DOI: 10.55415/deep-2023-0018.v1

Elevated Monocyte to High-density Lipoprotein Ratio is a Risk Factor for New-onset Atrial Fibrillation post Off-pump Coronary Revascularization Operation

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DOI: 10.55415/deep-2023-0018.v1

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Abstract

Atrial fibrillation (AF) is a common complication of coronary revascularization operation. Currently, the mechanisms of postoperative AF are still unclear. This study aims to investigate the risk factors for new-onset AF (NOAF) post coronary revascularization operation and explore the early warning effect of clinical inflammatory markers. A retrospective analysis was conducted on 293 patients with unstable angina pectoris who underwent coronary artery revascularization operation in Beijing Chao-Yang Hospital, Capital Medical University, from April 2018 to June 2021, including 224 patients who underwent coronary artery bypass grafting and 69 patients who underwent one-step hybrid coronary revascularization. Baseline data, clinical data, blood indicators and AF episodes within 7 days post operation were collected. We divided the subjects into two groups according to whether AF occurred or not, and analyzed the data of two groups. Also, multivariate logistic regression was used to explore the independent risk factors for developing AF post coronary revascularization. In conclusion, aging, increased inferior-superior diameter of left atrial, use of intra-aortic balloon pump, increased blood volumes transfused during perioperative period and increased value of monocyte to high-density lipoprotein ratio on postoperative day 1 were independent risk factors for high-risk occurrence of NOAF after coronary artery operation.

Key Words: Atrial fibrillation, coronary revascularization operation, Neutrophils, High-density lipoprotein

DOI: 10.55415/deep-2023-0018.v1

Significance Statement

In this study, we calculated the monocyte to high-density lipoprotein ratio (MHR) based on the levels of monocyte and high-density lipoprotein (HDL) to investigate the role of MHR in the AF after off-pump GABG, which has not been studied before.

Introduction

Coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), and hybrid coronary revascularization (HCR) are common procedures for coronary revascularization. However, patients after CABG and HCR are prone to atrial fibrillation (AF). The incidence of postoperative atrial fibrillation (POAF) is approximately 20-40%, most often occurring 2-4 days after surgery[1]. HCR is a new procedure for treating multi-branch lesions in coronary artery disease. However, a meta-analysis including seven studies shows that the incidence of AF was not significantly lower after HCR compared to the CABG group[2]. Studies have shown that POAF is associated with poor prognosis and is an independent predictor of complications such as infection, stroke, renal insufficiency, respiratory failure, and cardiac arrest[3]. Therefore, it is important to explore the risk factors for POAF after coronary revascularization operation to identify and intervene the patients at risk of POAF early.

The mechanism of POAF is still unclear currently. Dobrev et al.[4] assumed a model of POAF, which divides the occurrence of POAF into three stages. The first stage is the preoperative atrial substrate with susceptibility to AF, which is formed over several years and is often related to age, diabetes, hypertension, etc. The second stage is atrial substrate changes in the perioperative period, which is often associated with surgery, extracorporeal circulation, and aseptic inflammation. Based on the first stage, the susceptibility to developing atrial

DOI: 10.55415/deep-2023-0018.v1

fibrillation is increasing. The third stage is atrial substrate changes in the postoperative period, which is more evident within five days after surgery and often correlates with multiple triggers such as sympathetic excitation, inflammation, oxidative stress, and surgical pain. The various triggers cause structural and electrophysiological changes in the atria, the susceptibility to AF is further increasing, and it is extremely likely to induce AF. A growing number of studies have shown that inflammation response correlates with the occurrence of POAF. Alexander Weymann et al.[5] find that elevated preoperative and postoperative WBC count levels are a risk factor for POAF, including 22 studies with a total of 6,098 patients who have undergone CABG operation. In a prospective cohort study, Patrick H. Gibson et al.[6] include 275 patients undergoing non-emergency coronary artery bypass grafting and find that elevated neutrophil to lymphocyte ratio (NLR) pre- and postoperatively were associated with an increased incidence of POAF. Clinical composite indicators such as NLR, platelet to lymphocyte ratio, and lymphocyte to monocyte ratio (LMR) are newly identified markers of systemic inflammation, which are considered essential markers for prediction and prognosis in various cardiovascular diseases[7]. To sum up, classical inflammatory cells, such as neutrophils, monocytes, and lymphocytes, are associated with developing postoperative atrial fibrillation. Currently, Oliver Juul Olesen et al.[8] find that Increased postoperative CRP levels after CABG surgery are associated with the development of POAF, Yucel Yilmaz et al.[9] consider NLR as a predictor of AF, and Gökhan Ertas et al.[10] examines the role of red cell distribution width in postoperative AF and find that preoperative RDW level predicts new-onset AF after CABG in patients without histories of AF. HDL has anti-inflammatory and antioxidant effects, and studies have shown that HDL levels correlate with a decreased atrial fibrillation risk.

In this study, we calculated the MHR based on the levels of monocyte and HDL to investigate the role of MHR in the AF after off-pump GABG, which has not been studied

DOI: 10.55415/deep-2023-0018.v1

before.

Methods

Subjects

Patients with unstable angina were admitted to Beijing Chao-Yang Hospital, Capital Medical University, for coronary revascularization from April 2018 to June 2021, including off-pump CABG surgery and HCR surgery. The inclusion and exclusion criteria were as follows.

Inclusion criteria: (1) All patients with unstable angina who underwent coronary revascularization at our institution, including off-pump CABG surgery or HCR surgery; (2) All the procedures were performed by the chief surgeon of the Second Ward of the Heart Center of Beijing Chao-Yang Hospital, Capital Medical University.

Exclusion criteria: (1) Patients had a history of preoperative AF or previous antiarrhythmic medication; (2) Patients underwent emergency CABG surgery or emergency HCR surgery, off-pump CABG surgery with intraoperative transfer to extracorporeal circulation; (3) Patients with acute and chronic infections, valvular heart disease and rheumatic cardiomyopathy; (4) Patients with benign and malignant tumors, hematological disorders, immune system disorders; (5) patients using hormones, immunosuppressive drugs, radiotherapy drugs; (6) Patients with hepatic or renal insufficiency. (Glutathione > 2 times the upper limit of normal and blood creatinine > 177umol/L).

Observational indicators

Observational indicators were given below. (1) Baseline information: gender, age, body mass index (BMI), history of smoking, alcohol drinking, hypertension, diabetes, stroke, heart attack, PCI, non-AF arrhythmias, preoperative medication history (e.g., use of beta blockers, calcium channel blockers (CCB); (2) Clinical data: cardiac ultrasound: preoperative cardiac echocardiographic indices such as left ventricular end-diastolic diameter (LVEDd), left

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ventricular end-systolic diameter (LVESd), left ventricular ejection fraction (LVEF), the anterior-posterior diameter of left atrium, the right-left diameters of left atrium, the inferior-superior diameters of left atrium, the inferior-superior diameters of the right atrium, the right-left diameters of right atrium; operative data: operative time, number of vessels anastomosed, intraoperative bleeding, the blood volume transfused during the perioperative period, use of intra-aortic balloon pump (IABP). (3) Haematological parameters: preoperative, immediate postoperative, and postoperative day 1 white blood cell count (WBC), neutrophil count (N), neutrophil percentage (N%), red blood cell distribution width - coefficient of variation (RDW-CV), platelet distribution width (PDW), mean platelet volume (MPV), NLR, MHR, M%HR, LMR, NHR, N%HR, postoperative day 1 troponin (TnI).

Definition of new-onset AF

AF not detected on preoperative ECG, and new-onset AF on ECG monitoring or ECG within 7 days postoperatively. Diagnostic criteria for AF referred to the 2020 ESC Guidelines for Atrial Fibrillation.

This study complied with the review criteria established by the Ethics Committee of Beijing Chao-Yang Hospital, Capital Medical University and was approved by the Ethics Committee (Ethics No.: 2021-ke-26).

Statistical Analysis

Patients were divided into AF and non-AF groups according to the presence or absence of the first occurrence of AF within 7 days after surgery. SPSS 26.0 statistical software was used for statistical analysis. Count data were expressed as frequencies and percentages, and the $\chi 2$ test was used for comparison between the two groups; Continuous variables with a normal distribution were expressed as mean with standard deviation (SD), and the independent samples t-test was used for comparison between groups; while continuous variables with a skewed distribution were presented as median and interquartile ranges [M (Q1, Q3)] and the

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Mann-Whitney U test was used for comparison between groups. Variables with P<0.1 in the univariate analysis were included in the multivariate logistic regression analysis to analyze the risk factors for POAF after coronary revascularization. P<0.05 was considered statistically significant.

Results

Baseline data: the incidence of AF after coronary revascularization was 28.0%. The mean age was significantly higher in the AF group than in the non-AF group (65.9±8.3 vs. 61.2±8.6, P<0.001). There was no statistical difference between patients in the AF and non-AF groups in terms of gender, BMI, history of smoking, alcohol consumption, previous hypertension, diabetes mellitus, history of stroke, heart attack, and previous non-AF arrhythmias (P>0.05). The non-AF group had significantly higher use of preoperative β-blockers than the AF group (82.5% vs. 70.7%, P=0.026). There was no significant difference between the two groups regarding the preoperative use of CCB drugs (P=0.926) (Table 1).

Table 2 showed the comparison of the clinical data of the two groups. The anterior-posterior diameter of the left atrium was greater in the AF group than in the non-AF group (38.5±4.9mm vs. 37.3±4.1mm, P=0.042). The right-left diameters of left atrium were larger in the AF group than in the non-AF group (39.6±5.3mm vs. 38.2±4.9mm, P=0.041). The inferior-superior diameters of left atrium were significantly wider in the AF group compared with the non-AF group (51.9±5.2mm vs. 49.9±4.5mm, P=0.001). The inferior-superior diameters of the right atrium were larger in the AF group than in the non-AF group (45.6±4.1mm vs. 44.6±3.9mm, P=0.044). There was no statistical difference between the two groups in terms of LVEDd, LVEDd, LVEF, and the right-left diameters of right atrium (P>0.05). IABP was used in a higher proportion of patients during the operation in the AF group than in the non-AF group (24.4% vs. 9.5%, P=0.001). Perioperative transfusion volume

DOI: 10.55415/deep-2023-0018.v1

was greater in the AF group than in the non-AF group (359.8±493.3ml vs. 227.3±283.6, P=0.024). There was no statistical difference between the AF and non-AF groups regarding operative time, number of anastomosed vessels, and intraoperative bleeding.

Haematological data: Peripheral blood was drawn preoperatively, immediately postoperatively, and on the morning of the first postoperative day. WBC, N, lymphocyte count, monocyte count, N%, percentage of monocytes, RDW-CV, PDW, MPV, and HDL were measured and NLR, MHR, M%HR, LMR, N%HR and NHR were further calculated. As shown in Table 3, there were no statistically significant differences between the AF and non-AF groups in any of the preoperative blood indicators (P>0.05). In the immediate postoperative blood indices (Table 4), RDW-CV was significantly higher in the AF group than in the non-AF group (12.9%±1.3% vs. 12.5%±0.7%, P=0.020); there was no statistically significant difference between the two groups in WBC, N, N%, PDW, MPV, NLR, MHR, M%HR, LMR, N%HR, and NHR (P>0.05). Among the patients' blood indicators on postoperative day 1, as shown in Table 5, RDW-CV levels were significantly higher in the AF group than in the non-AF group (13.2 ± 1.3 vs. 12.8 ± 0.8, P=0.013); MPV levels were significantly higher in the AF group than in the non-AF group (10.9 ± 0.9 vs. 10.6 ± 0.9, P=0.039), and cTnI levels on postoperative day 1 in the AF group were markedly higher in the AF group compared to the non-AF group (16.5 ± 35.5 vs. 6.2 ± 16.0, P=0.013). There were no statistically significant differences in WBC, N, N%, PDW, NLR, MHR, M%HR, LMR, N%HR, and NHR between the two groups on postoperative day 1 (P>0.05).

Variables with P<0.1 in the univariate analysis were included in the multivariate logistic regression analysis model, as shown in Table 6. The results showed that age (OR=1.09, P<0.001, 95% CI: 1.05-1.13), inferior-superior diameter of left atrium (OR=1.08, P=0.011, 95% CI: 1.02-1.15), use of IABP (OR=2.48, P=0.020 95% CI: 1.16-5.33), perioperative transfusion volume (OR=1.00, P=0.038, 95% CI: 1.000-1.002), and MHR level on

DOI: 10.55415/deep-2023-0018.v1

postoperative day 1 (OR=2.38, P=0.023, 95% CI: 1.13-5.02) were independently associated with POAF after coronary revascularization operation.

Discussion

The pathophysiological process of POAF is complex. Patients with POAF often present a preoperative AF-susceptible atrial stroma due to chronic atrial remodeling. Based on the preoperative atrial stroma, surgery-related triggers could trigger AF and facilitate atrial remodeling to perpetuate AF. These surgery-related triggers include surgical trauma, ischemia-reperfusion injury, inflammatory response, oxidative stress, and sympathetic activation[4].

In the present study, we collected clinical data on three aspects: baseline data, preoperative clinical data, and blood indicators. The results showed that some indicators were independently associated with POAF after off-pump coronary revascularization, including age, upper and lower left atrial diameter, use of IABP, perioperative transfusion volume, and postoperative day 1 MHR level.

CABG surgery and PCI are the two main procedures currently used for coronary revascularization, of which the incidence of AF after CABG is high. The incidence of POAF is approximately 20-40%, most often occurring 2-4 days after surgery[1]. Combining the advantages of surgical coronary artery bypass grafting and coronary medical intervention, HCR has emerged as a new procedure for revascularization strategies in multi-vessel lesions in coronary atherosclerotic heart disease. However, the incidence of AF after HCR has not been significantly reduced. A meta-analysis including seven studies shows that the incidence of POAF is 17% in the HCR group compared to 19.2% in the CABG group. There is no difference in the odds of POAF between the HCR group and the CABG group[2, 11]. Our study showed that the incidence of AF after coronary revascularization was 28.0%, with

DOI: 10.55415/deep-2023-0018.v1

30.3% after CABG and 20.2% after HCR. There was no statistical difference in the incidence of POAF between CABG and HCR (P=0.103), which was generally consistent with other studies.

In the present study, advanced age was found to be a risk factor for the development of AF after coronary revascularization, which was consistent with previous findings. Studies have shown that the incidence of POAF in patients ≧72 years of age is five times higher than in patients ≦55[12, 13]. The possible reason for the increased incidence of AF with advanced age is that aging changes such as myocardial fibrosis, amyloid deposition, dysregulation of connexins, abnormal calcium handling, and degenerative changes in the cardiac conduction system can occur with age. These changes will lead to electrophysiological changes in the heart, such as shortening of the effective inactivity period, increased inactivity dispersion, and electrophysiological changes, such as delayed intra-atrial conduction and abnormal autoregulation, which in combination make the elderly prone to arrhythmias such as AF[14]. On the other hand, elderly patients often have a combination of underlying diseases such as hypertension, diabetes mellitus, and coronary artery disease, leading to increased myocardial oxygen consumption, which further deficient myocardial blood supply and induces the development of AF.

Also, trials have obtained that history of hypertension, history of heart attack, and history of diabetes are all risk factors for POAF after cardiac surgery[3]. However, our study did not find differences between the AF and non-AF groups regarding the history of hypertension, heart attack, diabetes and stroke, which might be due to insufficient sample size.

In this study, the atrial diameters of patients were found statistically significant between the AF and non-AF groups, including left atrial inferior-superior diameters, left atrial left-right diameters, left atrial anterior-posterior diameters and right atrial inferior-superior diameters. Left atrial volume accurately reflects the degree of left atrial enlargement, and its increase is

DOI: 10.55415/deep-2023-0018.v1

often closely associated with increased ventricular filling pressures and diastolic insufficiency. Osranek M. et al.[15] prospectively observed 205 patients undergoing CABG and found that the risk of AF in patients after CABG increased progressively with increasing left atrial volume, with a 5-fold increase in the risk of POAF when left atrial volume was >32 ml/m^2. An increased left atrial volume index (28.6 ± 12.3 vs. 37.9 ± 15.5; $p < 0.01$) was found to be a predictor of POAF after heart valve surgery and was associated with increased length of stay and postoperative morbidity[16].

As for surgical data, we found that the probability of POAF was significantly higher in patients with intraoperative IABP (OR=2.48, P=0.020, 95% CI: 1.16-5.33), which has also been confirmed by several studies[13, 17, 18]. In addition, we found that the higher the amount of perioperative blood transfusion, the more likely the patients were to develop AF. Alameddine AK et al.[19] find that patients transfused with 1-3 units of red blood cells have an AF incidence of approximately 22%, while patients receiving 4-6 units of transfusion increased the incidence of POAF to 39%. The amount of blood transfused in patients is often associated with advanced age, high blood loss, and poor cardiac function, predisposing them to AF. Moreover, surgical blood transfusion can also induce an inflammatory state. Bilgin YM et al.[20] find that blood transfusion during cardiac surgery can lead to the activation of WBCs and the production of inflammatory mediators such as IL-6 and IL-12, further inducing the development of AF.

Among the clinical indicators on postoperative day 1, we found that the inflammatory marker MHR was an independent risk factor for POAF after coronary revascularization. Canpolat et al. found that elevated pre-ablation MHR was associated with increased AF recurrence after cryo-catheter ablation after a mean follow-up of 20.6 ± 6.0 months[21]. Another study found that higher pre-procedure MHR levels were independently associated with a significantly increased risk of early AF recurrence after radiofrequency maze[22]. Suzuki et al.[23] reveal

DOI: 10.55415/deep-2023-0018.v1

that the proportion of CD14++CD16+ monocytes in peripheral blood is significantly higher in AF patients than in controls and that peripheral blood CD14++CD16+ intermediate type monocytes may be closely related to the pathogenesis of AF. High-density lipoproteins have anti-inflammatory and antioxidant effects, including inhibiting monocyte transport of oxidized low-density lipoproteins, expression of endothelial adhesion proteins, and promotion of reverse transport of oxidized molecules[24]. Watanabe et al.[25] study the relationship between lipids and AF risk in the general population, and find that lower HDL is associated with an increased risk of AF in women. In a case-control study, Annour et al.[26] report that the risk of paroxysmal AF is 9.40 times higher in patients with reduced HDL than in those with normal HDL. MHR combines inflammation and oxidative stress processes, which is simple and easy to measure. Still, there are relatively few domestic and international studies on the correlation between MHR and POAF after coronary revascularization. This study demonstrated the relationship between this marker and POAF, which could help provide theoretical support for the early identification of patients at high risk of POAF after coronary revascularization.

Limitations

Due to the limited availability of data from retrospective studies and the slightly different examinations patients underwent preoperatively, we were unable to obtain all the essential factors associated with POAF: for example, brain natriuretic peptide, an indicator of cardiac function, C-reactive protein, erythrocyte sedimentation rate, and D-dimer, markers of atrial inflammation such as interleukin-6 and tumor necrosis factor-alpha, intraoperative aortic clamping time Indicators. Additionally, owing to the relatively small number of patients undergoing the HCR procedure, the two procedures were not studied separately in this study. Our study is a single-center retrospective analysis with a small sample size, and future multicenter studies with expanded sample sizes are needed to validate the results of this study.

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In conclusion, this study explored the risk factors for new-onset AF after coronary artery operation and innovatively explored the early warning role of MHR in the AF after off-pump GABG. Compared to patients who did not develop AF after operation, patients with new-onset AF tend to be older, have larger inferior-superior diameters of left atrial, greater use of IABP, more blood volumes transfused during the perioperative period, and higher MHR values on postoperative day 1. This provided a unique perspective on the early detection of patients with new onset AF.

Table 1. Demographic data and clinical characteristics of patients undergoing coronary revascularization operation

Variables	AF group (n=82)	Non-AF group (n=211)	P value
Age (years old)	65.9±8.3	61.2±8.6	<0.001***
Male[n, (%)]	66 (80.5%)	168 (79.6%)	0.868
BMI	25.5 (23.8,27.9)	25.6 (23.6, 27.7)	0.882
Smoking[n, (%)]	54 (65.9%)	120 (56.9%)	0.160
Drinking[n, (%)]	28 (34.1%)	74 (35.1%)	0.881
Medical history			
Hypertension[n, (%)]	56 (68.3%)	146 (69.2%)	0.881
Diabetes[n, (%)]	36 (43.9%)	81 (38.4%)	0.387
Stroke[n, (%)]	21 (25.6%)	35 (16.6%)	0.078
Myocardial infarction [n, (%)]	24 (29.3%)	47 (22.3%)	0.210
PCI[n, (%)]	13 (15.9%)	34 (16.1%)	0.957
arrhythmia except for AF [n, (%)]	5 (6%)	10 (4.7%)	0.636

AF: atrial fibrillation; BMI: Body Mass Index

Table 2. Comparison of clinical data of patients undergoing coronary revascularization operation

Variables	AF group (n=82)	Non-AF group (n=211)	P Value

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LVEDd (mm)	49.4±7.0	48.9±5.4	0.522
LVESd (mm)	33.1±8.4	31.5±7.3	0.134
LVEF (%)	60.2±11.8	62.5±9.7	0.112
The anterior-posterior diameter of left atrium (mm)	38.5±4.9	37.3±4.1	0.042*
The right-left diameters of left atrium (mm)	39.6±5.3	38.2±4.9	0.041*
The inferior-superior diameters of left atrium (mm)	51.9±5.2	49.9±4.5	0.001
The right-left diameters of right atrium (mm)	34.4±3.5	33.6±3.7	0.097
The inferior-superior diameters of right atrium (mm)	45.6±4.1	44.6±3.9	0.044*
Preoperative medication			
β-Blocker[n, (%)]	58 (70.7%)	174 (82.5%)	0.026*
CCB[n, (%)]	31 (37.8%)	81 (38.4%)	0.926
Surgical classification [n, (%)]			
CABG[n, (%)]	68 (82.9%)	156 (73.9%)	0.103
HCR[n, (%)]	14 (17.1%)	55 (26.1%)	
duration of operation (h)	4.2±0.9	4.4±0.8	0.139
Number of anastomotic vessels (n)	2.7±1.0	2.5±1.0	0.142
Use of IABP[n, (%)]	20 (24.4%)	20 (9.5%)	0.001***
Bleeding volume during operation (ml)	496.0±204.8	461.9±211.7	0.212
Perioperative blood transfusion volume (ml)	359.8±493.3	227.3±283.6	0.024*

LVEDd: left ventricular end-diastolic diameter; LVESd: left ventricular end-systolic diameter; LVEF: left ventricular ejection fraction; CCB: Calcium Channel Blockers; HCR: hybrid coronary revascularization; IABP: intra-aortic balloon pump; CABG: Coronary artery bypass grafting

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Table 3. Comparison of preoperative blood parameters in patients undergoing coronary revascularization operation

Variables	AF group (n=82)	Non-AF group (n=211)	P Value
WBC ($\times 10^9$/L)	6.9±1.9	6.6±1.5	0.210
N ($\times 10^9$/L)	4.3±1.4	4.1±1.2	0.268
N% (%)	61.5 (56.8,66.3)	61.5 (55.3,67.3)	0.752
RDW-CV (%)	12.8±0.9	12.7±0.7	0.273
PDW (fl)	12.7±2.4	12.2±2.0	0.053
MPV (fl)	10.6±0.9	10.4±0.9	0.118
NLR	2.5±1.2	2.5±1.8	0.820
MHR	0.6±0.3	0.5±0.2	0.088
M%HR	8.2±3.2	7.8±2.7	0.294
LMR	4.4±1.7	4.6±1.7	0.443
N%HR	73.0±20.4	72.1±21.8	0.761
NHR	5.2±2.4	4.8±2.0	0.215

WBC: white blood cell count; N: neutrophil count; N%: neutrophil percentage; RDW-CV: red blood cell distribution width level; PDW: platelet distribution width; MPV: mean platelet volume; NLR: neutrophil to lymphocyte ratio; MHR: monocyte to high density lipoprotein ratio; LMR: lymphocyte to monocyte ratio

Table 4. Comparison of immediate postoperative blood parameters in patients undergoing coronary revascularization operation

Variables	AF group (n=82)	Non-AF group (n=211)	P Value
WBC ($\times 10^9$/L)	11.4±4.0	11.5±3.4	0.819
N ($\times 10^9$/L)	9.4±3.4	9.5±3.0	0.775

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N% (%)	82.0±6.6	82.2±5.9	0.807
RDW-CV (%)	12.9±1.3	12.5±0.7	0.020*
PDW (fl)	12.2±2.4	11.8±1.9	0.078
MPV (fl)	10.6±0.9	10.5±0.9	0.290
NLR	9.6±11.3	8.0±4.9	0.218
MHR	0.5±0.3	0.5±0.3	0.276
M%HR	4.4±2.0	4.2±2.0	0.353
LMR	4.0±2.8	4.6±4.3	0.256
N%HR	97.8±26.9	96.8±27.3	0.787
NHR	11.4±5.6	11.2±4.9	0.745

WBC: white blood cell count; N: neutrophil count; N%: neutrophil percentage; RDW-CV: red blood cell distribution width level; PDW: platelet distribution width; MPV: mean platelet volume; NLR: neutrophil to lymphocyte ratio; MHR: monocyte to high density lipoprotein ratio; LMR: lymphocyte to monocyte ratio

Table 5. Comparison of blood parameters on on postoperative day 1 in patients undergoing coronary revascularization operation

Variables	AF group (n=82)	Non-AF group (n=211)	P Value
WBC ($\times 10^9$/L)	10.9±2.9	10.9±2.8	0.991
N ($\times 10^9$/L)	9.4±2.7	9.5±2.6	0.882
N% (%)	86.1±3.5	86.5±3.6	0.305
RDW-CV (%)	13.2±1.3	12.8±0.8	0.013*
PDW (fl)	12.5±2.2	12.1±1.9	0.101
MPV (fl)	10.9±0.9	10.6±0.9	0.039*

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NLR	14.5±6.2	14.3±6.2	0.762
MHR	0.9±0.4	0.8±0.4	0.088
M%HR	7.8±2.9	7.1±2.8	0.066
LMR	1.2±1.4	1.2±0.5	0.918
N%HR	102.7±27.6	101.8±27.3	0.798
NHR	11.5±5.0	11.2±4.3	0.587
TnI on postoperative day 1 (ng/ml)	16.5±35.5	6.2±16.0	0.013*

WBC: white blood cell count; N: neutrophil count; N%: neutrophil percentage; RDW-CV: red blood cell distribution width level; PDW: platelet distribution width; MPV: mean platelet volume; NLR: neutrophil to lymphocyte ratio; MHR: monocyte to high density lipoprotein ratio; LMR: lymphocyte to monocyte ratio

Table 6: Multivariate logistic regression analysis of risk factors for POAF after coronary revascularization operation

Variables	Multivariate logistic regression		
	OR	95%CI	P Value
Age (years old)	1.09	1.05-1.13	<0.001***
the Inferior-superior diameters of left atrium (mm)	1.08	1.02-1.15	0.011*
Use of IABP [n (%)]	2.48	1.16-5.33	0.020*
Blood volume transfused during perioperative period (ml)	1.00	1.000-1.002	0.038*
MHR on postoperative day 1	2.38	1.13-5.02	0.023*

IABP: intra-aortic balloon pump; MHR: monocyte to high density lipoprotein ratio

Glossary of abbreviations

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Abbreviation	Full name
CABG	Coronary artery bypass grafting
HCR	Hybrid coronary revascularization
POAF	Postoperative atrial fibrillation
WBC	White blood cell count
N	Neutrophil count
N%	Neutrophilic granulocyte percentage
RDW-CV	Red blood cell distribution width-CV
PDW	Platelet distribution width
MPV	Mean platelet volume
NLR	Neutrophil to lymphocyte ratio
MHR	Monocyte to high-density lipoprotein ratio
M%HR	Monocyte percentage to high-density lipoprotein ratio
LMR	Lymphocyte to monocyte ratio
NHR	Neutrophil to high-density lipoprotein ratio
N%HR	Neutrophil percentage to high-density lipoprotein ratio
TnI	Troponin
BMI	Body mass index
CCB	Calcium channel blocker
LVEDd	Left ventricular end diastolic diameter
LVESd	Left ventricular end systolic diameter
LVEF	Left ventricular ejection fraction
IABP	Intra-aortic balloon pump
HDL	high-density lipoprotein

DOI: 10.55415/deep-2023-0018.v1

Figure legend

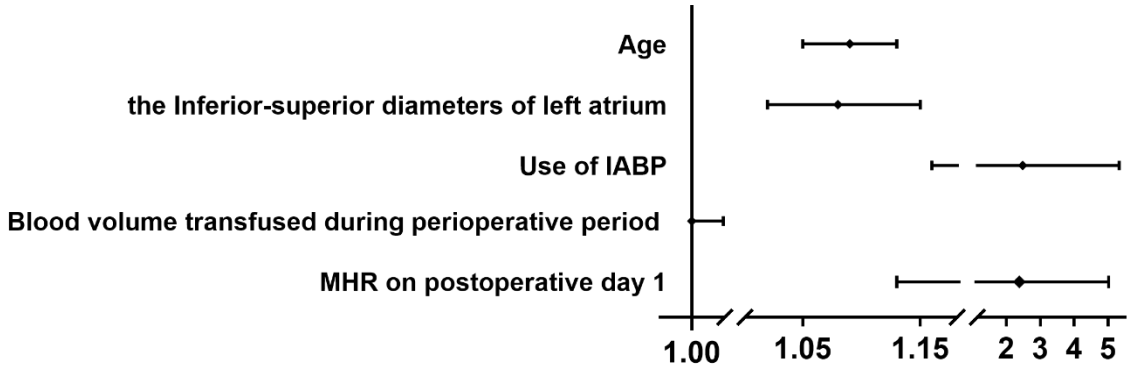

Figure 1 Forest plot of multivariate logistic regression analysis

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