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Plasma sLRP-1 Level Independently Relates to a Higher Risk of Moderate-Severe Stenosis by Gensini Score in Acute Coronary Syndrome Patients

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Soluble low-density lipoprotein receptor-related protein-1 (sLRP-1) plays a crucial role in facilitating inflammation, lipid accumulation, and atherosclerosis, and the latter factors are involved in the pathology of cardiovascular diseases. This study aimed to explore the ability of plasma sLRP-1 for reflecting stenosis degree in acute coronary syndrome (ACS) patients. sLRP-1 was detected from plasma by enzyme-linked immunosorbent assay in 169 ACS patients and 77 non-ACS subjects (as controls) after admission. Our study illustrated that sLRP-1 was increased in ACS patients versus controls ($P < 0.001$). Meanwhile, sLRP-1 was positively correlated with body mass index ($P = 0.021$), white blood cells ($P = 0.009$), neutrophils ($P = 0.002$), cardiac troponin I ($P = 0.009$), and brain natriuretic peptide ($P = 0.008$) in ACS patients. Notably, sLRP-1 was positively associated with the Gensini score ($P = 0.002$) and Gensini score stratified stenosis severity ($P = 0.004$) in ACS patients. After adjustment, sLRP-1 [odds ratio (OR) = 1.333, $P = 0.045$] independently estimated a higher risk of moderate-severe stenosis, so did numbers of coronary artery lesions (OR = 2.869, $P = 0.001$), but ejection fraction forecasted a lower risk (OR = 0.880, $P = 0.012$). Interestingly, a combination of sLRP-1, ejection fraction, and numbers of coronary artery lesions exhibited a good ability to estimate moderate-severe stenosis risk with an area under the curve (95% confidence interval) of 0.845 (0.783-0.906). In summary, increased plasma sLRP-1 represents an aggravated inflammation, impaired cardiac function, and especially a higher stenosis severity in ACS patients.

Keywords: acute coronary syndrome; cardiac function; inflammation; soluble low-density lipoprotein receptor-related protein-1; stenosis degree
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Introduction

Acute coronary syndrome (ACS) refers to three types of coronary artery diseases, including unstable angina (UA), ST-segment elevation myocardial infarction (STEMI), and non-STEMI (NSTEMI), which are classified based on electrocardiogram (EKG) and blood tests [including tests for cardiac troponin I (cTnI), high-sensitivity cTnI, and creatine kinase MB] (Bergmark et al. 2022). Globally, it is estimated that more than 7 million people are diagnosed with ACS each year (Bhatt et al. 2022). Treatments for ACS usually include percutaneous coronary intervention, coronary artery bypass graft, thrombolysis, nitrates, antiplatelet drugs, beta-blockers, etc. with the aim of improving blood flow and restoring heart function quickly (Agewall 2021; Rodriguez and Harrington 2021; Fanaroff and Nathan 2022; Hwang et al. 2022). However, ACS patients with moderate and severe stenosis have a worse prognosis compared to those with mild stenosis (Chew et al. 2022; Thompson 2022). Therefore, investigating potential markers that reflect the disease progression is crucial, and may assist in improving the management of ACS patients.

Low-density lipoprotein receptor-related protein-1 (LRP-1) is a transmembrane lipoprotein receptor consisting of two chains (515-kDa α-chain and 85-kDa β-chain), which would shed into the circulation as soluble LRP-1 (sLRP-1)

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with the presence of inflammation (Huang and Gui 2020). Notably, sLRP-1 plays a role in facilitating inflammation, lipid accumulation, and atherosclerosis (Quinn et al. 1997; Chen et al. 2021), and the latter factors are closely involved in the pathology of ACS (Duarte Lau and Giugliano 2022; Henein et al. 2022; Jebari-Benslaiman et al. 2022). According to a previous study, sLRP-1 induces inflammation by increasing the expression of tumor necrosis factor-alpha (TNF-α), interleukin (IL)-10, and C-C motif chemokine ligand 2 (CCL2) in macrophages (Gorovoy et al. 2010). Meanwhile, the release of sLRP-1 from vascular smooth muscle cells (VSMCs) reflects elevated lipid accumulation (de Gonzalo-Calvo et al. 2015). Moreover, increased sLRP-1 reflects aggravated atherosclerosis in VSMCs (Chen et al. 2020). These shreds of evidence suggest that sLRP-1 may participate in the pathogenesis of ACS. Clinically, a few studies have reported the clinical implication of sLRP-1 in cardiovascular disease patients (de Gonzalo-Calvo et al. 2019; Agirbasli et al. 2022). In detail, one study illustrates that sLRP-1 is independently correlated with coronary event risk in coronary artery disease patients (de Gonzalo-Calvo et al. 2019), and another one reports that sLRP-1 assists in discriminating ACS patients from myopericarditis patients (Agirbasli et al. 2022). However, rare studies report the relationship of sLRP-1 with stenosis degree in ACS patients, and this field deserves further exploration.

Accordingly, the present study aimed to investigate the dysregulation of plasma sLRP-1, and its potential to reflect stenosis degree in ACS patients.

Methods

Subjects

From July 8, 2019 to January 19, 2020, 169 ACS patients were consecutively enrolled in this study. The enrollment criteria contained: 1) diagnosed as ACS, including UA, NSTEMI, or STEMI; 2) over 18 years old; 3) patients who were willing to participate in this study. The exclusion criteria contained: 1) had a history of malignancies; 2) were complicated with severe dysfunction in the liver or kidney. Besides, 77 non-ACS patients were recruited as controls. The recruitment criteria contained: 1) diagnosed as non-ACS or had symptoms of ACS except for coronary atherosclerosis (excluded by coronary angiography); 2) matched in age and sex with ACS patients. The exclusion criteria contained: 1) had a history of ACS; 2) had a history of malignant diseases; 3) had severe dysfunction in liver or kidney, which was defined as the indexes of the liver or kidney function exceeding three times the normal range (Lassus 2020). Approval from Ethics Committee of the Affiliated Hospital of Chengde Medical College was obtained with the approval number of CYFYLL2021192. Written informed consent was collected from subjects.

Data and sample collection

All eligible ACS patients were considered for inclusion when they visited our hospital. After admission, all subjects' demographics, disease history, diagnosis information, and biochemical indexes were obtained from the electronic medical recordings for study use. In the early morning of the next day after admission, 4 mL of peripheral venous blood was collected from all subjects on an empty stomach, and the plasma was separated by centrifugation at 3,000 r/min for 12 min after standing for 20 min at room temperature. Then, the sLRP-1 level was determined by enzyme-linked immunosorbent assay (ELISA) using commercial kits which were purchased from Shanghai Lanji Biological Co., Ltd. (Shanghai, China) (catalog number, E01S0268; batch number, 20180917). The experiments were triplicated and conducted strictly according to manufacturer's instructions.

Gensini score assessment

The Gensini score was evaluated based on computed tomography angiography (CTA) images in ACS patients. Then the coronary artery stenosis degree was assessed based on Gensini score, which was classified as mild (Gensini score < 32), moderate (Gensini score 32-56), and severe (Gensini score > 56) according to the trisection method (Jiayin et al. 2022).

Statistics

SPSS V22.0 was utilized for analysis and GraphPad Prism V7.01 was utilized for figuring. Comparison analyses were carried out using the Wilcoxon rank sum test or the Kruskal-Wallis H rank sum test. Post-hoc comparison was determined using Bonferroni test. Correlation analyses were performed using Spearman's rank or Pearson correlation tests. Factors related to moderate-severe coronary artery stenosis degree were screened using the logistic regression model, then the independent factors were further determined by the receiver operating characteristic (ROC) curve. $P < 0.050$ was considered significant.

Results

Clinical characteristics of ACS patients

The included ACS patients had a mean age of 59.6 ± 9.5 years with 120 (71.0%) males and 49 (29.0%) females. At the same time, the median [interquartile range (IQR)] values of triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) were 1.5 (0.9-2.4) mmol/L, 4.3 (3.5-5.0) mmol/L, 2.4 (1.8-3.1) mmol/L, and 1.0 (0.9-1.2) mmol/L, respectively. In addition, the median (IQR) values of cTnI and brain natriuretic peptide (BNP) were 0.1 (0.1-4.4) μg/L and 26.2 (5.0-123.6) pmol/L, respectively. The mean Gensini score was 47.7 ± 29.7. Notably, 56 (33.1%), 56 (33.1%), and 57 (33.8%) patients had mild, moderate, and severe coronary artery stenosis degrees, respectively. Specific clinical information of ACS patients is exhibited in Table 1.

Table 1. Clinical characteristics.

Items	ACS patients (N = 169)
Age (years), mean ± SD	59.6 ± 9.5
Sex, No. (%)	
Male	120 (71.0)
Female	49 (29.0)
Nationality, No. (%)	
Han	117 (69.2)
Manchu	45 (26.6)
Hui	4 (2.4)
Mongol	3 (1.8)
Height (cm), mean ± SD	168.0 ± 7.1
Weight (kg), mean ± SD	72.4 ± 10.9
BMI (kg/m^2), mean ± SD	25.9 ± 3.2
Smoke history, No. (%)	
No	74 (43.8)
Yes	95 (56.2)
Hypertension, No. (%)	
No	65 (38.5)
Yes	104 (61.5)
Diabetes, No. (%)	
No	121 (71.6)
Yes	48 (28.4)
Family history of ACS, No. (%)	
No	146 (86.4)
Yes	23 (13.6)
Diagnosis	
UA	92 (54.4)
STEMI	53 (31.4)
NSTEMI	24 (14.2)
WBC (× 10^9/L), median (IQR)	7.4 (6.2-10.4)
Neutrophil (× 10^9/L), median (IQR)	5.0 (3.7-8.3)
Lymphocyte (× 10^9/L), median (IQR)	1.6 (1.2-2.0)
P-LCR (%), median (IQR)	28.1 (22.0-33.9)
TG (mmol/L), median (IQR)	1.5 (0.9-2.4)
TC (mmol/L), median (IQR)	4.3 (3.5-5.0)
LDL-C (mmol/L), median (IQR)	2.4 (1.8-3.1)
HLD-C (mmol/L), median (IQR)	1.0 (0.9-1.2)
AST (U/L), median (IQR)	34.5 (25.1-88.8)
ALT (U/L), median (IQR)	32.1 (24.2-46.9)
BUN (mmol/L), median (IQR)	5.4 (4.5-6.3)
Cr (μmoI/L), median (IQR)	61.3 (53.2-73.6)
SBP (mmHg), mean ± SD	146.1 ± 25.9
DBP (mmHg), mean ± SD	81.7 ± 12.9
EF (%), mean ± SD	59.6 ± 8.5
cTnI (μg/L), median (IQR)	0.1 (0.1-4.4)
BNP (pmol/L), median (IQR)	26.2 (5.0-123.6)
Numbers of coronary artery lesions, No. (%)	
1	53 (31.3)
2	40 (23.7)
3	76 (45.0)
Gensini score, mean ± SD	47.7 ± 29.7
Coronary artery stenosis degree, No. (%)	
Mild	56 (33.1)
Moderate	56 (33.1)
Severe	57 (33.8)

ACS, acute coronary syndrome; SD, standard deviation; BMI, body mass index; UA, unstable angina; STEMI, ST-elevation myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction; WBC, white blood cell; IQR, interquartile range; P-LCR, platelet-large cell rate; TG, triglyceride; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HLD-C, high-density lipoprotein cholesterol; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen; Cr, creatinine; SBP, systolic blood pressure; DBP, diastolic blood pressure; EF, ejection fraction; cTnI, cardiac troponin I; BNP, brain natriuretic peptide.

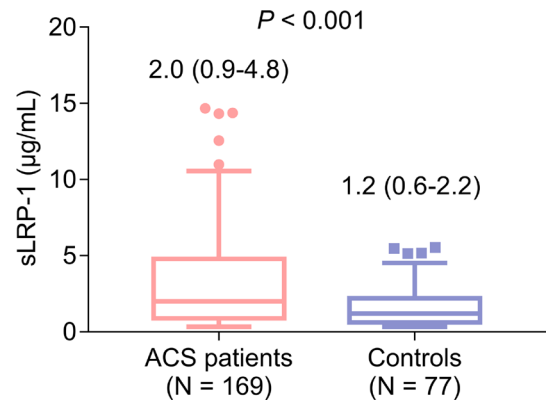

Fig. 1. Comparison of sLRP-1 between acute coronary syndrome (ACS) patients and controls.
Data are shown as the median (interquartile range; IQR).

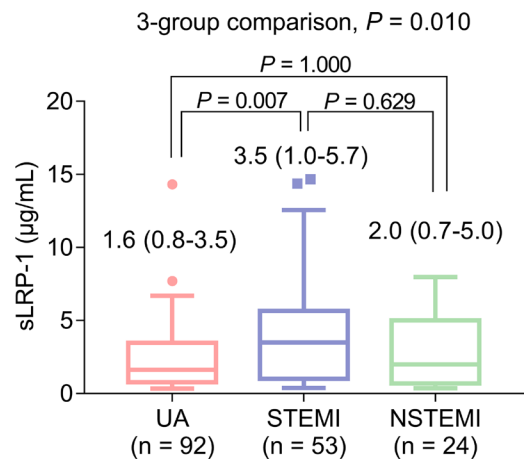

Fig. 2. Comparison of sLRP-1 among unstable angina (UA), ST-segment elevation myocardial infarction (STEMI), and non-STEMI (NSTEMI) patients.
Data are shown as the median (interquartile range; IQR).

Table 2. Correlation of sLRP-1 level with continuous characteristics in acute coronary syndrome (ACS) patients.

Items	*r* value	*P* value
Age (years)	0.028	0.718
Height (cm)	0.154	0.146
Weight (kg)	0.130	0.136
BMI (kg/m^2)	0.242	0.021
WBC (× 10^9/L)	0.200	0.009
Neutrophil (× 10^9/L)	0.233	0.002
Lymphocyte (× 10^9/L)	−0.115	0.136
P-LCR (%)	−0.071	0.360
TG (mmol/L)	0.013	0.871
TC (mmol/L)	0.075	0.330
LDL-C (mmol/L)	0.054	0.483
HLD-C (mmol/L)	0.048	0.535
AST (U/L)	0.117	0.130
ALT (U/L)	0.029	0.704
BUN (mmol/L)	−0.035	0.648
Cr (μmol/L)	−0.027	0.732
SBP (mmHg)	0.109	0.160
DBP (mmHg)	0.097	0.212
EF (%)	−0.088	0.263
cTnI (μg/L)	0.204	0.009
BNP (pmol/L)	0.253	0.008

sLRP-1, soluble low density lipoprotein receptor-related protein-1; BMI, body mass index; WBC, white blood cell; P-LCR, platelet-large cell rate; TG, triglyceride; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HLD-C, high-density lipoprotein cholesterol; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen; Cr, creatinine; SBP, systolic blood pressure; DBP, diastolic blood pressure; EF, ejection fraction; cTnI, cardiac troponin I; BNP, brain natriuretic peptide.

Table 3. Correlation of sLRP-1 level with categorical characteristics in acute coronary syndrome (ACS) patients.

Items	sLRP-1 level (μg/mL), median (IQR)	*P* value
Sex		0.251
Male	2.2 (1.0-4.8)	
Female	1.3 (0.8-4.7)	
Nationality		0.457
Han	2.0 (0.9-4.3)	
Others	2.2 (1.0-5.3)	
Smoke history		0.294
No	1.8 (0.8-4.9)	
Yes	2.4 (1.1-4.8)	
Hypertension		0.807
No	2.0 (1.0-4.7)	
Yes	2.0 (0.9-4.9)	
Diabetes		0.133
No	1.8 (0.7-4.5)	
Yes	2.4 (1.0-4.9)	
Family history of ACS		0.969
No	2.0 (0.9-4.8)	
Yes	2.2 (0.9-2.6)	
Numbers of coronary artery lesions		0.435
1	1.7 (0.8-4.0)	
2	2.6 (1.1-4.9)	
3	2.0 (0.8-5.2)	

sLRP-1, soluble low density lipoprotein receptor-related protein-1; IQR, interquartile range.

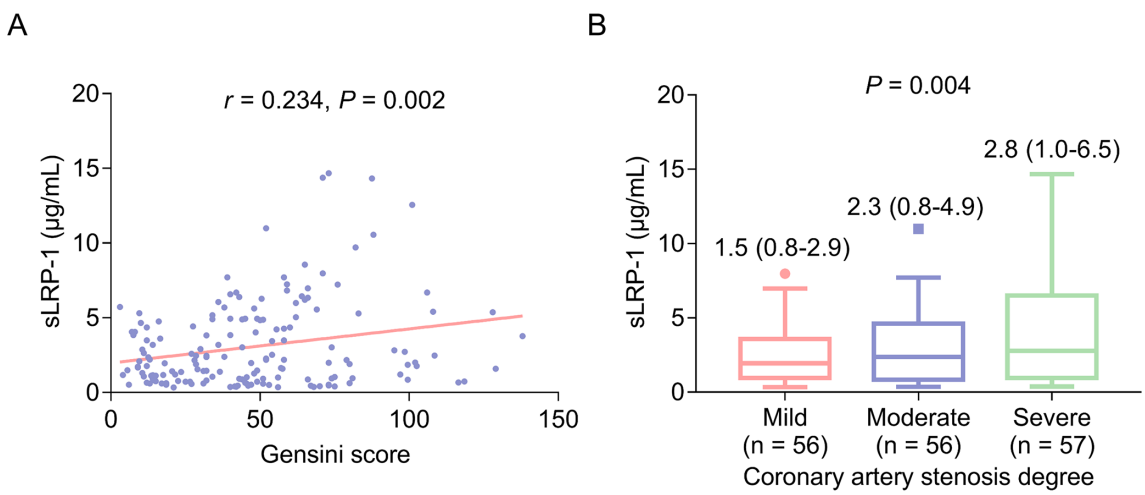

Fig. 3. Relationship of sLRP-1 with coronary artery stenosis degree in acute coronary syndrome (ACS) patients. (A) Correlation of sLRP-1 with Gensini score. (B) Comparison of sLRP-1 among patients with mild, moderate, and severe coronary artery stenosis degree. Data are shown as the median (interquartile range; IQR).

Table 4. Logistic regression model for moderate-severe coronary artery stenosis degree in acute coronary syndrome (ACS) patients.

Items	*P* value	OR	95% CI	
			Lower	Upper
Univariate logistic regression model				
sLRP-1 (μg/mL)	0.002	1.304	1.106	1.538
Age (years)	0.610	0.991	0.958	1.026
Female	0.458	0.768	0.382	1.543
Han	0.300	0.683	0.332	1.404
BMI (kg/m^2)	0.530	1.043	0.914	1.191
Smoke history	0.526	1.233	0.646	2.354
Hypertension	0.775	1.101	0.569	2.128
Diabetes	0.096	1.922	0.891	4.144
Family history of ACS	0.097	0.471	0.193	1.147
WBC (× 10^9/L)	< 0.001	1.374	1.178	1.602
Neutrophil (× 10^9/L)	< 0.001	1.349	1.160	1.569
Lymphocyte (× 10^9/L)	0.999	1.000	0.639	1.566
P-LCR (%)	0.519	1.013	0.973	1.055
TG (mmol/L)	0.497	0.921	0.725	1.169
TC (mmol/L)	< 0.001	2.063	1.406	3.026
LDL-C (mmol/L)	< 0.001	2.294	1.508	3.490
HLD-C (mmol/L)	0.192	2.262	0.664	7.704
AST (U/L)	0.007	1.010	1.003	1.017
ALT (U/L)	0.766	0.998	0.985	1.011
BUN (mmol/L)	0.882	0.984	0.800	1.211
Cr (μmoI/L)	0.203	1.013	0.993	1.035
SBP (mmHg)	0.002	1.024	1.009	1.040
DBP (mmHg)	0.248	1.015	0.989	1.042
EF (%)	< 0.001	0.885	0.838	0.934
cTnI (μg/L)	0.002	1.121	1.041	1.207
BNP (pmol/L)	0.004	1.017	1.005	1.029
Numbers of coronary artery lesions	< 0.001	2.887	1.899	4.391
Multivariate logistic regression model				
sLRP-1 (μg/mL)	0.045	1.333	1.006	1.766
EF (%)	0.012	0.880	0.796	0.972
Numbers of coronary artery lesions	0.001	2.869	1.534	5.363

OR, odds ratio; CI, confidence interval; sLRP-1, soluble low density lipoprotein receptor-related protein-1; BMI, body mass index; WBC, white blood cell; P-LCR, platelet-large cell rate; TG, triglyceride; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HLD-C, high-density lipoprotein cholesterol; AST, aspartate aminotransferase; ALT, alanine aminotransferase; BUN, blood urea nitrogen; Cr, creatinine; SBP, systolic blood pressure; DBP, diastolic blood pressure; EF, ejection fraction; cTnI, cardiac troponin I; BNP, brain natriuretic peptide.

Levels of sLRP-1 in ACS patients and controls

sLRP-1 was increased in ACS patients [median (IQR): 2.0 (0.9-4.8) μg/mL] versus controls [median (IQR): 1.2 (0.6-2.2) μg/mL] ($P < 0.001$) (Fig. 1). Meanwhile, among UA, STEMI, and NSTEMI patients, sLRP-1 was the highest in STEMI patients [median (IQR): 3.5 (1.0-5.7) μg/mL], followed by NSTEMI patients [median (IQR): 2.0 (0.7-5.0) μg/mL], and the lowest in UA patients [median (IQR): 1.6 (0.8-3.5) μg/mL)] ($P = 0.010$). Further post-hoc comparison suggested that sLRP-1 was increased in STEMI patients compared to UA patients ($P = 0.007$); however, sLRP-1 was not different between STEMI patients and NSTEMI patients ($P = 0.629$), as well as between NSTEMI patients and UA patients ($P = 1.000$) (Fig. 2).

Correlation of sLRP-1 with clinical features in ACS patients

sLRP-1 was positively related to body mass index (BMI) ($r = 0.242$, $P = 0.021$), white blood cell (WBC) ($r = 0.200$, $P = 0.009$), neutrophil ($r = 0.233$, $P = 0.002$), cTnI ($r = 0.204$, $P = 0.009$), and BNP ($r = 0.253$, $P = 0.008$).

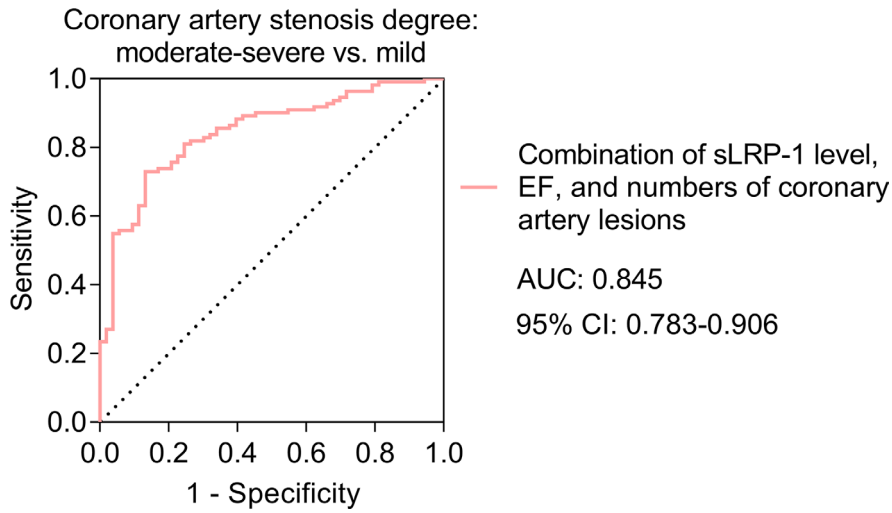

Fig. 4. Discriminating ability of the combination of sLRP-1 level, ejection fraction (EF), and numbers of coronary artery lesions for moderate-severe coronary artery stenosis degree in acute coronary syndrome (ACS) patients. AUC, area under the curve; CI, confidence interval.

However, sLRP-1 was not correlated with other clinical features, such as age, height, lymphocyte, sex, nationality, smoke history, hypertension, diabetes, family history of ACS, the number of coronary artery lesions, etc. in ACS patients (all $P > 0.050$) (Tables 2 and 3).

Association of sLRP-1 with stenosis degree in ACS patients

sLRP-1 was positively correlated with the Gensini score in ACS patients ($r = 0.234$, $P = 0.002$) (Fig. 3A). Comparison analysis revealed that sLRP-1 was the highest in patients with severe coronary artery stenosis degree [median (IQR): 2.8 (1.0-6.5) μg/mL], followed by patients with moderate coronary artery stenosis degree [median (IQR): 2.3 (0.8-4.9) μg/mL], and the lowest in patients with mild coronary artery stenosis degree [median (IQR): 1.5 (0.8-2.9) μg/mL] ($P = 0.004$) (Fig. 3B).

Independent factors for predicting moderate-severe coronary artery stenosis degree in ACS patients

The univariate logistic regression model disclosed that sLRP-1 [odds ratio (OR) = 1.304, $P = 0.002$] was related to a higher possibility to develop moderate-severe coronary artery stenosis degree. Further multivariate logistic regression model revealed that sLRP-1 (OR = 1.333, $P = 0.045$) and numbers of coronary artery lesions (OR = 2.869, $P = 0.001$) independently estimated increased risk of moderate-severe coronary artery stenosis degree. By contrast, ejection fraction (EF) independently estimated decreased risk of moderate-severe coronary artery stenosis degree in ACS patients (OR = 0.880, $P = 0.012$) (Table 4).

Moreover, the ROC curve displayed that the combination of independent factors, including sLRP-1, EF, and numbers of coronary artery lesions, had a good ability to discriminate patients with moderate-severe coronary artery stenosis degree from those with mild coronary artery stenosis degree with an area under the curve (AUC) [95% confidence interval (CI)] of 0.845 (0.783-0.906) (Fig. 4).

Discussion

The dysregulation of sLRP-1 in heart disease patients is studied by several previous studies (Roura et al. 2017; de Gonzalo-Calvo et al. 2019; Agirbasli et al. 2022). For example, sLRP-1 is increased in idiopathic dilated cardiomyopathy patients compared to healthy controls (Roura et al. 2017). Meanwhile, sLRP-1 is higher in coronary artery disease patients compared to normal subjects (de Gonzalo-Calvo et al. 2019). Notably, rare studies report the abnormal level of sLRP-1 in ACS patients, and the present study discovered that plasma sLRP-1 was elevated in ACS patients compared to controls. The possible reasons would be that: (1) sLRP-1 might accelerate the production of inflammatory cytokines to aggravate inflammation, which further caused the occurrence of ACS (Gorovoy et al. 2010; Schubert et al. 2019). (2) sLRP-1 was able to reflect the increase of atherogenic lipoproteins (such as LDL, aggregated LDL, etc.) in VSMCs, and the latter factors were responsible for atherosclerosis, which would further contribute to ACS (de Gonzalo-Calvo et al. 2015). As a result, sLRP-1 could reflect increased ACS risk. In addition, the current study also discovered that plasma sLRP-1 was the highest in SETMI patients, followed by NSTEMI patients, and the lowest in UA patients. The reason behind this might be that sLRP-1 could reflect aggravated atherogenesis, and increased atherogenesis further contributed to the occlusion of blood vessels (Chen et al. 2020). Hence, sLRP-1 was the highest in STEMI patients.

The present study also found that plasma sLRP-1 was positively related to BMI in ACS patients. It could be hypothesized that sLRP-1 could represent increased lipid accumulation, and the latter could further induce a higher

BMI (de Gonzalo-Calvo et al. 2015); therefore, sLRP-1 was positively related to BMI. Meanwhile, plasma sLRP-1 was positively associated with WBC and neutrophils in ACS patients. A reason behind this might be that as mentioned above, sLRP-1 could aggravate inflammation, which further increased WBC count and neutrophils (Gorovoy et al. 2010); hence, a positive association was found between sLRP-1 and WBC count, or neutrophils. In addition, plasma sLRP-1 was positively correlated with cTnI and BNP in ACS patients. A possible explanation would be that sLRP-1 could reflect accelerated atherogenesis, and the latter could further contribute to myocardial infarction (Chen et al. 2020). As a result, sLRP-1 was positively correlated with cTnI and BNP.

The present study further figured out that plasma sLRP-1 was positively related to the Gensini score; meanwhile, plasma sLRP-1 reflected a higher coronary artery stenosis degree in ACS patients. The potential reasons would be that: (1) as discussed above, sLRP-1 could reflect aggravated atherosclerosis, and the latter one further induced an increased stenosis degree (Chen et al. 2020). (2) sLRP-1 could also represent increased lipid accumulation, and the latter was partly responsible for the aggravation of stenosis degree (de Gonzalo-Calvo et al. 2015; Monga et al. 2022). Taken together, sLRP-1 possessed the ability to represent aggravated stenosis degree. This finding was further validated by logistic regression analysis. Moreover, this study also revealed that the combination of independent factors (including sLRP-1, EF, and numbers of coronary artery lesions) had a good ability to discriminate ACS patients with moderate-severe coronary stenosis degree from those with mild coronary stenosis degree. This finding might assist in accurately reflecting the stenosis degree in ACS patients.

Several limitations should be noticed. Firstly, multiple-time detection of sLRP-1 was not realized in this study; however, it might be meaningful to monitor the progression of ACS. Secondly, the numbers of non-ACS subjects were relatively fewer than ACS patients, which might affect the statistical power. Thirdly, sLRP-1 was shedding from LRP-1; however, the relationship of LRP-1 with stenosis degree in ACS patients should be further explored. Fourthly, patients were not regularly followed up in this study; thus, the prognosis, such as major adverse cardiovascular events were not recorded, and the correlation of sLRP-1 with prognosis of ACS patients was not explored. Further studies should consider investigating the prognostic effect of sLRP-1 in ACS patients. Fifthly, this study only found that sLRP-1 was positively related to WBC and neutrophil; however, the correlation of sLRP-1 with inflammatory cytokines and CCL2 in ACS patients did not explore yet, which could be a research direction.

In conclusion, plasma sLRP-1 is increased in ACS patients, which reflects an elevated inflammation, impaired cardiac function, and aggravated stenosis degree. Clinically, the findings of this study may help to better stratify ACS patients and further improve their management.

Conflict of Interest

The authors declare no conflict of interest.

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