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Dynamic Association Between the Index of Microcirculatory Resistance After PCI and Myocardial Injury and Inflammatory Markers in Patients with Acute Myocardial Infarction

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Abstract

Objective: To investigate the dynamic association between the index of microcirculatory resistance (IMR) measured after percutaneous coronary intervention (PCI) and myocardial injury and inflammatory markers in patients with acute myocardial infarction (AMI). **Methods:** A total of 128 patients with AMI who underwent PCI at our hospital between January 2022 and December 2025 were retrospectively analyzed. According to the IMR value measured immediately after PCI, patients were divided into a high-IMR group (n = 52) and a low-IMR group (n = 76). Differences in myocardial injury markers and inflammatory indices between the two groups were compared at multiple time points before and after surgery. Pearson correlation analysis was performed to explore the correlation between IMR values and the above indicators. **Results:** At 6 h, 24 h, and 72 h after PCI, the levels of cardiac troponin I (cTnI) and creatine kinase-MB (CK-MB) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). At 7 days postoperatively, there was no significant difference in cTnI or CK-MB levels between the two groups ($P > 0.05$). At 6 h, 24 h, and 72 h after PCI, the levels of interleukin-6 (IL-6) and high-sensitivity C-reactive protein (hs-CRP) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). Pearson correlation analysis showed that IMR values measured immediately after PCI were positively correlated with postoperative CK-MB, cTnI, hs-CRP, and IL-6 levels ($P < 0.05$). **Conclusion:** In patients with AMI, elevated IMR values after PCI are closely associated with more severe myocardial injury and a more pronounced inflammatory response.

Keywords

Acute myocardial infarction; percutaneous coronary intervention (PCI); index of microcirculatory resistance; myocardial injury; inflammatory markers

PCI is currently the first-line treatment for acute myocardial infarction in clinical practice, effectively reopening the infarct-related artery and restoring myocardial perfusion [1]. However, it is frequently observed in clinical settings that, due to coronary microvascular dysfunction, some patients experience inadequate myocardial tissue-level perfusion after PCI. Previous studies have shown [2] that elevated IMR values after PCI are associated with larger infarct size, reduced left ventricular function, and adverse cardiovascular events. Meanwhile, myocardial ischemia-reperfusion injury can trigger a robust inflammatory cascade, creating a vicious cycle. At present, research on the dynamic relationship between IMR and myocardial injury markers, as well as inflammatory indicators, remains insufficient

[3]. Therefore, this retrospective study analyzed the clinical data of 128 patients with AMI who underwent emergency PCI over the past three years, aiming to explore the dynamic association between postoperative IMR and myocardial injury and inflammatory markers.

1. Materials and Methods

1.1 General Information

A total of 128 patients with AMI who underwent PCI at our hospital between January 2022 and December 2025 were retrospectively analyzed. All patients and their families provided informed consent for participation in this study.

Among the 52 patients in the high-IMR group, 28 were male, and 24 were female, aged 48-81 years, with a mean age of (64.59 ± 4.23) years. Among the 76 patients in the low-IMR group, 41 were male, and 35 were female, aged 45-78 years, with a mean age of (65.02 ± 4.35) years. The study was approved by the hospital Ethics Committee.

Inclusion criteria:

(1) Diagnosis consistent with the treatment criteria for AMI formulated by the Chinese Society of Cardiology of the Chinese Medical Association;

(2) First onset of AMI and successful emergency PCI performed within 12 hours of symptom onset;

(3) Good treatment compliance;

(4) Complete clinical data.

Exclusion criteria:

(1) Abnormal mental status or cognitive dysfunction;

(2) Presence of malignant tumors;

(3) Presence of autoimmune diseases;

(4) Severe hepatic or renal insufficiency;

(5) Previous history of myocardial infarction.

1.2 Methods

All patients underwent PCI. Immediately after the procedure, IMR was measured using a pressure guidewire.

1.3 Observation Indicators

The levels of myocardial injury markers—cardiac troponin I (cTnI) and creatine kinase-MB (CK-MB)—were compared between the two groups at 6 h, 24 h, 72 h, and 7 days after PCI. Fasting venous blood samples were collected, and the above indicators were measured using chemiluminescence assays [4].

Inflammatory markers—interleukin-6 (IL-6) and high-sensitivity C-reactive protein (hs-CRP)—were compared between the two groups at 24 h, 72 h, and 7 days after PCI. Fasting venous blood samples were collected and analyzed using enzyme-linked immunosorbent assay (ELISA) and immunoturbidimetric methods, respectively [5].

Pearson correlation analysis was performed to evaluate the correlation between IMR values and myocardial injury and inflammatory markers.

1.4 Statistical Analysis

Statistical analyses were performed using SPSS version 26.0. Normally distributed continuous data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and comparisons between groups were performed using the independent-samples t-test. Categorical data were compared using the chi-square (χ^2) test. Pearson correlation analysis was used to assess the correlation between IMR values and myocardial injury and inflammatory markers. A P value < 0.05 was considered statistically significant.

2. Results

2.1 Comparison of Postoperative Myocardial Injury Markers Between the Two Groups

At 6 h, 24 h, and 72 h after PCI, the levels of cardiac troponin I (cTnI) and creatine kinase-MB (CK-MB) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). At 7 days after PCI, there were no statistically significant differences in cTnI or CK-MB levels between the two groups ($P > 0.05$). Details are shown in Table 1.

Table 1. Comparison of Postoperative Myocardial Injury Markers Between the Two Groups (mean ± SD)

Group	cTnI (ng/mL)				CK-MB (U/L)			
	6h	24h	72h	7d	6h	24h	72h	7d
	42.28±4.54	53.11±5.23	30.19±3.22	5.88±0.92	185.94±10.43	224.49±11.04	135.58±7.76	29.95±3.54
Low IMR group (n = 76)	65.77±5.44	83.02±6.65	38.92±3.81	6.01±1.02	286.57±16.65	343.48±14.57	156.82±9.54	30.04±3.56
High IMR group (n = 52)	26.507	28.427	13.976	0.751	42.033	52.521	13.843	0.141
t value	0.000	0.000	0.000	0.454	0.000	0.000	0.000	0.888

2.2 Comparison of Postoperative Inflammatory Markers Between the Two Groups

At 24 h, 72 h, and 7 days after PCI, the levels of interleukin-6 (IL-6) and high-sensitivity C-reactive protein (hs-CRP) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). Details are shown in Table 2.

Table 2. Comparison of Postoperative Inflammatory Markers Between the Two Groups (mean ± SD)

Group	IL-6 (pg/mL)			hs-CRP (mg/L)		
	24h	72h	7d	24h	72h	7d
Low IMR group (n = 76)	18.37±2.76	22.81±3.31	8.58±1.23	10.19±1.22	15.48±1.76	5.88±0.92
High IMR group (n = 52)	28.58±3.11	35.48±4.12	12.76±1.47	15.28±1.56	22.69±1.82	8.78±1.25
t value	19.517	19.238	19.238	20.677	22.450	15.117
P value	0.000	0.000	0.000	0.000	0.000	0.000

2.3 Correlation Between IMR and Myocardial Injury and Inflammatory Markers

Pearson correlation analysis demonstrated that IMR values measured immediately after PCI were positively correlated with postoperative CK-MB, cTnI, hs-CRP, and IL-6 levels ($P < 0.05$).

3. Discussion

The present study demonstrated that at 6 h, 24 h, and 72 h after PCI, the levels of cardiac troponin I (cTnI) and creatine kinase-MB (CK-MB) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). At 7 days postoperatively, no significant differences in cTnI or CK-MB levels were observed between the two groups ($P > 0.05$). In addition, at 6 h, 24 h, and 72 h after PCI, the levels of interleukin-6 (IL-6) and high-sensitivity C-reactive protein (hs-CRP) in the high-IMR group were significantly higher than those in the low-IMR group ($P < 0.05$). Pearson correlation analysis further revealed that IMR values measured immediately after PCI were positively correlated with postoperative CK-MB, cTnI, hs-CRP, and IL-6 levels ($P < 0.05$). These findings suggest that a higher IMR is associated with more severe myocardial injury and a more pronounced inflammatory response [6].

Mechanistically, microvascular spasm, distal embolization, and structural damage impair the effective perfusion of myocardial cells. As a result, cardiomyocytes may remain in a state of ischemia and hypoxia even after epicardial coronary reperfusion, and may also experience reperfusion injury, thereby enlarging the area of myocardial necrosis [7]. Furthermore, myocardial ischemia and reperfusion trigger marked oxidative stress and inflammatory responses. Activated neutrophils and platelet aggregation lead to the release of large amounts of inflammatory mediators, which can directly damage the microvascular endothelium, resulting in endothelial edema and dysfunction. This, in turn, further increases microcirculatory resistance and aggravates microvascular impairment [8].

In conclusion, elevated IMR values after PCI in patients with acute myocardial infarction are positively correlated with the severity of myocardial injury and inflammatory response.

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