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Beneficial Effects of Immediate Stenting After Thrombolysis in Acute Myocardial Infarction

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OBJECTIVES The Southwest German Interventional Study in Acute Myocardial Infarction (SIAM III) investigated potentially beneficial effects of immediate stenting after thrombolysis as opposed to a more conservative treatment regimen.

BACKGROUND Treatment of acute myocardial infarction (AMI) by thrombolysis is compromised by Thrombolysis In Myocardial Infarction (TIMI) 3 flow rates of only 60% and high re-occlusion rates of the infarct-related artery (IRA). Older studies showed no benefit of coronary angioplasty after thrombolysis compared with thrombolytic therapy alone. This observation has been challenged by the superiority of primary stenting over balloon angioplasty in AMI.

METHODS The SIAM III study was a multicenter, randomized, prospective, controlled trial in patients receiving thrombolysis in AMI (<12 h). Patients of group I were transferred within 6 h after thrombolysis for coronary angiography, including stenting of the IRA. Group II received elective coronary angiography two weeks after thrombolysis with stenting of the IRA.

RESULTS A total of 197 patients were randomized, 163 patients fulfilled the secondary (angiographic) inclusion criteria (82 in group I, 81 in group II). Immediate stenting was associated with a significant reduction of the combined end point after six months (ischemic events, death, reinfarction, target lesion revascularization 25.6% vs. 50.6%, $p = 0.001$).

CONCLUSIONS Immediate stenting after thrombolysis leads to a significant reduction of cardiac events compared with a more conservative approach including delayed stenting after two weeks. (J Am Coll Cardiol 2003;42:634–41) © 2003 by the American College of Cardiology Foundation

Prompt and permanent restoration of epicardial blood flow and tissue level perfusion is the prominent goal of treatment strategies after myocardial infarction (MI) (1–3). Thrombolytic therapy alone accomplishes Thrombolysis In Myocardial Infarction (TIMI) 3 flow in only 60% of the patients (1) and is prone to recurrent ischemia before hospital discharge in 29% (4). Notably, re-occlusion of the infarct-related artery (IRA) is associated with increased mortality (5). Prediction of infarct vessel patency by electrocardiogram and other non-invasive markers of reperfusion is limited (6).

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Primary angioplasty offers several advantages compared with thrombolysis: higher recanalization rates, direct and immediate verification of procedural success, and additional information concerning the left ventricular (LV) function. Consequently, angioplasty appears to be superior to thrombolysis with respect to survival and reinfarction rates (7). The main limitation of primary angioplasty is its limited availability (8). Patients treated with angioplasty derive benefit compared with thrombolysis only when transfer can be expedited without delay (9,10). Furthermore, patients with acute MI (AMI) treated at hospitals with low angioplasty volumes show similar outcomes with primary angioplasty or thrombolysis (11).

The rationale for a combination of thrombolysis and angioplasty is the rapid onset of reperfusion therapy accompanied by reassurance of vessel patency, although data supporting this concept are lacking. However, older studies showed no benefit of early angioplasty after thrombolysis compared with thrombolytic therapy alone (12). More recent investigations demonstrated superiority of primary stenting in AMI over angioplasty (13,14). It may be assumed that coronary stents may overcome the limitations of balloon angioplasty after thrombolysis by preventing early re-occlusions. However, there are no data available on the effects of immediate stenting compared with delayed intervention in patients with AMI after thrombolysis. To examine the effects of percutaneous coronary intervention we designed the Southwest German Interventional Study in Acute Myocardial Infarction (SIAM III) comparing the strategy of immediate stenting with a more conservative

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Abbreviations and Acronyms

AMI	= acute myocardial infarction
GP	= glycoprotein
IRA	= infarct-related artery
LV	= left ventricular
MI	= myocardial infarction
SIAM III	= Southwest German Interventional Study in Acute Myocardial Infarction
TIMI	= Thrombolysis In Myocardial Infarction

approach including elective stenting after stabilization of the patients condition (i.e., two weeks after the acute event and thrombolysis).

METHODS

Selection of patients. The SIAM III study was a prospective, controlled, randomized multicenter trial among patients with AMI enrolled from July 1998 to April 2001. Patients were recruited from community hospitals without cathlab facilities located within a distance to the interventional center up to 35 km. Each patient gave informed consent. The study protocol was approved by the ethics committee of the state medical board. Table 1 shows the inclusion and exclusion criteria.

Drug regimens and treatment strategies. Reteplase (Rapilysin, Hoffmann-La Roche AG, Grenzach-Wyhlen, Germany) was administered in two boluses of 10 MU 30 min apart. Patients received 250 mg of aspirin intravenously (Aspisol, Bayer Vital, Germany) and a bolus of 5,000 IU heparin. Heparin was continued by an infusion of 1,000 IU/h. The initial rate of heparin infusion was reduced to 800 U/h for patients weighing <80 kg and was adjusted to maintain an activated partial thromboplastin time of 50 to 70 s in all patients.

Table 1. Inclusion and Exclusion Criteria of the Study

Primary inclusion criteria:
- Age >18 yrs
- Patients presenting with symptoms of MI present for <12 h and having, on the basis of 12-lead electrocardiography, ST-segment elevation of at least 1 mm in two or more limb leads, ST-segment elevation of at least 2 mm in the precordial leads, or new bundle-branch block
- Patients eligible for thrombolysis, which means no history of stroke or central nervous system damage, recent major surgery, systolic blood pressure >200 mm Hg, or diastolic blood pressure >110 mm Hg at any time after arrival, no recent noncompressible vascular puncture, or concomitant use of an oral anticoagulant with an international normalized ratio >2
- No secondary or iatrogenic infarction
- No chronic renal insufficiency requiring dialysis
- Informed consent for participation

Secondary angiographic inclusion criteria:
- Indication for angioplasty independent of the study
- Infarct-related lesion in a native coronary artery >2.5 mm
- Diameter stenosis of at least 70% or TIMI flow <grade 3

Secondary angiographic exclusion criteria:
- Coronary anatomy unsuitable for stent placement
- Anticipated indication for surgical coronary revascularization within 6 months
- Previous MI in the area of the infarct-related vessel
- Infarct-related lesion not clearly defined

MI = myocardial infarction; TIMI = Thrombolysis In Myocardial Infarction.

Table 2. Baseline Data of Secondary Excluded and Included Patients

	Excluded	Included	p Value
n	34	163	
Male gender	76.5%	78.5%	0.474
Age	68 ± 13 yrs	63 ± 11 yrs	0.017
Diabetes mellitus	20.6%	31.9%	0.134
Time from symptom onset to thrombolysis	3.2 ± 1.9 h	3.4 ± 2.4 h	0.710
CK	833 ± 732 U/l	951 ± 781 U/l	0.566
CK-MB	135 ± 126 U/l	121 ± 97 U/l	0.683
Three-vessel disease	58.8%	27.0%	0.001
Left ventricular ejection fraction	56.8 ± 12.9%	54.7 ± 12.4%	0.422
Cardiogenic shock at randomization	0	2.5%	0.466

CK = creatine kinase.

During thrombolysis in the primary hospital, the patients were randomized either to immediate stenting (group I) or elective stenting (group II) using a computer algorithm. Patients of group I were transferred to the interventional center within 6 h after thrombolysis for coronary angiography, including stenting of the IRA followed by a second coronary angiography after two weeks. Group II had elective coronary angiography after two weeks with stenting of the IRA, or earlier in case of ongoing ischemia. The patients received optimal medical treatment, including use of glycoprotein (GP) IIb/IIIa inhibitors according to the judgment of the treating physician.

Catheterization procedure and angiographic analysis. Cardiac catheterization was carried out through the right or left femoral artery. Additional heparin was given in the cathlab depending on the activating clotting time, with a target of 250 s. Aspirin and clopidogrel were continued for four weeks. The MultiLink stent (Duet, Tetra, Guidant GmbH, Isernhagen, Germany) was used.

Primary interventional success was defined as stent implanted, residual stenosis <15%, and TIMI grade 3 flow after stent implantation. The index lesion was evaluated with the CAAS-II System (Pie Medical, Rotterdam, The Netherlands). Biplane LV angiography was used to evaluate measures of LV function. Ejection fraction was calculated by end-diastolic and end-systolic LV area and averaged between frontal and lateral view. The observers were blinded to the treatment.

Follow-up and study end points. Patients were interviewed about their medical history and cardiovascular risk factors, and previous patient records were reviewed. During the acute phase of MI, serum creatine kinase levels and creatine kinase-MB fractions were measured every 4 h. All participants had invasive monitoring of hemodynamic pa-

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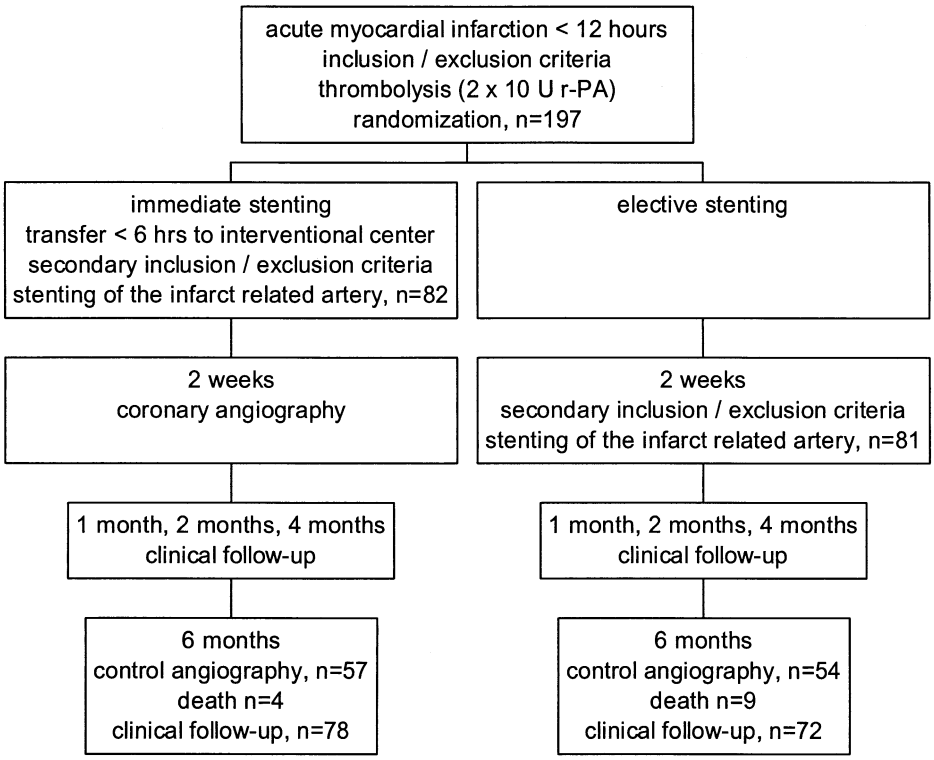

Figure 1. Flow chart of randomization. r-PA = reteplase.

rameters. The patients were followed up with telephone interviews at two, four, and six months. Patient records were reviewed in the case of repeated hospitalization. Repeated coronary angiography was scheduled after six months.

The primary end point was a combined end point of death, reinfarction, ischemic events, and target lesion revascularization at six months. "Reinfarction" was defined as two or more of the following criteria: chest pain lasting for more than 30 min; a new significant ST-elevation; and a rise in the serum creatine kinase level to >3× the upper normal limit. "Target lesion revascularization" was defined as any reintervention or coronary artery bypass graft surgery involving the infarct-related vessel. Ischemic events included unplanned hospitalization and/or unplanned angiography due to postinfarction angina, recurrent angina pectoris lasting for more than 15 min despite the administration of nitrates or being accompanied by electrocardiographic changes, pulmonary edema, or hypotension. Left ventricular

Table 3. Baseline Data: Comparison of Randomization Groups

	Immediate Stenting	Delayed Stenting	p Value
n	82	81	
Male gender	76.8%	80.2%	0.367
Age	62.4 ± 11.2 yrs	63.4 ± 9.9 yrs	0.562
Time from symptom onset to thrombolysis	3.2 ± 2.2 h	3.6 ± 2.6 h	0.273
CK	945 ± 874 IU/l	969 ± 684 IU/l	0.860
CK-MB	125 ± 101 IU/l	116 ± 95 IU/l	0.629
Cardiogenic shock at randomization	3.7%	1.2%	0.315
Anterior wall infarction	43.9%	40.7%	0.401
Diabetes mellitus	29.3%	34.6%	0.289
Smoker	42.7%	38.3%	0.340
Hypertension	62.2%	63.0%	0.524
Hyperlipidemia	51.2%	60.5%	0.150
In-hospital medical treatment			
β-blocker	77.3%	76.2%	0.525
Nitrates	57.6%	77.8%	0.012
ACE inhibitors	93.9%	93.7%	0.615
AT antagonists	1.5%	1.6%	0.740
Statins	62.1%	57.1%	0.346

ACE = angiotensin-converting enzyme; AT antagonists = angiotensin receptor antagonists; CK = creatine kinase.

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Table 4. Angiographic Data: Comparison of Randomization Groups

	Immediate Stenting	Delayed Stenting	p Value
n	82	81	
Time from symptom onset to first angiography	6.7 ± 2.9 h	11.7 ± 6.8 days	0.001
Time from thrombolysis to angiography	3.5 ± 2.3 h	11.7 ± 6.8 days	0.001
Unplanned prior angiography	0	23.5%	0.001
Two-week angiography during initial hospital stay	61.0%	79.0%	0.009
Three-vessel disease	28.0%	25.9%	0.449
Infarct-related vessel			
LAD	41.5%	37.0%	
CX	11.0%	8.6%	0.672
RCA	47.6%	54.3%	
Lesion type			
A	1.2%	1.3%	
B	40.2%	55.0%	0.166
C	58.5%	43.8%	
Angiographic evidence of thrombus formation	62.2%	39.5%	0.003
Abciximab	9.8%	16.0%	0.167
TIMI flow before intervention			
0/1	21.0% (5.8% with collaterals)	24.3% (11.1% with collaterals)	
2	18.5%	16.2%	0.892
3	60.5%	59.5%	
Stent diameter	3.4 ± 0.4 mm	3.4 ± 0.5 mm	0.762
Stent length	20.3 ± 7.4 mm	20.5 ± 9.7 mm	0.878
# Stents	1.1 ± 0.5	1.0 ± 0.6	0.350
Reference diameter before intervention	3.1 ± 0.6 mm	3.1 ± 0.7 mm	0.962
Minimal lumen diameter before intervention	0.4 ± 0.3 mm	0.4 ± 0.4 mm	0.924
Diameter stenosis before intervention	85.8 ± 10.8%	84.9 ± 14.4%	0.664
Reference diameter post-intervention	3.3 ± 0.4 mm	3.3 ± 0.5 mm	0.642
Minimal lumen diameter post-intervention	3.0 ± 0.6 mm	2.9 ± 0.8 mm	0.637
Diameter stenosis post-intervention	9.6 ± 15.2%	12.3 ± 20.6%	0.372
Acute vessel occlusion/no reflow in cath lab	4.9%	6.2%	0.492
TIMI 3 flow post intervention	97.5%	91.9%	0.204
TIMI 3 flow after 2 weeks	98.6%	58.9%	0.001
Reference diameter after 6 months	3.0 ± 0.5 mm	3.1 ± 0.8 mm	0.457
Minimal lumen diameter after 6 months	2.1 ± 0.9 mm	1.8 ± 1.0 mm	0.081
Diameter stenosis after 6 months	31.5 ± 25.3%	43.4 ± 27.7%	0.015
Late lumen loss	0.93 ± 0.86 mm	1.19 ± 0.92 mm	0.113
Binary restenosis rate	25.0%	36.2%	0.126
TIMI 3 flow after 6 months	95.5%	91.2%	0.619

CX = circumflex artery; LAD = left anterior descending coronary artery; RCA = right coronary artery; TIMI = Thrombolysis In Myocardial Infarction.

ejection fraction was evaluated at baseline in group I and compared between the groups after two weeks and six months.

Major bleeding included need for transfusion, bleeding requiring surgical intervention with a timely connection with the coronary intervention, bleeding documented by computed tomography and/or ultrasound, intracerebral as well as ocular, retroperitoneal, abdominal, intestinal, or urogenital, or a decrease in hemoglobin >4 g% within 72 h with a timely connection with the coronary intervention.

Statistical analysis. Final enrollment of 163 patients randomly assigned to either immediate stenting or delayed stenting, with a two-sided type I error rate of 0.05, yielded 90% power to detect a decrease in the incidence of the primary end point from 50% to 25% by immediate stenting. The assumption of these event rates was based on SIAM I and II results (unpublished data).

Comparisons between the two treatment groups were performed on an intention-to-treat basis, unless otherwise specified. Continuous data are expressed as mean ± SD. Categorical variables were compared using the chi-square test, and continuous variables were compared using the Student *t* test. The effect of randomized treatment on event-free survival was determined by a Kaplan-Meier survival analysis. Statistical analysis was performed with the software package SPSS 10.0 for Windows (SPSS Inc., Chicago, Illinois).

RESULTS

A total of 197 patients were randomized; 34 patients met the secondary exclusion criteria due to an indication for coronary bypass grafting (n = 17), a non-significant infarct-related lesion (i.e., diameter stenosis of <70% including TIMI 3 flow; n = 13), or an undefined IRA (n = 4). Table 2 shows the baseline data of all patients. A total of 163 patients were finally included (Fig. 1). There were no relevant differences in baseline data between the two study

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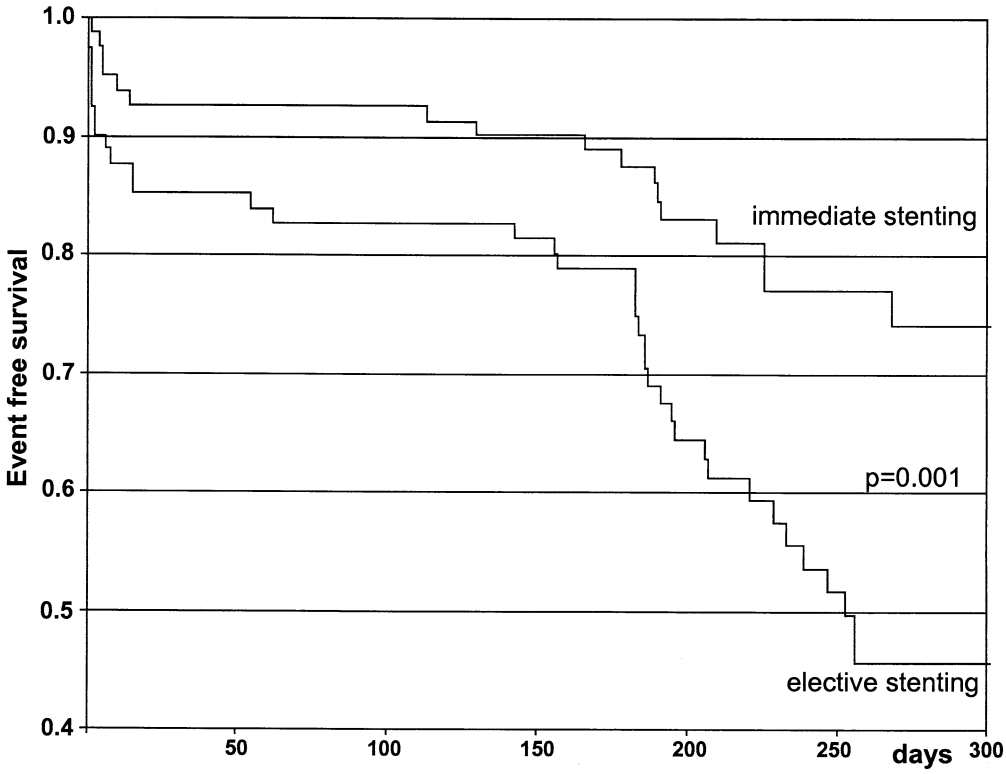

Figure 2. Event-free survival (freedom from death, reinfarction, target lesion reintervention, or ischemic events), comparison of randomization groups.

groups (Table 3). Angiographic data were comparable between the two groups (Table 4); TIMI 3 flow rates at two-week angiography were 98% in group I vs. 59% in group II ($p = 0.001$).

Major bleeding complications occurred in 9.8% of patients with immediate stenting versus 7.4% in delayed stenting ($p = 0.374$). At randomization, three patients in the immediate-stenting group and one patient in the elective group were in cardiogenic shock. The three patients in group I were transferred to the interventional center for angiography after 1.2, 1.4, and 5.2 h, respectively. The patient in group II presenting with cardiogenic shock was transferred for premature angiography 3.4 h after the initial treatment. All patients with cardiogenic shock received an intra-aortic balloon pump. During follow-up, two patients with immediate intervention and six patients in the elective group developed a new episode of cardiogenic shock. Cerebral bleeding after thrombolysis occurred in one patient of group I and two patients of group II. Five patients of group II died in the first 48 h after thrombolysis, whereas all patients of group I survived the acute phase.

A total of 19 patients (23.5%) in group II underwent unplanned premature angiography 3.1 ± 4.2 days after thrombolysis due to persistent electrocardiographic signs of ischemia ($n = 9$), postinfarction angina pectoris ($n = 9$), and hemodynamic instability ($n = 1$). During a mean follow-up time of 287 ± 225 days, immediate stenting was associated with a significant reduction of the combined end point (ischemic events, death, reinfarction, target lesion revascularization; 25.6% vs. 50.6%, $p = 0.001$; Fig. 2). This beneficial effect was driven mainly by the reduction of ischemic events (4.9% vs. 28.4%, $p = 0.01$; Table 5). On an intention-to-treat basis, immediate stenting lead to a significant reduction of death, reinfarction, and target lesion revascularization (27.7% vs. 39.8%, $p = 0.049$; Table 6). Patients with and without reperfusion after thrombolysis undergoing immediate stenting showed similar outcomes in contrast with those patients with delayed stenting (Table 7).

Patients with immediate stenting showed a LV ejection fraction of 52.2 ± 12.6% immediately after thrombolysis. Left ventricular function after two weeks was significantly better in patients undergoing immediate stenting than in the elective group (56.7 ± 11.5% vs. 52.5 ± 13.1%, $p = 0.037$). After six months, patients in the group of immediate stenting showed a further improvement in LV function from 56.7 ± 11.5% to 61.5 ± 12.0% ($p = 0.015$), whereas the difference in the delayed stenting group failed the statistical significance (from 52.5 ± 13.1% to 56.4 ± 11.4%, $p = 0.082$) (Table 5).

DISCUSSION

Thrombolysis is regarded as the standard treatment for AMI. Percutaneous coronary intervention with stenting

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Table 5. End Points: Comparison of Randomization Groups

	Immediate Stenting	Delayed Stenting	p Value
n	82	81	
Acute phase			
Cardiogenic shock at randomization	3.7%	1.2%	0.315
Cardiogenic shock at follow-up	6.1% (new 2)	8.6% (new 6)	0.374
Major bleeding	9.8%	7.4%	0.400
Stroke after thrombolysis	2.4%	2.5%	0.685
30 days			
CABG	0	0	1.000
Target lesion reintervention	2.4%	2.5%	0.685
Ischemic events	3.7%	24.7%	0.001
Reinfarction	2.4%	2.5%	0.685
Death	4.9%	9.9%	0.179
Death or reinfarction	7.3%	12.3%	0.208
Death, reinfarction, target lesion reintervention	7.3%	13.6%	0.146
Death, reinfarction, target lesion reintervention, ischemic events	8.5%	30.9%	0.001
6-months follow-up			
Follow-up	272.4 ± 191.0 days	302.0 ± 255.8 days	0.404
CABG	7.3%	7.4%	0.609
Target lesion reintervention	19.5%	23.5%	0.336
Ischemic events	4.9%	28.4%	0.001
Reinfarction	2.4%	2.5%	0.685
Death	4.9%	11.1%	0.119
Death or reinfarction	7.3%	13.6%	0.146
Death, reinfarction, target lesion reintervention	24.4%	35.8%	0.078
Death, reinfarction, target lesion reintervention, ischemic events	25.6%	50.6%	0.001
LV ejection fraction			
LV ejection fraction acute phase	52.2 ± 12.6%	NA	
LV ejection fraction after two weeks	56.7 ± 11.5%*	52.5 ± 13.1%†	0.037
LV ejection fraction after six months	61.5 ± 12.0%*	56.4 ± 11.4%†	0.018

Left ventricular (LV) ejection fraction at different time points: two weeks versus six months immediate stenting group *p = 0.015; delayed stenting group †p = 0.082.
CABG = coronary artery bypass grafting; major bleeding = transfusion or surgery due to beleeding complication.

(13) in combination with GP IIb/IIIa antagonists (14) appears to be superior to thrombolysis (15). However, this requires immediate transfer to an experienced interventional center, which often poses logistical problems and a loss of time. The additional time delay in the Air Primary Angioplasty in Myocardial Infarction (AIR-PAMI) trial for transfer to primary angioplasty was about 52 min (16). Thrombolysis, in contrast, is available without delay. Coronary intervention immediately after thrombolysis could be an attractive option to cover this gap and improve the limited patency rates. However, randomized trials in the late 1980s and early 1990s have shown no advantage of immediate and early intervention after thrombolysis (12). There was no improvement in mortality, LV function, or rates of reocclusion. In contrast, early coronary angioplasty was associated with higher rates of bleeding and transfusions and emergency coronary artery bypass grafting. In some studies, in fact, the more aggressive approach with early coronary

Table 6. End Points: Comparison of TIMI Flow Rates After Thrombolysis in the Two Groups

	Immediate Stenting		Delayed Stenting		
	TIMI 0/1	TIMI 2/3	TIMI 0/1	TIMI 2/3	p Value
n	17	65	18	63	
LV ejection fraction acute phase	48.9 ± 9.2%	53.0 ± 13.2%	NA	NA	
LV ejection fraction after two weeks	50.8 ± 8.9%*	58.2 ± 11.6%*	45.9 ± 12.8%‡	54.6 ± 12.6%‡	0.001
LV ejection fraction after six months	54.8 ± 13.5%†	63.5 ± 10.9%†	51.3 ± 9.2%§	57.8 ± 11.6%§	0.002
Target lesion reintervention	29.4%	16.9%	27.8%	22.2%	0.598
Ischemic events	5.9%	4.6%	50.0%‖	22.2%‖	0.001
Reinfarction	5.9%	1.5%	5.6%	1.6%	0.576
Death	0	6.2%	11.1%	11.1%	0.415
Death or reinfarction	5.9%	7.7%	16.7%	12.7%	0.574
Death, reinfarction, target lesion reintervention	29.4%	23.1%	44.4%	33.3%	0.308
Death, reinfarction, target lesion reintervention, ischemic events	29.4%	24.6%	72.2%¶	44.4%¶	0.001

Comparison of patients with TIMI 0/1 vs. TIMI 2/3 within the immediate stenting group: *p = 0.017, †p = 0.013. Comparison of patients with TIMI 0/1 vs. TIMI 2/3 within the delayed stenting group: ‡p = 0.013, §p = 0.079, ‖p = 0.025, ¶p = 0.034.
LV = left ventricular; TIMI = Thrombolysis In Myocardial Infarction.

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Table 7. End Points: Six Months Follow-Up Intention-to-Treat Analysis (Including Secondary Excluded Patients): Comparison of Randomization Groups

	Immediate Stenting	Delayed Stenting	p Value
n	94	103	
CABG	12.8%	18.4%	0.185
Target lesion reintervention	23.4%	30.1%	0.185
Ischemic events	7.4%	27.2%	0.001
Reinfarction	3.2%	2.9%	0.614
Death	4.3%	8.7%	0.164
Death or reinfarction	7.4%	11.7%	0.225
Death, reinfarction, target lesion reintervention	27.7%	39.8%	0.049
Death, reinfarction, target lesion reintervention, ischemic events	29.8%	53.4%	0.001

CABG = coronary artery bypass grafting.

angioplasty was even associated with higher mortality (12). One reason for this finding may be intimal and medial hemorrhage at the angioplasty site, leading to re-occlusion of the IRA (17). Furthermore, beneficial effects of modern antiplatelet therapy and device technology were not yet available.

Patients randomized to thrombolytic therapy before transfer for angioplasty in the Primary Angioplasty in AMI Patients from General Community Hospitals Transported to PTCA Units Versus Emergency Thrombolysis (PRAGUE) trial showed higher rates of bleeding (18). Only patients with an occluded infarct-related vessel after thrombolysis have been shown to benefit from angioplasty (19). However, the Primary Angioplasty with a Strategy of Short-Acting Thrombolysis (PACT) study provided evidence for a safe use of thrombolytic agents and angioplasty (20). Only retrospective data indicate that the combination of full dose pre-hospital thrombolysis and immediate angioplasty with stent implantation is safe and achieves high early patency rates (21).

In the present trial, immediate patient transfer within 6 h for coronary angiography after thrombolysis was performed. This concept would be suitable in daily life practice to provide the earliest possible interventional therapy in the majority of patients suffering from AMI in community hospitals. A significant improvement in event-free survival was achieved by immediate coronary stent implantation after thrombolysis. The strategy of coronary angiography with stenting after recovery and stabilization for two weeks (or in some cases earlier in the presence of signs of continuing or complicating ischemia) was observed to be inferior to coronary intervention even when thrombolysis was judged successful according to non-invasive measures. Patients with failed reperfusion after thrombolysis in the immediate intervention group showed an outcome similar to that of patients who had undergone successful thrombolysis. Furthermore, immediate intervention compared with delayed intervention after two weeks produced a significant improvement in LV function, which even increased during the six months of follow-up. It has been reported that myocardium at risk recovers within the first 14 days (22). This fits well with the results of this study by the significant improvement in LV ejection fraction noted already after 14 days. Mortality in the acute phase and during follow-up was reduced by about 50%. However, the study was not designed to show differences in mortality. For this purpose larger trials are necessary. The use of GP IIb/IIIa antagonists was particularly uncommon in the early intervention group.

It may be speculated that immediate stenting could potentially be further improved by a combination of thrombolysis and GP IIb/IIIa antagonists.

Our results compare favorably with recently reported outcomes of patients with acute coronary syndromes. The Intracoronary Stenting With Antithrombotic Regimen Cooling Off (ISAR-COOL) trial showed a significantly worse outcome for patients in whom percutaneous coronary intervention was delayed for 72 to 120 h while they were given antiplatelet therapy, including GP IIb/IIIa antagonists, than for those undergoing immediate stenting (23). However, lack of IIb/IIIa blockade may alter the benefits of early invasive strategies in acute coronary syndromes (ELISA) (24).

In summary, immediate transfer of patients to centers for coronary angiography and stenting within 6 h after thrombolysis for AMI is safe and improves event-free survival, in particular recurrent ischemia as well as LV function, compared with elective stenting later on.

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APPENDIX

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