of many hematological markers on prognosis in critically ill COVID-19 patients, by comparing the results of laboratory parameters between survivors and non-survivors. In the study, among all inflammatory hematological markers, MII

showed the best performance for the prediction of mortality. Therefore, it was expressed that MII could be useful in the early determination of poor prognosis in COVID-19. In other studies, the diagnostic efficiency of MII was showed in patients with degenerated intervertebral disc [27] and erectile dysfunction [28] as well.

Recently, studies investigating the prognostic and/or predictive role of MII in various cardiovascular diseases such as ACS, AIS and PE have been conducted, and the results of these studies have been published in the current literature. In a recent study conducted by Doğanay et al. [16], the prognostic role of MII for predicting acute stent thrombosis and in-hospital mortality was evaluated on 1488 patients with ACS undergoing percutaneous coronary intervention. The study revealed that MII-3 exhibited better diagnostic performance than other inflammatory indices, and concluded that MII-3 was a strong predictor of acute stent thrombosis after percutaneous coronary intervention and it was related to the subsequent increased risk of mortality. In the study, it was also indicated that MII could be an essential prognostic screening tool to identify high-risk patients before the intervention. Demirel et al. [17] examined the possible relationship between MIIs and the severity of AIS in 452 patients with ischemic stroke who admitted to hospital within 72 hours of the onset of symptoms, by comparing the results of many laboratory parameters including all MIIs (MII-1, MII-2 and MII-3) between survivors and non-survivors. In the study, according to the simple and multiple logistic regression analyses for identifying mortality predictors, all MIIs were detected as significant variables and thereby were considered as novel predictors of in-hospital mortality in AIS. A study conducted by Boyuk [18] investigated the roles of MII-1 and MII-2 in the differential diagnosis of massive and non-massive PE, and revealed that these inflammatory indexes showed a strong ability for distinguishing massive and non-massive PE compared to the previously studied classical inflammatory indexes. In another study, the prognostic and predictive abilities of MII-1 and MII-2 for acute symptomatic seizures in patients with cerebral venous sinus thrombosis (CVST) were searched. In the study, MII-1 and MII-2 were detected to significantly predict the occurrence of seizures in CVST, and it was stated that these indexes could be utilized as novel prognostic and predictive hematological markers of acute symptomatic seizures in patients with CVST [29]. Furthermore, apart from these aforementioned studies related to the prognostic and/or predictive role of MII in various cardiovascular diseases, in an interesting study, the relationship of MII-1 and MII-2 with mortality was investigated in operated patients due to Stanford type A aortic dissection. Many hematological markers including MII-1 and MII-2 were compared between survivor and non-survivor patients, and none of the studied hematological markers were surprisingly found to be related to mortality in type A aortic

dissection [30]. Our study demonstrated that all MIIs including MII-1, MII-2 and MII-3 were detected to be significant variables in the univariate analysis of laboratory parameters, and even in the multiple explanatory variable logistic regression analysis for identifying the independent predictors of POAF. Therefore, we consider that MIIs are useful hematological markers for predicting new-onset AF after off-pump CABG.

The role of different inflammatory biomarkers such as CRP and ILs for the prediction of POAF after cardiac surgery was also extensively investigated. In a systematic review and meta-analysis evaluating the relationship of several inflammatory markers such as CRP and ILs with POAF following cardiac operations including isolated CABG, isolated valve surgery and combine cardiac procedures, the baseline levels of CRP and IL-6, postoperative levels of CRP, IL-6, IL-8 and IL-10 were found to be relevant inflammatory parameters significantly associated with POAF [9]. In our study, CRP was found as a significant variable in the univariate analysis, however it could not remain among the significant variables and dropped from the model in the logistic regression analysis. Therefore, we could not accept CRP as a significant and independent marker in the prediction of POAF. On the other hand, ILs were not studied in our study.

Study limitations

The present study also had some important limitations. The most important limitations of the study were that it was retrospectively designed and data were collected and analyzed from a single center. Another important limitation was that a correlation analysis with other classical inflammatory biomarkers was not conducted in the study. In addition, after the intensive care unit stay, cardiac rhythm monitoring was not conducted continuously in acute inpatient ward. There was a probability of undetected brief and temporary episodes of asymptomatic AF during follows in acute inpatient ward, even though cardiac rhythm was regularly monitored with conventional ECGs at least twice in a day and extra ECGs were taken from the patients when any irregularity in cardiac rhythm was suspected.

CONCLUSIONS

To the best of our knowledge, the present study is the first clinical investigation examining the predictive role of MII for new-onset POAF in patients undergoing off-pump CABG. Our study showed for the first time in the literature that MIIs, a novel hematological index group involving MII-1, MII-2 and MII-3, predicted POAF in patients undergoing off-pump CABG. Therefore, all MIIs could be used as novel and promising markers for predicting new-onset AF after off-

pump CABG. However, further large-scale prospective studies are necessary to support the findings of our study and achieve more valuable scientific information.

Article information

Acknowledgement: The authors would like to thank Professor Dr. Seyit Ali Kayis, from the Department of Bioistatistics, Bolu Abant Izzet Baysal University Faculty of Medicine, Bolu, Turkey, for conducting the statistical analyses.

Conflict of interest: None declared.

Funding: None.

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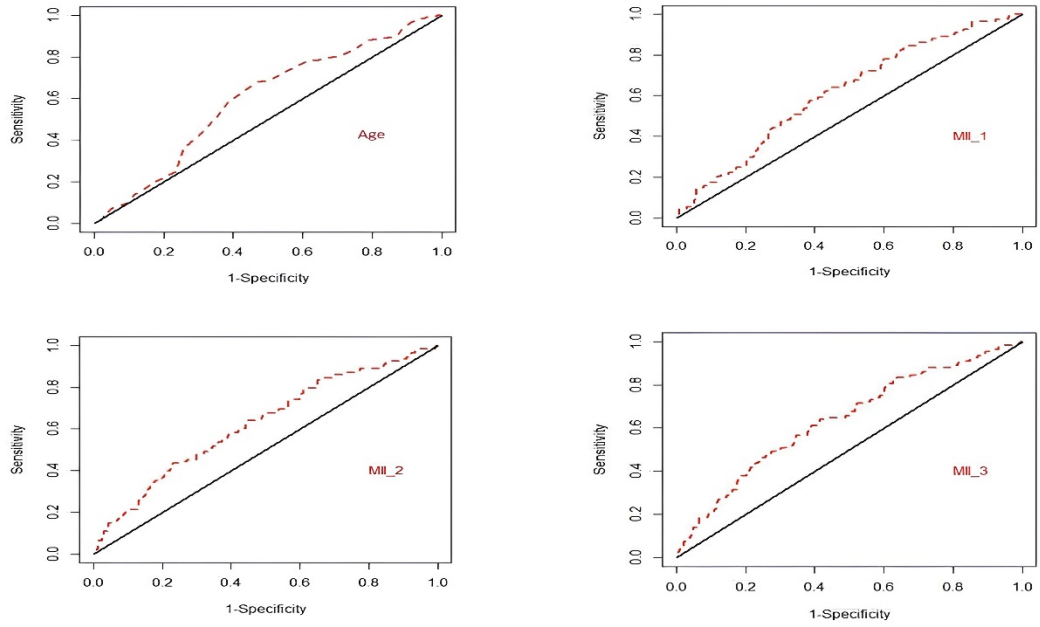

Figure 1. Receiver operating characteristic curves of the determined independent predictors

Table 1. Demographics, clinical characteristics and comorbidities

Variable	Non-AF group (n = 319)	AF group (n = 108)	*P*-value
Age, years	63 (41–84)	67 (47–83)	**0.003**
Sex (female)	88 (27.5%)	34 (31.4%)	0.27
Weight, kg	77 (50–122)	77 (55–122)	0.54
Height, cm	169 (145–190)	168 (145–190)	0.98
BMI, kg/m^2	27.4 (18.5–39.8)	26.9 (18.5–39.4)	0.52
Obesity	78 (24.4%)	20 (18.5%)	0.26
LVEF level	55 (25–70)	55 (30–65)	0.69
Hypertension	212 (66.4%)	63 (58.3%)	0.16
Diabetes mellitus	119 (37.3%)	45 (41.6%)	0.49
Hyperlipidemia	125 (39.1%)	37 (34.2%)	0.42
Myocardial infarction	108 (33.8%)	38 (35.1%)	0.89

COPD	22 (6.9%)	5 (4.6%)	0.54
Peripheral arterial disease	35 (10.9%)	10 (9.2%)	0.75
Chronic renal failure	20 (6.2%)	7 (6.4%)	1.00
Chronic hepatic failure	1 (0.3%)	0 (0.0%)	1.00
Previous PCI	46 (14.4%)	16 (14.8%)	1.00
Previous CVE	22 (6.9%)	8 (7.4%)	1.00
Smoking	118 (37.0%)	29 (26.8%)	0.07

Abbreviations: AF, atrial fibrillation; BMI, body mass index; COPD, chronic obstructive pulmonary disease; CVE, cerebrovascular event; LA, left atrium; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention

Table 2. Laboratory parameters

Variable	**Non-AF group (n = 319)**	**AF group (n = 108)**	***P*-value**
HGB, g/dl	13.0 (8.4–19.0)	13.0 (9.5–18.0)	0.44
HCT, %	39.0 (24.8–55.0)	39.8 (27.2–54.0)	0.53
MCV, fl	87.7 (65.9–103.3)	87.2 (65.9–99.2)	0.85
RDW, %	16 (13.2–30.8)	16 (13.3–23.1)	0.19
WBC, 10^3/µl	9 (2.6–30.5)	9 (4.4–28.6)	0.66
PLT, 10^3/µl	235 (93–719)	254 (103–745)	**0.04**
NEU, %	70.2 (27.8–92.1)	74.5 (37.1–92.0)	**0.01**
LYM, %	17.0 (5.0–54.2)	15.6 (5.3–42.0)	0.51
MPV, fl	8 (3.2–18.3)	8 (5.4–12.5)	0.82
PDW, %	17.5 (15.4–20.9)	17.6 (15.7–20.7)	0.38
PCT, %	0.170 (0.020–0.640)	0.174 (0.060–0.510)	0.19
NLR	3.900 (1.104–15.038)	4.379 (1.415–17.019)	0.09
PLR	14.254 (3.333–67.600)	16.39 (3.25–65.06)	0.06

SII, 10^3/µl	987.6 (196.3–4895.4)	1204.7 (211.5–5120.1)	**0.001**
CRP, mg/l	4.3 (0.4–143.0)	6.55 (0.3–37.2)	**0.004**
MII-1, mg/l	18.47 (0.85–321.03)	28.53 (1.73–231.44)	**<0.001**
MII-2, mg/l	67.52 (2.68–1469.7)	106.0 (3.9–994.6)	**<0.001**
MII-3, g/l	4599 (147–81863)	7646 (254–83748)	**<0.001**

Abbreviations: CRP, C-reactive protein; HCT, hematocrit; HGB, hemoglobin; LYM, lymphocyte; MCV, mean corpuscular volume; MII, multi-inflammatory index; MPV, mean platelet volume; NEU, neutrophil; NLR, neutrophil-to-lymphocyte ratio; PCT, plateletcrit; PDW, platelet distribution width; PLT, platelet; PLR, platelet-to-lymphocyte ratio; RDW, red cell distribution width; SII, systemic immune-inflammation index; WBC, white blood cell; other — see Table 1

Table 3. Operative data and postoperative outcomes

Variable	**Non-AF group (n = 319)**	**AF group (n = 108)**	***P*-value**
LITA usage	302 (94.6%)	102 (94.4%)	1.00
Complete revascularization	300 (94.0%)	100 (92.5%)	0.76
Number of distal bypass	3 (1–6)	4 (1–6)	0.08
Length of ICU stay, hour	24 (14–360)	27 (14–192)	0.55
Length of hospital stay, day	6 (3–27)	7 (5–19)	**0.006**
Inotrope requirement	60 (18.8%)	20 (18.5%)	1.00
IABP requirement	9 (2.8%)	6 (5.5%)	0.30
Low cardiac output syndrome	9 (2.8%)	6 (5.5%)	0.30
Myocardial infarction	12 (3.7%)	4 (3.7%)	1.00
Cerebrovascular event	13 (4.0%)	2 (1.8%)	0.43
Reintubation	14 (4.3%)	4 (3.7%)	0.98
Pneumonia	8 (2.5%)	5 (4.6%)	0.43
Mediastinitis	8 (2.5%)	4 (3.7%)	0.75
Reexploration for bleeding	10 (3.1%)	3 (2.7%)	1.00

AKI requiring hemodialysis	7 (2.1%)	2 (1.8%)	1.00
Gastrointestinal bleeding	2 (0.6%)	0 (0.0%)	0.99
In-hospital mortality	5 (1.5%)	2 (1.8%)	1.00

Abbreviations: AKI, acute kidney injury; IABP, intraaortic balloon pump; ICU, intensive care unit; LITA, left internal thoracic artery; other — see Table 1

Table 4. Results of the multiple explanatory variable logistic regression analysis for predicting the independent risk factors

Variable	**Odds ratio (95% CI)**	***P*-value**
Age, year	1.0405 (1.0133–1.0683)	**0.003**
PLT, 10^3/µl	1.0172 (0.9008–1.1448)	0.78
NEU, %	0.9911 (0.9662–1.0153)	0.47
CRP, mg/l	1.0079 (0.9879–1.0278)	0.40
SII, 10^3/µl	1.0502 (0.9735–1.1305)	0.11
MII-1, mg/l	1.0064 (1.0009–1.0119)	**0.003**
MII-2, mg/l	1.0020 (1.0007–1.0034)	**0.02**
MII-3, g/l	1.0000 (1.0000–1.0000)	**0.002**

Abbreviations: CI, confidence interval; other — see Table 2

Table 5. Results of the ROC curve analysis for the determined independent predictors

	Optimum cut-off value	**AUC (95% CI)**	**Sensitivity (%)**	**Specificity (%)**
Age, year	64	0.595 (0.535–0.655)	67.6	53.6
MII-1, mg/l	22.47	0.614 (0.554–0.674)	62.0	57.0

MII-2, mg/l	141.77	0.624 (0.563–0.686)	43.5	76.8
MII-3, g/l	5669	0.637 (0.576–0.698)	63.8	58.3

Abbreviations: AUC, area under the curve; ROC, receiver-operating characteristic; other — see Tables 2 and 4