# Effect of preoperative intensive statin on the efficacy and inflammatory response of acute ST-segment elevation myocardial infarction after emergency percutaneous coronary intervention

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| ARTICLE INFO | ABSTRACT |
|---|---|
| | It was to explore the application value of individualized nursing oriented by solution-focused nursing mode in postoperative nursing of patients with pelvic fractures. 90 patients with ST-segment elevation myocardial infarction (STEMI) undergoing emergency percutaneous coronary intervention (PCI) were enrolled. They were randomly grouped into a control group and an experimental group, with 45 cases in each group. Patients in the general group were treated with conventional treatment, and patients in the enhancement group were treated with high-dose rosuvastatin based on conventional treatment. The experimental group was compared for indicators such as serum inflammatory factors, cardiac function, overall efficacy, and follow-up prognosis before and after the operation. After treatment, the total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) in the enhancement group were better as against the control group ($P<0.05$). Through treatment, the concentration of high-sensitivity C-reactive protein (hs-CRP), tumor necrosis factor-$\alpha$ (TNF-$\alpha$), and interleukin-6 (IL-6) in the enhancement group was lower compared to the general group. The total effective rate of the enhancement group (95.56%) was higher relative to the general group (86.67%) ($P<0.05$). In patients with STEMI, preoperative intensive statin therapy can improve the efficacy of PCI, and reduce the inflammatory response and the incidence of cardiovascular events. |

## Introduction

Coronary heart disease (CHD) is a common chronic heart disease, which refers to the stenosis or occlusion of the lumen caused by coronary artery atherosclerosis, leading to myocardial ischemia, hypoxia, or necrosis (1). Acute myocardial infarction (AMI) is the most serious type of CHD. Cardiovascular disease has become the number one killer in the 21st century (2). With the aggravation of population aging, the incidence and mortality of AMI accelerate sharply. It has a high incidence in economically developed countries and is the cardiovascular disease with the highest mortality in the world (3). STEMI is a common cardiovascular disease in clinical practice, which is caused by the sudden interruption of coronary blood flow caused by acute occlusion of the coronary artery and long-term ischemia and hypoxia of the myocardium (4). STEMI patients generally have an acute onset and a high mortality rate. The principle of clinical treatment is to restore myocardial blood supply as soon as possible and reduce myocardial ischemia and hypoxia damage. PCI is currently the best treatment for STEMI, which can restore reperfusion as early as possible and reduce the infarct area. However, ischemia-reperfusion injury can cause slow blood flow in myocardial tissue and no-reflow in the kidney, which seriously affects cardiac function and the prognosis of patients (5). Intensive statin therapy for STEMI patients before PCI can effectively reduce ischemia-reperfusion injury (6,7). Intensive statin therapy is generally adopted to treat cerebral infarction, atherosclerosis, and hypercholesterolemia (8). Once cerebral infarction or atherosclerosis occurs, intensive statin drugs can generally be taken to regulate the concentration of blood lipids and promote blood circulation, thereby alleviating vascular obstruction and other phenomena (9). For patients with hypercholesterolemia, taking intensive statin can inhibit cholesterol synthesis and regulate lipid metabolism, to reduce the concentration of cholesterol and relieve and control the disease to a certain extent (10,11).

After PCI, patients are prone to produce many free radicals during myocardial perfusion, which can cause oxidative stress and inflammatory reactions, leading to an increased risk of cardiovascular events and poor prognosis of patients (12). The success rate of PCI is getting higher and higher, but some patients have decreased diastolic and systolic function after PCI. Statins are widely used in cardiovascular problems because of their lipid-lowering, anti-inflammatory, anti-oxidation, and promotion of the stability of atherosclerotic plaques. Studies revealed that PCI can evidently reduce the mortality and reinfarction rate of STEMI patients (13,14). Previous studies adopted a relatively small dose of statins, and there are relatively few studies on the application of high-dose statins. Therefore, it aimed to investigate the use of atorvastatin before PCI in patients with STEMI and analyze its therapeutic outcome and the influence of inflammatory response.

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## Materials and Methods

### Subjects

A retrospective analysis was performed, and 90 patients with STEMI admitted in May 2019 to May 2022 to Beijing Anzhen Hospital who underwent emergency PCI within 12h at onset received emergency PCI and recanalization of the infarcted vessel. Patients with indications for emergency reperfusion signed the consent for PCI. The operation was performed through the right radial artery, and the infarct-related vessels were intervened by drug-coated stents.

STEMI was defined as ischemic chest pain for 30 minutes or more; electrocardiogram showed ST-segment elevation $\geq 0.1$ mV in at least two adjacent limb leads or $\geq 0.2$ mV in two adjacent precordial leads.

In the enhancement group (n=45), there were 24 men and 21 women, aged from 53 to 72 years, with a mean age of (59.1±7.3), and mean body mass index (BMI) of (25.16±2.13) kg/m$^2$.

The general group (n=45) had 28 men and 17 women, aged 52-68 years, with a mean age of (56.1±8.1), and a mean BMI of (24.93±1.43) kg/m$^2$. There was similar in gender, age, disease condition, and others between both groups ($P > 0.05$). The baseline data of the two groups were comparable. The approval was obtained by the Ethics committee of Beijing Anzhen Hospital, and patients signed the informed consent form.

### Inclusion criteria

Patients with complete clinical data; Patients were diagnosed with STEMI by imaging diagnosis, echocardiography, and clinical comprehensive examination; Patients voluntarily participated in the trial; Patients who met the criteria of emergency PCI; The patient had no contrast agent allergy. Patients with clear consciousness, are able to actively cooperate with the examination.

### Exclusion criteria

Patients with language communication disorder, dementia, or cognitive impairment; Patients with mental illness; Patients with a history of statin use within the previous week; Severe systemic and tissue abnormalities; Patients with complications due to illness; Genes that affect serum inflammatory factors, such as severe liver and kidney dysfunction, infectious diseases, and tumors.

### Implementation measures

Before surgery, 300 mg aspirin (H32025901, Jiangsu Pingguang Pharmaceutical Co., LTD., specification 50 mg) and 300 mg clopidogrel (H20000542, Shenzhen Salubris Pharmaceuticals Co., Ltd., specification 25 mg) were taken.

The general group received conventional statin therapy, and clopidogrel sulfate tablets (J20180029, Sanofi Pharmaceutical Co., LTD., specification 75 mg/28 tablets) and aspirin enteric-coated tablets (J20171021, Bayer Healthcare Co., LTD., specification 100 mg/30 tablets) were adopted before PCI. After the operation, preventive drugs were taken, and rosuvastatin was taken orally once every night (H20080670, Nanjing Chia-Tai Tianqing Pharmaceutical Company, 10 mg).

The enhancement group was treated with 20 mg rosuvastatin before the operation based on the general group, and the same treatment as group A after PCI, and the treatment was given for 6 months.

### Determination of inflammatory factors

Within 24h following admission and 1 week post-treatment, 5 ml of peripheral venous blood was collected in the fasting state and then separated and stored in the refrigerator at -70°C for further storage. Serum hs-CRP concentration was measured by nephelometry. The serum levels of TNF-α and IL-6 were measured by enzyme-linked immunosorbent assay. The kit was obtained from Beijing Rose-Gene Medical Technology Co., LTD. The microplate reader was from the America Bio-Rad Company Model enzyme-linked assay instrument, and the automatic immunoassay system was from America Company Immage.

### Observation indicators

### Evaluation of coronary blood flow

To indirectly reflect myocardial perfusion status, TIMI grade was applied and coronary flow was evaluated by corrected TIMI frame count (CTFC) post-operation. The readers were unaware of the grouping and were unaware of the preoperative drug doses.

### Efficacy evaluation

The therapeutic effect was evaluated at 1 month post-operation, total effective = markedly effective + effective, the symptoms and signs of patients disappeared, and the improvement of ECG ST-segment by more than 50% indicated markedly effective treatment; The above were clearly improved, and the improvement of ECG ST-segment less than 50% meant effective. There was no improvement or aggravation of symptoms and signs, and no resolution or elevation of ST-segment meant ineffective.

### Evaluation of cardiac function

Cardiac function indexes, including wall motion score index and left ventricular ejection fraction, were evaluated before and one month after operation.

In the evaluation of the wall motion index, 5 scores were given for ventricular aneurysm formation, 4 scores for paradoxical or abnormal motion, 3 scores for disappeared motion, 2 scores for decreased motion, and 1 score for normal motion.

### Laboratory index analysis

The levels of TC, TG, HDL-C, and LDL-C were compared between two groups before and one week post-surgery.

The inflammatory factors, hs-CRP, IL-6, and TNF-α of the two groups were analyzed.

### Follow-up results

Following 6 months of follow-up, the safety, adverse reactions, and expectations of the patients were evaluated.

### Statistical analysis

SPSS 20.0 software was adopted to analyze the experimental data. The measurement data were presented as mean ± standard deviation ($\bar{x}±s$), the chi-square test for the comparison of count data between groups, and the $T$-test was adopted. The rate (n, %) was adopted for the count data. $P<0.05$ was considered statistically meaningful.

# Results

## General baseline data of patients

The enhancement group had 24 men and 21 women (53 to 72 years), with a mean age of (59.1±7.3) years, and a mean BMI of (25.16±2.13) kg/m².

In the general group, there were 28 men and 17 women, aged 52-68 years, with a mean age of (56.1±8.1) years, and a mean BMI of (24.93±1.43) kg/m². The general baseline data of two groups were analyzed (*P*>0.05) (Table 1).

## Evaluation of coronary blood flow in patients

Figure 1 suggests that the enhancement group was (41.3±5.9) % before surgery and (56.91±6.3) % one month after surgery, and the general group was (41.5±5.7) % and (48.49±6.6) %, respectively. The left ventricular ejection fraction was superior as against before surgery in both groups. The enhancement group was better (*P*<0.05).

Figure 2 illustrates that the enhancement group was (2.6±0.4) % before surgery and (1.7±0.5) % one-month post-surgery, and the general group was (2.7±0.5) % and (2.3±0.6) %, respectively. The wall motion score index of the two groups was superior relative to before surgery, with the enhancement group better (*P*<0.05).

## Efficacy evaluation

Table 2 shows the efficacy of the two groups at one-month post-operation. The overall effective rate of the enhancement group was higher (*P*<0.05).

## hs-CRP

As illustrated in Figure 3, the hs-CRP of the enhancement group was lower as against the general group within 12h and 24h post-surgery (*P*<0.05).

## Comparison of TNF-α and IL-6

Through one week of treatment, the concentrations of TNF-α and IL-6 in both groups were decreased, but the re-
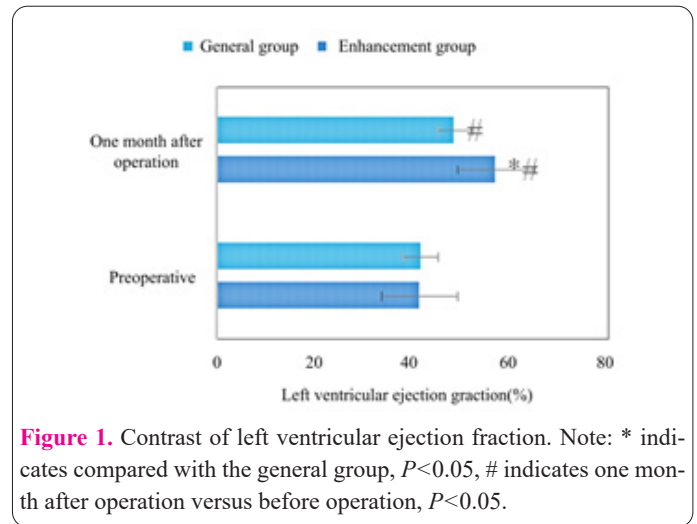


**Figure 1.** Contrast of left ventricular ejection fraction. Note: * indicates compared with the general group, *P*<0.05, # indicates one month after operation versus before operation, *P*<0.05.
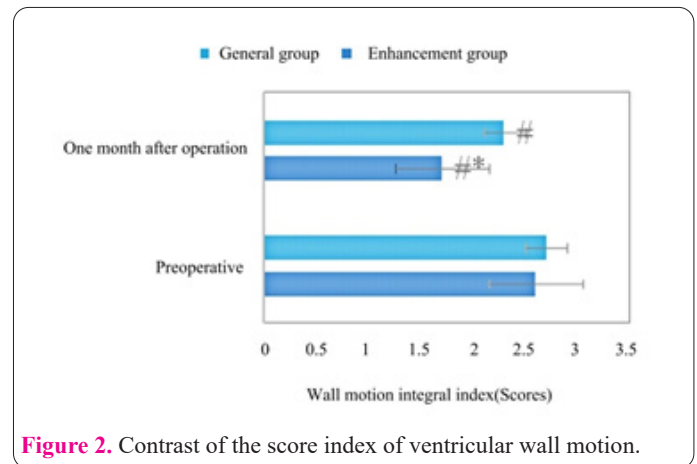


**Figure 2.** Contrast of the score index of ventricular wall motion.

duction of inflammatory factors in the enhancement group was greater (*P*<0.05) (Figure 4).

## Laboratory indicators

There were no clear differences in TC, TG, LDL-C, and HDL-C levels between the two groups pre-treatment

**Table 1.** Comparison of general baseline data.

| Indicators | Enhancement group (n=45) | General Group (n=45) | $\chi^2$ | *P* |
|---|---|---|---|---|
| Gender | | | 0.357 | 0.71 |
| Male | 24(53.33%) | 28(62.22%) | | |
| Female | 21(46.67%) | 17(37.78%) | | |
| Age | 59.1±7.3 | 56.1±8.1 | 8.56 | 0.38 |
| BMI | 25.16±2.13 | 24.93±1.43 | 9.76 | 0.87 |
| History of hypertension | 22(48.89%) | 19(42.22%) | 6.75 | 0.54 |
| History of angina pectoris | 7(15.56%) | 16(35.56%) | 7.36 | 0.28 |
| History of smoking | 16(35.56%) | 26(57.78%) | 21.78 | 4.87 |
| Family history of CHD | 7(15.56%) | 4(8.89%) | 13.54 | 2.45 |
| History of diabetes mellitus | 9(20.0%) | 6(13.33%) | 6.17 | 0.97 |
| Taking nitrates | 7(15.56%) | 8(17.78%) | 8.76 | 0.83 |
| Taking CCB drugs | 5(11.11%) | 6(13.33%) | 7.49 | 0.67 |
| Severe liver injury | 4(8.89%) | 5(11.11%) | 4.13 | 2.04 |

**Table 2.** Comparison of efficacy.

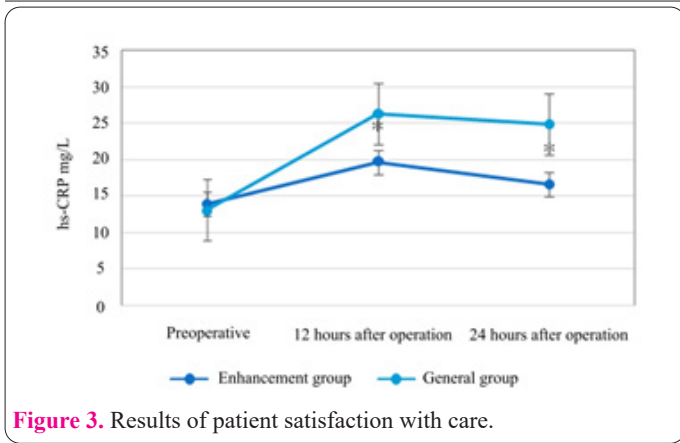| | Enhancement group (n=45) | General Group (n=45) | $\chi^2$ | *P* |
|---|---|---|---|---|
| Markedly effective | 19(42.22%) | 10(22.22%) | | |
| Effective | 22(48.89%) | 29(64.44%) | | |
| Invalid | 2(4.44%) | 6(13.33%) | | |
| Total effective rate | 43(95.56%) | 39(86.67%) | 5.317 | 0.035 |

**Figure 3.** Results of patient satisfaction with care.

(*P*<0.05). Through treatment, the levels of TC, TG, LDL-C, and HDL-C in the enhancement group were lower, and the level of HDL-C was higher (*P*<0.05) (Figure 5).

**Follow-up results**

Through 6 months of follow-up, the incidence of cardiovascular events and adverse events in two groups were statistically analyzed. Cardiovascular events included re-myocardial infarction, arrhythmia, heart failure, cardiogenic shock, and adverse reactions included fatigue, gastrointestinal symptoms, abdominal discomfort, nausea, and muscle soreness. As can be observed from the statistical values, the incidence of cardiovascular events and adverse conditions in the general group was higher (Table 3).

**Discussion**

Myocardial infarction is a cardiovascular disease, and the incidence of AMI is increasing, which seriously threatens human health. In acute STEMI, based on coronary atherosclerosis, plaque rupture induces thrombosis, resulting in acute coronary occlusion (15). STEMI patients often have dyslipidemia, which can be caused by high TC and TG, and low HDL-C. In clinical practice, there will be AMI, unstable angina, sudden death, etc. At present, the main control methods for hyperlipidemia are hypertension control and early drug intervention. Rapid and repeated recanalization of infarct-related vessels is the key to the treatment of acute STEMI, which is conducive to reducing the mortality of patients (16). CDL-C is a risk factor for cardiovascular disease, and reducing the occurrence of LDL-C is beneficial to reduce the incidence of myocardial infarction. There was a similar in TC, TG, LDL-C, and HDL-C between the two groups pre-operation. Following one week of treatment, the indexes of the two groups changed. The levels of TC, TG, and LDL-C were lower and the
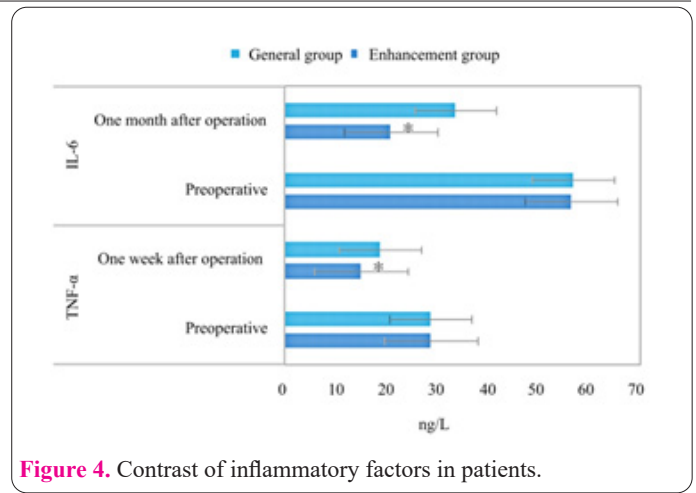


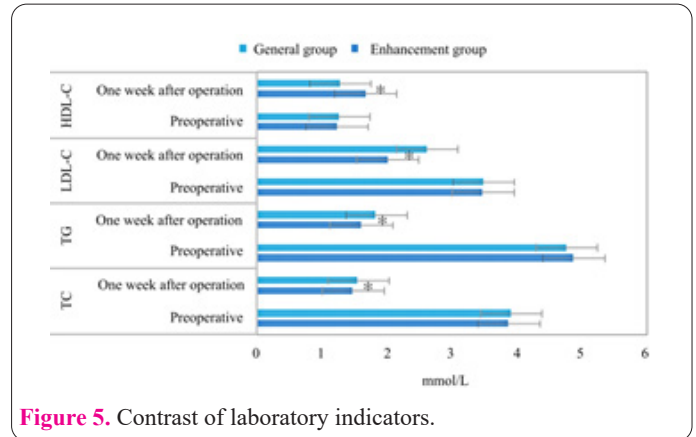**Figure 4.** Contrast of inflammatory factors in patients.



**Figure 5.** Contrast of laboratory indicators.

level of HDL-C was higher in the enhancement group as against before treatment (*P*<0.05). It indicates that preoperative intensive treatment can reduce LDL-C. HDL-C has the characteristics of anti-oxidation and anti-proliferation and can play an anti-inflammatory role. Through treatment, the HDL-C value of patients in the enhancement group increased, indicating that the patients play a role in slowing down atherosclerosis, and reducing the incidence of myocardial infarction.

Inflammatory factors are a predictor of the prognosis of cardiovascular diseases. The occurrence of an inflammatory process promotes the thickening of arterial intima and causes the instability of arterial plaque. hs-CRP is a circulating marker that can reflect inflammation and atherosclerosis (17). There are many modifiable risk factors for identifying and preventing cardiovascular morbidity and mortality in older adults, such as dyslipidemia and inflammatory markers, as well as cardiovascular event risk factors, Płociniczak et al. (18) showed that hs-CRP is a cardiovascular risk marker for independent community-living

**Table 3.** Comparison of prognostic status.

| | Enhancement group (n=45) | General Group (n=45) | $\chi^2$ | *P* |
|---|---|---|---|---|
| Recurrent myocardial infarction | 1(2.22%) | 2(4.44%) | 1.123 | 0.214 |
| Heart rate disorder | 3(6.67%) | 4(8.89%) | 1.365 | 0.305 |
| Heart failure | 1(2.22%) | 3(6.67%) | 1.087 | 0.201 |
| Gastrointestinal symptoms | 2(4.44%) | 3(6.67%) | 1.675 | 0.103 |
| Fatigue | 4(8.89%) | 5(11.11%) | 1.078 | 0.105 |
| Muscle soreness | 3(6.67%) | 2(4.44%) | 2.301 | 0.078 |
| Nausea | 1(2.22%) | 2(4.44%) | 0.871 | 0.514 |
| Abdominal discomfort | 1(2.22%) | 2(4.44%) | 0.913 | 0.607 |
| Cardiogenic shock | 1(2.22%) | 2(4.44%) | 5.317 | 0.035 |

elderly people. The level of hs-CRP in enhancement group was lower as against general group at 12h and 24h post-surgery ($P<0.05$). The results revealed that intensive statin can reduce hs-CRP and promote the recovery of myocardial function in patients with STEMI. Inflammatory factors are closely related to coronary artery disease, and the changes in serum inflammatory factors help predict the prognosis of patients with cardiovascular disease. Many studies have shown that atherosclerosis is an inflammatory disease, inflammatory factors cause thrombosis, and atherosclerotic plaque rupture, and inflammatory factors affect hemodynamics, ventricular remodeling, and microcirculation function, playing a certain positive role in prognosis (19,20). It was found that statins have a major role in the secondary prevention of coronary artery disease. The main mechanism of action is to reduce LDL-C value, increase HDL-C value, and play a role in the process of regulating lipids, such as anti-thrombosis, improving endothelial function, and dilating coronary microvessels. Solheim et al. (21) showed that aspirin could reduce hs-CRP and TNF-α in patients with AMI. Altaf et al. (22) pointed out that high-dose rosuvastatin can regulate the inflammatory process of atherosclerosis by down-regulating the expression of NLRP3, cathepsin B and its downstream mediators. The inflammatory factors IL-6 and TNF-α affect the prognosis of patients with AMI in the process of onset. Sun et al. (23) proposed that changes in serum MMP-2 and IL-18 levels may be helpful for the diagnosis and prognosis prediction of acute coronary syndrome. Derosa et al. (24) proposed that the combination of nutritional supplements reduced TC and LDL-C. The hs-CRP, IL-6, and TNF-α of patients with dyslipidemia were clearly reduced, and the inflammatory response was reduced. Following one week of treatment, the concentrations of TNF-α and IL-6 in the two groups were decreased, but the reduction in the enhancement group was greater ($P<0.05$). It suggests that the inflammatory factors in patients with STEMI are gradually decreased after preoperative intensive statin therapy, and the decrease is more obvious in the enhancement group, indicating that intensive statin therapy before emergency PCI effectively inhibits the development of inflammatory factors. It is beneficial to improve myocardial perfusion.

### Author contributions

Xianliang Yan and Chengqian Yin designed this retrospective study, Xianliang Yan and Qian Wang wrote this paper; Xianliang Yan, Qian Wang, Yulong Gao, and Chengqian Yin were responsible for sorting the data.

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