

Clinical value of GRACE score combined with DFR in predicting short-term prognosis of patients undergoing early PCI after thrombolysis for acute myocardial infarction

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Abstract. – OBJECTIVE: The aim of the study was to investigate the clinical value of the Global Registry of Arterial Events in Acute Coronary Syndromes (GRACE) score combined with the D-dimer/fibrinogen ratio (DFR) in predicting the short-term prognosis of patients undergoing percutaneous coronary intervention (PCI) early after thrombolysis for acute myocardial infarction (AMI).

PATIENTS AND METHODS: A total of 102 patients who underwent PCI early after thrombolysis for AMI during April 2020 to January 2022 in our hospital were picked as study subjects. These subjects were assigned as the good prognosis group (without adverse cardiovascular events) and poor prognosis group (with adverse cardiovascular events) according to whether adverse cardiovascular events occurred during hospitalization and follow-up. Changes in GRACE scores and DFR levels in patients with different prognoses were analyzed. The GRACE score and DFR level of patients with different prognosis were analyzed. The clinic pathological characteristics were collected, and the risk factors for poor prognosis of AMI patients were analyzed by logistic risk regression; ROC curve was used to analyze the prognostic value of GRACE score combined with DFR in early PCI patients after AMI thrombolysis.

RESULTS: Compared with the good prognosis group, the GRACE score and DFR level in the poor prognosis group were much higher ($p < 0.001$). Significant differences existed in blood pressure, ejection fraction, number of diseased branches, and Killip grading between the patients with good prognosis and those with poor prognosis ($p < 0.05$). There existed no significant difference in clinical medication between the patients with good prognosis and those with poor prognosis ($p > 0.05$). Logistic multivariate analysis indicated that GRACE

score, DFR, ejection fraction, number of lesion branches, and Killip grade were all risk factors influencing the prognosis of patients undergoing early PCI after thrombolysis in AMI ($p < 0.05$). The ROC curve was established and the area under the curve (AUC) of GRACE score, DFR, and combined detection were 0.815, 0.783, and 0.894, respectively, and the sensitivity and specificity were 80.24%, 60.42%, 83.71%, 66.78%, 91.42% and 77.83%, respectively. The AUC, sensitivity, and specificity of combined detection were higher than those of the two alone and had a higher predictive value for the short-term prognosis of patients.

CONCLUSIONS: The GRACE score combined with DFR was of great value in diagnosing the short-term prognosis of patients undergoing PCI early after thrombolysis for AMI. Furthermore, the GRACE score, DFR, ejection fraction, number of lesion branches, and Killip classification were all important factors influencing the short-term prognosis of patients, which were of great significance in determining the prognosis of patients.

Key Words:

GRACE score, Acute myocardial infarction, Early PCI, Short term prognosis, Clinical value.

Introduction

Acute myocardial infarction (AMI) is not only a serious coronary heart disease, but also one of the main causes of death and physical disability, especially in the rapidly growing elderly population. Relevant research¹ found that compared with people under 60 years old, people over 75 years old had a clearly higher risk of AMI. The main

method to treat AMI is to dredge the occluded coronary artery as soon as possible and restore the reperfusion of the ischemic myocardium. Thrombolytic therapy is one of the important treatment methods for AMI, which opens the era of modern cardiology, with the characteristics of simple and fast operation. Thrombolytic therapy is less difficult to operate, which significantly improves the opening rate of occluded vessels with high safety². However, the rate of re-occlusion of blood vessels after thrombolytic therapy is relatively high, which often requires secondary revascularization.

With the continuous progress of medical technology, percutaneous coronary intervention (PCI) has gradually developed and been widely used in clinical practice. PCI can quickly dredge occluded vessels and effectively restore coronary blood flow. A previous study³ found that early PCI after thrombolysis had significant clinical effects, which could effectively reduce the risk of recurrence after surgery. However, some patients still have adverse cardiovascular events in the short term after treatment, which affects the prognosis of patients. Therefore, it is important to find relevant methods to effectively predict the short-term prognosis of patients and timely intervene to reduce the risk of adverse events and improve the prognosis of patients. Global register of arterial events in acute coronary syndromes GRACE score is an important indicator to evaluate the degree of coronary stenosis in patients with acute coronary syndrome⁴. The D-dimer/fibrinogen ratio (DFR) is an important indicator for diagnosing thrombotic disease and evaluating the prognosis⁵. However, there is no relevant report on the short-term prognosis of patients undergoing PCI early after thrombolytic therapy in AMI.

In this study, patients with AMI undergoing PCI early after thrombolytic therapy who were diagnosed and treated in our hospital were grouped according to the prognosis. The clinical value of the Global Registry of Arterial Events in Acute Coronary Syndromes (GRACE) score combined with DFR in predicting short-term prognosis of patients was analyzed, to provide a reference for clinical effective evaluation of patient prognosis.

Patients and Methods

Patients

In this study, 156 patients with AMI who underwent PCI early after thrombolytic therapy

from April 2020 to January 2022 in our hospital were selected as the study subjects. According to the inclusion and exclusion criteria, 54 patients were excluded, and 102 patients were finally included as the study subjects. Inclusion criteria were: (1) Meet the criteria for diagnosis and treatment of AMI⁶ and be confirmed by imaging detection. (2) Have complete clinical data. (3) Patient's age between 18 and 75 years old. (4) Sign an informed consent form. (5) High degree of patient's cooperation with relevant inspections in the study. Exclusion criteria were: (1) Patients with lung cancer and other malignant tumors. (2) Patients with severe liver and kidney dysfunction. (3) Patients accompanied by infectious diseases. (4) Patients with coagulation dysfunction. (5) Patients who did not tolerate the surgery in the study. Then, 102 eligible patients were followed up for half a year by telephone or outpatient service. These subjects were assigned as the good prognosis group (without adverse cardiovascular events) and poor prognosis group (with adverse cardiovascular events) according to whether adverse cardiovascular events occurred during hospitalization and follow-up. Among which, there were 69 patients in the good prognosis and 33 patients in the poor prognosis. The selection process of general data was shown in Figure 1. This study was approved by the Hospital Ethics Committee, and all procedures met the medical ethics standards.

Collection of Clinical and Pathological Characteristics

The clinic pathological characteristics of patients undergoing PCI early after thrombolysis in AMI were collected, including age (<55 years old, ≥55 years old), gender (female, male), drinking history, smoking history, blood pressure (systolic blood pressure, diastolic blood pressure), heart rate, past medical history (coronary heart disease, stroke, hypertension, diabetes), whether it was anterior myocardial infarction, ejection fraction, the number of diseased branches (single branch, multiple branches), Killip classification⁷ (I+II, III+IV), etc.

GRACE Score

The risk of cardiovascular events of patients in the two groups was evaluated by GRACE score questionnaire, which included age, serum creatinine level, systolic blood pressure, heart rate, Killip grade, ST change, cardiac arrest, and elevation

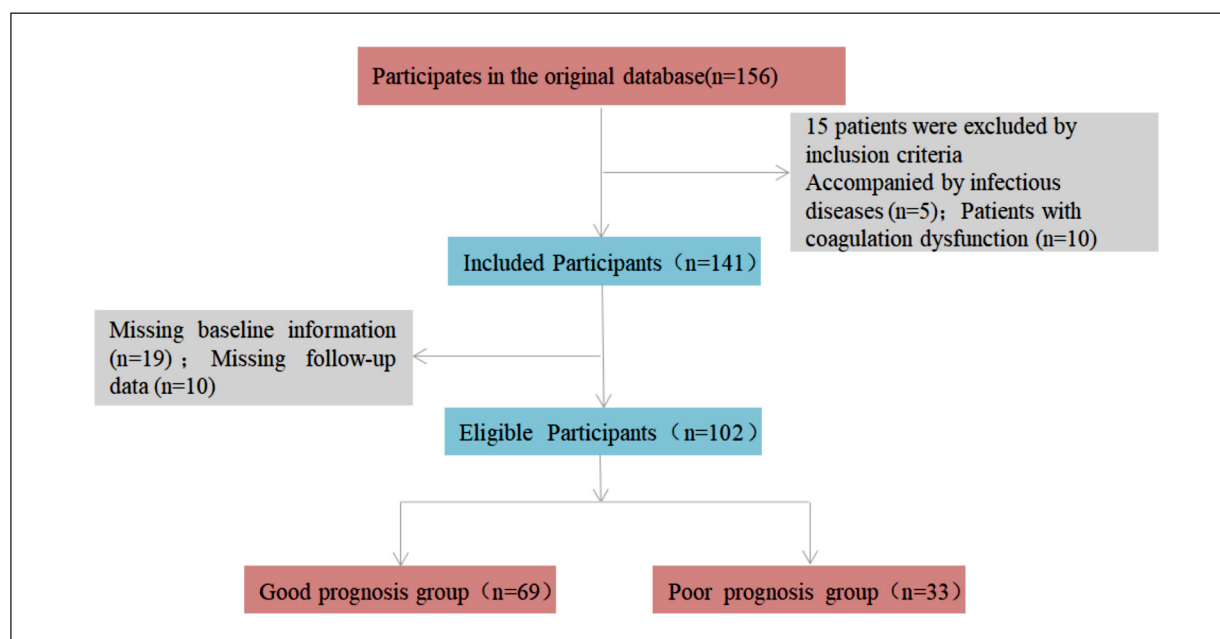


Figure 1. The selection process of general data.

of myocardial enzyme markers. The score of each item was not equal, and the total score was calculated. The higher the score, the more serious the patient's condition was.

Outcome Measures

A total of 3 mL of fasting venous blood after early PCI was collected through each subject, stood still, and centrifuged at a speed of 4,500 r/min for 15 minutes. The supernatant was isolated and was stored at -80°C .

- (1) The levels of D-dimer and Fibrinogen ratio were detected by automatic biochemical analyzer. DFR was calculated, and GRACE score and DFR levels of patients with different prognosis were analyzed.
- (2) Study end points: adverse cardiovascular events occurred during hospitalization and follow-up, including the primary end point of all-cause death (cardiogenic death, no cardiogenic death), and the secondary end point of vascular remodeling, recurrent nonfatal myocardial infarction, malignant arrhythmia, and heart failure.

Statistical Analysis

SPSS 23.0 data statistics software (IBM Corp., Armonk, NY, USA) was used for data processing. The measurement data were all tested by normal distribution, and all were in accordance with

normal distribution. The measurement data were expressed in the form of $(\bar{x}\pm s)$ and were compared using t -test between the two groups. The enumeration data was expressed in [example (%)] and compared using χ^2 test. Logistic risk regression analysis was used to analyze the risk factors of poor prognosis in patients with AMI. The ROC curve was established to analyze the prognostic value of GRACE score combined with DFR in patients with early PCI after thrombolytic therapy for AMI. $p<0.05$ indicated that the difference was statistically significant.

Results

Comparison of GRACE Score and DFR Level in Patients with Different Prognosis

Compared with the good prognosis group, the GRACE score and DFR level in the poor prognosis group were much higher ($p<0.001$; Table I, Figure 2).

Comparison of Clinic Pathological Characteristics of Patients with Different Prognosis

No significant difference was detected in age, gender, drinking history, smoking history, and past medical history between patients with good

Table I. Comparison of GRACE score and DFR level in patients with different prognosis ($\bar{x} \pm s$).

Groups	Cases	GRACE score (score)	DFR ($\times 10^{-3}$)
Good prognosis group	69	103.50 \pm 10.89	70.26 \pm 12.42
Poor prognosis group	33	152.85 \pm 12.96	101.17 \pm 12.16
<i>t</i>		20.113	11.837
<i>p</i>		< 0.001	< 0.001

prognosis and those with poor prognosis ($p > 0.05$). However, a notable difference was observed in blood pressure, ejection fraction, number of diseased branches, and Killip grading between the patients with good prognosis and those with poor prognosis ($p < 0.05$, Table II).

Comparison of Clinical Medications in Patients with Different Prognosis

There existed no significant difference in clinical medication between the patients with good prognosis and those with poor prognosis ($p > 0.05$; Table III).

Logistic Risk Regression Analysis of Risk Factors for Poor Prognosis in Patients with AMI

A COX proportional risk regression model was established with poor prognosis as the dependent variable and factors with statistically significant differences in Tables I and II as independent variables. The results indicated that GRACE score, DFR, ejection fraction, number of lesion branches, and Killip grade were all risk factors

influencing the prognosis of patients undergoing early PCI after thrombolysis in AMI ($p < 0.05$; Table IV).

Prognostic Value of GRACE Score Combined with DFR in early PCI After Thrombolytic Therapy in Patients with AMI

The ROC curve was established and the area under the curve (AUC) of GRACE score, DFR, and combined detection were 0.815, 0.783, and 0.894, respectively, and the sensitivity and specificity were 80.24%, 60.42%, 83.71%, 66.78%, 91.42% and 77.83% respectively. The AUC, sensitivity, and specificity of combined detection were higher than those of the two alone and had a higher predictive value for the short-term prognosis of patients (Table V and Figure 3).

Discussion

AMI is a disease caused by ischemic heart disease or coronary artery disease. When the athero-

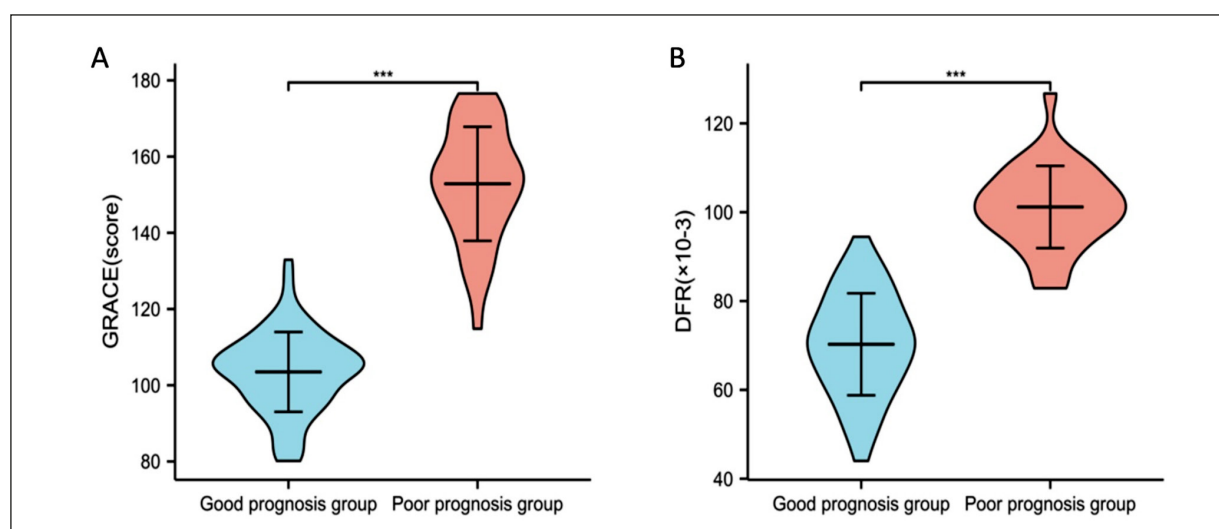


Figure 2. Comparison of GRACE score and DFR level in patients with different prognosis. **A**, Comparison of GRACE scores in patients with different prognosis. **B**, Comparison of DFR level in patients with different prognosis. *** $p < 0.001$.

Table II. Comparison of clinicopathological characteristics of patients with different prognosis [$(\bar{x} \pm s)$, cases (%)].

Groups	Good prognosis group (n = 69)	Poor prognosis group (n = 33)	χ^2/t	<i>p</i>
Age (year)			0.467	0.495
< 55	30 (43.48)	12 (36.36)		
≥ 55	39 (56.52)	21 (63.64)		
Gender (%)			0.096	0.757
Female	25 (36.23)	13 (39.39)		
Male	44 (63.77)	20 (60.61)		
Drinking history (%)	23 (33.33)	13 (39.39)	0.359	0.549
Smoking history (%)	38 (55.07)	21 (63.64)	0.671	0.413
Blood pressure (mmHg)				
Systolic pressure	105.71 ± 9.42	120.69 ± 10.27	7.297	< 0.001
Diastolic pressure	62.16 ± 6.12	73.95 ± 4.38	9.908	< 0.001
Heart rate (times/min)	78.55 ± 18.50	79.25 ± 14.26	0.192	0.848
Past medical history (%)				
Coronary heart disease	14 (20.29)	10 (30.30)	1.244	0.265
Cerebral apoplexy	12 (17.39)	9 (27.27)	1.333	0.248
Hypertension	37 (53.62)	20 (60.61)	0.442	0.506
Diabetes	34 (49.28)	17 (51.52)	3.078	0.079
Ejection fraction (%)	54.37 ± 8.58	42.18 ± 5.47	7.458	< 0.001
Anterior myocardial infarction (%)			0.248	0.618
Yes	34 (49.28)	18 (54.55)		
No	35 (50.72)	15 (45.45)		
Number of diseased branches (%)			4.756	0.029
Single branch	45 (65.22)	14 (42.42)		
Multiple branches	24 (34.78)	19 (57.58)		
Killip Grade (%)			6.148	0.013
Grade I + II	39 (56.52)	10 (30.30)		
Grade III + IV	30 (43.48)	23 (69.70)		

Table III. Comparison of clinical medication in patients with different prognosis (%).

Clinical medication	Good prognosis group (n = 69)	Poor prognosis group (n = 33)	χ^2	<i>p</i>
Clopidogrel (%)	65 (94.20)	32 (96.97)	0.367	0.545
β Receptor blockers (%)	45 (65.22)	20 (60.61)	0.205	0.650
Aspirin (%)	66 (95.65)	31 (93.94)	0.141	0.708
ACEI/ARB class (%)	33 (47.19)	15 (45.45)	0.050	0.822
Statins (%)	11 (15.94)	6 (18.18)	0.081	0.776

Table IV. Logistic risk regression analysis of risk factors for poor prognosis in patients with AMI.

Indicators	B value	Standard error	Wald value	<i>p</i> -value	Odds ratio	95% CI	
						Lower limit	Upper limit
GRACE score	1.316	0.407	10.748	< 0.001	4.969	1.847	7.462
DFR	0.460	0.280	12.795	< 0.001	5.184	1.986	8.127
Blood pressure	0.478	0.237	4.489	0.062	1.607	0.974	2.600
Ejection fraction	1.861	0.527	5.573	0.004	3.641	1.317	4.746
Number of diseased branches	1.373	0.480	5.341	0.007	3.502	1.526	8.181
Killip grade	0.628	0.369	4.729	0.014	2.937	0.872	3.965

Table V. Prognostic value of GRACE score combined with DFR in early PCI after thrombolytic therapy in patients with AMI.

Indicators	AUC	95% CI	Sensitivity (%)	Specificity (%)	Yodon index	<i>p</i>
GRACE score	0.856	0.780-0.931	81.80	78.30	0.601	< 0.001
DFR	0.803	0.801-0.905	80.90	69.60	0.505	< 0.001
Combined detection	0.928	0.874-0.982	87.90	91.30	0.792	< 0.001

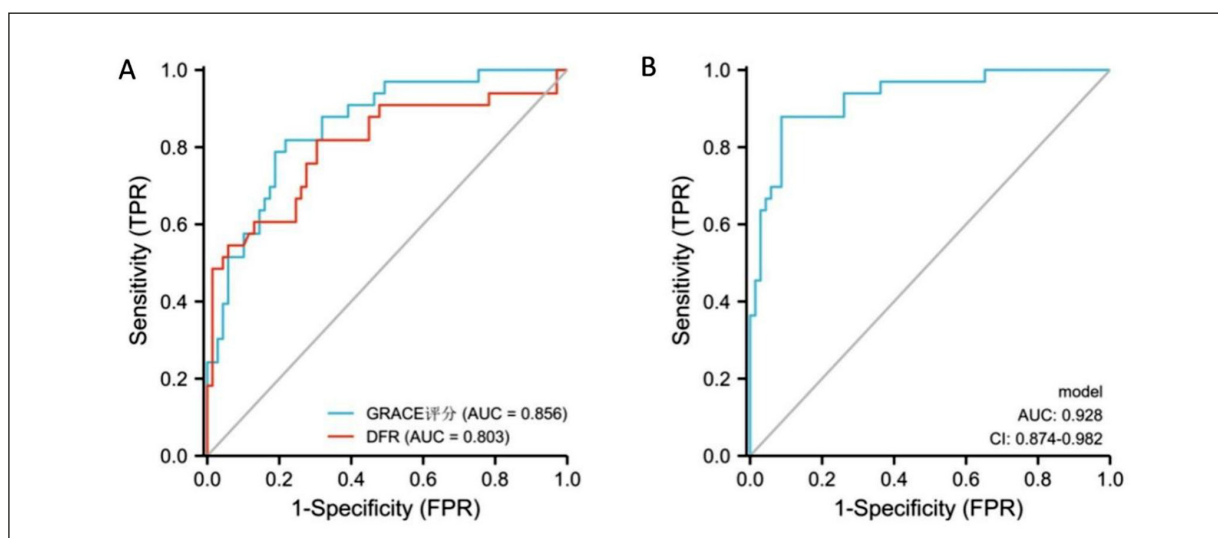


Figure 3. Prognostic value of GRACE score combined with DFR in early PCI after thrombolytic therapy in patients with AMI. **A**, ROC curve predicted by GRACE score and DFR separately. **B**, ROC curve predicted by GRACE score combined with DFR.

sclerotic plate ruptures and the developing thrombus completely or partially blocks the coronary artery, the blood flow is blocked, and the heart cannot supply blood normally, resulting in serious ischemia and hypoxia of the corresponding myocardium, leading to myocardial injury and even death⁸. With the continuous development of medical technology, thrombolytic therapy and PCI have become important treatment methods for AMI and have achieved significant results. When acute ischemic stroke occurs, intravenous thrombolytic therapy can quickly dredge the occluded cerebral vessels and obtain good functional results⁹. The time window of thrombolytic therapy with recombinant tissue plasminogen activator has been extended from 3 hours after stroke to 4.5 hours. In the study¹⁰ of ST segment elevation myocardial infarction, it was found that rehabilitation treatment for patients after PCI can clearly improve their quality of life. However, after thrombolysis or PCI treatment, especially in elderly patients, the incidence of postoperative bleeding largely increased. Early evaluation of short-term prognosis of patients can help to adjust treatment methods in time, which is of great significance in effectively improving the prognosis of patients.

This study showed that GRACE score, DFR, ejection fraction, number of diseased branches, and Killip grade were all risk factors affecting the prognosis of early PCI patients after thrombolytic therapy in AMI. The guidelines of the American

College of Cardiology and the European College of Cardiology recommend that GRACE score can be used as one of the main tools to assess the risk of patients with acute coronary syndrome, because it can effectively predict the mortality and reinfection rate of patients after discharge. GRACE score includes age, heart rate, systolic blood pressure, Killip grading, etc. Previous studies^{11,12} have found that the GRACE score was closely related to the mortality of patients. The higher the GRACE score, the higher the mortality of patients was. Although GRACE score has been considered to have a certain predictive ability for the hospitalization risk and 5-years mortality of patients with acute coronary syndrome, it still has limitations such as lack of inflammatory evaluation components, and more complex evaluation and detection procedures.

Thrombosis is also considered as a key factor affecting the prognosis of patients with myocardial infarction¹². FIB is an acute phase protein, which is synthesized by the liver in response to the stimulation derived from interleukin-1 (IL-1) and IL-6 and participates in fibrin formation as the last step of triggering blood coagulation. FIB has become an important biomarker in the development of many diseases. D-D, produced by fibrinolytic enzymes, is another biomarker closely related to thrombosis and fibrinolysis. In addition to the diagnosis of abnormal blood coagulation, D-D will increase in many cases, such as inflammation, vasculitis, pregnancy, cancer,

and heart failure^{13,14}. In the study¹⁵ of progressive hemorrhagic injury, DFR ratio may be a potential predictor of venous thrombosis. In addition, ventricular diastolic and systolic functions are important factors reflecting the ventricular arterial coupling, and the phenotype and treatment decisions of heart failure largely depend on the evaluation of the ejection fraction. The prevalence of patients with reduced left ventricular ejection fraction was markedly reduced, and the prognosis was greatly improved¹⁶. Both the number of diseased branches and Killip grade have an important relationship with the patient's condition. With the increase of the number of diseased branches and Killip grade, the patient's condition was aggravated, and the prognosis worsened. The number of diseased branches and Killip grading are helpful for medical staff to quickly judge the patient's condition and prognosis. In addition, the results of this study found that the GRACE score and DFR level of patients with poor prognosis were largely increased, and the combined detection of the two played an important role in evaluating the short-term prognosis of patients. The above results suggest that GRACE score and DFR could be used as important indicators to evaluate the prognosis of patients.

Conclusions

GRACE score combined with DFR was of great value in diagnosing the short-term prognosis of early PCI patients after thrombolytic therapy in AMI. GRACE score, DFR, ejection fraction, number of diseased branches, and Killip grade were all important factors affecting the short-term prognosis of patients, which were of great significance in judging the prognosis of patients¹⁷. However, due to the limited sample size and research time, the impact of these above indicators on the long-term prognosis of patients is not clear and will be further analyzed in following studies.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

None.

Ethics Approval

This study was approved by the Medical Ethics Committee of Jintang County First People's Hospital and all procedures met the medical ethics standards. The Ethics Committee acceptance number: 2022040708.

Informed Consent

All patients agreed to be included in the study and signed informed consent.

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