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Original Article

The clinical effects of IABP pumps combined with tirofiban in the treatment of acute myocardial infarction and on patients' serum levels

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Abstract: Objective: To explore the clinical effects of the intra-aortic balloon pump (IABP) combined with tirofiban in the treatment of acute myocardial infarction (AMI) and to analyze the combination's influence on patient serum levels. Method: 106 patients with AMI admitted to our hospital from February 2017 to February 2018 were recruited as the research cohort. The patients were randomly placed into a control group and an experimental group according to their order of admission, with 53 patients in each group. The patients in the control group were treated with IABP, while the experimental group was treated with IABP combined with tirofiban. The two groups' clinical efficacy and serum levels were compared. Results: The clinical efficacy in the experimental group was significantly higher than the clinical efficacy in the control group. After the treatment, both groups' serum indexes were significantly better, and the experimental group's indexes were comparatively better than the control group's indexes. The experimental group's thrombolysis and thrombin myocardial infarction (TIMI) glow grades were much better than the glow grades in the control group. The experimental group's left ventricular ejection fraction (LVEF) index was higher than the control group', while the left ventricular end-diastolic dimension (LVEDD) index and the left ventricular end-systolic dimension (LVESD) index in the experimental group exhibited lower levels when compared to the control group. The hemorheological parameters in the experimental group were much lower than the hemorheological parameters in the control group, and the difference between the two groups was statistically significant ($P < 0.05$). Conclusion: The clinical effects of an IABP pump combined with tirofiban in treating AMI are significant. The patients' clinical symptoms were alleviated drastically, and their serum levels and cardiac and cardiovascular functions improved significantly. Therefore IABP combined with tirofiban in the treatment of AMI is worthy of clinical application and promotion.

Keywords: IABP, tirofiban, acute myocardial infarction, serum levels

Introduction

Acute myocardial infarction (AMI) is an acute and fatal disease of the middle-aged and elderly. Most AMI cases develop from coronary atherosclerosis. A rupture or the erosion of the atherosclerotic plaque in the coronary artery and secondary thrombosis leads to a continuous total occlusion of the coronary artery, which drastically interrupts and reduces the coronary blood supply [1-4]. Severe and persistent myocardial ischemia leads to severe chest pain, which can cause a sharp decline in cardiac function. Clinically, AMI is mainly treated by restoring the myocardial blood supply and preventing thrombosis. A type of mechanical auxiliary circulation, intra-aortic balloon counter pulsation (IABP) is used to improve patients' intra-aortic diastolic pressure through physical action, the coronary artery blood supply, and myocardial function. It is widely adopted in clinics. Tirofiban is an anticoagulant and antiplatelet drug that can inhibit thrombosis by restraining the synthesis of fibrinogen and platelet receptors, prolonging the bleeding time and inhibiting platelet aggregation effectively [5-8]. There are few clinical research studies on the combination of IABP and tirofiban in the treatment of AMI. Therefore, we recruited 106 patients with AMI admitted to our hospital to explore the clinical efficacy of IABP combined with tirofiban to treat AMI and to analyze the

combination's impact on the patients' serum levels.

Data and methods

General data

106 patients with AMI admitted to our hospital from February 2017 to February 2018 were recruited as the research cohort. They were randomly placed into the control group and the experimental group (with 53 patients in each group) according to their admission order. There were 34 male patients and 19 female patients in the control group and they ranged in age from 42 years old to 73 years old, with an average age of (58.3 ± 4.5) years old. There were 32 male patients and 21 female patients in the experimental group, and they ranged in age from 41 to 74 years old, with average age of (57.8 ± 4.6). There were no significant differences in the two groups' general clinical data ($P > 0.05$), so they were comparable.

Inclusion criteria

① Patients who meet the clinical diagnostic criteria of AMI. ② Patients suitable for IABP therapy. ③ Patients with complete clinical medical records. ④ This research was approved by the hospital ethics committee (LPEC 2018-16). The patients and their family members were made aware of the purpose and process of this study, and they signed the informed consent form.

Exclusion criteria

① Patients comorbid with brain, heart, kidney, liver, or other organ tissue diseases. ② Patients who were allergic to the drugs used in the study. ③ Patients who had mental or other cognitive impairments or who refused to cooperate with the experiment.

Methods

All the patients were given blood volume supplements before their operation, and the index standards included a heart index < 2.2 L/(min·m^2), a urine volume < 30 ml/h, a map < 60 mmhg, a dobutamine dosage ≥ 20 μg/(kg·min) (2 ml:20 mg, SFDA approval number H2005-3297), a dopamine dosage ≥ 15 μg/(kg·min) (2 ml:20 mg, SFDA approval number H4202-0915), and a blood pressure rise that was not significant. We chose an appropriate disposable balloon catheter according to each patient's condition, with a small volume rather than a large one (volume > half of the cardiac output per stroke), so generally choose a 40-60 ml 8.5-9 catheter for adults.

All the patients were treated with IABP, a right femoral artery puncture was performed using the Seldinger technique, an 8f-10f arterial sheath and an 8F or 9.5f aortic counterpulsation balloon was inserted, and then 5000 units of heparin sodium was injected intravenously [9-11]. We then turned on the IABP, adjusted it to the ECG trigger mode, and ensured that the counterpulsation pressure was slightly higher than the aortic pressure. We paid attention to the catheter and observed the patients' postoperative situations closely. Based on the above methods, the patients in the experimental group were intravenously injected with 5 μg/kg tirofiban hydrochloride and sodium chloride (specification: 100 ml:5 mg tirofiban hydrochloride and 0.9 g sodium chloride, manufacturer: Yuanda Pharmaceutical (China) Co., Ltd., SFDA approval number H20041165). Following the doctor's instructions, we used a micropump for continuous pumping within 36 hours after the operation, with the dose controlled at 0.15 μg/(kg·min).

Observation indexes

Clinical efficacy: The NYHA rating scale was used to evaluate the cardiac function of the two groups after their treatment. There are three evaluation criteria levels: ineffective, effective, and remarkably effective. Remarkably effective: The patient's condition is basically under control, and the cardiac function improved by more than 2 grades. Effective: the cardiac function improved by 1 grade. Ineffective: the cardiac function did not improve, and the condition even worsened. The effective rate of treatment = (remarkably effective + effective)/total number of cases × 100%.

Serum levels: The tumor necrosis factor-α (TNF-α)'s serum levels and the interleukin-6 (IL-6)'s serum levels were measured using double antibody sandwich enzyme linked immunosorbent assays. The brain natriuretic peptide (BNP) serum levels were measured using immunofluorescence assays. The troponin I (CTN-I) serum levels were measured using microparticle immunoassays. The serum high sensitivity C-re-

Table 1. Comparison of the clinical treatment effects between the two groups [n (%)]

Groups	Ineffective	Effective	Remarkably effective	Total treatment efficiency rate
Control group (n = 53)	13 (24.53%)	22 (41.51%)	18 (33.96%)	40 (75.47%)
Experimental group (n = 53)	4 (7.55%)	18 (33.96%)	31 (58.49%)	49 (92.45%)
X^2				5.6748
P				0.017

Table 2. Comparison of the two groups' serum levels before and after the treatment (x ± s, n = 53)

Group	Time	BNP (ng/L)	TNF-α (ng/L)	IL-6 (ng/L)	cTn-II (μg/L)	hs-CRP (mg/L)
control group	Before treatment	(4032.01±459.86)	(36.96±8.67)	(16.23±4.51)	(27.58±7.39)	(8.65±2.83)
	After treatment	(2455.69±451.07)	(27.45±7.84)	(11.52±4.26)	(19.51±6.94)	(4.35±2.09)
t		17.8153	5.923	5.2711	5.7952	8.8981
P		0.001	0.011	0.002	0.003	0.001
experimental group	Before treatment	(4051.01±452.31)	(36.93±8.69)	(16.47±4.48)	(27.85±7.41)	(8.59±2.72)
	After treatment	(1958.73±415.74)*	(21.24±7.47)*	(7.49±4.13)*	(14.55±6.54)*	(2.47±1.96)*
t		24.7938	9.9678	1.7292	9.7969	13.2894
P		0.012	0.001	0.022	0.002	0.001

Note: *indicates a significant difference compared with the control group (P < 0.05).

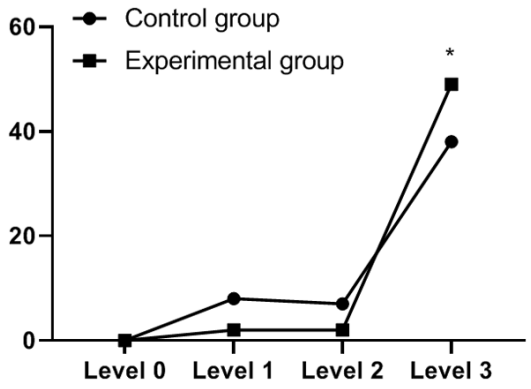

Figure 1. The TIMI flow grades of the two groups of patients [n (%)]. Note: The vertical axis indicates the TIMI flow grade, and the horizontal axis indicates the number of cases. The numbers of grade 0, 1, 2, and 3 patients in the experimental group were 0 (0%), 2 (3.77%), 2 (3.77%), and 49 (92.46%) respectively; The numbers of grade 0, 1, 2, and 3 patients in the control group were 0 (0%), 8 (15.09%), 7 (13.21%), and 38 (71.70%). *indicates a notable difference in the blood flow grades between the two groups above level 3 (t = 7.7592, P = 0.005).

active protein (hs CRP) levels were measured using immunoturbidimetry.

TIMI flow grade: The two groups' blood flow grades after the treatment were scored according to TIMI. Grade 0 indicates no perfusion. Grade 1 indicates no perfusion but some infiltration. Partial perfusion is grade 2. Grade 3 indicates complete perfusion. Grades 2-3 indicate successful reperfusion.

Cardiac function index: The two groups' left ventricular ejection fractions, their left ventricular end diastolic diameters, and their left ventricular end systolic diameters were measured using a Color Doppler Ultrasound Diagnostic System.

Hemorheological parameters: The two groups' whole blood viscosity, their plasma viscosity, their hematocrit and their other hemorheological parameters were measured and compared.

Statistical analysis

In this study, SPSS 20.0 was chosen as the data processing software, and GraphPad Prism 7 (GraphPad Software, San Diego, USA) was used to map the graphics. The count data and the measurement data were examined using X^2 tests and t tests, respectively. P < 0.05 indicated a significant difference.

Results

Clinical treatment effects

Table 1 shows that the total effective rate in the experimental group was significantly higher than the total effective rate in the control group (P < 0.05).

Table 3. The two groups' cardiac function indexes (x ± s)

Groups	LVEF (%)	LVEDD (mm)	LVESD (mm)
Control group (n = 53)	(49.72±6.61)	(48.96±5.31)	(41.86±2.28)
Experimental group (n = 53)	(57.43±6.86)	(43.74±3.78)	(34.65±3.27)
X^2	5.8920	5.8303	13.1672
P	0.001	0.014	0.023

Table 4. The two groups' hemorheological parameters (x ± s)

Groups	Whole blood viscosity (mPa/s)	Plasma viscosity (mPa/s)	Hematocrit
Control group (n = 53)	(5.94±0.92)	(1.66±0.15)	(0.45±0.13)
Experimental group (n = 53)	(5.01±0.23)	(1.20±0.14)	(0.35±0.12)
X^2	7.1395	16.3213	4.1150
P	0.015	0.021	0.0001

The serum levels

Table 2 shows that the two groups' serum levels after the treatment were significantly better, and the experimental group's performance was superior to the control group's ($P < 0.05$).

Blood flow grading

The TIMI flow grade in the experimental group after treatment was observed to be substantially better than the TIMI flow grade in the control group ($P < 0.05$), as shown in **Figure 1**.

The cardiac function indexes

The LVEF index in the experimental group was notably higher ($P < 0.05$), but the LVEDDs and LVESDs were much shorter when compared to the control group ($P < 0.05$), as shown in **Table 3**.

The hemorheological parameters

Overall, the hemorheological parameters in the experimental group were comparatively lower than they were in the control group ($P < 0.05$), as shown in **Table 4**.

Discussion

AMI attacks will lead to acute chest pain accompanied by vomiting, an impending death feeling, and other adverse symptoms. If timely medical treatment is not provided, heart failure and shock could occur. Timely and effective treatment play an important role in the treatment of damaged myocardia, and prompt effective measures will help to maintain patients' normal myocardial function [12-15]. Tirofiban hydrochloride is a non-peptide platelet surface glycoprotein receptor antagonist that can drastically and efficiently inhibit the binding of glycoprotein and fibrinogen on platelet surfaces. Therefore, tirofiban hydrochloride has notable effects on blocking platelet aggregation and thrombosis. For patients who have AMI, the drug can reduce thrombus at the lesion location, can even inhibit thrombosis, and wields a protective effect on vascular endothelial function. The reperfusion effect can be maintained through a continuous intravenous drip during the administration of the medication [16-19]. The authors found that the total effective rate in the experimental group was notably higher than it was in the control group. the two groups' serum levels after the treatment were significantly better, and the experimental group's performance was superior to the control group. What's more, the authors found that the TIMI flow grades in the experimental group after the treatment was observed to be substantially better than the TIMI flow grades in the control group. The LVEF index of the experimental group was notably higher, but the LVEDDs and LVESDs were much shorter when compared to the control group. Furthermore, the hemorheological parameters in the experimental group were found to be comparatively lower than they were in the control group.

The results show that IABP combined with tirofiban can improve the reperfusion of infarcted areas, relieve myocardial ischemia, and improve patients' cardiovascular functions, so it is conducive to the prognosis. The results of this study are consistent with Chen-Xi Song's results [20] in which the combined use of tirofiban hydrochloride in the interventional treatment of patients with AMI can significantly alleviate the AMI patients' ischemia, improve their cardiovascular function prognoses, and increase the blood flow velocity of the vessels in the

embolized area effectively and safely with no adverse reactions, so it is worthy of wide adoption and promotion. This further proves that IABP combined with tirofiban in the treatment of AMI has a better clinical performance and can wield a positive impact on the patients' serum levels.

In conclusion, the effects of IABP combined with tirofiban in the treatment of AMI is significant, as it alleviates patients' clinical symptoms, and improves their cardiac function, cardiovascular function and serum levels effectively, therefore it is worthy of wide clinical adoption and promotion.

Disclosure of conflict of interest

None.

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