Anti-inflammatory effects of rosuvastatin treatment in coronary artery ectasia patients in different age groups

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Abstract

Background: Coronary artery ectasia (CAE) is an angiographic finding of abnormal coronary dilatation. The role of inflammation in atherosclerosis is becoming increasingly well known. This study investigated the relationship between CAE and serum levels of high-sensitivity C-reactive protein (Hs-CRP) and interleukin-6 (IL-6) to test our hypothesis that patient age is associated with the efficacy of anti-inflammatory therapy for CAE.

Methods: We conducted a prospective analysis of 217 patients with CAE treated at the Department of Cardiology, Shanghai East Hospital, Shanghai East Hospital (Ji'an Campus), and Cardiovascular Medicine of Baoshan People's Hospital of Yunnan Province, from January 1, 2015 to July 30, 2019. Baseline data of patients, including sex, age, hypertension, hyperlipidemia, and diabetes, were collected from patient medical records. Study participants were grouped by age as follows: CAE-A (age ≤50 years), CAE-B (50 years <age ≤70 years), and CAE-C (age >70). Additionally, there was a normal control (NC) group with normal coronary arteries.

Results: All patients received oral rosuvastatin therapy (10 mg, QN quaque nocte) when they were diagnosed with CAE and maintained good follow-up, with a loss rate of 0.0% at the 6-month follow-up. The NC group (n = 73, with normal coronary arteries) received regular symptom-relieving treatments and rosuvastatin therapy. Among these four groups, the inflammatory markers were significantly higher in patients with CAE than in the NCs ($p<0.01$). Logistic regression analysis showed that Hs-CRP (OR=1.782, 95% CI: 1.124-2.014, P=0.021) and IL-6 (OR=1.584, 95% CI: 1.112-1.986, P=0.030) were independent predictors of CAE. The inflammatory markers in the CAE-A group were higher than those in the CAE-B group, which were higher than those in the CAE-C group. Follow-up after 6 months of rosuvastatin therapy showed a significantly greater reduction in Hs-CRP and IL-6 levels in the CAE-A group than in the CAE-B group, which, again, were higher than those in the CAE-C group.

Conclusions: Anti-inflammatory therapy using rosuvastatin was more effective in younger CAE patients, indicating the need for early statin therapy in CAE patients.

Background

Coronary artery ectasia (CAE) is an abnormal coronary dilatation that is mainly diagnosed through coronary angiography, which provides information on the size, location, and number of dilatations. CAE is characteristically defined as a dilated coronary artery segment whose diameter is at least 1.5-times that of the adjacent normal coronary lumen [1] and is a relatively rare coronary artery abnormality (incidence <5%) among coronary artery diseases [2]. The increased prevalence of CAE in recent years has resulted in a greater focus on the incidence and factors influencing CAE [3];estimates of the incidence of coronary ectasia have varied from 0.3% to 4.7%. However, the etiopathogenetic mechanism of CAE is not yet completely known, although it may be related to systemic inflammation, stimulated nitric oxide production, coronary balloon angioplasty, nodular polyarteritis, and Kawasaki syndrome [4, 5]. Coronary ectasia is more prevalent in patients with familial hypercholesterolemia (FH) than in other patients with coronary atherosclerosis and shows a strong inverse association with high-density lipoprotein cholesterol (HDL) cholesterol levels. This suggests that disordered lipoprotein metabolism in individuals with FH may predispose patients to aneurysmal coronary artery disease . The pathogenesis of coronary artery ectasia is not fully known. Alterations in nitric oxide levels, inflammation, extracellular matrix degradation, dyslipidemia, and genetic predisposition are suspected mechanisms. Moreover, potential risk factors for CAE include an imbalance between matrix metalloproteinases (MMPs) and tissue inhibitor metalloproteinases (TIMPs), angiotensin-converting enzyme genotypes, a lower HDL cholesterol level, a higher low-density lipoprotein (LDL)/HDL ratio [6], elevated levels of homocysteine, cocaine usage, smoking, vascular trauma, and diabetes [7-10]. We followed a total of 217 patients, and divided them into four groups: the normal control (NC) group (n=73), CAE-A (n=60), CAE-B (n=83), and CAE-C (n=74) Figure 1. Conventionally, CAE has been considered a variant of coronary atherosclerosis, and an important clinical complication in interventional cardiology is the thrombogenic potential of ectatic arteries. Recent studies have found that inflammation plays a key role in active defense against various assaults. The current consensus indicates that atherosclerosis is an inflammatory disease, although the triggering factors and atherosclerotic processes, including plaque rupture, coronary artery spasm, coronary slow flow, coronary microvascular dysfunction, asymptomatic myocardial ischemia, and restenosis, may be variable. Furthermore, CAE is closely related to myocardial infarction; however, there are currently no standard treatment guidelines specified for CAE. The anti-inflammatory and endothelium-protective effects of rosuvastatin have been suggested to improve symptoms in patients with coronary artery disease. We chose rosuvastatin because it has stronger anti-inflammatory and antioxidant activity than atorvastatin [11]. However, there is no conclusive evidence of the therapeutic efficacy or optimal timepoint for rosuvastatin therapy in CAE patients in different age groups. We conducted the present study to compare the inflammatory status and therapeutic effects of rosuvastatin in CAE patients in different age groups.

Methods

Subjects

We prospectively enrolled 6542 patients who were first diagnosed using coronary angiography at our centers from January 1, 2015, to July 30, 2019. The exclusion criteria included various malignant tumors, intolerance to statin treatment, dilated segments appearing within or directly associated with coronary bypass grafts, coronary dilation development after coronary interventions, a diagnosis of Kawasaki disease, or coronary artery anomalies, acute or chronic coronary total occlusion, acute coronary syndrome [12], or inability to complete a 6-month follow-up. Finally, 302 patients were diagnosed with CAE, and 85 patients were excluded (Figure 1). There were 21 patients with congestive heart failure, 26 patients with abnormal hepatic or renal function, and 38 patients who met other exclusion criteria. We included 217 patients with CAE (grouped by age) and collected clinical data, including blood lipids, high-sensitivity C-reactive protein (Hs-CRP), interleukin-6 (IL-6) and other biochemical indicators (Table 1). Patients received rosuvastatin treatment when they were diagnosed with CAE, not oral statin therapy before the time of enrollment.

Table 1. Basic information and laboratory findings of CAE patients and normal controls

Groups	NC group (n=73)	CAE-A (n=60) (age≤50 years)	CAE-B (n=83) (50 years<age≤70 years)	CAE-C (n=74) (age>70 years)	Total CAE (A+B+C, n=217)	*p*-value	CAE-A vs CAE-B	CAE-B vs CAE-C	CAE-A vs CAE-C
Sex (M), n (%)	42 (57.5)	39 (65.0)	57 (68.7)	50 (67.6)	146 (67.3)	0.2794			
Diabetes mellitus, n (%)	13 (17.8)	11 (18.3)	18 (21.6)	18 (24.3)	47 (21.7)	0.1712			
Hypertension, n (%)	23 (31.5)	19 (31.7)	28 (33.7)	27 (36.5)	74 (34.1)	0.2142			
Waist circumference (cm)	90.3 ± 14.8	91.6 ±12.7	92.7 ±16.1	93.8 ± 19.1	92.8 ± 16.2	0.5277			
Creatinine (mg/dL)	70.34 ± 11.6	67.6 ±12.7	77.8 ± 13.2	87.8 ± 14.8	78.48 ± 12.5	0.2560			
Smoking index	119.2 ± 15.5	110.3 ±10.5	135.5 ±15.6	130.2 ± 15.1	126.7 ± 17.8	0.2391			
Total cholesterol (mmol/L)	4.89 ± 1.04	5.59 ± 1.21*	5.39 ± 1.18	4.95 ± 1.07	5.30 ± 1.16*	0.0452			
Low-density lipoprotein-C (mmol/L)	2.89 ± 0.36	3.92 ± 0.54*	3.74 ± 0.51*	3.73 ± 0.49*	3.79 ± 0.52*	0.0237			
High-density lipoprotein-C (mmol/L)	1.08 ± 0.12	1.22 ± 0.27	1.15 ± 0.19	1.13 ± 0.15	1.16 ± 0.16	0.9161			
Triglycerides (mmol/L)	1.56 ± 0.19	1.69 ± 0.19	1.89 ± 0.21	1.75 ± 0.18	1.78 ± 0.15	0.8493			
High-sensitivity CRP (mg/L)	16.9 ± 3.82	32.3 ± 5.51*	26.1 ± 4.23*	22.5 ± 4.82*	25.6 ± 4.65*	0.0213	0.230	0.198	0.048*
Glycated hemoglobin (%)	5.89 ± 1.12	5.90 ± 1.07	6.50 ± 1.12	6.89 ± 1.25	6.46 ± 1.21	0.1421			
Ejection fraction (%)	56.3 ± 12.58	59.4 ± 9.14	55.5 ± 9.23	50.3 ± 8.47	54.8 ± 8.53	0.3432			
Hemoglobin (g/L)	125.5 ± 26.5	131.1 ± 28.6	125.1 ± 26.3	119.1 ± 29.8	123.8 ± 28.1	0.6535			
Red blood cell distribution width (%)	36.8 ± 5.26	36.7 ± 5.95	38.7 ± 4.94	36.4 ± 4.68	37.4 ± 5.59	0.8601			
Mean platelet volume (fL)	10.5 ± 1.26	10.7 ± 1.05	11.2 ± 1.35	10.5 ± 1.91	10.8 ± 1.45	0.2503			
WBC (10^9/L)	6.25 ± 2.56	8.85 ± 2.21	8.35 ± 2.06	8.25 ± 2.36	8.38 ± 2.30	0.0763			
Neutrophils(10^9/L)	4.12±1.69	6.12±1.58	5.76±1.49	5.66±1.52	5.89±1.60	0.0752			
Lymphocytes(10^9/L)	0.50±0.22	0.65±0.25	0.68±0.23	0.72±0.20	0.70±0.23	0.3854			
Interleukin-6 (pg/dL)	4.1±0.6	12.3±1.5*	10.9±1.3*	8.9±1.1*	10.6±1.3*	0.001	0.120	0.095	0.025*

*:NC group vs. Total CAE group. p-value is considered significant if <0.05

The primary endpoint included confirming inflammatory markers such as Hs-CRP and IL-6 after six months' treatment. The secondary endpoint included levels of Hs-CRP and IL-6,observed if there were any side effects of rosuvastatin. This study was approved by the medical ethics committee of Shanghai East Hospital, Shanghai East Hospital (Ji'an Campus), and Baoshan People's Hospital of Yunnan Province. According to the results of coronary angiography and patient age, participants were divided into four groups: CAE-A (age ≤50 years), CAE-B (50 years <age ≤70 years), CAE-C (age >70 years), and the NC group (age matched) with normal coronary arteries. According to 1:1 age matching, other risk factors (such as sex, hypertension, diabetes, etc.) were matched as much as possible except for CAE status.

Measurement of related indicator characteristics

Hypertension was defined as a systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg [13]; BP was measured three times on the same day on patients not using antihypertensive drugs. The smoking index was calculated as the number of cigarettes smoked per day × the number of years of smoking [14]. Fasting venous blood samples of all subjects were collected to measure hematological parameters and biochemical indices. The red blood cell distribution width, hemoglobin, mean platelet volume, and white blood cell (WBC) counts were analyzed using a Horiba ABX 80 Diagnostics (ABX pentra Montpellier, France). Serum glucose and creatinine, HDL-C, LDL-C, total cholesterol (TC), triglycerides (TGs), Hs-CRP, and interleukin-6 (IL-6) were detected with enzymatic colorimetric methods using a fully automatic biochemical analyzer (Roche Cobas c702) in Shanghai East Hospital, Shanghai East Hospital (Ji'an Campus), and Baoshan People's Hospital of Yunnan Province.

Coronary angiography

The Siemens Artis zeego III was used to conduct coronary angiography with a routine radial artery approach. X-ray photography was performed with the injection of a contrast agent. Blood vessel diameter measurements were performed by skilled coronary intervention doctors. CAE was defined as local or diffuse dilated coronary arteries with a diameter exceeding 1.5-fold that of the adjacent normal coronary lumen [15]. The coronary artery images considered indicative of CAE after qualitative comparative analysis by two independent operators were included in this study. Representative CAE images of the left circumflex branch (LCX) and right coronary artery (RCA) are shown (Figure 2). Pharmacological therapy was withheld for at least 24 h before angiography.

Statistical analysis

Statistical analysis was conducted using SPSS 19.0 software. Data of continuous variables are presented as the means ± standard deviations; nonnormally distributed data are presented as medians. Comparisons between two groups were conducted with an independent samples *t*-test, and qualitative data were evaluated by Fisher's exact test. A comparison of continuous variables between the three groups was performed by one-way ANOVA with post hoc Dunnett's correction. A *p*-value <0.05 was considered statistically significant. Logistic regression analysis and stepwise methods were applied to screen the factors showing correlations with CAE, with the entry criteria set at $p<0.05$ and rejection criterion at $p>0.1$.

Results

In this study, the prevalence was 302/6542=0.046, representing a 4.6% CAE prevalence among all patients undergoing angiography. Eighty-five patients were excluded. There were 21 patients with congestive heart failure, 26 patients with abnormal hepatic or renal function, and 38 patients who met other exclusion criteria.

The baseline characteristics of the risk factors associated with CAE, including sex (male), hypertension, diabetes, hyperlipidemia, and smoking history, were similar between the total CAE group and the NC group. Particularly, WBC was not different between the groups. In addition, subclasses of leukocytes, such as neutrophils and lymphocytes, were not significantly different between the NC group and total CAE group.

Laboratory findings such as TC, LDL-C, Hs-CRP, WBC, and IL-6 were elevated in the total CAE group compared to those in the NC group (p<0.05). The levels of TC, LDL-C, Hs-CRP, and IL-6 were higher in the CAE-A group than in the CAE-B, CAE-C, and NC groups; furthermore, the levels of TC, LDL-C, Hs-CRP, and IL-6 in the CAE-B group were higher than those in the CAE-C or NC group. Under similar circumstances, the levels of TC, LDL-C, Hs-CRP, and IL-6 in the CAE-C group were higher than those in the NC group. There were significant differences in Hs-CRP between the CAE-A and CAE-C groups (P=0.048) and significant differences in IL-6 between the CAE-A and CAE-C groups (P=0.025). There were no significant differences in sex, hypertension, diabetes, waist circumference, smoking index, TGs, glycosylated hemoglobin, red blood cell distribution width (RBW), or mean platelet volume among the three different age groups of CAE patients (p>0.05; Table 1).

Logistic regression analysis was performed to identify the independent risk factors associated with CAE. In the stepwise analysis, covariant factors included hypertension, diabetes mellitus, Hs-CRP, LDL-C, smoking, triglycerides, WBC, and IL-6. Multivariate analysis showed that increased levels of Hs-CRP and IL-6 were independent predictors of CAE (p<0.05; Table 2). Multivariate analysis showed that increased levels of Hs-CRP (OR, 1.782; CI, 1.124-2.014; p = 0.021) and IL-6 (OR, 1.584; CI, 1.112-1.986; p = 0.030) were independent predictors of CAE (Table 2). The baseline drug treatments of patients with a confirmed diagnosis of CAE at study inclusion are shown in Table 3. Each CAE patient was subjected to rosuvastatin treatment, with or without other drugs such as angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers (ACEIs/ARBs), beta-receptor blockers, calcium-channel blockers, diuretics, aspirin, and clopidogrel. The patients in the NC group received rosuvastatin treatment. There were no significant differences in the selection of therapeutic medications among the three CAE groups and the NC group, except for differences in rosuvastatin (p>0.05).Regarding compliance issues, the three authors, who have some prestige, were dedicated to ensuring patient compliance, regular health education, and regular outpatient follow-up visits and reminding patients to take medication by telephone, WeChat and other means; for various reasons, such as financial constraints, some patients could not access drugs.

Table 2. Multivariate analysis of variables associated with CAE

	OR	95% CI	p-value
Hypertension	1.364	0.932–1.648	0.248
Diabetes mellitus	1.407	0.802–2.053	0.198
Waist circumference	1.448	0.967–1.938	0.124
LDL-C	1.492	0.986–2.091	0.099
Smoking	1.119	0.932–1.422	0.176
TGs	1.238	0.836–1.865	0.236
WBC	1.690	0.990–1.785	0.061
Hs-CRP	1.782	1.124–2.014	0.021*
Interleukin-6	1.584	1.112-1.986	0.030*

CAE: coronary artery ectasia; Hs-CRP: high-sensitivity C-reactive protein; LDL-C: low-density lipoprotein cholesterol; TGs: triglycerides; WBC: white blood cells. *: p<0.05 vs NC group OR, odds ratio and CI, confidence interval

Table 3. Baseline medication selection of CAE patients after confirmed diagnosis

Treatments	Group NC (n=73)	CAE-A (n=60) (age≤50 years)	CAE-B (n=83) (50 years<age≤70 years)	CAE-C (n=74) (age>70 years)	Total CAE (A+B+C, n=217)	p-value
ACEI/ARB	18	16	27	28	71	0.895
β-receptor blocker	21	25	36	28	89	0.424
Rosuvastatin	73	60	83	74	217	NA
Calcium-channel blocker	16	18	15	17	50	0.310
Diuretics	14	15	13	16	44	0.769
Aspirin	35	42	56	50	148	0.424

p-value: total CAE vs NC. CAE, coronary artery ectasia. ACE, angiotensin-converting enzyme.

After the 6-month treatment with rosuvastatin, serum levels of Hs-CRP and IL-6 were differentially reduced in the three CAE age groups (Table 4), supporting the efficacy of rosuvastatin as an anti-inflammatory agent. Among the three CAE age groups, the CAE-A (age ≤50 years) group showed the greatest effect of rosuvastatin treatment, as evidenced by the most significant reduction in serum levels of Hs-CRP (delta value was 15.1±3.33, P=0.0001) and IL-6 (delta value was 5.9±1.6, P=0.021). The CAE-A group showed the greatest reduction in serum levels of Hs-CRP and IL-6, followed by the CAE-B group (delta value of Hs-CRP was 9.4±2.86, delta value of IL-6 was 3.0±1.5). The results of follow-up found that younger patients had a greater reduction in the serum levels of Hs-CRP and IL-6, suggesting that rosuvastatin had a greater anti-inflammatory effect in younger patients (Table 4). Moreover, comparisons between CAE groups of

different ages revealed that the highest serum levels of Hs-CRP and IL-6 were found in younger CAE patients (CAE-A), suggesting that cardiovascular inflammation related to CAE may occur at a comparatively younger age (Table 4).

Table 4. Comparison of serum Hs-CRP and IL-6 levels in CAE patients treated with rosuvastatin

Groups	CAE-A (n=60) (age ≤50)				CAE-B (n=83) (50<age≤70)				CAE-C (n=74) (age >70)		
	Pretreatment	Posttreatment	*Delta*	*p*-value	Pretreatment	Posttreatment	*Delta*	*p*-value	Pretreatment	Posttreatment	*Delta*
Hs-CRP (mg/L)	32.3 ± 5.51	17.5 ± 2.38 *	15.1 ±3.3	0.0001	26.1 ± 4.23	18.8 ± 2.74 *	9.4 ± 2.86	0.023	22.5 ± 4.82	19.8 ± 2.98	4.5 ± 3.12
IL-6 (pg/dL)	12.3 ± 1.5	6.4 ± 1.7*	5.9 ±1.6	0.021	10.9 ± 1.3	7.5 ± 2.0*	3.0 ± 1.5	0.043	8.9 ± 1.1	7.6 ± 2.3	1.9 ± 1.5

CAE: coronary artery ectasia. Hs-CRP: high-sensitivity C-reactive protein. IL-6: interleukin-6. Pretreatment: values measured at study inclusion. Posttreatment: values measured after 6 months of treatment with rosuvastatin. *: $p<0.05$ vs corresponding pretreatment group.

Discussion

Dyslipidemia is a well-recognized, major risk factor for atherosclerosis [16, 17]. Increased serum lipids, especially LDL-C, will deposit in the arterial wall and gradually form atherosclerotic plaques, which can consequently block the native artery and cause cardiovascular diseases such as coronary heart disease [18]. Increased inflammation is the core process in all stages of atherosclerosis. With the application and development of many techniques, such as anti-inflammatory therapy, antithrombotics, thrombolysis drugs, and catheter treatment, in recent decades, the incidence and mortality of atherosclerosis or obstructive vascular diseases have been significantly reduced [19, 20]. CAE is a multifactorial disease, and its pathogenic mechanism has not yet been fully elucidated. CAE is considered a variation in atherosclerosis, mainly resulting from the thinning and/or destruction of the myocardial membrane. However, the dilatation process may be independent of the atherosclerotic process because it can be found as an isolated lesion in coronary arteries and other vascular systems [21]. Elevated inflammatory markers, such as plasma IL-6 and plasma soluble adhesion molecules, are closely linked to the presence of coronary artery dilation [22-24]. Some studies have indicated increasing evidence that neutrophils and neutrophil-derived products participate in atherogenesis and CAE [25]. The neutrophil/lymphocyte ratio was higher in patients with CAD, coronary slow flow and CAE than in individuals with normal coronary anatomy. The NLR may be an indicator of CAD, CAE and coronary slow flow. This finding suggests that a more severe inflammatory process could be involved in the development of CAE [26-28]. A more significant level of chronic inflammation might be linked with the pathogenesis of CAE, which is associated with not only inflammatory markers but also inflammatory cells in patients with CAE [29].

Long-term exposure to nitrites, herbicide sprays, acetylcholine inhibitors, cocaine, and smoking can also lead to degeneration of the endometrium of the coronary arteries through oxidative stress-induced inflammation, which can eventually cause CAE. Research on inflammation and CAE has characterized CAE-related inflammation, which includes elevated Hs-CRP and IL-6 levels [30]. The accumulation of excess circulating LDL-C was associated with an overproduction of reactive oxygen species and an increase in proinflammatory cytokines in the coronary endothelium, linking elevated cholesterol with cardiovascular inflammation [31].

Rosuvastatin is a selective hydroxy methylglutaryl coenzyme A (HMG-CoA) reductase inhibitor widely used in the field of coronary atherosclerotic heart disease [32]. The liver is the main target organ of rosuvastatin, where it can lower cholesterol levels and increase the number of LDL receptors on the surface of liver cells, thereby improving lipid metabolism by promoting LDL absorption and inhibiting hepatic synthesis of very-low-density lipoprotein (VLDL) [33]. Statin therapy can exert pleiotropic effects in atherosclerotic processes such as regulating inflammatory responses, endothelial function, and thrombus formation based on the reduction in LDL-C levels [34]. Rosuvastatin can also stabilize or reverse atherosclerotic plaques by suppressing MMP expression and protecting the vascular endothelium against inflammation [35, 36]. There are limited studies focused on the inflammatory status of different age groups of CAE patients. The TC and LDL-C levels are important for the risk evaluation of coronary heart disease, which benefits from statin therapy through the reduction in LDL-C, Hs-CRP, and IL-6 [37]. There are some potential explanations for this result. First, younger patients are more likely to be stressed, resulting in a more primed or activated inflammatory status [38]. In addition, younger patients responded more strongly to physical and emotional stimulation [39], which can lead to increased levels of inflammatory markers. There are other lifestyle factors that can also lead to inflammation, such as cocaine abuse and trauma [8].

Previous prospective studies have also found that statins could efficiently slow down the growth rate of an abdominal aortic aneurysm compared with the growth rate of abdominal aortic aneurysms in controls [40]. In the present study, the efficacy of rosuvastatin in CAE patients in different age groups was investigated and compared. The findings may be explained by higher levels of inflammatory markers in younger patients compared to those in older patients; thus, the same dose of rosuvastatin could be more likely to produce a greater anti-inflammatory effect. Moreover, a smaller percentage of younger people have never taken rosuvastatin before. Older patients had a higher proportion of rosuvastatin history because of arteriosclerosis, hyperlipidemia, and stroke, among other health complications. Therefore, the lipid-lowering effect of rosuvastatin may be more potent, which boosts its anti-inflammatory effects in young patients. The Cholesterol Treatment Trialists' Collaboration reported that the efficacy of statin therapy in older patients was lower than that in younger patients [41]. Furthermore, younger individuals have a higher basal metabolism level in regard to lipid synthesis and degradation [42]; therefore, younger CAE patients could be more sensitive to rosuvastatin treatment. After rosuvastatin treatment, the Hs-CRP and IL-6 levels of the CAE-A group were reduced to levels

comparable to those of the NC group, while those in the CAE-C group were only partially reversed, indicating that the inflammatory status of younger CAE patients was more severe but reversible, while inflammation in older CAE patients was comparatively mild, persistent, and irreversible.

Study limitations

First, this study is based on a relatively small number of patients, although a large sample size was examined. Second, although specific exclusion criteria were selected, some confounding factors may still cause interference; for example, the accurate assessment of coronary artery diameter may be limited due to uncertainty in identifying the reference part of the vessel. It would be better to use intravascular ultrasound or optical coherence tomography to provide more accurate information about the vessel. Third, pharmacological therapy was withheld for at least 24 h before cardiac catheterization, but this period may not be enough to exclude the possible effects of drugs on plasma inflammatory markers.

Conclusion

Younger CAE patients had higher levels of inflammatory markers than older CAE patients. The greatest efficacy of anti-inflammatory treatment was found in younger CAE patients, suggesting that the clinical focus of rosuvastatin in the treatment of CAE patients should be to prescribe rosuvastatin at a comparatively early stage.

List Of Abbreviations

ACEIs: angiotensin-converting enzyme inhibitors; ARBs: angiotensin-receptor blocker; CAE: coronary artery ectasia; Hs-CRP: high-sensitivity C-reactive protein; IL-6: interleukin-6; LDL-C: low-density lipoprotein cholesterol; PO: per os; QN: quaque nocte; WBC: white blood cell.

Declarations

Ethics approval and consent to participate

The ethics committee of Shanghai East Hospital, Shanghai East Hospital (Ji'an Campus), and Cardiovascular Medicine of Baoshan People's Hospital of Yunnan Province approved the study, and all patients provided written informed consent prior to participating in the study.

Consent for publication

Not applicable.

Availability of data and materials

Study protocol and data set: Not available. Statistical code: Available from Dr. Luo (e-mail, luoyu201909@163.com).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CHF and YH contributed equally to this work. CHF acquired, analyzed and interpreted the data and wrote the manuscript. YH acquired, analyzed and interpreted the data and revised the manuscript. RLL designed the study and acquired, analyzed and interpreted the data. LY revised the manuscript, and XLL, YHL and ZHH acquired the data. All authors read and approved the final manuscript.

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Figures

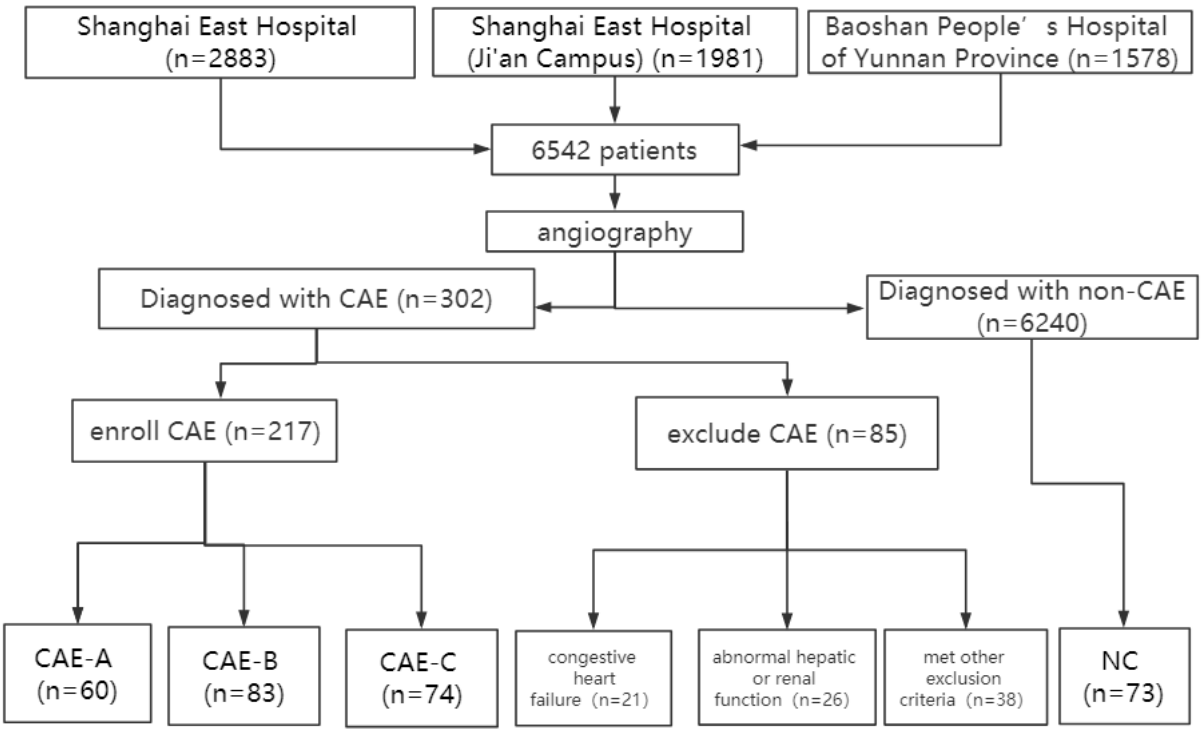

Figure 1

The patient screening flow chart.

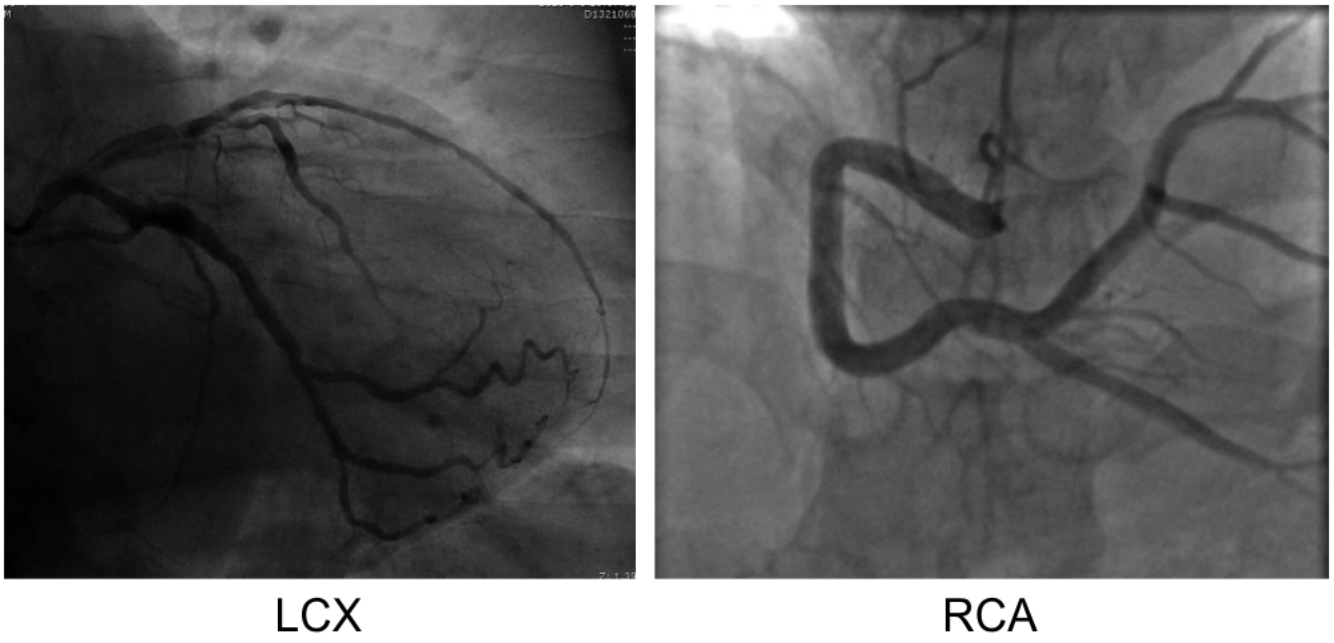

Figure 2

Representative coronary artery ectasia images of the left circumflex branch (LCX) and right coronary artery (RCA).

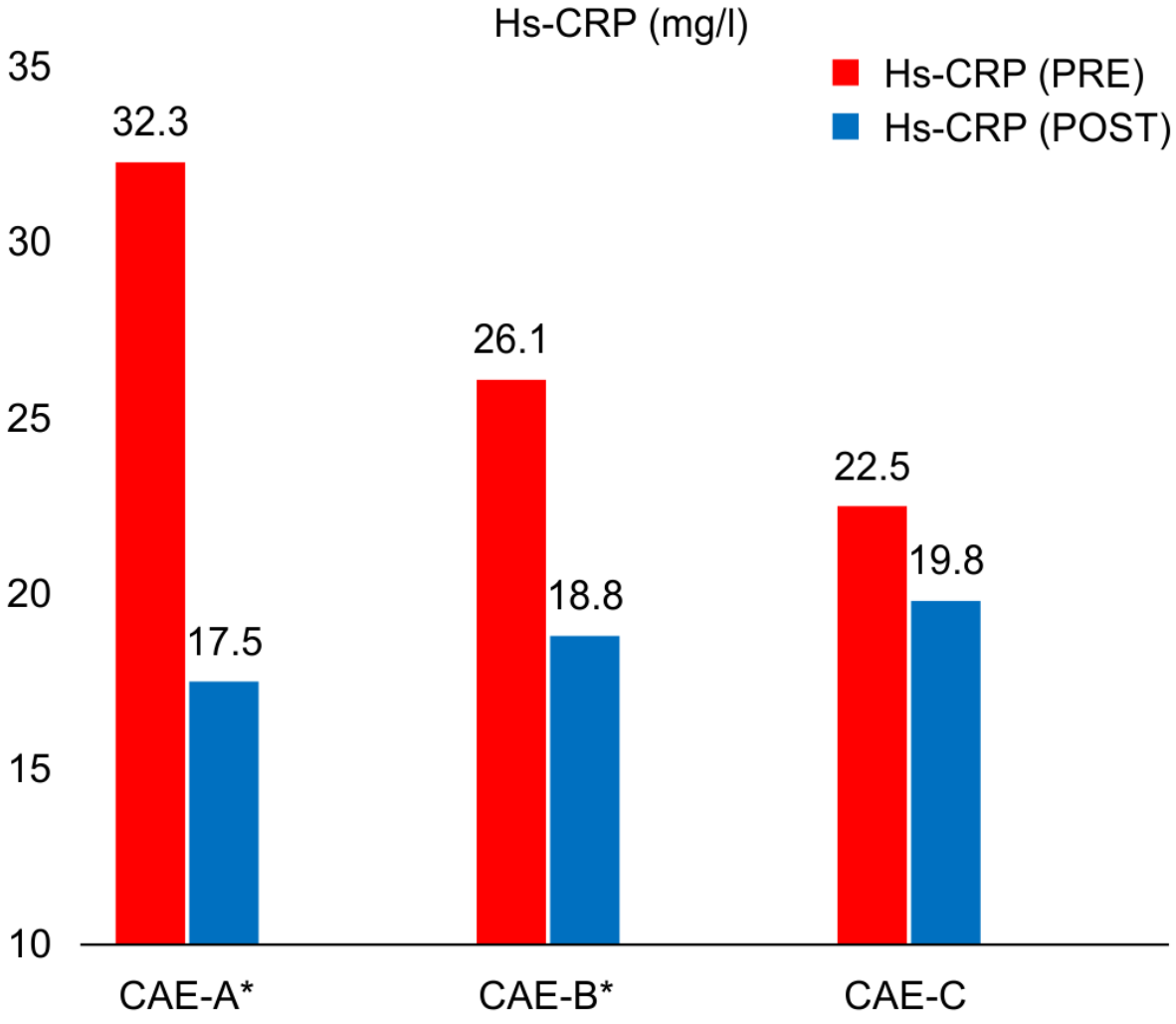

Figure 3

Comparison of serum Hs-CRP levels in CAE patients treated with rosuvastatin

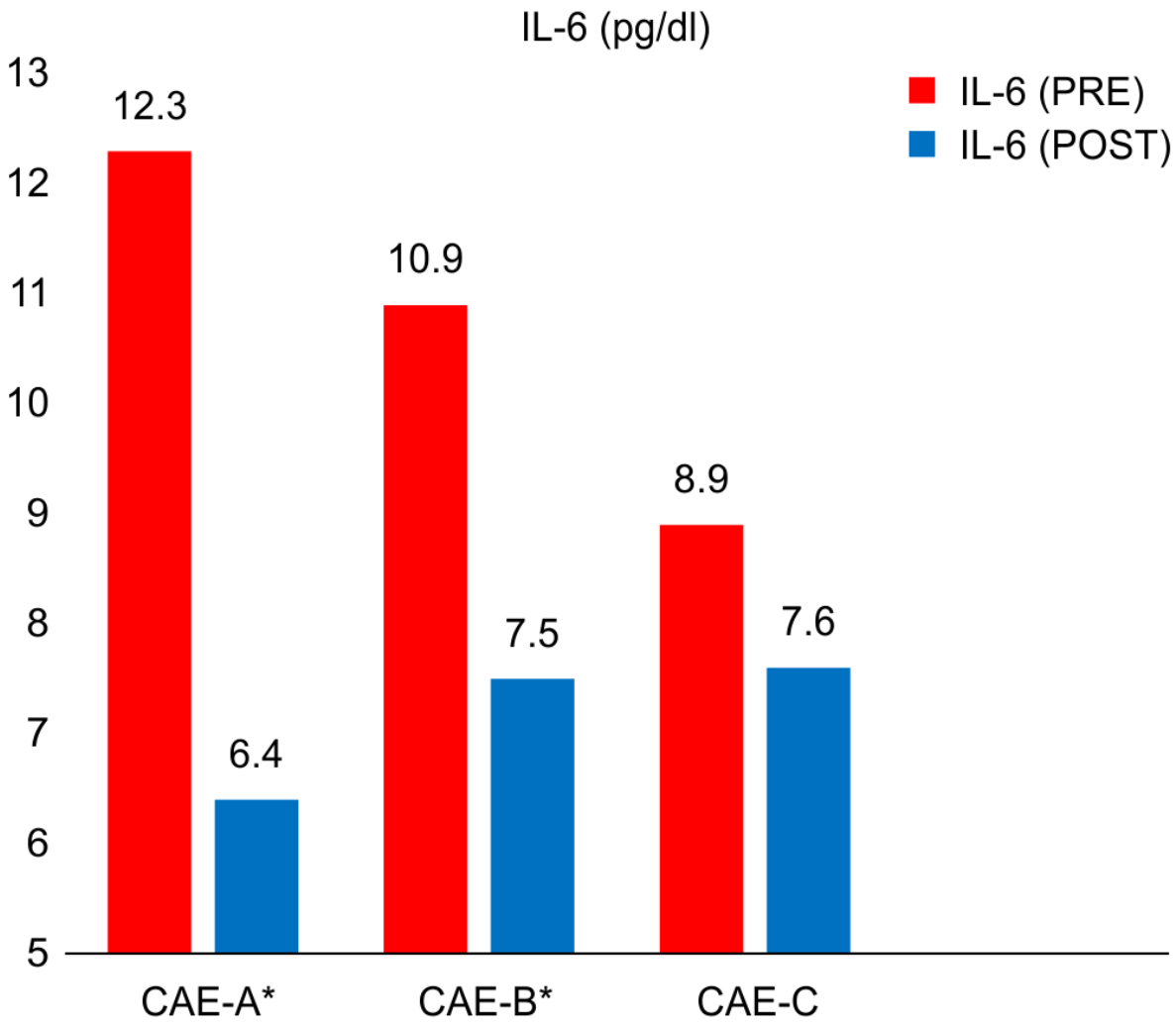

Figure 4

Comparison of serum IL-6 levels in CAE patients treated with rosuvastatin