

Analysis and Research on the Effect of Isosorbide Mononitrate Combined with Nicorandil in the Treatment of Myocardial Ischemia in Coronary Heart Disease

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Abstract: Objective: To study the efficacy of isosorbide mononitrate combined with nicorandil in the treatment of myocardial ischemia in coronary heart disease. Methods: 100 patients with myocardial ischemia due to coronary heart disease who visited our hospital from January 2022 to January 2025 were selected as samples and randomly divided into two groups. Group A received isosorbide mononitrate combined with nicorandil, while Group B received isosorbide mononitrate only. The efficacy, electrocardiogram, cardiac function, and complications were compared between the two groups. Results: The efficacy of Group A was higher than that of Group B ($P < 0.05$). The electrocardiogram indicators of Group A were better than those of Group B ($P < 0.05$). The cardiac function indicators of Group A were better than those of Group B ($P < 0.05$). The complication rate of Group A was lower than that of Group B ($P < 0.05$). Conclusion: The combination of isosorbide mononitrate and nicorandil in the treatment of myocardial ischemia in coronary heart disease can improve cardiac function, reduce myocardial ischemia load, and is safe and efficient.

Keywords: Myocardial ischemia in coronary heart disease; Nicorandil; Isosorbide mononitrate; Efficacy

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1. Introduction

Coronary heart disease is caused by partial or complete blockage of blood vessels due to coronary atherosclerotic plaques, which can lead to insufficient blood and oxygen supply and necrosis of the myocardium over time. It has a certain mortality rate. Some patients with myocardial ischemia due to coronary heart disease choose surgical treatment, but cardiac surgery has high risks, high costs, and difficulties in promotion. With the deepening of clinical research on the treatment of coronary heart disease, there are various types of anti-myocardial ischemia drugs available, and the number of patients choosing drugs such as isosorbide mononitrate and nicorandil for treatment has increased. Isosorbide mononitrate is administered intravenously to rapidly stimulate blood vessel

dilation and correct myocardial ischemia, but its effect on improving cardiac function is limited when used as a single drug. Nicorandil is administered orally and can reduce coronary artery spasms, improve coronary blood flow, and has a low impact on blood pressure and heart rate when used long-term^[1]. Based on this, this article explores the efficacy of isosorbide mononitrate combined with nicorandil using 100 patients with myocardial ischemia due to coronary heart disease who visited our hospital from January 2022 to January 2025 as samples.

2. Materials and methods

2.1. Materials

100 patients with myocardial ischemia due to coronary heart disease who visited our hospital from January 2022 to January 2025 were selected as samples and randomly divided into two groups. There was no statistically significant difference in baseline data between Group A and Group B ($P > 0.05$) (**Table 1**).

Table 1. Information on myocardial ischemia in coronary heart disease

Group	<i>n</i>	Gender (%)		Age (years)		Duration of illness (months)	
		Male	Female	Range	Mean	Range	Mean
Group A	50	21 (42.00)	29 (58.00)	41–79	63.82 ± 2.15	11–27	18.42 ± 1.88
Group B	50	22 (44.00)	28 (56.00)	41–78	63.79 ± 2.13	11–28	18.39 ± 1.92
χ^2/t	-	0.0408		0.0701		0.0789	
<i>P</i>	-	0.8399		0.9443		0.9372	

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Coronary angiography indicating moderate stenosis of coronary arteries (stenosis degree < 70%); (2) Signed informed consent; (3) ECG results showing ST segment depression of 0.1 mV.

Exclusion criteria: (1) Clear surgical indication; (2) Psychiatric diseases; (3) Taking medications that may affect myocardial blood supply before enrollment.

2.3. Treatment methods

Observation group: Intravenous infusion of isosorbide mononitrate injection, single dose of 20 mg, once per day; oral administration of nicorandil tablets, single dose of 5 mg, twice per day. The medication was administered for 2 weeks.

Control group: Intravenous infusion of isosorbide mononitrate injection, single dose of 20 mg, once per day. The medication was administered for 2 weeks.

2.4. Observation indicators

- (1) Curative effect: increased exercise tolerance, ECG prompted exercise/resting ST segment recovery $\geq$ (1) mV in clinical treatment, marked as effective; improved exercise tolerance, ECG prompted ST segment recovery, but did not meet the health standards, marked as valid; unable to perform normal activities, ECG did not improve, marked as invalid.
- (2) ECG: Record the number of ST segment depressions and myocardial ischemia load.
- (3) Cardiac function: Color Doppler ultrasound was used to record cardiac output, cardiac output index, stroke volume, and left ejection fraction.

(4) Complications: Record the incidence of angina pectoris, arrhythmia, and heart failure.

2.5. Statistical analysis

SPSS 23.0 was used to process the data. Count data were described using percentages (%) and analyzed using the chi-square test (χ^2 test). Measurement data were described using mean $\pm$ standard deviation (SD) and analyzed using the t-test. Statistical differences were considered significant at $P < 0.05$.

3. Results

3.1. Efficacy

The efficacy of group A was higher than that of group B, with $P < 0.05$ (Table 2).

Table 2. Efficacy of coronary heart disease with myocardial ischemia (n, %)

Group	Markedly effective	Effective	Ineffective	Effective rate
Group A ($n = 50$)	38 (72.00)	11 (22.00)	1 (2.00)	49 (98.00)
Group B ($n = 50$)	30 (60.00)	13 (26.00)	7 (14.00)	43 (86.00)
χ^2	-	-	-	4.8913
P	-	-	-	0.0270

3.2. ECG

After medication, the ECG indicators of group A were better than those of group B, with $P < 0.05$ (Table 3).

Table 3. ECG indicators of coronary heart disease with myocardial ischemia (mean $\pm$ SD)

Group	ST-segment depression frequency (times/h)		Myocardial ischemia load (mm·min)	
	Before medication	After medication	Before medication	After medication
Group A ($n = 50$)	7.19 $\pm$ 0.81	2.01 $\pm$ 0.11	84.15 $\pm$ 6.82	25.41 $\pm$ 4.26
Group B ($n = 50$)	7.21 $\pm$ 0.79	3.72 $\pm$ 0.49	84.16 $\pm$ 6.79	43.99 $\pm$ 5.81
t	0.1250	24.0773	0.0073	18.2361
P	0.9008	0.0000	0.9942	0.0000

3.3. Cardiac function

After medication, the cardiac function indicators of group A were better than those of group B, with $P < 0.05$ (Table 4).

Table 4. Cardiac function indicators of coronary heart disease with myocardial ischemia (mean $\pm$ SD)

Group	Cardiac output (L/min)		Cardiac index (L/min·m ²)		Stroke volume (mL)		Left ejection fraction (%)	
	Before	After	Before	After	Before	After	Before	After
Group A ($n = 50$)	2.79 $\pm$ 0.46	4.17 $\pm$ 0.26	1.81 $\pm$ 0.25	2.57 $\pm$ 0.44	44.06 $\pm$ 2.41	58.61 $\pm$ 4.19	44.16 $\pm$ 2.18	54.29 $\pm$ 3.81
Group B ($n = 50$)	2.81 $\pm$ 0.51	3.39 $\pm$ 0.37	1.83 $\pm$ 0.24	2.14 $\pm$ 0.31	44.09 $\pm$ 2.39	50.36 $\pm$ 3.87	44.19 $\pm$ 2.21	48.61 $\pm$ 3.22
t	0.2059	12.1964	0.4081	5.6491	0.0625	10.2277	0.0683	8.0514
P	0.8373	0.0000	0.6841	0.0000	0.9503	0.0000	0.9457	0.0000

3.4. Complications

The complication rate of group A was lower than that of group B, with $P < 0.05$ (Table 5).

Table 5. Complications of coronary heart disease with myocardial ischemia (n, %)

Group	Angina pectoris	Arrhythmia	Heart failure	Incidence rate
Group A ($n = 50$)	0 (0.00)	1 (2.00)	0 (0.00)	1 (2.00)
Group B ($n = 50$)	1 (2.00)	3 (6.00)	3 (6.00)	7 (14.00)
χ^2	-	-	-	4.8913
P	-	-	-	0.0270

4. Discussion

The pathological features of coronary heart disease mainly include coronary stenosis, which cannot provide sufficient blood to the heart, leading to reduced heart perfusion and myocardial metabolic disorders, which can induce a series of diseases [2]. Analyzing the common risk factors for myocardial ischemia in coronary heart disease, abnormally elevated blood pressure increases myocardial load, which can exacerbate coronary atherosclerosis; elevated blood lipids and blood glucose damage vascular endothelium, which can cause a large number of plaques to form in coronary arteries; long-term smoking stimulates vascular endothelium with nicotine, which can accelerate endothelial damage and increase thrombus production; and those with a family history of heart disease have a higher risk of developing myocardial ischemia in coronary heart disease. Further analysis of the pathological mechanism of myocardial ischemia in coronary heart disease is related to platelet aggregation and inflammatory stimulation, damaging the vascular endothelium, leading to exacerbated arteriosclerosis; it is also related to massive lipid deposition under the influence of multiple factors, generating coronary plaques and blocking coronary blood vessels to cause the disease.

After the occurrence of myocardial ischemia in coronary heart disease, the common symptom is chest pain, clinically known as angina pectoris, accompanied by a sense of urgency and oppression, and severe pain during disease attacks, involving the left arm, left shoulder, and back. The pain intensifies during overeating, emotional distress, and overexertion. Some patients experience relief after rest or sublingual administration of nitroglycerin. As the course of myocardial ischemia in coronary heart disease progresses, patients develop symptoms of dyspnea after activity, and even shortness of breath at rest. In severe cases, there is insufficient blood supply to the whole body, which can lead to symptoms such as palpitations, dizziness, and fatigue due to myocardial ischemia. After the onset of myocardial ischemia in some patients with coronary heart disease, there is excessive concern about secondary acute myocardial infarction, which can easily lead to severe anxiety and depression. Therefore, medication should be started as early as possible to restore coronary blood perfusion and optimize vascular function [3].

Isosorbide mononitrate is a nitrate ester drug that stimulates coronary dilation and smooth muscle relaxation, which can restore normal myocardial blood perfusion and help reduce the occurrence of angina pectoris. Additionally, intravenous infusion of isosorbide mononitrate can regulate venous system function, reduce blood return, and reduce left ventricular pressure, resulting in reduced venous circulation resistance and increased cardiac output [4]. However, during actual drug treatment for myocardial ischemia in coronary heart disease, a few patients experience symptoms such as orthostatic hypotension, dizziness, and headache, and even develop

resistance to nitrate ester drugs, affecting the effectiveness of coronary heart disease management. Nicorandil has a chemical structure similar to traditional nitrate ester drugs, but it belongs to a combined efficacy agent. After oral administration, it can exhibit the pharmacological effects of nitrate ester drugs and potassium ion opening. Taking nicorandil reasonably as prescribed can improve the body's hemodynamic indicators, reduce ventricular volume, and reduce coronary resistance, which is beneficial for stabilizing coronary blood flow. Long-term medication does not affect heart rate and has high safety; it can also expand potassium ion channels, accelerate the efflux of potassium ions from cells, thereby relaxing vascular smooth muscle and protecting the vascular endothelium; it can also improve coronary blood flow, restore coronary vascular filling, and reduce the occurrence of angina pectoris ^[5].

Based on the data analysis in this article, the efficacy of coronary heart disease and myocardial ischemia treatment in Group A is higher than that in Group B, with $P < 0.05$. The reason for this is the combined therapy with nicorandil. The active ingredients of the medication target intracellular guanylate cyclase, enhancing its enzymatic activity. This leads to an increase in cyclic guanosine monophosphate (cGMP) levels in the patient's body, which subsequently reduces intracellular calcium ions. This exerts multiple effects such as expanding coronary arteries, relaxing smooth muscles, stimulating vasodilation, and improving microvascular circulation. Consequently, myocardial oxygen consumption decreases while myocardial oxygen supply increases, benefiting the improvement of stress responses caused by myocardial ischemia and the repair of vascular endothelial damage due to coronary artery blockage, thereby enhancing myocardial function. Additionally, when combined with isosorbide mononitrate, it rapidly alleviates patient symptoms and restores exercise tolerance, exhibiting excellent efficacy ^[6].

Another set of data indicates that the electrocardiographic indicators of Group A are superior to those of Group B, with $P < 0.05$. The reason for this is that changes in the ST segment observed during electrocardiographic examination serve as a basis for physicians to analyze the degree of myocardial ischemia in patients. If the myocardial blood supply is inadequate, it affects myocardial electrical activity, manifesting as ST-segment depression. The degree of ST-segment depression directly reflects the severity of myocardial ischemia. Myocardial ischemia load is an important indicator for quantitatively analyzing the condition of patients with coronary heart disease. It comprehensively reflects changes in ST-segment depression amplitude, as well as the duration and frequency of single ST-segment depressions. This can predict adverse cardiac events and guide clinical treatment ^[7]. In this article, the nitrate drug isosorbide mononitrate is selected for treatment. After entering the body, it releases large amounts of nitric oxide, which accelerates smooth muscle relaxation by enhancing guanylate cyclase activity. This stimulates vasodilation, reduces cardiac load, and is beneficial for reducing the degree of myocardial ischemia and the occurrence of angina pectoris. Nicorandil can optimize the body's microcirculation state, further regulate myocardial ischemia load, and is conducive to preventing cardiovascular adverse events ^[8].

Another set of data shows that the cardiac function indicators of Group A are better than those of Group B, with $P < 0.05$. The reason for this is that cardiac output, measured in minutes, records the total amount of blood pumped by the heart and objectively reflects heart's pumping function. If myocardial ischemia damages myocardial contractility, it can lead to a decrease in cardiac output, impaired pumping function, and subsequently reduced blood supply to bodily tissues and organs. The cardiac index can also assist physicians in evaluating heart pumping status. This index is directly proportional to heart's pumping function, and values below normal indicate reduced blood supply to peripheral organs and tissues. Stroke volume refers to the amount of blood pumped out per heartbeat, directly reflecting changes in cardiac output. A decrease in this indicator after myocardial ischemia

suggests abnormal heart function. The left ejection fraction provides feedback on ventricular contraction status. In patients with myocardial ischemia, due to reduced heart pumping and weakened myocardial contractility, this indicator decreases. The combination therapy of isosorbide mononitrate and nicorandil in this article stimulates myocardial contraction and corrects myocardial ischemia, thereby increasing the amount of blood pumped by the heart per minute and improving the relationship between the body and various organs and tissues. This is beneficial for improving cardiac output and cardiac index ^[9].

Furthermore, isosorbide mononitrate treatment for coronary heart disease and myocardial ischemia can restore coronary blood flow, reduce myocardial load, and subsequently restore heart pumping capacity. The combination with nicorandil corrects microcirculation disorders, further optimizing myocardial blood supply and improving heart function. These two drugs improve heart function through different mechanisms, rapidly increasing left ventricular ejection fraction, enhancing left ventricular systolic function, and elevating stroke volume. This is conducive to enhancing the efficiency of heart pumping ^[10]. The final set of data demonstrates that the complication rate in Group A is lower than that in Group B, with $P < 0.05$. The reason for this is the combined therapy of isosorbide mononitrate and nicorandil. These two drugs have different mechanisms of action and do not exhibit mutual toxic effects, enabling rapid improvement of heart function safely and efficiently. However, patients with coronary heart disease and myocardial ischemia should reduce their intake of sodium salt and preserved foods while increasing their intake of vitamins and trace elements during medication to meet the body's nutritional needs and reduce oxidative stress responses.

5. Conclusion

Patients with coronary heart disease and myocardial ischemia receiving combined therapy with isosorbide mononitrate and nicorandil can achieve improved heart function, reduced frequency of electrocardiographic ST-segment depression, and decreased severity of myocardial ischemia. This treatment approach holds promise for widespread application.

Disclosure statement

The author declares no conflict of interest.

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