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Original Article

Impact of early coronary angiography on short-term clinical outcomes in patients with acute myocardial infarction: a retrospective study

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Abstract: Objectives: To investigate the impact of early coronary angiography on clinical outcomes in patients with acute myocardial infarction (AMI). Methods: This retrospective study included 221 AMI patients admitted to Zhangye People's Hospital Affiliated to Hexi University from December 2020 to December 2024. The patients were divided into two groups based on whether they received early coronary angiography or not: the non-early coronary angiography group (n=95) and the early coronary angiography group (n=126). Early coronary angiography was defined as within 120 minutes of admission. Baseline characteristics, in-hospital outcomes, echocardiogram indicators, and 6-month follow-up data were compared between the two groups. Results: Compared with the non-early coronary angiography group, the early coronary angiography group demonstrated significantly lower incidences of target lesion revascularization (11.90% vs. 24.21%), left ventricle thrombosis (8.73% vs. 18.95%), major bleeding (11.11% vs. 22.11%), and cardiogenic shock (8.73% vs. 18.95%) during hospitalization (all P<0.05). The average hospital stay in the early angiography group was shorter (7.95 ± 1.92 days vs. 8.76 ± 2.27 days, P=0.005), and the readmission rate was also lower (18.25% vs. 35.79%, P=0.003) compared with the non-early coronary angiography group. During the 6-month follow-up, the early angiography group continued to exhibit significantly lower rates of percutaneous coronary intervention (0.00% vs. 6.32%), coronary artery bypass grafting (3.17% vs. 11.58%), and angina incidence (3.97% vs. 12.63%) (all P<0.05). Conclusions: Early coronary angiography may help improve the in-hospital outcomes and 6-month follow-up outcomes in patients with AMI.

Keywords: Early coronary angiography, outcomes, acute myocardial infarction, retrospective study

Introduction

Acute myocardial infarction (AMI) is a disease that requires urgent treatment, and patients must undergo prompt evaluation and intervention to restore coronary blood flow, prevent complications, and improve prognosis [1-3]. Over the past decades, important advances have been made in AMI treatment, especially in immediate reperfusion therapy [4-6]. Direct percutaneous coronary intervention (PCI) remains the preferred reperfusion strategy [7].

Early coronary angiography within 120 minutes of admission has been shown to improve outcomes in AMI [8, 9]. This procedure provides direct visualization of the anatomy of coronary arteries, clarifies the site and degree of occlusion, and facilitates timely revascularization [10, 11]. Current guidelines recommend early coronary angiography for patients with ST-segment elevation myocardial infarction (STEMI), as well as those with non-ST segment elevation myocardial infarction (NSTEMI) having high-risk characteristics [12, 13].

However, in practicality, implementing the above suggestions requires a well-coordinated system to ensure timely transfer to PCI-available hospitals, which may be difficult across different regions or medical systems [14, 15]. At present, there is still controversy over the clinical net benefit of early coronary angiography, and the evidence obtained from observational

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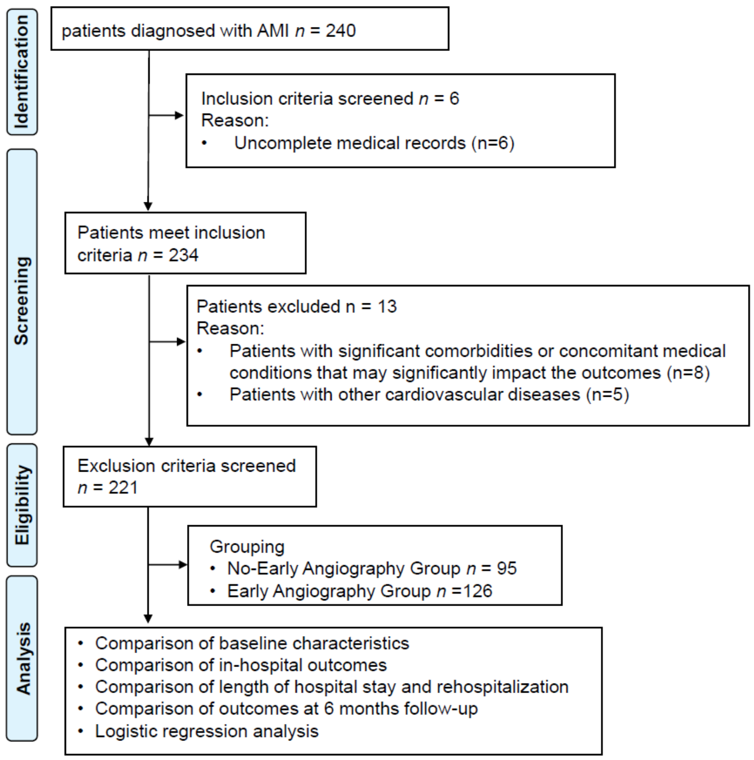

Figure 1. Study flow diagram.

studies and clinical trials remains inconsistent [16-18]. While some studies report improved patient survival rates and reduced major adverse cardiovascular events (MACE) [19, 20], others have reached different conclusions that early coronary angiography is not associated with significant reductions in mortality and recurrent infarction [21, 22].

This retrospective study aimed to evaluate the impact of early coronary angiography on clinical outcomes in AMI patients treated at a regional hospital in China. By comparing in-hospital outcomes, length of stay, readmission rates, and 6-month follow-up events between early and non-early angiography groups, this study seeks to provide real-world evidence from a typical regional healthcare setting. The innovation of this study lies in its focus on a specific real-world clinical environment, rather than idealized conditions. These findings are valuable for optimizing the management process and resource allocation for AMI in similar regional medical centers and can help improve patient care in places where logistical challenges are common.

Materials and methods

Study participants

This retrospective study retrieved electronic medical records of AMI patients admitted to Zhangye People's Hospital Affiliated to Hexi University from December 2020 to December 2024. The patients were divided into two groups based on whether they received early coronary angiography or not: the non-early coronary angiography group (95 cases) and early coronary angiography group (126 cases) (**Figure 1**). Early angiography was defined as an examination completed within 120 minutes upon admission [23]. The decision to perform early coronary angiography within 120 minutes of admission was made by the same attending cardiologists based on clinical judgment and current guidelines for AMI management. Patients or their guardians were informed about the potential benefits and risks associated with early coronary angiography. However, due to the emergency nature of AMI, detailed discussions regarding all possible alternatives and long-term implications may have been limited. Thus, the choice between early and non-early coronary angiography was not randomized but determined by clinical urgency and the attending physician's assessment. Group allocation was therefore based on real-world clinical practice.

Inclusion Criteria: diagnosis of AMI; Availability of complete medical records; age ≥18 years. Exclusion Criteria: Lack of Coronary Angiography Data; Incomplete medical records or missing key outcome data, including in-hospital outcomes and follow-up data; Prior enrollment in interventional trials assessing early coronary angiography in AMI; Significant comorbidities or concomitant medical conditions that may significantly impact the outcomes, as determined by clinical judgment and medical records; Pregnancy; Presence of other cardiovas-

Table 1. Comparison of demographic data between the two groups

Parameter	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	t/χ^2	P
Age (years)	58.53 ± 5.21	59.4 ± 6.14	1.111	0.268
Sex (Male)	57 (60%)	84 (66.67%)	1.042	0.307
BMI (kg/m²)	24.61 ± 2.57	24.84 ± 2.99	0.603	0.547
Smoking history (pack-years)	21.07 ± 4.06	20.43 ± 3.82	1.206	0.229
Alcohol consumption (g/week)	20.09 ± 4.51	18.99 ± 3.79	1.968	0.051
Hypertension (yes/no)	32 (33.68%)	50 (39.68%)	0.835	0.361
Diabetes (yes/no)	44 (46.32%)	50 (39.68%)	0.975	0.323
Previous MI [n (%)]	16 (16.84%)	16 (12.7%)	0.751	0.386
Previous PCI [n (%)]	13 (13.68%)	11 (8.73%)	1.373	0.241
Previous CABG [n (%)]	9 (9.47%)	6 (4.76%)	1.901	0.168

BMI: Body Mass Index; MI: myocardial infarction; PCI: percutaneous coronary intervention; CABG: Coronary artery bypass graft.

cular diseases, such as congenital heart disease, valvular disease, and diseases of the great vessels, myocarditis, amyloidosis, or other myocardial diseases.

Ethics statement

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Zhangye People's Hospital Affiliated to Hexi University. Given its retrospective nature and use of existing, de-identified patient data, patients' informed consent was waived.

Data collection

All data were collected by a centrally trained health care provider to ensure accuracy and consistency. Patient information was collected from the electronic medical system, including demographic data, laboratory parameters, echocardiography findings, in-hospital outcomes and clinical outcomes at the 6-month follow-up. The follow-up period was 6 months, or until the occurrence of a primary endpoint event, including PCI, coronary artery bypass grafting [CABG], and angina.

Outcome measures

The primary outcome of this study was a composite endpoint of in-hospital MACE, defined as the occurrence of any of the following events during the hospitalization period: in-hospital all-cause mortality, target lesion revascularization, left ventricular thrombus, major bleeding, or cardiogenic shock, with measurement time points from admission to discharge. Secondary outcomes included length of hospital stay, rehospitalization rate, and clinical outcomes including PCI, CABG, and angina at a 6-month follow-up. The measurement time points for hospital stay were from admission to appearance, and for rehospitalization rate, it was within 6 months after discharge.

Statistical analysis

SPSS 25.0 was used for data analysis. Categorical data was presented as [n (%)]. When the sample size was ≥40 and the theoretical frequency (T) was ≥5, the standard chi-square test was used; If the sample size was ≥40 but the theoretical frequency was 1≤T<5, the continuity-corrected chi-square test was applied; When the sample size was <40 or the theoretical frequency T was less than 1, Fisher's exact probability test was used for statistical analysis. Continuous data following a normal distribution were presented as mean ± standard deviation; Non-normally distributed data were transformed to normal distribution before analysis, and comparisons between groups were performed using the t-test. Univariate and multivariate logistic regression analyses were conducted to identify independent risk factors for in-hospital MACE events in AMI patients. A *P* value of <0.05 was considered to have statistical significance.

Results

Demographic data

As shown in **Table 1**, the average age was 58.53 ± 5.21 years in the non-early angiogra-

Table 2. Comparison of laboratory indicators between the two groups

Parameter	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	t	P
Troponin I (ng/ml)	11.14 ± 2.58	10.76 ± 3.02	0.979	0.329
LDL Cholesterol (mmol/L)	3.68 ± 0.81	3.49 ± 0.94	1.570	0.118
Hemoglobin (g/dL)	13.59 ± 1.25	13.78 ± 1.35	1.091	0.277
Creatinine (mg/dL)	1.08 ± 0.29	1.12 ± 0.37	0.893	0.373
Glucose (mmol/L)	8.62 ± 1.56	9.02 ± 1.76	1.743	0.083

LDL: Low-Density Lipoprotein.

Table 3. Comparison of echocardiography results between the two groups

Parameter	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	t	P
Ejection Fraction (%)	51.45 ± 5.09	52.56 ± 6.04	1.442	0.151
LV end-diastolic volume (ml)	119.36 ± 15.04	116.57 ± 12.05	1.484	0.140
E/A ratio	1.27 ± 0.34	1.34 ± 0.45	1.474	0.142
E/e' ratio	8.24 ± 1.58	8.02 ± 1.78	0.922	0.357
RV systolic pressure (mmHg)	25.26 ± 3.06	25.89 ± 2.83	1.576	0.117

LV: Left Ventricular; RV: Right Ventricular; E/A: Early to Late Diastolic Transmitral Flow Velocity Ratio; E/e': Early Diastolic Mitral Inflow Velocity to Early Diastolic Mitral Annular Velocity Ratio.

phy group and 59.4 ± 6.14 years in the early angiography group (t=1.111, P=0.268). Gender distribution was 60.00% male and 40.00% female in the non-early group, and 66.67% male and 33.33% female in the early angiography group (χ^2=1.042, P=0.307). Body mass index (BMI) was 24.61 ± 2.57 kg/m^2 in the non-early angiography group and 24.84 ± 2.99 kg/m^2 in the early angiography (t=0.603, P=0.547). Other baseline parameters didn't differ significantly between groups (P>0.05), establishing comparable baseline characteristics between the two groups.

Laboratory indicators

Laboratory indicators were compared between groups, revealing no significant differences: troponin I (No-Early Angiography: 11.14 ± 2.58 ng/ml, Early Angiography: 10.76 ± 3.02 ng/ml; P=0.329), low-density lipoprotein (LDL) cholesterol (3.68 ± 0.81 mmol/L vs. 3.49 ± 0.94 mmol/L; P=0.118), hemoglobin (13.59 ± 1.25 g/dL vs. 13.78 ± 1.35 g/dL; P=0.277), creatinine (1.08 ± 0.29 mg/dL vs. 1.12 ± 0.37 mg/dL; P=0.373), and glucose (8.62 ± 1.56 mmol/L vs. 9.02 ± 1.76 mmol/L; P=0.083) (P>0.05 for all) (**Table 2**). These findings indicate baseline group comparability, facilitating assessment of early angiography's impact.

Echocardiography results

Echocardiography results were compared, showing no significant differences between groups: ejection fraction (No-Early Angiography: 51.45 ± 5.09%, Early Angiography: 52.56 ± 6.04%; P=0.151), left ventricular (LV) end-diastolic volume (119.36 ± 15.04 ml vs. 116.57 ± 12.05 ml; P=0.140), early to late diastolic transmitral flow velocity (E/A) ratio (1.27 ± 0.34 vs. 1.34 ± 0.45; P=0.142), early diastolic mitral inflow velocity to early diastolic mitral annular velocity (E/e') ratio (8.24 ± 1.58 vs. 8.02 ± 1.78; P=0.357), and RV systolic pressure (25.26 ± 3.06 mmHg vs. 25.89 ± 2.83 mmHg; P=0.117) (P>0.05 for all) (**Table 3**). These findings indicate baseline similarity between groups, establishing a comparative baseline condition for assessing early angiography's impact on the outcomes of patients with AMI.

In-hospital outcomes

In-hospital outcomes differed significantly between groups (**Table 4**). The early angiography group had lower rates of target lesion revascularization (24.21% vs. 11.9%; P=0.016), left ventricular thrombus (18.95% vs. 8.73%; P=0.026), major bleeding events (22.11% vs.

Table 4. Comparison of in-hospital outcomes between the two groups

Parameter	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	χ^2	P
In-hospital Mortality (%)	6 (6.32%)	3 (2.38%)	1.258	0.262
Target Lesion Revascularization (%)	23 (24.21%)	15 (11.9%)	5.761	0.016
Left Ventricular Thrombus (%)	18 (18.95%)	11 (8.73%)	4.960	0.026
Major Bleeding Events (%)	21 (22.11%)	14 (11.11%)	4.912	0.027
Cardiogenic Shock (%)	18 (18.95%)	11 (8.73%)	4.960	0.026
Stroke (%)	3 (3.16%)	0 (0%)	2.020	0.155

Table 5. Comparison of length of hospital stay and rehospitalization between the two groups

Parameters	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	t	P
Hospital Stay (days)	8.76 ± 2.27	7.95 ± 1.92	2.853	0.005
Rehospitalization (%)	34 (35.79%)	23 (18.25%)	8.702	0.003

Table 6. Comparison of 6-month outcomes between the two groups

Parameters	Non-Early Angiography Group (n=95)	Early Angiography Group (n=126)	χ^2	P
PCI (%)	6 (6.32%)	0 (0%)	5.963	0.015
CABG (%)	11 (11.58%)	4 (3.17%)	6.047	0.014
Angina (%)	12 (12.63%)	5 (3.97%)	5.725	0.017
Death (%)	16 (16.84%)	12 (9.52%)	2.622	0.105

PCI: Percutaneous Coronary Intervention; CABG: Coronary Artery Bypass Graft.

11.11%; P=0.027), and cardiogenic shock (18.95% vs. 8.73%; P=0.026). However, inter group comparison showed no significant difference in mortality and stroke incidence during hospitalization (both P>0.05). This result suggests that early angiography may help reduce the risk of in-hospital adverse outcomes.

Length of hospital stay and rehospitalization

The comparison of hospitalization days and readmission rates between the two groups of patients showed significant differences (**Table 5**). The average length of hospital stay for patients in the early angiography group was shorter than those who did not receive early angiography (7.95 ± 1.92 days vs. 8.76 ± 2.27 days; t=2.853, P=0.005). Meanwhile, the readmission rate of the early angiography group was 18.25% (23 cases), significantly lower than 35.79% (34 cases) in the non-early angiography group (χ^2=8.702, P=0.003). These data suggest that early angiography may be associated with shorter hospitalization time and reduced risk of readmission, reflecting the clinical value of early intervention.

Outcomes at 6 months of follow-up

At the 6-month follow-up, multiple outcome measures in the early angiography group were superior to those in the non-early angiography group (**Table 6**). The proportion of patients receiving repeat PCI was 0.00% in the early angiography group, significantly lower than 6.32% in the non-early angiography group (P=0.015); the incidence of CABG was 3.17%, compared to 11.58% in the non-early angiography group (P=0.014); the incidence of angina pectoris was 3.97% and 12.63%, respectively (P=0.017). Meanwhile, the all-cause mortality rate of the early angiography group was 9.52%, which was lower than the non-early angiography group's 16.84%, but the difference did not reach statistical significance (P=0.105). The above results indicate that the clinical benefits of early angiography extend beyond the hospitalization period, contributing to reduced revas-

Table 7. Univariate logistic regression analysis of risk factors for MACE in AMI patients during hospitalization

Parameters	Coefficient	Std Error	Wald	P	OR	95% CI
Early Angiography	-0.783	0.341	5.273	0.022	0.457	0.234-0.890
Age	0.045	0.021	4.592	0.032	1.046	1.004-1.090
Diabetes (Yes)	0.652	0.335	3.789	0.014	1.920	1.195-3.705
Troponin I	0.098	0.045	4.741	0.029	1.103	1.010-1.205
Ejection Fraction	-0.067	0.029	5.338	0.021	0.935	0.884-0.990

MACE: Major Adverse Cardiovascular Events; OR: Odds Ratio; CI: Confidence Interval.

Table 8. Multivariate logistic regression analysis of risk factors for MACE in AMI patients during hospitalization

Parameters	Coefficient	Std Error	Wald Stat	P	OR	OR CI Lower	OR CI Upper
Early Angiography	-0.861	0.362	5.656	0.017	0.423	0.208	0.859
Age	0.051	0.023	4.915	0.027	1.052	1.006	1.101
Diabetes (Yes)	0.794	0.371	4.578	0.032	2.212	1.069	4.576
Troponin I	0.112	0.048	5.444	0.020	1.119	1.018	1.230
Ejection Fraction	-0.074	0.031	5.698	0.017	0.929	0.875	0.986

MACE: Major Adverse Cardiovascular Events; OR: Odds Ratio; CI: Confidence Interval.

cularization needs and a lower risk of angina recurrence during the 6-month follow-up.

Univariate logistic regression analysis

Univariate logistic regression analysis showed that early coronary angiography was significantly associated with a reduced incidence of in-hospital MACE events (OR=0.457, 95% CI: 0.234-0.890, P=0.022) (**Table 7**). Additionally, increasing age (OR=1.046, P=0.032), history of diabetes (OR=1.920, P=0.014), and elevated troponin I levels at admission (OR=1.103, P=0.029) were risk factors for MACE, while a higher ejection fraction (OR=0.935, P=0.021) was a protective factor.

Multivariate logistic regression analysis

Subsequent multivariate logistic regression analysis, after adjusting for confounding factors, confirmed that early coronary angiography (OR=0.423, 95% CI: 0.208-0.859, P=0.017) and a higher left ventricular ejection fraction (OR=0.929, P=0.017) remained independent protective factors for MACE; while older age (OR=1.052, P=0.027), history of diabetes (OR=2.212, P=0.032), and high troponin I levels at admission (OR=1.119, P=0.020) were independent risk factors (**Table 8**).

Discussion

Against the backdrop of continuous developments in the diagnosis and treatment strategies for AMI, it is of great significance to evaluate the impact of early coronary angiography on patient prognosis [24, 25]. The aim of this retrospective study was to assess the impact of early coronary angiography on patient outcomes and to determine the clinical utility of this intervention.

Baseline characteristics were comparable between the two groups across demographic and clinical variables, supporting subsequent analysis of the impact of the timing of coronary angiography on outcomes by eliminating confounding factors from baseline imbalances.

The results of this study demonstrated the clinical utility of early coronary angiography. While in-hospital mortality and stroke did not differ significantly between the two groups, the incidences of target lesion revascularization, left ventricular thrombosis, major bleeding and cardiogenic shock were lower in the early coronary angiography group, suggesting that early coronary angiography may exert a greater influence on outcomes related to myocardial injury and revascularization than overall mortality or stroke.

The incidences of readmission, PCI, CABG, and angina in the early coronary angiography group were all lower compared to the non-early coronary angiography group. These findings indicate that early angiography may reduce recurrent ischemic events and the need for repeated revascularization, thereby improving long-term outcomes.

The mean hospital stay was also significantly shorter in the early coronary angiography group, potentially reflecting more efficient use of medical resources. Shorter hospital stays can reduce the financial burden on the healthcare system and enhance patient comfort and overall hospitalization experience [26-28]. The lower readmission rate in the early angiography group also suggests that early intervention may reduce patients' demand for subsequent medical resources and related costs.

Our results are consistent with several recent clinical studies on early coronary angiography in AMI patients. For example, in the PEARL trial, Kern et al. [23] demonstrated that it is feasible and safe to perform early coronary angiography for cardiac arrest without ST-segment elevation. Onnis et al. [29] found that early angiography can help reduce the risk of mortality and MACE in AMI patients. In addition, a systematic review and meta-analysis of randomized controlled trials by Al Lawati et al. [30] further noted that early coronary angiography is associated with improved outcomes in patients experiencing out-of-hospital cardiac arrest, even without ST segment elevation. This evidence supports the trend toward reduced MACE that we observed in the early intervention group.

These improvements may be attributed to several key factors. On one hand, early visualization of coronary artery disease enables timely restoration of coronary blood flow, thereby shortening the total duration of heart ischemia and effectively limiting the extent of myocardial infarction. Our study also confirms that patients who receive early angiography have significantly lower incidence of target lesion revascularization and left ventricular thrombus. On the other hand, early risk assessment facilitates the optimization of pharmacological therapy and development of personalized treatment plans. This may explain the significantly lower incidences of major bleeding and cardiogenic shock observed in our early angiography group.

There are several limitations to our study. First, despite our efforts to control confounding factors through a variety of analytical methods, selection bias may still exist due to the retrospective, single-center design. Patients were grouped by whether they received early and non-early angiography, which was not randomized but reflected actual clinical practice. Therefore, there might be some characteristics that were not evenly balanced between the two groups. Second, while our sample size was sufficient to detect differences in major outcomes, it may not be large enough to support detailed subgroup analysis or to generalize the findings to all types of AMI. In addition, some clinically important information was not included in the analysis. For example, patient adherence to medication, specific time of revascularization after angiography, and socioeconomic factors may affect efficacy. Third, the follow-up period was limited to only six months, allowing assessment of only short- to medium-term outcomes. Longer observation is needed to determine the long-term benefits and safety of early angiography. Finally, our data came from a regional hospital in China, and variations in healthcare resources across different regions may limit the generalizability of the findings. Future research should prioritize prospective, randomized studies to validate our findings and to identify the optimal timing for different AMI populations.

Conclusion

Early coronary angiography may improve both in-hospital and 6-month outcomes in patients with AMI, as reflected by a shorter duration of hospital stay, less subsequent need for revascularization procedures, and lower readmission rates.

Disclosure of conflict of interest

None.

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