Original Article
Percutaneous coronary stent implantation versus intravenous thrombolytic therapy for acute myocardial infarction

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Abstract: Objective: To investigate and compare the clinical efficacies and follow-up results of percutaneous coronary stent implantation (PCSI) and intravenous thrombolytic therapy for acute myocardial infarction (AMI). Methods: Sixty-seven patients with AMI who were treated in the Department of Cardiology in Linyi Central Hospital from January 2014 to October 2016 were retrospectively analyzed in this study (45-90 years old, mean age of 60.91±15.49 years old). According to different treatment methods the patients chose, they were divided into 3 groups: intervention group 1 (drug-eluting stent group, n=20), intervention group 2 (bare-metal stent group, n=22) and thrombolysis group (n=25). Curative judgment: Two intervention groups were classified according to the blood flow of thrombolysis in myocardial infarction (TIMI); revascularization of thrombolysis group was indirectly judged by clinical standard and post therapeutic adverse cardiac events were recorded. Left ventricular ejection fraction (LVEF) was measured by echocardiogram before discharge and cardiac events were observed and recorded during the follow-up of 6 months after discharge including arrhythmia, heart failure, shock, papillary muscle dysfunction or rupture, cardiac rupture and embolism. Results: The revascularization rate of intervention group 1 was significantly higher than that of intervention group 2 (P=0.015), and the revascularization rate of intervention group 2 was obviously higher than that of thrombolysis group (P=0.000). The hospital stay of intervention group 1 was significantly shorter than that of intervention group 2 and thrombolysis group (respectively P=0.012, P=0.007). Compared with intervention group 2, the LVEF of intervention group 1 increased significantly (P=0.000), while the LVEF of thrombolysis group showed no statistical difference (P=0.094). Compared with thrombolysis group, postoperative cardiac function of intervention group 1 distinctly got better (P=0.013), while that of intervention group did not (P=0.032). There was no difference in the proportion of cardiac functional grading between intervention groups (P=1.00). And there was no difference in the rate of cardiac events among those three groups (P>0.05). Conclusion: Compared with percutaneous coronary bare-metal stent implantation (PCBSI) and intravenous thrombolysis, percutaneous coronary drug-eluting stent implantation (PCDSI) has many advantages with high revascularization rate, shorter hospital stay, increasing LVEF, decreasing cardiac functional grading and restenosis rate in the treatment of AMI.

Keywords: Acute myocardial infarction, percutaneous, coronary artery, stent

Introduction

Acute myocardial infarction (AMI) is a local myocardial necrosis due to severely persistent ischemia caused by coronary artery occlusion and blood flow interruption [1]. The scope of myocardial infarction will expand without timely and effective treatment, which further promotes the occurrence of heart failure [2]. Therefore, early implementation of reperfusion, control of lesion, protection of cardiac function and prevention of complications are main guidelines of treatment [3]. Thrombolytic or interventional therapy is commonly used in clinical treatment for AMI [4].

Intravenous thrombolysis is the main treatment for AMI. It has been reported that intravenous thrombolysis could significantly reduce the mortality of patients with AMI, but there still exists deficiencies like low reperfusion rate of coronary artery and many contraindications. However, the percutaneous coronary stent implantation (PCSI) is a therapeutic method that can improve the blood perfusion of myocardium through dredging narrow or occlusive

coronary artery lumen with cardiac catheterization. At present, percutaneous coronary bare-metal stent implantation (PCBSI) or percutaneous coronary drug-eluting stent implantation (PCDSI) is widely used in clinic, due to its minimal invasion, better therapeutic effects and fewer complications. But there still exists some disadvantages: for example, myocardial remodeling and stability of myocardial electrophysiological activities will be inhibited after the implantation of stent [5]. Some patients only have remained partial activated myocardial cells within 1 month after the onset. Insufficient blood perfusion, vascular stenosis and other reasons, are likely to trigger various adverse cardiac events including thrombosis, arrhythmia, etc. [6]. Thus, early treatment is critical for prognosis and myocardial preservation [7]. Therefore, this study compared the effects of clinical application of PCBSI, PCDSI and intravenous thrombolysis in the treatment of AMI in order to provide guidance for clinical treatment.

Materials and methods

General materials

Sixty-seven patients who were initially diagnosed as having AMI in the Department of Cardiology of Linyi Central Hospital from January 2014 to October 2016 were included in the study. The study was approved by the Hospital Ethics Committee and all the patients signed informed consents.

Inclusion criteria: All the patients who were diagnosed as AMI by echocardiogram, electrocardiogram, etc.; without contraindications to intravenous thrombolytic therapy or stent implantation; in accordance with the criteria of stent implantation indications of Adult PCI Guideline by American College of Cardiology/American Heart Association (ACC/AHA) in 2013.

Exclusion criteria: Patients with hemorrhagic diseases who are not suitable for anticoagulant therapy; patients who are allergic to antiplatelet drugs or stent materials; simple coronary artery spasm; diameter of target vessel <2.5 mm; severe calcification lesions and insufficient pre-dilation; other cases unsuitable for coronary stent implantation.

According to different treatment methods, 67 patients with AMI were divided into 3 groups: intervention group 1 (drug-eluting stent group, n=20), intervention group 2 (bare-metal stent group, n=22) and thrombolysis group (n=25).

Methods

At first, all patients were performed routine treatment, and after diagnosis they were immediately prescribed to chew 300 mg clopidogrel bisulfate tablets (Lepu Pharmaceutical Inc) and 300 mg aspirin enteric-coated tablets (Shenyang Original Pharmaceutical Co. Ltd.) and inhale oxygen, etc.

Then patients in thrombolysis group acquired intravenous thrombolytic therapy with intravenous infusion of 1,500 thousand U urokinase (Yantai Dongcheng Beifang Pharmaceutical Co. Ltd.) and 100 ml normal saline within 30 minutes. During the treatment, the patients were monitored coronary artery revascularization by dynamic electrocardiogram. After thrombolytic therapy, patients were asked to chew 300 mg/d of aspirin enteric-coated tablets, and the dose was adjusted to 100 mg/d after 3 days.

Patients in intervention groups underwent coronary stent procedures. Before operation, they acquired routine preoperative skin preparations (iodine allergy test), establishments of intravenous infusion channelt, ECG monitoring, and they were asked to chew 600 mg clopidogrel and 300 mg aspirin. After that, the lesion of coronary artery stenosis was dilated by balloon angioplasty. And aspiration was performed with thrombus aspiration catheter if the lesion had a heavier thrombus burden. Accurately positioning the lesion site, the stent was pushed towards the lesion position and released, then the type and quantity of coronary stent were selected strictly in accordance with the actual condition of the patient in this process. Intervention group 1 and 2 adopted metal stent and drug stent respectively. Coronary angiography was performed on the patient with fixed stent. The adhesion of the stent and thrombolysis in myocardial infarction (TIMI) blood flow were observed closely once in two months after operation.

Follow-up

Two intervention groups were graded according to TIMI blood flow; the revascularization of thrombolysis group was indirectly judged by clinical criteria. The left ventricular ejection

Table 1. Comparison of patients' general information in three groups

Term	Classification	Intervention group 1 (n=20)	Intervention group 2 (n=22)	Thrombolysis group (n=25)	P value
Sex					0.957
	Male	10 (50)	10 (45.45)	12 (48)	
	Female	10 (50)	12 (54.55)	13 (52)	
Age (years old)		61.36±15.46	60.91±15.49	60.28±15.03	0.989
Time from onset of chest pain to hospital admission (h)		5.38±3.90	5.23±3.97	5.89±3.92	0.967
Cardiac functional grading					0.967
	Stage I	5 (25.00)	5 (22.73)	6 (24.00)	
	Stage II	6 (30.00)	6 (27.27)	5 (20.00)	
	Stage III	6 (30.00)	9 (40.90)	10 (40.00)	
	Stage IV	3 (15.00)	2 (9.10)	4 (16.00)	
Infarct location	Extensive anterior wall	5 (25.00)	5 (22.73)	10 (40.00)	0.370
	Inferior wall	5 (25.00)	5 (22.73)	4 (16.00)	0.373
	Anterior and inferior wall	2 (12.50)	3 (13.64)	5 (25.00)	0.632
	Anteroseptal	3 (10.00)	3 (13.64)	2 (8.00)	0.738
	Posterior wall	4 (20.00)	3 (13.64)	2 (8.00)	0.502
	Lateral wall	1 (5.00)	3 (13.64)	2 (8.00)	0.606
Past history	Angina	10 (50.00)	8 (36.36)	12 (48.00)	0.620
	Hypertension	6 (30.00)	6 (27.27)	8 (32.00)	0.939
	Diabetes	2 (10.00)	4 (18.18)	2 (8.00)	0.890
	Other	2 (10.00)	4 (18.18)	3 (12.00)	0.714

fraction (LVEF) was measured by echocardiography one week after myocardial infarction. The patients were followed up monthly for 6 months after discharge, and cardiac events including arrhythmia, heart failure, shock, papillary muscle dysfunction or rupture, cardiac rupture and embolism were observed and recorded.

Clinical diagnostic criteria for revascularization: (1) within 2 h after thrombolytic therapy, precordial pain is completely or obviously relieved; (2) compared with before and after every 30 min within 2 h after thrombolytic treatment, the elevation of ST-segment decreased by more than 50%; (3) there are new arrhythmias within 2 h after thrombolytic therapy; (4) myocardial enzyme peaks move forward as the peaks of serum creatine kinase isoenzyme (CK-MB) is less than 14 h, creatine kinase is less than 16 h. Except from meeting the standards of 1 and 3, conforming to any two remaining criteria of the above can be judged as revascularization, then calculate the rate of revascularization.

Observation indexes

Primary observation indexes are recanalization rate, LVEF at discharge, hospital stay and cardiac function 6 months after operation. And secondary ones are the occurrences of postop-erative cardiac events, including arrhythmia, heart failure, shock, papillary muscle dysfunction or rupture, cardiac rupture and embolism [8].

Statistical analysis

SPSS20.0 was used for data analysis. Three groups' measurement data including hospital stay, LVEF, etc. were expressed by standard deviation ($\bar{x}$±s). Variance analysis was used to compare the differences among the groups and Bonferroni method to compare the difference between two groups. Count data of three groups were expressed by rate (%) including cardiac function, clinical efficacy, arrhythmia, heart failure, shock, papillary muscle dysfunction or rupture, cardiac rupture and embolism. χ^2 test was used to examine the comparison among groups and the test criterion of pairwise comparison was α=0.05/3=0.017.

Results

Comparison of patients' general information among three groups

Three groups had similar sex ratio, age distribution, time from onset of chest pain to hospital admission, cardiac functional grading, past his-

Table 2. Comparison of patients' hospital stay and LVEF in three groups ($\bar{x} \pm s$)

	Group	Case	Revascularization	Hospital stay (d)	LVEF (%)
	Intervention group 1	20	20 (100.00)	10.72±1.12	60.26±2.76
	Intervention group 2	22	14 (81.82)	15.32±1.30	50.25±2.44
	Thrombolysis group	25	8 (32.00)	20.43±1.32	44.44±2.43
P value	Intervention group 1 vs 2		0.015	0.012	0.009
	Intervention group 1 vs T		0.029	0.007	0.001
	Intervention group 2 vs T		0.000	0.000	0.094

Note: T: thrombolysis group.

Table 3. Comparison of patients' cardiac functional grading in three groups (cases/%)

	Group	Case	Stage I	Stage II	Stage III	Stage IV
	Intervention group 1	20	10 (50.00)	5 (25.00)	3 (15.00)	2 (10.00)
	Intervention group 2	22	12 (54.55)	5 (22.72)	3 (13.64)	2 (9.09)
	Thrombolysis group	25	4 (16.00)	5 (20.00)	12 (48.00)	4 (16.00)
P value	Intervention group 1 vs 2			1.00		
	Intervention group 1 vs T			0.032		
	Intervention group 2 vs T			0.013		

Note: T: thrombolysis group.

Table 4. Comparison of patients' cardiac events in three groups (case/%)

Group	Case	Arrhythmia	Heart failure	Shock	Papillary muscle dysfunction or rupture	Cardiac rupture	Embolism
Intervention group 1	20	2 (10.00)	2 (10.00)	2 (10.00)	1 (5.00)	0 (0)	2 (10.00)
Intervention group 2	22	4 (18.18)	1 (45.45)	3 (13.64)	2 (9.09)	1 (4.55)	2 (9.09)
Thrombolysis group	25	2 (24)	1 (8)	2 (28)	2 (8)	2 (8)	6 (24)
P value		0.457	0.782	0.246	0.866	0.297	0.017

tory and myocardial infarct location, and the differences had no statistical significance. The comparison of patients' general information among three groups indicated no statistically significant difference, which was comparable (P>0.05). See **Table 1**.

Comparison of patients' hospital stay and LVEF among three groups

The revascularization rate of intervention group 1 was significantly higher than that of intervention group 2 (P=0.015), and that of intervention group 2 was obviously higher than that of thrombolysis group (P=0.000). The differences between intervention group 1 and thrombolysis group had no statistical significance in revascularization rate (P=0.029). The hospital stay of intervention group 1 was significantly shorter than that of intervention group 2 and thrombolysis group (respectively P=0.012, P=0.007),

and that of intervention group 2 was significantly shorter than that of thrombolysis group (P=0.007). Compared with intervention group 1, LVEF of intervention group 2 and thrombolysis group were significantly lower (respectively P=0.000, P=0.007), and the differences between intervention group 2 and thrombolysis group had no statistical significance in LVEF (P=0.094). See **Table 2**.

Comparison of patients' cardiac function among three groups

Compared with thrombolysis group, cardiac function of intervention groups improved obviously (P=0.013, P=0.032 respectively). And the difference of cardiac function had no statistical significance in the proportion of cardiac functional grading between intervention groups (P=1.00). See **Table 3**.

Comparison of patients' cardiac events among three groups

As for patients' cardiac events, no statistical significance had been found in the differences between patients among three groups (P> 0.05). See **Table 4**.

Discussion

AMI is a myocardial necrosis caused by acute and persistent ischemia and hypoxia in coronary artery with the incidence in China rising year by year, and there have been at least 2 million patients at present [9-11]. Reperfusion therapy is the main treatment for AMI [8]. Within 12 hours of onset, opening the occluded coronary artery and restoring blood flow can reduce the area and mortality of myocardial infarction. Earlier recanalization can make patients get more benefits. PCSI is now a new technique for the treatment of AMI, and becoming increasing popular in clinical practice [12, 13]. It refers to a treatment for improving myocardial blood perfusion by inserting stents to dredge the stenotic or occluded coronary artery lumen with cardiac catheterization technique [13, 14]. Currently, there are two main developments of this technology in clinic, one is the webbed and interstitial stent made by stainless steel or alloy material, the other is the drug-eluting stent, which is inserted into the stenotic coronary artery to support vascular wall, maintain blood flow, reduce vascular elasticity retraction after percutaneous transluminal coronary angioplasty (PTCA), close the potential dissection formed after PTCA, and largely decrease the occurrence of acute vascular occlusion during the procedure of PTCA [15].

Traditional metal stents need to be kept in patients' bodies all their life, and the stents may stimulate the blood vessels to produce inflammatory responses, and even to cause life-threatening consequences, such as stent thrombosis, etc. The appearance of drug-eluting stent provides an effective way to solve this problem. With itsgradual enhancement of biocompatibility, the incidence rate of stent thrombosis decreases significantly, clinical indications are widened, and patients have good prognosis. The design concept of completely degradable drug stents is that drug-eluting stent can mechanically support the stenotic coronary artery for a period of time after the stent implantation, and at the same time, it can release the drugs to prevent restenosis. Then the stent is degraded slowly till the complete absorption by tissues, and complete recoveries of vascular structure and diastolic and systolic functions to their natural states [16, 17]. Nijhoff et al. have found that revascularization rate, hospital stay and cardiac function in intervention groups were all significantly better than those in thrombolysis group [18]. Similarly, this study also found that revascularization rate, hospital stay and cardiac function in intervention group 1 were better than those in intervention group 2.

If there is no condition for emergency PCT treatment, or capacity of completing the first balloon dilatation in 90 minutes, patients who has no contraindications of thrombolytic therapy with acute ST-segment elevation myocardial infarction should be performed thrombolytic therapy during the 12 hours of onset. Intravenous injection with thrombolytic agent was performed on patients, common thrombolytic agents including urokinase, streptokinase and recombinant tissue-type plasminogen activator (rt-PA), etc. The main complication of thrombolytic therapy is hemorrhage, and the most serious one is cerebral hemorrhage [19, 20]. And there are also other complications. Yao et al. have found that there was no significant difference in clinical efficacy, cardiac functional grading, cardiac events, recurrence and death difference comparing intervention groups with thrombolysis group, which was similar to the results of this study [21].

The deficiencies of this study were a small number of cases, shorter follow-up time, and potential significant differences of clinical efficacy in three groups (with larger cases and long-time follow-up). In addition, without using randomized double-blind manner, it might produce a larger selection bias, thereby impacting the reliability of results.

In conclusion, the application of PCSI for the treatment of AMI can achieve a higher recanalization rate and increase left ventricular ejection fraction.

Disclosure of conflict of interest

None.

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