Association Between Preinfarction Angina and Angiographic Findings in Non-ST-Segment Elevation Myocardial Infarction

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ABSTRACT

Background: The association between preinfarction angina and angiographic findings has not been elucidated in patients with non-ST-segment elevation myocardial infarction (NSTEMI).

Hypothesis: Patients with preinfarction angina have favorable angiographic findings.

Methods: This retrospective study analyzed 481 patients who underwent coronary angiography within 5 days of presenting NSTEMI. Preinfarction angina was defined as experiencing ≥ 1 chest-pain episode within 7 days prior to admission. Infarct size was measured as the peak cardiac troponin I (cTnI) level, and large myocardial infarction (MI) was defined as a peak cTnI level > 85 th percentile value in the study population. Infarct-related artery (IRA) patency was defined as Thrombolysis In Myocardial Infarction grade 2 or 3 flow. Clinical and angiographic characteristics and in-hospital mortality were compared between patients with and without preinfarction angina.

Results: Among 481 patients, 200 (42%) had preinfarction angina. Preinfarction angina was associated with smaller infarct size, indicated by lower peak cTnI levels ($P = 0.006$) and lower incidence of large MI ($P = 0.02$), and IRA patency ($P = 0.03$). There was no significant difference in in-hospital mortality. On multivariate analysis, both preinfarction angina (odds ratio: 0.53, 95% confidence interval: 0.29-0.94, $P = 0.03$) and IRA patency (odds ratio: 0.30, 95% confidence interval: 0.17-0.52, $P < 0.001$) were independent negative predictors of large MI.

Conclusion: Our study demonstrates that preinfarction angina is a predictor of smaller infarct size and infarct-related artery patency in NSTEMI patients, suggesting that NSTEMI patients presenting without preinfarction angina are at increased risk of developing a large MI.

Introduction

Preinfarction angina, defined as an angina episode preceding the onset of myocardial infarction (MI), is associated with smaller infarct size¹⁻⁶ and favorable in-hospital^{1,7,8} and long-term^{4,7,9} outcomes after ST-segment elevation myocardial infarction (STEMI) in both the thrombolytic and the percutaneous coronary intervention (PCI) eras. Although data regarding the clinical significance of preinfarction angina in non-ST-segment elevation myocardial infarction (NSTEMI) patients are limited compared with those in STEMI patients, 2 studies reported that preinfarction angina was associated with smaller infarct size and a lower incidence of in-hospital ventricular arrhythmia.^{10,11}

The reduction in infarct size associated with preinfarction angina has been attributed to an ischemic preconditioning phenomenon, which involves a brief episode of ischemia that boosts the tolerance of the heart to a subsequent prolonged ischemic insult.^{12,13} However, other confounding factors potentially affect infarct size. In fact, various angiographic factors, including preprocedural coronary blood flow,¹⁴⁻¹⁷ thrombus burden,¹⁸ and collateral circulation to the infarct-related artery (IRA),^{16,19,20} have been reported to affect the infarct size in STEMI patients. Interestingly, STEMI patients with preinfarction angina were reported to have favorable angiographic findings compared with those without preinfarction angina, which included a patent IRA,^{7,9,21,22} lower thrombus burden,¹⁸ and presence of collateral circulation.^{21,23}

Unlike in STEMI patients, the association between preinfarction angina and those angiographic findings has not been robustly reported in NSTEMI patients. The present study assessed the impact of preinfarction angina on infarct

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Table 1. Baseline Characteristics of Patients Included in the Study

	Preinfarction Angina, n = 200	No Preinfarction Angina, n = 281	P Value
Baseline characteristics and risk factors			
Age, y	64 (56–71)	68 (58–79)	<0.001
Male sex	131 (66)	167 (59)	0.18
HTN	154 (77)	208 (74)	0.46
DM	80 (40)	109 (39)	0.79
Hyperlipidemia	114 (57)	162 (58)	0.89
Current smoking	44 (22)	63 (22)	0.91
Family history	39 (20)	60 (21)	0.62
Previous MI	33 (17)	48 (17)	0.87
Previous PCI	64 (32)	84 (30)	0.62
Previous CABG	20 (10)	41 (15)	0.14
TIMI risk score			0.08
Low risk, 0–2	46 (23)	42 (15)	
Intermediate risk, 3–4	94 (47)	148 (53)	
High risk, 5–7	60 (30)	91 (32)	
Treatment before presentation			
ASA	106 (53)	155 (55)	0.64
Thienopyridine	48 (24)	58 (21)	0.38
ACEI	47 (24)	81 (29)	0.19
ARB	30 (15)	45 (16)	0.76
Nitrate	19 (10)	21 (7)	0.43
β-Blocker	86 (43)	130 (46)	0.48
Hemodynamic, laboratory, and echocardiographic data			
Killip class >1 on admission	24 (12)	43 (15)	0.3
Killip class			0.29
1	176 (88)	238 (85)	
2	19 (10)	34 (12)	
3	5 (3)	5 (2)	
4	0 (0)	4 (1)	
SBP, mm Hg	144 (127–159)	142 (123–158)	0.19
DBP, mm Hg	81 (73–94)	79 (70–90)	0.07
Heart rate, bpm	80 (71–94)	80 (69–94)	0.98
WBC count, 10 ⁹ /L	8.0 (6.6–10.0)	8.7 (6.9–10.6)	0.11
Hemoglobin, g/L	134 (119–142)	129 (116–141)	0.07
Glucose, mmol/L	6.2 (5.3–8.8)	6.6 (5.6–9.5)	0.05
eGFR, mL/min/1.73 m ²	77 (58–90)	68 (50–88)	0.02

Table 1. Continued

	Preinfarction Angina, n = 200	No Preinfarction Angina, n = 281	P Value
Peak Tn I, μg/L	0.40 (0.07–4.49)	0.92 (0.15–6.31)	0.006
LVEF, %	60 (43–63)	60 (45–64)	0.55
In-hospital treatment			
ASA	192 (96)	276 (98)	0.14
Thienopyridine	142 (71)	199 (71)	0.97
ACEI	113 (57)	138 (49)	0.11
ARB	21 (11)	41 (15)	0.19
β-Blocker	180 (90)	241 (86)	0.17
Statin	191 (96)	263 (94)	0.37
Heparin infusion	132 (66)	200 (71)	0.23
Enoxaparin	14 (7)	15 (5)	0.45
Thienopyridine loading	61 (31)	88 (31)	0.85

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; ASA, aspirin; CABG, coronary artery bypass grafting; DBP, diastolic blood pressure; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; HTN, hypertension; IQR, interquartile range; LVEF, left ventricular ejection fraction; MI, myocardial infarction; PCI, percutaneous coronary intervention; SBP, systolic blood pressure; TIMI, Thrombolysis In Myocardial Infarction; Tn, troponin; WBC, white blood cell.
Data are presented as n (%) or median (IQR).

size and the association between preinfarction angina and angiographic findings in NSTEMI patients.

Methods

This retrospective analysis included all patients who had undergone coronary angiography between January 2013 and June 2014 at our institution. Two researchers independently reviewed medical records and identified NSTEMI patients from our angiography database. Myocardial infarction was diagnosed according to the European Society of Cardiology and American College of Cardiology criteria.²⁴ The details of the database were also described in our previously published articles.^{25,26}

Inclusion criteria were (1) troponin (Tn) value >99th percentile reference value before cardiac catheterization; (2) chest pain (or anginal equivalent) or ischemic change on the electrocardiogram, including horizontal or down-sloping ST-segment depression (≥ 0.05 mV) or T-wave inversion (≥ 0.1 mV) in ≥ 2 contiguous leads; and (3) absence of ST elevation and new left bundle branch block on the electrocardiogram. Exclusion criteria were (1) cardiac catheterization >5 days after presentation; (2) severe aortic stenosis, hypertrophic cardiomyopathy, self-reported cocaine use within 5 days, cardiac arrest, ventricular tachycardia, supraventricular tachycardia with heart rate >150 bpm, implantable cardioverter-defibrillator shock, and blood pressure on presentation >230/130 mm Hg; (3) subsequent documented diagnosis of Takotsubo

Table 2. Angiographic Findings of Patients With and Without Preinfarction Angina

	Preinfarction Angina, n = 200	No Preinfarction Angina, n = 281	P Value
Interval, d ^a	1.1 (0.6–2.1)	1.2 (0.7–2.3)	0.27
Catheterization within 24 h	89 (45)	119 (42)	0.64
No. of diseased vessels			0.44
0	37 (19)	66 (23)	
1	58 (29)	67 (24)	
2	55 (28)	81 (29)	
3	50 (25)	67 (24)	
IRA			0.56
LAD	49 (25)	66 (23)	
LCX	41 (21)	50 (18)	
RCA	43 (22)	50 (18)	
LMCA	8 (4)	8 (3)	
Graft	6 (3)	6 (2)	
Multi-territory ischemia	16 (8)	35 (12)	
≥70% stenosis			
LAD	116 (58)	153 (54)	0.44
LCX	96 (48)	138 (49)	0.81
RCA	101 (51)	135 (48)	0.6
LMCA (≥50%)	14 (7)	16 (6)	0.56
In-stent restenosis	24 (12)	33 (12)	0.93
Stent thrombosis	3 (2)	9 (3)	0.37
TIMI flow grade			0.03
0–1	38 (19)	77 (27)	
2–3	161 (81)	204 (73)	
Thrombus (TIMI grade 1–5)	74 (37)	88 (31)	0.19
Thrombus grade ^b			0.02
High-grade thrombus (TIMI grade 4–5)	25 (34)	46 (52)	
Low-grade thrombus (TIMI grade 1–3)	49 (66)	42 (48)	
Collateral circulation (Rentrop grade 2–3)	37 (19)	62 (22)	0.34

Table 2. Continued

	Preinfarction Angina, n = 200	No Preinfarction Angina, n = 281	P Value
In-hospital revascularization	138 (69)	155 (55)	0.002
In-hospital PCI	117 (59)	133 (47)	0.02
In-hospital CABG	21 (11)	22 (8)	0.31

Abbreviations: CABG, coronary artery bypass grafting; IQR, interquartile range; IRA, infarct-related artery; LAD, left anterior descending artery; LMCA, left main coronary artery; LCX, left circumflex artery; PCI, percutaneous coronary intervention; RCA, right coronary artery; TIMI, Thrombolysis In Myocardial Infarction.
Data are presented as n (%) or median (IQR).
^aInterval from presentation to catheterization. ^bAnalysis among patients with thrombus.

cardiomyopathy, myocarditis, and pulmonary embolism; and (4) insufficient data for analysis.

The present study complied with the Declaration of Helsinki and was approved by the institutional review board of our hospital. Patients' demographic data and risk factors, along with admission characteristics, were obtained. Laboratory data on admission were recorded. Cardiac troponin I (cTnI) level was measured using the second-generation Vitros TnI assay (Ortho-Clinical Diagnostics Inc., Raritan, NJ). The upper limit of normal for cTnI was 0.034 µg/L, which represented the 99th percentile reference value. The cTnI level was measured serially at approximately a 6-hour interval before and after catheterization, as clinically indicated, with the highest level designated as the peak cTnI. Transthoracic echocardiography was performed during hospitalization. Left ventricular ejection fraction was calculated by either the Teichholz or biplane Simpson method.

Preinfarction angina was defined as ≥1 separate episode of chest pain or anginal equivalent, similar to the symptoms that lead to the hospital presentation, within 7 days before the admission. We used this cutoff of 7 days in line with a previous study in NSTEMI patients.¹¹ Patients were categorized into 2 groups: those with and without documented preinfarction angina.

All patients had undergone cardiac catheterization within 5 days after presentation. We used the cutoff of 5 days because angiography performed later is less likely to represent the actual coronary flow at the time of the event. An independent cardiologist blinded to the clinical data reviewed all coronary angiography findings, and the assessment was compared with the primary assessment by the treating cardiologist. In case of a discrepancy in assessments, a third investigator performed the final interpretation. In line with the standard definition of flow-limiting stenosis,^{27,28} obstructive coronary artery disease was defined as stenosis ≥70% (≥50% for the left main coronary artery). Angiographic findings including the number of diseased vessels, definite stent thrombosis as defined by the Academic Research Consortium,²⁹ and revascularization procedures were recorded. Coronary blood flow was graded according to the Thrombolysis

Table 3. In-hospital Outcomes of the Patients Recruited in the Study

In-hospital Outcomes of All Patients, n = 481	Preinfarction Angina, n = 200	No Preinfarction Angina, n = 281	P Value
Large MI	21 (11)	51 (18)	0.02
In-hospital all-cause death	2 (1)	5 (2)	0.7
In-hospital recurrent MI	0 (0)	2 (0.7)	0.51
In-hospital HF	27 (14)	46 (16)	0.39
In-hospital cardiogenic shock	5 (3)	10 (4)	0.51
In-hospital VT/VF	4 (2)	3 (1)	0.46
Length of stay, d	4.1 (2.5–7.2)	4.9 (2.7–8.0)	0.16
In-hospital Outcomes of Patients With Obstructive Lesion, n = 378	Preinfarction Angina, n = 163	No Preinfarction Angina, n = 215	P Value
Large MI	20 (12)	51 (24)	0.005
In-hospital all-cause death	2 (1)	5 (2)	0.7
In-hospital recurrent MI	0 (0)	2 (0.9)	0.51
In-hospital HF	25 (15)	39 (18)	0.47
In-hospital cardiogenic shock	5 (3)	10 (5)	0.43
In-hospital VT/VF	3 (2)	3 (1)	1
Length of stay, d	4.2 (2.4–7.8)	5.4 (3.0–8.9)	0.047
Abbreviations: HF, heart failure; IQR, interquartile range; MI, myocardial infarction; VT/VF, sustained ventricular tachycardia/ventricular fibrillation. Data are presented as n (%) or median (IQR).			

In Myocardial Infarction (TIMI) criteria.³⁰ Collateral circulation to the IRA was graded according to the Rentrop grade classification.³¹ Thrombus burden was graded according to the TIMI classification.³² The primary outcomes were peak cTnI level, used as a surrogate of infarct size as previously validated,^{33,34} and large MI defined by a peak cTnI level >85th percentile of the study population (10.8 µg/L). The cutoff level was determined based on a previous study demonstrating that patients with a peak Tn level >90th percentile of the study population had the worst prognosis.³⁵ The 85th percentile cutoff level instead of the 90th percentile cutoff level was adopted to maintain a sufficient number of events for a prediction model. The secondary outcome was in-hospital mortality. In addition, in-hospital recurrent MI, heart failure, sustained ventricular tachycardia or ventricular fibrillation, and cardiogenic shock were recorded. These outcomes were also analyzed in the subgroup of patients with an obstructive lesion on angiography.

Statistical Analysis

Data are expressed as number (%) or median (interquartile range). Continuous variables were compared using either the Student *t* test or Wilcoxon rank sum test, as appropriate. Dichotomous variables were compared using the χ^2 test or Fisher exact test. The following potential confounding variables were evaluated first in a univariate model to assess the independent predictors of large MI: age, sex, obesity, preinfarction angina, hypertension, diabetes mellitus, hyperlipidemia, current smoking, previous MI,

previous coronary artery bypass graft, previous PCI, estimated glomerular filtration rate, TIMI grade 2 or 3 flow, angiographic thrombus (grade 1–5), and collateral circulation to the IRA with Rentrop grade 2 or 3. Significant variables with a *P* value <0.15 in the univariate analysis were then entered into a multivariate logistic-regression analysis using backward stepwise selection. A significance level of 0.10 was required to allow a variable to stay in the model. Univariate and multivariate logistic regression analyses were also performed in the subgroup of the patients with an obstructive lesion on angiography. Two-sided *P* values <0.05 were considered statistically significant. All statistical analyses were performed with R software version 3.0.1 (<http://www.r-project.org>).

Results

Among 728 patients who met the inclusion criteria, 247 were excluded. Thus, 481 patients were included in the final analysis. Baseline characteristics are summarized in Table 1. Among 481 patients, 200 (42%) had documented preinfarction angina. Patients with preinfarction angina were significantly younger than those without preinfarction angina. Regarding demographic data and risk factors, there was no significant difference except for age. Patients with preinfarction angina had significantly lower peak cTnI levels than patients without preinfarction angina.

Angiographic findings are summarized in Table 2. Among the 481 patients, 378 (79%) had obstructive coronary artery disease. There was no significant difference between the 2 groups in the number of diseased vessels, location of

Table 4. Univariate and Multivariate Analyses of Predictors for Large MI in All Patients (n = 481)

	OR	95% CI	P Value
Univariate analysis			
Age (per decade increase)	1.14	0.94-1.39	0.18
Male sex	1.18	0.71-2.02	0.53
Preinfarction angina	0.53	0.30-0.90	0.02
HTN	0.9	0.52-1.63	0.73
DM	0.69	0.40-1.16	0.17
Hyperlipidemia	0.75	0.45-1.25	0.27
Current smoking	0.66	0.33-1.24	0.22
Previous MI	0.58	0.25-1.19	0.16
Previous PCI	0.66	0.36-1.15	0.16
Previous CABG	1.66	0.82-3.17	0.14
eGFR (per 10 mL/min/1.73 m ² increase)	0.96	0.88-1.04	0.32
TIMI grade 2–3 flow	0.21	0.12-0.35	<0.001
Angiographic thrombus	3.88	2.32-6.58	<0.001
Collateral (Rentrop grade 2–3)	2.23	1.27-3.83	0.004
Multivariate analysis			
Preinfarction angina	0.53	0.29-0.94	0.03
TIMI grade 2–3 flow	0.30	0.17-0.52	<0.001
Angiographic thrombus	2.99	1.71-5.25	<0.001
Abbreviations: CABG, coronary artery bypass grafting; CI, confidence interval; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; HTN, hypertension; MI, myocardial infarction; OR, odds ratio; PCI, percutaneous coronary intervention; TIMI, Thrombolysis In Myocardial Infarction.			

the IRA, and the rate of in-stent restenosis and definite stent thrombosis. Patients with preinfarction angina were more likely to have a patent IRA than those without preinfarction angina. The overall incidence of angiographic thrombus (TIMI grade 1–5) was similar between the 2 groups. However, among patients with angiographic evidence of thrombus, patients with preinfarction angina were less likely to have higher thrombus burden (TIMI grade 4–5) than those without preinfarction angina. The rate of collateral circulation to the IRA with Rentrop grade 2 or 3 was comparable between the 2 groups. Patients with preinfarction angina had a significantly higher rate of in-hospital revascularization driven by a significantly higher rate of PCI.

In-hospital outcomes are shown in Table 3. Patients with preinfarction angina had a significantly lower incidence of a large MI than those without preinfarction angina. There was no significant difference in in-hospital mortality between the groups. The association between preinfarction angina and lower incidence of a large MI remained statistically significant in the subgroup of patients who had an obstructive coronary lesion.

Table 5. Univariate and Multivariate Analyses of Predictors for Large MI in Patients With Obstructive Lesion (n = 378)

	OR	95% CI	P Value
Univariate analysis			
Age (per decade increase)	1.10	0.89-1.36	0.39
Male sex	1.01	0.59-1.76	0.96
Preinfarction angina	0.45	0.25-0.78	0.005
HTN	0.82	0.46-1.53	0.52
DM	0.64	0.37-1.10	0.11
Hyperlipidemia	0.71	0.42-1.19	0.19
Current smoking	0.60	0.29-1.13	0.13
Previous MI	0.50	0.21-1.05	0.09
Previous PCI	0.52	0.28-0.92	0.03
Previous CABG	1.30	0.64-2.52	0.44
eGFR (per 10 mL/min/1.73 m ² increase)	0.94	0.86-1.03	0.19
TIMI grade 2–3 flow	0.29	0.17-0.49	<0.001
Angiographic thrombus	2.61	1.54-4.48	<0.001
Collateral (Rentrop grade 2–3)	1.58	0.90-2.74	0.11
Multivariate analysis			
Preinfarction angina	0.45	0.24-0.81	0.009
Current smoking	0.53	0.25-1.04	0.08
Previous PCI	0.56	0.29-1.03	0.07
TIMI grade 2–3 flow	0.37	0.21-0.64	<0.001
Angiographic thrombus	2.29	1.31-4.08	0.004
Abbreviations: CABG, coronary artery bypass grafting; CI, confidence interval; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; HTN, hypertension; MI, myocardial infarction; OR, odds ratio; PCI, percutaneous coronary intervention; TIMI, Thrombolysis In Myocardial Infarction.			

Tables 4 and 5 show univariate and multivariate analyses findings of potential predictors of large MI. Multivariate analysis indicated preinfarction angina as an independent negative predictor of large MI in all patients and the subgroup of the patients with an obstructive lesion. Moreover, IRA patency was an independent negative predictor of large MI in all patients and the subgroup of the patients with an obstructive lesion. In contrast, angiographic thrombus (TIMI grade 1–5) was an independent positive predictor of large MI in all patients and the subgroup of the patients with an obstructive lesion.

Discussion

The primary findings of our study are: (1) preinfarction angina was associated with smaller infarct size, as indicated by a lower peak cTnI level and lower incidence of large MI; (2) preinfarction angina was associated with a patent IRA;

and (3) both preinfarction angina and IRA patency were independent negative predictors of large MI.

The result of the present study further supports existing data that preinfarction angina was associated with smaller infarct size indicated by lower peak creatine kinase level in patients with NSTEMI.^{10,11} In addition, our study demonstrated that preinfarction angina was associated with IRA patency defined as having a TIMI grade 2 or 3 flow, suggesting that IRA patency is one of the mechanisms of cardioprotection associated with preinfarction angina in the setting of NSTEMI. Preprocedural TIMI grade 0 or 1 flow is associated with larger scintigraphic infarct size in STEMI patients.^{15,16} The association between preinfarction angina and IRA patency has been reported in the STEMI population,^{7,9,21,22} though not all studies supported this association.^{23,36} To the best of our knowledge, this is the first study that evaluated the association between preinfarction angina and various angiographic findings in the NSTEMI population. Our findings suggest that NSTEMI patients presenting without preinfarction angina are at increased risk of developing a large MI.

Another interesting finding of our study was that preinfarction angina was associated with lower thrombus burden among patients with angiographic thrombus, although the overall incidence of angiographic thrombus was similar between the 2 groups. The association between preinfarction angina and lower thrombus burden has also been demonstrated in the STEMI population.¹⁸ This association was consistent with that in a previous study³⁷ that demonstrated that the culprit plaques of patients with preinfarction angina had less necrotic core component, which has been shown to be the most thrombogenic component in human atherosclerotic plaques,³⁸ than those of patients without preinfarction angina. In addition, the association between preinfarction angina and lower thrombus burden was consistent with the findings of previous reports showing that STEMI patients with preinfarction angina had a faster reperfusion after thrombolysis³⁹ and a higher successful rate of reperfusion after thrombolysis⁷ than those without preinfarction angina. Although preinfarction angina was associated with collateral circulation in STEMI patients,^{21,23} there was no statistically significant association between preinfarction angina and collateral circulation to the IRA in our patient population.

Regarding the association between preinfarction angina and IRA patency, whether the cardioprotective effect associated with preinfarction angina is related to patency of the IRA is worth considering. In this context, we assessed the impact of potential confounding variables on large infarct size and found that both preinfarction angina and IRA patency were independent negative predictors of large MI. This finding was consistent with that of a previous report demonstrating a cardioprotective effect of preinfarction angina, as indicated by a lower 5-year all-cause mortality, in the subgroup of the patients with both TIMI grade 0 flow and TIMI grade 1–3 flow in the STEMI population.⁹ Our results suggest that the cardioprotective effects observed in patients with preinfarction angina were associated with both an ischemic preconditioning phenomenon and IRA patency. Preconditioning phenomenon can be divided into 2 phases, and delayed preconditioning (second phase) reappears 12 to

24 hours later and lasts for 3 to 4 days.⁴⁰ Coronary circulation is a major determinant of cardioprotection associated with preconditioning phenomenon.⁴¹

Study Limitations

Our study has several limitations. First, it is subject to the usual limitations associated with a retrospective observational study. We cannot exclude the possibility that some patients might have had undocumented preinfarction angina. Although we reviewed all patients who had undergone cardiac catheterization, selection bias might have affected the results. Second, we used a peak Tn value as a surrogate of infarct size instead of an imaging study. It should be noted that Tn value could be affected by various clinical factors, such as age, renal function, and heart failure. Third, the higher rate of in-hospital revascularization in patients with preinfarction angina might have contributed to smaller infarct size in patients with preinfarction angina. The association between the infarct size and impaired coronary flow may not be causal.⁴² Finally, our study evaluated only in-hospital clinical outcomes; therefore, the impact of preinfarction angina on long-term outcomes was not assessed.

Conclusion

Our study demonstrated that preinfarction angina was associated with smaller infarct size and IRA patency in NSTEMI patients. Both preinfarction angina and IRA patency were independent negative predictors of large MI. Our study suggests that NSTEMI patients presenting without preinfarction angina are at increased risk of developing a large MI.

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