

# Study on the Correlation between NLR, PLR, LMR and the Degree of Coronary Artery Stenosis

Yao Zhou, Xishan Yang

The First Affiliated Hospital, and College of Clinical Medicine of Henan University of Science and Technology, Luoyang, 471003, China.

---

## Abstract

**Objective:** To investigate the correlation between neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), lymphocyte-monocyte ratio (LMR) and the degree of coronary artery stenosis. **Methods:** 439 patients with suspected coronary heart disease who were treated in the Department of Cardiology, the First Affiliated Hospital of Henan University of Science and Technology from September 2018 to September 2019 were selected as the research objects. According to the results of coronary angiography, they were first divided into a coronary heart disease group of 360 and There were 79 people in the control group. According to Gensini score, coronary heart disease is divided into 3 subgroups. **Results:** The NLR of the coronary heart disease group was higher than that of the control group, and the LMR was lower than that of the control group. The difference was statistically significant ( $P<0.01$ ); the differences in NLR and LMR levels between the subgroups were still statistically significant ( $P<0.01$ ); Spearman correlation The results showed that NLR was positively correlated with Gensini score ( $r=0.180$ ,  $P<0.01$ ); LMR was negatively correlated with Gensini score ( $r=-0.203$ ,  $P<0.01$ ); Logistic regression analysis showed that NLR is an independent risk of coronary heart disease Factors ( $OR=1.263$ ,  $95\%CI: 1.015\sim 1.573$ ,  $P<0.05$ ). **Conclusion:** NLR and LMR are correlated with coronary heart disease and can predict the degree of coronary artery stenosis.

## Keywords

**Neutrophil to Lymphocyte Ratio; Platelet to Lymphocyte Ratio; Coronary Heart Disease; Lymphocyte to Monocyte Ratio; Coronary Artery; Stenosis.**

---

## 1. Introduction

With the development of society, the changes in people's lifestyles and the acceleration of the aging of our country's population, the prevalence of cardiovascular diseases in our country is still rising, and the mortality rate of cardiovascular diseases is higher than that of tumors and other diseases. "China Cardiovascular Health and Disease Report 2019" estimates that the current number of cardiovascular patients in my country is 330 million, of which 11 million are coronary heart disease, and the death rate of cardiovascular disease in rural areas is higher than that in urban areas, which has also caused a lot of damage to the national economy. Big burden [1]. The pathological basis of coronary heart disease is atherosclerosis, which is a lipid-driven inflammatory disease of the arterial intima [2]. Neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR), and lymphocyte to monocyte ratio (LMR) are new inflammatory markers. Some studies have shown that they are related to the prognosis of cardiovascular diseases [3,4], malignant tumors [5,6], pulmonary embolism [7] and other diseases. This study aims to explore the correlation between NLR, PLR, LMR and the degree of coronary artery stenosis.

## 2. Materials and methods

### 2.1 General information

A total of 439 patients were selected from September 2018 to September 2019 who were hospitalized in the Department of Cardiovascular Medicine of our hospital due to chest tightness and chest pain and were examined by coronary angiography (CAG). According to the results of coronary angiography, 360 people were divided into coronary heart disease group and 79 people in control group. According to the coronary artery stenosis score (Gensini score), the coronary heart disease group is divided into different subgroups (1 point-30 is divided into low-risk subgroup, 31 points-60 is divided into middle-risk subgroup, and >60 points are high-risk subgroups. Group), further compare the differences of NLR, PLR, LMR in each subgroup.

### 2.2 Exclusion criteria

(1) Congenital heart disease, myocarditis, chronic heart failure or old myocardial infarction and other organic heart disease patients, acute and chronic infectious diseases, autoimmune diseases, blood system diseases, malignant tumors, etc. (2) Take drugs that affect white blood cells and platelets (such as glucocorticoids, immunosuppressants, etc.) in the past 3 months; (3) Severe liver and kidney dysfunction; (4) Past stent implantation or cardiac surgery; (5) Lack of clinical information patient. Informed consent was obtained from all included patients before coronary intervention, and the research protocol was approved by the hospital medical ethics committee.

### 2.3 Method

(1) Acquisition of general clinical data: retrieve the medical records of selected patients, including general data, past history, and personal history, and calculate NLR, PLR, and LMR.

(2) Coronary angiography: The coronary angiography of all patients is completed by 2 or more experienced cardiovascular physicians in our hospital, and the operation process is strictly regulated. The Gensini score [8-16] was used to determine the severity of coronary atherosclerosis.

### 2.4 Statistical processing:

Use SPSS 21.0 statistical software for data analysis and processing. Measurement data conforming to the normal distribution are expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). The comparison between the two groups is by t- test, and the comparison between multiple groups is by analysis of variance. The measurement data of the normal distribution are expressed as the median (25% digits, 75% digits), the Mann-Whitney U test is used for comparison between the two groups, the Kruskal-Wallis test is used for the comparison between multiple groups. Enumeration data is expressed in percentage (%), and the comparison between groups adopts  $\chi^2$  test. Use Spearman correlation analysis for relevant statistics. A multivariate logistic stepwise regression model was used to analyze the influencing factors related to coronary artery stenosis.

## 3. Results

(1) Baseline data: Comparison of general data between the two groups (Table 1) There was no significant difference between the coronary heart disease group and the control group in lymphocytes, platelets, urea nitrogen, uric acid, cholesterol, triglycerides, low-density lipoprotein, and PLR ( $P > 0.05$ ). The coronary heart disease group was higher in age, male, hypertension, diabetes, smoking, neutrophils, monocytes, creatinine, and NLR levels than the control group, the difference was statistically significant ( $P < 0.05$ ). The levels of HDL-C and LMR in the coronary heart disease group were lower than those in the control group, and the difference was statistically significant ( $P < 0.05$ ).

(2) Comparison of NLR, PLR, and LMR levels between different Gensini score groups (Table 2). The differences in NLR and LMR levels between subgroups were statistically significant ( $P < 0.001$ ), but there was no statistically significant difference in PLR levels ( $P > 0.05$ ). Further pairwise comparison, the NLR level of the high-risk group was higher than that of the low-risk group, and the difference was statistically significant ( $P < 0.05$ ), the NLR level of the intermediate-risk group was

higher than that of the low-risk group, and the difference was statistically significant ( $P<0.001$ ), while the high-risk group There was no statistically significant difference in NLR levels between the middle-risk group and the middle-risk group ( $P>0.05$ ); the LMR levels of the middle-risk group and the high-risk group were lower than the low-risk group, and the difference was statistically significant ( $P<0.05$ ), while the high-risk group was compared with the middle-risk group. There was no statistically significant difference in LMR levels between the risk groups ( $P>0.05$ ).

Table 1. Comparison of baseline data between coronary heart disease group and control group

Project	Control group(n=79)	CHD group(n=360)	P
Age	56.19±9.95	59.96±10.59	0.004
Gender (male, %)	28 (35.4)	226 (62.8)	0.000
Hypertension (cases, %)	39 (49.4)	229 (63.6)	0.019
Diabetes (cases, %)	9 (11.4)	99 (27.5)	0.003
Smoking (cases, %)	19 (24.1)	153 (42.5)	0.002
Neutrophils ( $\times 10^9/L$ )	3.20 (2.53,4.09)	3.51 (2.81,4.80)	0.014
Lymphocytes ( $\times 10^9/L$ )	1.76 (1.39,2.29)	1.76 (1.35,2.15)	0.309
Monocytes ( $\times 10^8/L$ )	3.50 (2.80,4.30)	3.80 (2.90,4.90)	0.028
Platelet ( $\times 10^9/L$ )	210 (179.00,251.00)	212.50 (178.00,251.25)	0.988
Urea nitrogen (mmol/L)	4.70 (4.10,5.90)	4.90 (4.20,5.80)	0.666
Creatinine (umol/L)	60.31 (52.11,69.68)	63.80 (54.99,74.37)	0.025
Uric acid (umol/L)	314 (262,401)	311 (262,365.75)	0.778
Total cholestero (mmol/L)	4.00 (3.35,4.78)	4.00 (3.40,4.65)	0.899
Triglycerides (mmol/L)	1.33 (0.98,2.03)	1.47 (1.01,2.11)	0.681
LDL-C (mmol/L)	1.88 (1.45,2.50)	2.07 (1.65,2.60)	0.054
HDL-C (mmol/L)	1.16 (0.98,1.37)	1.07 (0.92,1.28)	0.034
NLR	1.79 (1.31,2.21)	2.04 (1.50,2.90)	0.007
PLR	119.28 (89.33,152.59)	121.24 (98.48,157.01)	0.315
LMR	5.29 (4.33,6.56)	4.50 (3.38,6.03)	0.001

Note: LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol.

Table 2. Comparison of NLR, PLR and LMR levels among different Gensini score groups

Project	Low-risk group(n=131)	Middle-risk group(n=90)	High-risk group(n=139)	P
NLR	1.76 (1.41,2.46)	2.33 (1.76,3.68) <sup>b</sup>	2.23 (1.55,3.36) <sup>a</sup>	<0.001
PLR	117.54 (99.65,141.42)	123.43 (99.21,159.74)	122.56 (98.32,168.15)	0.169
LMR	5.03 (4.00,6.28)	4.22 (3.13,5.72) <sup>a</sup>	4.24 (3.03,5.85) <sup>a</sup>	<0.001

Compared with the low-risk group, <sup>a</sup> $P<0.05$ , <sup>b</sup> $P<0.001$

Table 3. Single factor Logistic regression analysis of risk factors for coronary heart disease

Project	B	Wald	OR	95%CI	P
Age	0.034	8.105	1.035	1.011~1.060	0.004
Gender (male)	1.122	18.741	3.072	1.848~5.106	0.000
Hypertension	0.584	5.442	1.793	1.098~2.928	0.020
Diabetes	1.082	8.401	2.950	1.419~6.132	0.004
Smoking	0.848	8.907	2.334	1.338~4.073	0.003
Neutrophils	0.251	8.117	1.285	1.081~1.527	0.004
Monocytes	0.245	6.715	1.278	1.062~1.538	0.010
LDL-C	0.409	5.196	1.505	1.059~2.138	0.023
HDL-C	-0.928	4.981	0.395	0.175~0.893	0.026
NLR	0.344	7.523	1.397	1.100~1.774	0.006
LMR	-0.124	4.955	0.883	0.792~0.985	0.026

(3) Correlation analysis between NLR and LMR levels and Gensini score Spearman correlation analysis showed that NLR and Gensini score were significantly positively correlated ( $r=0.180$ ,  $P<0.001$ ); LMR and Gensini score were significantly negatively correlated ( $r=-0.203$ ,  $P<0.001$ ).

Table 4. Multivariate logistic regression analysis of risk factors for coronary heart disease

Project	<i>B</i>	<i>Wald</i>	<i>OR</i>	<i>95%CI</i>	<i>P</i>
Age	0.054	14.083	1.056	1.026~1.086	0.000
Gender (male)	1.494	24.835	4.455	2.475~8.017	0.000
Hypertension	0.567	4.196	1.762	1.025~3.031	0.041
Diabetes	1.100	7.627	3.004	1.376~6.559	0.006
LDL-C	0.500	6.097	1.650	1.109~2.454	0.014
NLR	0.234	4.366	1.263	1.015~1.573	0.037

(4) Analysis of risk factors for coronary heart disease (Tables 3 and 4) According to whether the subject is suffering from coronary heart disease (Yes=1, No=0), each variable is first subjected to single-factor Logistic regression analysis, and variables with  $P < 0.05$  are included in the multivariate analysis. The logistic regression analysis of factors showed that age, male sex, hypertension, diabetes, LDL-C, and NLR were risk factors for coronary heart disease ( $P < 0.05$ ).

#### 4. Discussion

Coronary heart disease is a common disease that seriously endangers human health. Its main pathological features are lipid deposition after endothelial injury and infiltration of different inflammatory cells (such as neutrophils, macrophages, dendritic cells, lymphocytes, etc.), Smooth muscle cells and fibrous matrix proliferation, and gradually develop into atherosclerotic plaque, inflammation plays an important role in this process.

In this study, it was found that the neutrophil count and monocyte count of the coronary heart disease group increased compared with the control group, and the difference was statistically significant ( $P < 0.05$ ). A prospective cohort study in the United States found that the neutrophil count in healthy subjects was independently associated with an increased risk of cardiovascular death. Ionita et al. conducted a study on carotid atherosclerotic plaques of 355 patients and found higher levels in atherosclerotic plaques with huge lipid cores, high macrophages, low collagen, and low smooth muscle cells. The number of neutrophils. This study also shows that the number of neutrophils is closely related to the histopathological characteristics of atherosclerotic plaques. The study by SahBandar et al. also found that the increase in monocyte count was significantly correlated with the increase in carotid artery intima thickness.

However, the counts of centrioles and monocytes are relatively unstable and are susceptible to infection, drugs and other factors. Some scholars have proposed new inflammation indicators, such as NLR, PLR, LMR, etc. This study found that NLR is positively correlated with the degree of coronary artery stenosis and is an independent risk factor for coronary heart disease. LMR is negatively correlated with the degree of coronary artery stenosis. Some recent studies have shown that NLR and LMR are not only related to the degree of coronary artery stenosis, but can also predict the prognosis of patients with coronary heart disease. A meta-analysis of 9406 patients included 8 studies showing that patients with acute coronary syndromes were treated before treatment. A higher NLR value is associated with a higher in-hospital mortality. A study included 500 patients undergoing percutaneous coronary intervention, followed up for 5 years, and found that a higher preoperative NLR was associated with an increased risk of 5 years of clinical adverse cardiovascular events. A retrospective study in my country included 1369 patients with ST-segment elevation myocardial infarction. The median follow-up period was 556 days. The study population was divided into 3 groups according to the LMR tertiles. The results found that the lower LMR and the patients Long-term major adverse cardiovascular events after discharge from the hospital are independently associated with all-cause mortality. A recent meta-analysis included 5 studies, including 4343 patients, and found that lower LMR in ACS patients is closely related to higher short-term and long-term mortality and major adverse cardiovascular events.

In summary, NLR and LMR can be obtained from blood routines. They are fast and economical. They are not only related to the degree of coronary heart disease stenosis, but also can predict the prognosis

of coronary heart disease, and can assist primary hospitals in early screening of high-risk patients. This study has certain limitations. It is a single-center retrospective study without dynamic observation of the indicators. It may require further confirmation by multi-center, prospective studies.

## References

- [1] China Cardiovascular Health and Disease Report Writing Group. China Cardiovascular Health and Disease Report 2019[J]. China Recycling Magazine,2020,35(09): 833-854.
- [2] BACK M, YURDAGUL A J, TABAS I, et al. Inflammation and its resolution in atherosclerosis: mediators and therapeutic opportunities[J]. Nat Rev Cardiol, 2019,16(7): 389-406.
- [3] SEROPIAN I M, ROMEO F J, PIZARRO R, et al. Neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio as predictors of survival after heart transplantation. [J]. ESC heart failure, 2018,5(1): 149-156.
- [4] SILVA N, BETTENCOURT P, GUIMARÃES J T. The lymphocyte-to-monocyte ratio: an added value for death prediction in heart failure.[J]. Nutrition, metabolism, and cardiovascular diseases : NMCD, 2015,25(11): 1033-1040.
- [5] MANDALIYA H, JONES M, OLDMEADOW C, et al. Prognostic biomarkers in stage IV non-small cell lung cancer (NSCLC): neutrophil to lymphocyte ratio (NLR), lymphocyte to monocyte ratio (LMR), platelet to lymphocyte ratio (PLR) and advanced lung cancer inflammation index (ALI).[J]. Translational lung cancer research, 2019,8(6): 886-894.
- [6] SUN Y, ZHANG L. The clinical use of pretreatment NLR, PLR, and LMR in patients with esophageal squamous cell carcinoma: evidence from a meta-analysis.[J]. Cancer management and research, 2018,10: 6167-6179.
- [7] KÖSE N, YILDIRIM T, AKIN F, et al. Prognostic role of NLR, PLR, and LMR in patients with pulmonary embolism.[J]. Bosnian journal of basic medical sciences, 2020,20(2): 248-253.
- [8] GENSINI G G. A more meaningful scoring system for determining the severity of coronary heart disease[J]. The American journal of cardiology, 1983,51(3): 606.
- [9] ZHU Y, XIAN X, WANG Z, et al. Research Progress on the Relationship between Atherosclerosis and Inflammation.[J]. Biomolecules, 2018,8(3).
- [10] WHEELER J G, MUSSOLINO M E, GILLUM R F, et al. Associations between differential leucocyte count and incident coronary heart disease: 1764 incident cases from seven prospective studies of 30,374 individuals.[J]. European heart journal, 2004,25(15): 1287-1292.
- [11] IONITA M G, van den BORNE P, CATANZARITI L M, et al. High neutrophil numbers in human carotid atherosclerotic plaques are associated with characteristics of rupture-prone lesions.[J]. Arteriosclerosis, thrombosis, and vascular biology, 2010,30(9): 1842-1848.
- [12] SAHBANDAR I N, NDHLOVU L C, SAIKI K, et al. Relationship between Circulating Inflammatory Monocytes and Cardiovascular Disease Measures of Carotid Intimal Thickness. [J]. Journal of atherosclerosis and thrombosis, 2020,27(5): 441-448.
- [13] DONG C, WANG Z, CHEN S. Neutrophil to lymphocyte ratio predict mortality and major adverse cardiac events in acute coronary syndrome: A systematic review and meta-analysis.[J]. Clinical biochemistry, 2018,52: 131-136.
- [14] BRESSI E, MANGIACAPRA F, RICOTTINI E, et al. Impact of Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio on 5-Year Clinical Outcomes of Patients with Stable Coronary Artery Disease Undergoing Elective Percutaneous Coronary Intervention.[Z]. 2018: 11, 517-523.
- [15] CAI M, LIANG D, GAO F, et al. Association of lymphocyte-to-monocyte ratio with the long-term outcome after hospital discharge in patients with ST-elevation myocardial infarction: a retrospective cohort study.[J]. Coronary artery disease, 2020,31(3): 248-254.
- [16] QUAN X, WANG R, ZHANG Q, et al. The predictive value of lymphocyte-to-monocyte ratio in the prognosis of acute coronary syndrome patients: a systematic review and meta-analysis.[J]. BMC cardiovascular disorders, 2020,20(1): 338.