

# Randomized Comparison of Percutaneous Transluminal Coronary Angioplasty and Medical Therapy in Stable Survivors of Acute Myocardial Infarction With Single Vessel Disease

## A Study of the Arbeitsgemeinschaft Leitende Kardiologische Krankenhausärzte

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**Background**—Percutaneous transluminal coronary angioplasty of the infarct-related artery in stable survivors of acute myocardial infarction is often performed, even in patients without any symptoms or residual ischemia. Despite the lack of randomized studies, it is widely believed that this intervention will improve the clinical outcome of these patients.

**Methods and Results**—Three hundred patients with single vessel disease of the infarct vessel and no or minor angina pectoris in the subacute phase (1 to 6 weeks) after an acute myocardial infarction were randomized to angioplasty (n=149) or medical therapy (n=151). Primary end point was the survival free of reinfarction, (re)intervention, coronary artery bypass surgery, or readmission for severe angina pectoris at 1 year. The event-free survival at 1 year was 82% in the medical group and 90% in the angioplasty group ( $P=0.06$ ). This difference was mainly driven by the difference in the need for (re)interventions (20 versus 8,  $P=0.03$ ). At long-term follow-up (mean, 56 months), survival was 89% and 96% ( $P=0.02$ ). Survival free of reinfarction, (re)intervention, or coronary artery bypass surgery was 66% and 80% in the medically and interventionaly treated patients, respectively ( $P=0.05$ ). The use of nitrates was significantly lower in the angioplasty group, both at 1 year (38% versus 67%,  $P=0.001$ ) and at long-term follow-up (36% versus 55%,  $P=0.006$ ).

**Conclusions**—Percutaneous revascularization of the infarct-related coronary artery in stable patients with single vessel disease improves clinical outcome at long-term follow-up and reduces the use of nitrates. The results of our study should be reproduced in a confirmatory study with a larger sample size before percutaneous coronary intervention in this low-risk patient subgroup, after myocardial infarction can be recommended as routine treatment in clinical practice. (*Circulation*. 2003;108:1324-1328.)

**Key Words:** myocardial infarction ■ angioplasty ■ prognosis ■ survival

Most patients with acute ST elevation myocardial infarction are initially treated with fibrinolytic therapy or even no acute reperfusion therapy, whereas only <20% are treated with primary percutaneous intervention.<sup>1,2</sup> In the Western world, more than 50% of patients undergo cardiac catheterization during the subacute phase after an acute myocardial infarction.<sup>1,2</sup>

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Percutaneous revascularization of the infarct vessel in patients recovering from an acute myocardial infarction and no or mild angina pectoris is often performed, especially in those with single vessel disease.<sup>3</sup> According to the current ACC/AHA guidelines for percutaneous coronary intervention, this approach is a class IIb (occluded artery) or class III (stenosis

without evidence of spontaneous or provokable angina) indication.<sup>4</sup> However, it is widely believed that this strategy will improve the ventricular function, clinical course, and, ultimately, prognosis of these patients.<sup>5-10</sup> So far, there are no large randomized trials to support this concept. Therefore, we conducted a randomized study comparing percutaneous revascularization and medical therapy in the subacute phase in stable survivors of an acute myocardial infarction with single vessel disease of the infarct-related coronary artery.

## Methods

### Patients

Eligible for randomization were stable patients 8 to 42 days after a ST elevation acute myocardial infarction. The myocardial infarction

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had to be documented by typical chest pain lasting at least 30 minutes, ST elevations in 2 or more continuous ECG leads, and the development of elevations of the creatine kinase (CK) or CK-MB fraction or at least 2 new Q waves in the 12-lead ECG. In the coronary angiography, a significant stenosis or total occlusion of the infarct-related artery had to be present, and the infarct vessel should have been clearly identifiable. Percutaneous transluminal coronary angioplasty or recanalization of the infarct vessel should have appeared technically feasible. Patients had to have no or only mild angina pectoris (Canadian Cardiovascular Society class 1 or 2). Written informed consent was obtained from all subjects before randomization.

Exclusion criteria were angina pectoris Canadian Cardiovascular Society class 3 or 4, a stenosis >70% in another coronary artery, a coronary artery bypass graft as infarct vessel, an indication for coronary artery bypass surgery (eg, left main stenosis, left ventricular aneurysm, or significant valve disease), or a noncardiac disease reducing life expectancy of the patient.

The study was performed in the compliance with the ethical principals of the Declaration of Helsinki and was approved by the ethics committee of the University of Göttingen, Germany.

### End Points

Primary end point of this study was the survival free of reinfarction, ischemia-driven (re)percutaneous transluminal coronary angioplasty, coronary artery bypass surgery, or rehospitalization for severe angina at 1 year. In addition, we evaluated survival, reinfarctions, and revascularization procedures during long-term follow-up. However, long-term survival alone was not a prespecified end point.

### Study Design and Procedures

This was a German, multicenter, open, randomized study. Randomization was stratified by center and done by telephone at the coordination center in Kassel.

In patients randomized to percutaneous transluminal coronary angioplasty, the intervention was performed according to the clinical routine of the local investigator. Because of the existing guidelines, it was recommended that all patients without contraindications should receive 100 mg aspirin and  $\beta$ -blockers. Additional medication was left to the discretion of the local investigator.

It was recommended to perform an ECG stress test before randomization. An ECG stress test was judged as positive in case of typical chest pain or horizontal or descending ST depressions >0.1 mV in at least 2 leads or complex ventricular premature beats.

### Statistical Analysis

It was assumed that with medical therapy, event-free survival at 1 year would be 75%. The study was designed to detect an increase in event-free survival to 85% in the percutaneous transluminal coronary angioplasty (PTCA) group, which would imply a decrease in the event rate of 40%. To have a 90% power with an  $\alpha$  error of 0.05, 355 patients in each group would have been necessary. Taking into account a 10% rate of dropout, it was planned to randomize at least 800 patients.

Descriptive statistics were generated for baseline and clinical demographics, treatment variables, and outcomes. Comparisons between the groups were done with Fisher's exact tests.  $P < 0.05$  was considered significant. Kaplan-Meier estimates were generated to describe the timing of events. A log-rank test was performed to compare event-free survival.

### Results

Between August 1994 and September 1997, a total of 300 patients were randomized in 22 hospitals of the ALKK in Germany. Because of a dramatic drop in enrollment in the years 1996 and 1997, it was decided to finish enrollment before completion of the intended number of 800 patients.

The 2 groups were well balanced with respect to their clinical and angiographic baseline characteristics (Tables 1

**TABLE 1. Clinical Baseline Characteristics of Patients Randomized to Interventional or Conservative Therapy**

Characteristic	Angioplasty (n=149)	Medical Therapy (n=151)	P Value
Age, y	58.2 $\pm$ 9.2	57.5 $\pm$ 9.8	NS
Men (%)	126 (84)	134 (89)	NS
Hypertension (%)	48 (32)	69 (46)	0.02
Diabetes (%)	22 (15)	25 (17)	NS
Hyperlipidemia (%)	79 (53)	80 (53)	NS
Smoker (%)	88 (59)	93 (62)	NS
Previous myocardial infarction (%)	7 (5)	4 (3)	NS
Thrombolytic therapy (%)	94 (63)	86 (57)	NS
Maximum of creatine kinase level, U/L	960 $\pm$ 899	897 $\pm$ 860	NS
Medication (%)			
Nitrates	107 (72)	121 (80)	NS
$\beta$ -blockers	109 (74)	113 (75)	NS
Calcium-channel blockers	18 (12)	9 (6)	NS
Angina class (%)			
CCS 1	146 (98)	149 (98)	NS
CCS 2	3 (2)	2 (2)	NS
Heart failure class (%)			
NYHA 1	145 (98)	144 (95)	NS
NYHA 2	3 (2)	7 (5)	NS
Positive ECG stress test	22 (15)	18 (12)	NS

and 2). The mean time interval between the index myocardial infarction and randomization was 18 (range, 14 to 28) days and did not differ between the treatment groups. The mean time interval between randomization and percutaneous transluminal coronary angioplasty in the interventional group was 5 (range, 1 to 15) days.

Angioplasty was not performed in 11 patients of the interventional group; 10 of the latter refused to come back for the procedure after randomization. In 1 patient, the infarct-related artery did not have a significant stenosis anymore at the control angiography before the planned intervention. Interestingly, no patient with a total occlusion of the infarct vessel refused the interventional procedure. The intervention was successful (<50% residual stenosis) in 119 of 138 (86.2%), with a success rate of 92.5% in patients with a stenosed and 72.7% in patients with an occluded vessel. A stent was implanted in 17% of the cases.

**TABLE 2. Angiographic Baseline Variables of the 2 Treatment Groups**

	Angioplasty (n=149)	Medical Therapy (n=151)	P Value
Mean diameter stenosis, %	89 $\pm$ 10	88 $\pm$ 11	NS
Total occlusion (%)	44 (29)	42 (28)	NS
Infarct-related artery (%)			
Left anterior descending	52 (35)	56 (37)	NS
Circumflex	27 (18)	26 (17)	NS
Right coronary	70 (47)	69 (46)	NS

**TABLE 3. Clinical Events Until 1 Year After Randomization**

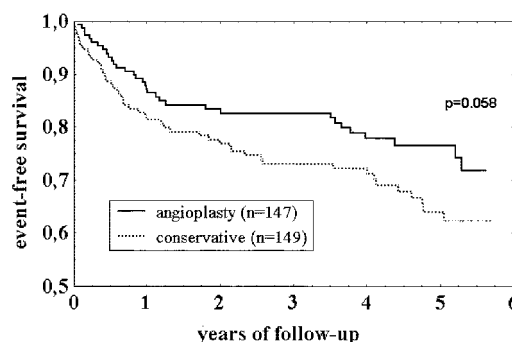
Event	Angioplasty (n=149)	Medical Therapy (n=151)	P Value
Death (%)	1 (0.7)	5 (3.3)	0.21
Nonfatal reinfarction (%)	3 (2.0)	7 (4.6)	0.33
(Re)angioplasty (%)	8 (5.4)	20 (13.2)	0.03
Coronary artery bypass grafting (%)	1 (0.7)	4 (2.7)	0.37
Readmission for severe angina (%)	6 (4.0)	20 (14.6)	0.007
Alive, event-free (%)	134 (90)	124 (82)	0.066

One-year follow-up was obtained in all patients. The clinical events during the first year after randomization are shown in Table 3. The only significant difference was observed for the need of a (re)angioplasty, which occurred significantly more often in the medical group. The combined primary end point was observed less often in the interventional group, but the difference was statistically not significant ( $P=0.066$ ). All percutaneous interventions except 1 during the first 1 year were performed at the infarct-related coronary artery because of angina despite medical therapy. The primary end point without revascularization procedures occurred in 6.7% (10 of 149) of the interventional and 14.5% (22 of 151) of the medical-treated patients ( $P=0.04$ ). The use of nitrates was significantly lower in the angioplasty group (38% versus 67%,  $P=0.001$ ).

Long-term follow-up for a mean of 56 months (range, 0 to 72 months) was available in 296 (98%) patients. During long-term follow-up, we observed 17 (11.2%) deaths in the conservative group compared with 6 (4.0%) deaths in the angioplasty group ( $P=0.02$ ). The reasons for death in the angioplasty group were cardiac in 4 and unknown in 2 patients, and in the conservative group were cardiac in 14, noncardiac in 2, and unknown in 1 patient. There were 2 deaths related to a revascularization procedure; 1 death in the conservative group was observed after coronary artery bypass grafting and 1 death in the angioplasty group was caused by an intracerebral bleeding after administration of urokinase during the study-related angioplasty. There was no difference in the incidence of nonfatal reinfarction (12 versus 10). There was a trend to a higher rate of revascularization procedures in the conservative group (24% versus 17%,  $P=0.17$ ). Survival free of reinfarction or revascularization was observed in 80% of the patients in the interventional group and 66% of the patients in the conservative group ( $P=0.05$ ). In the Kaplan-Meier curves, the event-free survival was borderline significantly improved in the group with interventional therapy ( $P=0.058$ ) (Figure).

Significantly fewer patients in the angioplasty group were taking nitrates during long-term follow-up (36% versus 56%,  $P=0.006$ ), whereas there were no significant differences for the intake of  $\beta$ -blockers (68% versus 61%) and calcium-channel blockers (8% versus 12%). Free of symptoms were 77% in the angioplasty and 61% in the conservative group, mild symptoms were reported of 18% and 26%, and symptoms of Canadian Cardiovascular Society class 3 or 4 were observed in 5% and 13% of the patients, respectively.

In the subgroup of patients with an occluded infarct vessel, there were 13 of 44 patients (29.5%) with an event in the



Kaplan-Meier estimates of survival free of reinfarction, percutaneous coronary intervention, or coronary artery bypass grafting in patients assigned to interventional or conservative therapy.

angioplasty and 11 of 42 patients (26.1%) with an event in the medical group. In patients with left anterior descending coronary artery as infarct-related artery, again there was no statistical significant difference in the event rate during follow-up (15 of 55, 27.3% in the interventional versus 20 of 56, 35.7% in the conservative group,  $P=0.41$ ). In another subgroup analysis comparing patients with and without thrombolysis for the index event, there were no significant differences between the groups and treatment strategies (with thrombolysis, 21 of 94, 22.3% in the interventional group versus 27 of 86, 31.4% in the conservative group; without thrombolysis, 12 of 55, 21.8% in the interventional group versus 21 of 65, 32.3% in the medical group).

## Discussion

This is the first large randomized study to compare conservative and interventional therapy in stable patients in the subacute phase after an acute myocardial infarction with angiographically documented single vessel disease. Even in the Western countries, primary percutaneous intervention in patients with ST elevation myocardial infarction is performed in fewer than 20% of patients. Because cardiac angiography is performed in the subacute phase in more than 50% of the patients treated with thrombolysis or just medically without reperfusion therapy, the results of our study are relevant to a large proportion of patients experiencing an acute ST elevation myocardial infarction. Despite contrary recommendations, early postinfarction angioplasty is still commonly practiced by many physicians. In the United States, an estimated 15% of all coronary interventions in the <65-year-old population is performed in the postinfarction period. In a large German PTCA registry, more than 40% of angioplasties in asymptomatic patients were performed in the postinfarction period.<sup>11</sup> The belief by cardiologists that this intervention improves the prognosis of the patients is so high that our study had to be terminated early because the enrollment rate dropped dramatically. The physicians did not want to randomize patients any more but instead wanted to send these patients directly for interventional therapy.

Earlier studies had compared early invasive and interventional therapy versus conservative management at different time points after thrombolysis for acute myocardial infarction. These studies have found that angioplasty performed

electively 1 to 3 days after myocardial infarction has neutral or deleterious effects on clinical outcome compared with conservative management.<sup>12–15</sup> A small randomized trial did not show any beneficial effect of late (4- to 14-day) angioplasty in patients with a negative functional test and residual stenosis after thrombolytic therapy.<sup>16</sup> Another small randomized pilot trial reported similar efficacy of intensified medical therapy compared with angioplasty for suppression of myocardial ischemia after an acute myocardial infarction.<sup>17</sup> In contrast, Danish investigators found a reduction in the incidence of reinfarction, fewer admissions for unstable angina, and a lower prevalence of stable angina with invasive compared with conservative treatment in 1008 patients with inducible ischemia after thrombolysis.<sup>18</sup> However, there was no significant effect on survival with the invasive approach.

Our study is unique for several reasons. It compares not an invasive versus a noninvasive strategy but interventional versus conservative therapy in patients with invasively documented single vessel disease of the infarct-related coronary artery; all patients were in stable condition without angina in the subacute phase after myocardial infarction and certainly represent a low-risk subgroup of myocardial infarction patients; we present long-term follow-up over 5 years in which progression of the underlying coronary artery disease can take place and subsequent events in a sufficient number of patients can be evaluated. In contrast to earlier studies, we did not observe an early hazard of angioplasty, which was performed  $\approx 3$  weeks after the index event, when the intervention can be performed safely without an increased risk of thrombotic complications. This long time between the index event and coronary angiography and randomization was attributable to the clinical practice in Germany at the initiation of the study and certainly would be shorter nowadays.

We observed a strong trend toward an improved clinical course and a significant reduction of total mortality in patients treated with angioplasty. Because our study was stopped before the preplanned number of 800 patients, it did not have the statistical power to detect a significant reduction in event-free survival at 1 year, which was only borderline significant ( $P=0.066$ ). The overall mortality at the mean follow-up of 56 months was low, indicating a 2% mortality risk per year. Despite this low total mortality, we observed a significant reduction in mortality from 11% to 4% with interventional therapy. Therefore, we observed a significant improvement in the hardest end point, all-cause mortality. One of the reasons might be that an open nonstenosed vessel is beneficial in the case of a progression of the underlying coronary artery disease. Additional potential beneficial effects of angioplasty in this setting might be the prevention of later closure of the artery with subsequent reinfarction or elimination of a potential conduit for collateral formation, regardless of the early effect on ventricular function. Supportive of the interventional strategy are observational studies, which report a beneficial effect of lower-grade residual stenosis after thrombolytic therapy on left ventricular dilation and function, which might influence long-term clinical outcome.<sup>19</sup> Other mechanisms might include the improvement of electrical stability by an open nonstenosed coronary artery by altering the electrical arrhythmogenic substrate.<sup>8</sup>

## Limitations

The study was performed before the widespread use of stents and glycoprotein IIb/IIIa receptor inhibitors for percutaneous coronary intervention. However, the low reintervention rate of 8 (5%) within the first year after PTCA makes it unlikely that the results would be different with a higher rate of stents, which have been shown to reduce the rate of reinterventions but not to influence mortality at follow-up.<sup>20</sup> If the results of the first studies with drug-coated stents hold true, it can be assumed that the outcome of the angioplasty group with respect to repeat revascularization procedures would be even better.<sup>21</sup>

## Summary

This is the first study to show an improvement in long-term outcome in asymptomatic patients with single vessel disease treated with angioplasty in the subacute phase after an acute myocardial infarction. Therefore, this study supports the concept of the late open-artery hypothesis<sup>9</sup> and might indicate the usefulness of interventional therapy even in this low-risk subgroup of patients after acute myocardial infarction. It has to be noted that the study was not designed to investigate a difference in survival. However, we observed a significantly lower mortality in the interventional group at long-term follow-up. The study was too small to identify specific subgroups of patients who might have the greatest benefit of the intervention. Our results are supported by a recent cohort study of a large Swedish Coronary Care Registry in 21 912 survivors of an acute myocardial infarction, in which early revascularization was associated with a significant lower mortality after 1 year.<sup>22</sup> The results of our study should be reproduced in a confirmatory randomized study with a larger sample size before percutaneous coronary intervention in this low-risk patient subgroup after myocardial infarction can be recommended as routine treatment in clinical practice.

## Appendix

Participating members and their centers were the following: H.G. Glunz, Klinikum der Stadt Kaiserslautern, Kaiserslautern; H.F. Vöhringer, DRK-Klinikum Köpenick, Berlin; D. Harmjanz, Allgemeines Krankenhaus, Celle; K.-L. Neuhaus, Klinikum Kassel, Kassel; E.-R. von Leitner, Siloah-Krankenhaus, Hannover; E. Stammwitz, Kreiskrankenhaus Leer, Leer; P. Schuster, Sankt-Marienkrankenhaus Siegen, Siegen; K.W. Heinrich, Herzzentrum Duisburg, Duisburg; P. Limbourg, Stadtkrankenhaus Worms, Worms; R. Uebis, Klinikum Aschaffenburg, Aschaffenburg; T. Bonzel, Klinikum Fulda, Fulda; K.-H. Kuck, Sankt-Georg Krankenhaus, Hamburg; A. Hepp, Vinzenz-Krankenhaus, Hannover; J. Seneges, Klinikum Ludwigshafen, Ludwigshafen; A. Girth, Klinikum Offenbach, Offenbach; R. Lindlbauer, Städtisches Krankenhaus München-Harlaching, München; U. Tebbe, Klinikum Lippe-Detmold, Detmold; H.-P. Schuster, Städtisches Krankenhaus, Hildesheim; J. Rox, Allgemeines Krankenhaus Hagen, Hagen; G. Hennersdorf, Kreiskrankenhaus, Völklingen; B. Niehues, Sankt-Marien Hospital, Lünen; and H. Kuhn, Städtische Krankenanstalten, Bielefeld.

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## References

1. Fox KAA, Goodman SG, Klein W, et al. Management of acute coronary syndromes: variations in practice and outcome. Findings from the Global Registry of Acute Coronary Events. *Eur Heart J*. 2002;23:1177–1189.
2. Hasdai D, Behar S, Wallentin L, et al. A prospective survey of the characteristics, treatments and outcomes of patients with acute coronary syndromes in Europe and the Mediterranean basin: the Euro Heart Survey of acute coronary syndromes. *Eur Heart J*. 2002;23:1190–2001.
3. Pilote L, Miller DP, Califf RM, et al. Determinants of the use of angiography and revascularisation after thrombolysis for acute myocardial infarction. *N Engl J Med*. 1996;335:1198–1205.
4. Smith SC, Dove JT, Jacobs AK, et al. ACC/AHA guidelines for percutaneous coronary intervention: executive summary and recommendations. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1993 Guidelines for Percutaneous Transluminal Coronary Angioplasty). *Circulation*. 2001;103:3019–3041.
5. Golia G, Marino P, Rametta F, et al. Reperfusion reduces left ventricular dilation by preventing infarct expansion in the acute and chronic phases of myocardial infarction. *Am Heart J*. 1994;127:489–509.
6. Hirayama A, Adachi T, Asada S, et al. Late reperfusion for acute myocardial infarction limits the dilatation of left ventricle without reduction of infarct size. *Circulation*. 1993;88:2565–2574.
7. White H, Cross DB, Elliott JM, et al. Long-term prognostic importance of patency of the infarct-related coronary artery after thrombolytic therapy for acute myocardial infarction. *Circulation*. 1994;89:61–67.
8. Kim CB, Braunwald E. Potential benefits of late reperfusion of infarcted myocardium: the open artery hypothesis. *Circulation*. 1993;88:2426–2436.
9. Sadanandan S, Buller C, Menon V, et al. The late open artery hypothesis: a decade later. *Am Heart J*. 2001;142:411–421.
10. Horie H, Takahashi M, Minai K, et al. Long-term beneficial effect of late reperfusion for acute anterior myocardial infarction with percutaneous transluminal coronary angioplasty. *Circulation*. 1998;98:2377–2382.
11. Vogt A, Tebbe U, Weber MA, Gottwik M. PTCA-Register der ALKK: Bericht 1998 und 1999. *Z Kardiol*. 2000;89:838–840.
12. The SWIFT Investigators. SWIFT trial of delayed elective intervention versus conservative treatment after thrombolysis with anistreplase in acute myocardial infarction: SWIFT (Should We Intervene Following Thrombolysis) Trial Study Group. *BMJ*. 1991; 302: 555–560.
13. Topol EJ, Califf RM, George BS, et al. A randomized trial of immediate versus delayed elective angioplasty after intravenous tissue plasminogen activator in acute myocardial infarction. *N Engl J Med*. 1987;317: 581–588.
14. The TIMI Study Group. Comparison of invasive and conservative strategies after treatment with intravenous tissue plasminogen activator in acute myocardial infarction: results of the TIMI phase II trial. *N Engl J Med*. 1989; 320:618–627.
15. Simoons ML, Arnold AER, Betriu A, et al. Thrombolysis with tissue plasminogen activator in acute myocardial infarction: no additional benefit from immediate percutaneous coronary angioplasty. *Lancet*. 1988; 1:197–203.
16. Ellis SG, Mooney MR, George SB, et al for the TOPS Study Group. Randomized trial of late elective angioplasty versus conservative management for patients with residual stenosis after thrombolytic treatment of myocardial infarction. *Circulation*. 1992;86:1400–1406.
17. Dalik HA, Kleiman NS, Farmer JA, et al. Intensive medical therapy versus coronary angioplasty for suppression of myocardial ischemia in survivors of acute myocardial infarction. *Circulation*. 1998;98: 2017–2023.
18. Madsen JK, Grande P, Saunamäki K, et al. Danish multicenter randomized study of invasive versus conservative treatment in patients with inducible ischemia after thrombolysis in acute myocardial infarction (DANAMI). *Circulation*. 1997;96:748–755.
19. Leung WH, Lau CP. Effects of severity of the residual stenosis of the infarct-related coronary artery on left ventricular dilation and function after acute myocardial infarction. *J Am Coll Cardiol*. 1992;20:307–313.
20. Rankin JM, Spinelli JJ, Carere RG, et al. Improved clinical outcome after widespread use of coronary-artery stenting in Canada. *N Engl J Med*. 1999;341:1957–1965.
21. Morice C, Serruys PW, Sousa JE, et al. A randomized comparison of a sirolimus-eluting stent with standard stent for coronary revascularization. *N Engl J Med*. 2002;346:1773–1780.
22. Stenestrand U, Wallentin L. Early revascularisation and 1-year survival in 14-day survivors of acute myocardial infarction: a prospective cohort study. *Lancet*. 2002;359:1805–1811.