Review

Timing of Coronary Artery Bypass Graft Surgery Following Acute Myocardial Infarction: A Critical Literature Review

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Summary: Despite more than 30 years' experience with coronary artery bypass surgery, controversy still exists about the optimal timing of surgical revascularization following acute myocardial infarction. To review the published information on this topic, a Medline search of the literature published between 1984 and October 2000 was performed. After reviews and individual case reports were excluded, 11 retrospective and prospective studies remained for analysis. Pervasive heterogeneity with respect to inclusion criteria, outcome measurement, definitions, variance among studies of measured time between myocardial infarction (MI) and coronary artery bypass graft (CABG), differences in study endpoints, and evolution of surgical techniques and medical regimens over this time precluded formal meta-analysis. Although prospective randomized trials are lacking, the preponderance of data from the 11 retrospective and prospective observational studies suggests that timing of bypass surgery after infarction is not an independent predictor of outcome and that delaying coronary bypass surgery for an arbitrary period of time following acute MI is unwarranted. Rather, ventricular function, post-infarction ischemia, noncardiac comorbid conditions, and the urgency of the surgery itself constitute the important predictors of perioperative mortality, and these clinical factors should be used to estimate perioperative risk and decide upon the risk:benefit relationship for CABG in this patient population.

Key words: myocardial infarction, coronary artery bypass surgery, coronary artery disease/therapy, review

Introduction

In the United States, 1.5 million patients suffer an acute myocardial infarction (MI) annually. Approximately 30% do not survive, with 5% reaching the hospital alive only to succumb during that admission. Historically, a poorly defined waiting period between infarction and coronary artery bypass graft surgery (CABG) has been advocated, citing concerns for reperfusion injury and suboptimal postoperative outcomes when revascularization is performed too early. The absence of large prospective trials describing safety and/or benefit from early CABG, combined with a historically conservative approach to post-MI CABG, contributes to the controversy. However, there is a fairly large volume of retrospective data, combined with some small prospective studies, which strongly suggest early post-MI CABG is not only safe but may provide a survival advantage compared with delayed CABG or medical therapy alone. The evolution of surgical technique, myocardial preservation, and medical management (including mechanical ventricular assistance) has enhanced care sufficiently to require reassessment of the approach to this patient population.

Medline Search of the Literature

A Medline search of the literature dating from 1984 to October 2000 was performed using key words "myocardial infarction," "CABG," and "timing." Reviews and individual case reports were excluded (except to examine bibliographies for completeness of retrieval over the timeframe of interest), leaving 11 retrospective and prospective studies for analysis. Pervasive heterogeneity with respect to inclusion criteria, outcome measurement, definitions of "urgent" and "emergent surgery," variance among studies of measured time between MI and CABG, differences in study endpoints, and evolution of surgical techniques and medical regimens over this time precluded formal meta-analysis.

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Retrospective and Prospective Studies on the Timing of Surgery after Myocardial Infarction

In 1984, Hochberg *et al.*¹ examined predictors of postoperative congestive heart failure (CHF) in patients undergoing CABG <7 weeks after acute MI. This retrospective study looked at 174 patients between 1978 and 1982. Overall in-hospital mortality was 16%. Hospital mortality for CABG performed within 1 week of MI was 46%, but 23% (half) of these patients were in cardiogenic shock at the time of surgery. Hospital mortality for patients undergoing surgery an average of 7 weeks later was only 6%, but was 0% in patients with a left ventricular ejection fraction (LVEF) >50%, regardless of timing. If the LVEF was <50%, mortality was 22% ($p < 0.001$). The investigators concluded that CABG was safe at any time if the EF was >50%, while CABG should be delayed if possible in patients with LVEF <50%.

In 1986, Katz *et al.*² published a study of 145 patients recruited between 1980 and 1985, who underwent CABG within 4 weeks of acute MI. Using univariate and stepwise logistic regression analysis to determine predictors of postoperative CHF, the following risk factors achieved statistical significance: LVEF <45%, preoperative ischemia, and preoperative heart failure. Timing of CABG post MI was not a predictor ($p = 0.96$). Although underpowered for determining differences in mortality, this study found no significant difference in postoperative heart failure incidence between patients undergoing CABG <72 h and >72 h after infarction. Katz *et al.* concluded that post-MI ischemia or clinical deterioration should lead to early CABG, as delay did not appear to decrease risk of CHF in these patients.

Salem *et al.*³ published a prospective study of 50 patients undergoing CABG after intracoronary infusion of streptokinase for acute MI. Of patients randomized between 1982 and 1985, 43 had Thrombolysis in Myocardial Infarction (TIMI) grade 2–3 flow in the infarct-related vessel at angiography, and 3 patients received surgery after a percutaneous transluminal coronary angioplasty (PTCA) attempt. Twenty patients underwent CABG less than 3 days following MI, 18 within 7 days, and 12 patients within 14 days of their index infarct. Mortality at 36 months was 0%. Excess bleeding was noted in four patients, two of whom received CABG within 24 h of streptokinase infusion. Salem *et al.* concluded that early CABG in suitable candidates could be achieved with low risk and favorable results.

Kouchoukos *et al.* reported a prospective study of 240 patients undergoing CABG within 30 days of an MI between 1985 and 1987. The postoperative 30-day mortality was 3.3%. Multivariate and univariate analyses of 20 independent variables revealed the following highly significant independent predictors of postoperative mortality: left main coronary disease, female gender, and preoperative LV systolic dysfunction. The authors concluded that timing and urgency of CABG are not independent determinants of increased operative risk.⁴

Kennedy *et al.*⁵ published a retrospective study of 793 patients undergoing CABG within 30 days of an MI between 1982 and 1987, comparing them to a control group of patients

undergoing elective CABG. Stepwise logistic regression was used to determine predictors of perioperative mortality. Overall mortality was 5.7% in patients with MI and 1.9% in controls. Predictors of mortality were age, surgical priority (emergent vs. elective), prior CABG, preoperative CHF, and Q-wave MI. Kennedy *et al.* concluded that although operative mortality was low during the first week after MI, a 1-week waiting period was recommended.

Floten *et al.* reported retrospective data obtained in 832 patients undergoing post-MI CABG between 1974 and 1987.⁶ Patient cohorts included those undergoing CABG within, versus more than, 30 days of acute MI, plus an elective CABG (no recent MI) control group, with long-term survival as the primary endpoint. The 5- and 10-year survival for the early CABG group was 84 and 71%, respectively, compared with 85 and 68% for patients revascularized later. The 5- and 10-year survival of the control group was 90 and 78%, respectively. Mortality of patients operated on within 24 h of infarction was 7.6% (10 of 132 patients); from 1–7 days it was 4.0% (24 of 293), from 8–14 days it was 4.0%, and from 15–30 days it was 4.6%. Univariate and multivariate analyses showed age and elevated LV end-diastolic pressure (LVEDP) to be significant risk factors for operative mortality. Five- and 10-year survival for patients aged <65 years was 89 and 80%, respectively, while it was 75 and 58%, respectively, for patients >65 years old. The 5- and 10-year survival figures for patients with an LVEDP <15 mmHg was 89 and 75%, while patients with an LVEDP >15 mmHg showed survival of 77 and 67%, respectively. Floten *et al.* also observed that infarct extension occurred in 35–45% of transmural anterior wall MIs, with a peak extent within 7 to 14 days. The incidence of demonstrable in-hospital extension in the patient group ranged from 6 to 31% and was associated with a 2–5 fold increase in mortality compared with patients without infarct extension. They concluded that based on long-term results there appears to be little gain in delaying CABG when indicated post MI, and that delay may lead to infarct extension or recurrent infarction with dire consequences.

Sintek *et al.* presented prospective data on 530 patients undergoing CABG after acute MI between 1990 and 1993.⁷ Patients underwent left heart catheterization if they had post-infarction angina or a positive low-level stress test, and were referred for surgery if left main or multivessel coronary artery disease was present. Twenty-three patients underwent CABG within 24 h of acute MI (mortality of 4.4%), 30 patients between 24 and 72 h (0% mortality), 193 between Days 3 and 7 (2.1% mortality), and 284 between postinfarction Weeks 1 and 4 (1.4% mortality). Surgery performed at any time <30 days after MI was not associated with increased mortality when adjusted for the following independent risk factors: reoperative surgery, gender, age, location of infarction, and type of MI (Q-wave vs. non-Q-wave). From these data, Sintek *et al.* concluded that nonemergent CABG can be performed at any time after MI, with no increased operative mortality and acceptable morbidity.

A much larger retrospective study by Creswell *et al.*⁸ examined 3,942 patients undergoing CABG between 1986 and

1993. They reviewed 2,296 patients revascularized after an acute MI, comparing them with 1,646 control patients with CABG but not recently post infarct. Patients with acute MI were subdivided into two cohorts based upon the status of their surgery (elective vs. urgent/emergent). Elective surgery was defined as that performed in a hemodynamically stable patient, or with the ability to be scheduled > 24 h after the initial decision to operate. All other patients were categorized as urgent or emergent, including patients who failed percutaneous coronary intervention (PCI). Predictably, most operations performed before 48 h were classified as urgent or emergent: at < 6 h, 10 of 11 (91%) were urgent/emergent, while by 6 to 48 h, 104 of 132 (78%) were urgent/emergent. The percentage of nonelective operations dropped significantly after this, with 582 of 689 (67%) of the 2–14 day group, 219 of 261 (84%) of the 2–6 week group, and 862 of 1,023 (84%) of the > 6 week group performed on an elective basis. Although mortality was highest in patients receiving CABG within 48 h of infarction, the authors suggest this finding was a function of the acuity of the patient rather than the timing of the operation.

Operative mortality in Creswell *et al.*'s control group was 2.5%. In the urgent/emergent group, operative mortality was 1 of 10 (10.0%) for < 6 h, 9.6% (n = 104) for 6–48 h, 11.5% (n = 287) for 2–14 days, 7.1% (n = 42) for 2–6 weeks, and 7.5% (n = 161) for > 6 weeks postinfarction delay. The elective cohort's operative mortalities were 0% (n = 1), 3.6% (n = 28), 2.1% (n = 582), 6.4% (n = 219), and 2.1% (n = 862) for these same waiting periods. It was also noted that operative mortality at 0–14 days was 5.3% for patients placed on intra-aortic balloon pump (IABP) support preoperatively (permitting actively ischemic patients to receive CABG more electively), versus 11.8% for those not receiving mechanical ventricular assistance. A higher incidence of stroke, atrial fibrillation, and perioperative MI, as well as a longer stay in the intensive care unit was noted in the < 48 h group, 80% (114/143) of whom were operated upon on an urgent/emergent basis. Multivariate logistic regression identified urgency of CABG, advanced age, renal insufficiency, number of previous infarcts, and hypertension as independent risk factors for perioperative mortality; timing of CABG per se did not influence outcome. The authors noted that urgency of surgery seemed to be the strongest predictor of operative mortality, concluding that morbidity and mortality are acceptable in early elective CABG after acute MI, and that IABP support should be used aggressively for post-MI angina to allow more elective operating conditions.

Braxton *et al.* published prospective data on 116 patients undergoing CABG after acute MI between 1991 and 1992.⁹ Subjects had suffered Q-wave (n = 58) or non-Q-wave (n = 58) infarcts, while an additional 255 patients undergoing elective CABG served as controls. Patients post infarction were divided into three groups: Group I patients were operated on within 48 h of MI, Group II patients between postinfarction Days 3 and 5, and Group III patients after Day 5. The operative mortality of Group I patients was 3 of 6 (50%) for Q-wave and 0 of 1 (0%) for non-Q-wave MIs. Mortality in Group II (0/7 or 0% for Q-wave MI and 1/6 or 17% for non-Q-wave MI) and in Group III (4/45 or 10% Q-wave and 1/51 or 1.9% non-Q-wave

MI) was also reported and compared with 6 of 255 (2.7%) in the control group. As demonstrated in earlier studies, patients operated on < 48 h post infarct were more gravely ill and had a greater number of risk factors. Of patients taken to the operating room within the first 2 days, 43% required an IABP, only half the expected number of internal mammary grafts was used, and the cohort had twice as many women compared with the subset of patients operated on after 48 h, identifying the early surgery groups as hemodynamically unstable, less well revascularized, and at overall higher risk from their disease, respectively. The authors noted that the risk of infarct extension in the < 48 h group was greater than the risk of developing a (new) perioperative MI in the control group. Although they concluded that urgent/emergent CABG < 48 h after acute MI is associated with a higher operative mortality than later surgery, it was not clearly higher than medical management alone in these generally sicker patients. Mortality difference after 48 h was not statistically significant between Q-wave and non-Q-wave MI, suggesting that no safety benefit is afforded by delaying CABG for either type of MI after 48 h. In addition, by multivariable logistic regression of these data, CABG at < 48 h remained an independent predictor of mortality (all three deaths were Q-wave infarcts); other significant factors included age > 65 years, clinical status at surgery (urgent/emergent CABG), and Q-wave infarction. The authors concluded that revascularization of patients with Q-wave infarction any time after 48 h is acceptable as there was little to be gained by waiting. In patients with non-Q-wave MI, CABG could be performed at any time with no significant increase in mortality compared with controls.

Svensson *et al.* conducted a prospective study of 338 patients undergoing post-MI CABG between 1990 and 1994. Patients were divided into two groups: Group I consisted of patients undergoing CABG with evolving infarcts (defined by elevated creatine kinase or the appearance of Q waves), while Group II patients had CABG up to 21 (mean 8) days after MI. Thirty-day survival was 65 of 74 (89%) for Group I and 258 of 265 (97.4%) for Group II patients, and overall survival was 323 of 338 (95.6%). Multivariate independent preoperative predictors of mortality included aortic regurgitation; chronic lung disease; preoperative requirements for diuretics, IABP, and/or inotropes; and the need for concomitant noncardiac surgery. From these data, which included some of the earliest post-MI CABG procedures reviewed, Svensson *et al.* concluded that CABG early after acute MI is not a risk factor per se, but rather that preoperative hemodynamic status and comorbid disease primarily dictate outcome. Furthermore, he concluded that CABG should be performed early if the patient is persistently symptomatic.¹⁰

All of the above papers described patients receiving care at university/teaching centers. Every *et al.* published data on 1,114 patients undergoing post-MI CABG; these data were taken from the MITI registry of 19 Seattle area hospitals including university, Veterans Affairs, and community hospitals (enrolled 1988–1994).¹¹ Of these patients, 193 were revascularized within 24 h and 917 after 24 h from MI symptom onset. Hospital mortality was 8.3% in the < 24 h group and 7.2% in

the > 24 h group ($p = \text{NS}$). In the subset of 273 patients receiving initial thrombolytic therapy, those who received early CABG were more likely to die (16.7 vs. 5.9%, $p = 0.02$). Age, prior CABG, CHF or stroke during admission, and infarct extension predicted death. The authors concluded that early CABG is safe and that risk factors for hospital mortality in this group are not different from those in the noninfarct setting. They noted that patients receiving thrombolysis may constitute a special higher risk subgroup because of bleeding and may benefit by delaying CABG for > 24 h after lytic therapy.

Wasvary *et al.* presented a retrospective study, derived from the Society of Thoracic Surgeons (STS) database, of 423 patients undergoing CABG after acute MI between 1992 and 1995.¹² Operative mortality when surgery was performed < 6 h after MI was 17.4% (four deaths, 95% confidence interval [CI] = 5–39%), 9.1% between 6 and 24 h (three deaths, 95% CI = 2–24%), 4.0% at 1–7 days (95% CI = 2–8%), and 5.8% at 7–21 days (95% CI = 3–10%). Analysis of the data revealed the following predictors of trends toward higher perioperative mortality: LVEF < 30%, cardiogenic shock, and age > 70 years; however, the only statistically significant predictor of death was a severely depressed cardiac index (< 1.5 l/min/m²). The authors concluded that timing of CABG has no significant effect on hospital mortality of symptomatic patients within 3 weeks of an MI. In addition, in the presence of decreased LVEF, advanced age, or cardiogenic shock, CABG can be delayed with medical stabilization, with surgery performed if medical therapy fails to prevent further ischemic events.

Deeik *et al.* published a retrospective study of elective CABG after MI in 59 patients at a university medical center between 1994 and 1996.¹³ Patients with either chronic stable angina or unstable angina were included and divided into three groups: Group I (155 control patients with chronic stable angina), Group II (39 patients with non-Q-wave MI), and Group III (20 patients with Q-wave MI). Bypass surgery was performed a mean of 2.3 days after admission in Group I, 4.2 days after MI in Group II, and 5.2 days after MI in Group III patients. Operative mortality was 2.6, 2.6, and 0% in the three groups, respectively. Based on this small sample, size the authors recommended that CABG be delayed 3–5 days after non-Q-wave infarcts and 5–7 days after Q-wave infarcts. However, timing of surgery could not be analyzed separately from type of infarct because of the small number of patients enrolled.

Stone *et al.* published prospective data from a subgroup of the PAMI-II data base.¹⁴ In all, 1,100 patients underwent left heart catheterization within 12 h of an acute MI at 34 centers. Percutaneous transluminal coronary angioplasty was performed when appropriate, while CABG was performed in 120 patients (10.9%). Of these surgeries, 42.6% were performed under elective conditions and 57.4% under urgent or emergent conditions. Hospital mortality was 6.4% for the urgent/emergent group, 2.0% for the elective group, 2.6% for controls, and 5.0% overall. Multivariate analysis revealed that early and late infarction-free survival was similar in patients undergoing in-hospital (index admission) CABG compared with those undergoing this procedure later. Significant multivariate correlates of late death or reinfarction were age > 70

years, admission Killip class 2–3, and initial TIMI flow grade 0–1. Predictors of operative mortality were reduced systolic function and advanced age. Of note, major bleeding was more common in patients undergoing CABG before hospital discharge. The authors point out that urgent/emergent procedures were generally undertaken without mammary artery harvesting/grafting, decreasing aortic clamp time and minimizing perioperative infarct rates, but perhaps leading to higher incidence of late infarcts.

Discussion

The major limitation to a definitive timing algorithm for post-MI CABG is the lack of large randomized prospective trials comparing postinfarction timing intervals for CABG with outcomes. Although a large volume of data supports the safety and benefit of early CABG after acute MI, the data are flawed by a preponderance of retrospective reports and prospective studies that are small and/or insufficiently powered for identifying differences in patient subsets. The papers reviewed differ greatly in inclusion criteria, independent variables identified, and definitions of urgent and emergent operative indications. The expanse of time over which these data were collected (approximately 17 years) encompasses a significant evolution of surgical and myocardial preservation techniques, perioperative medical management, and nonoperative support modalities. A particularly salient issue is the outcome of patients undergoing early CABG after fibrinolysis or primary PCI with glycoprotein IIb/IIIa inhibitor therapy, which may significantly confound the outcome data (due to bleeding complications) among patients undergoing very early (< 24 h) CABG. Most papers failed to address the issue of patients who died while awaiting surgery, after the decision for eventual surgical revascularization was made, and addressed only postoperative mortality or heart failure—this may be the greatest flaw in the existing data on this subject. Similarly, no mention is made of patients who could have been revascularized early as elective cases, but destabilized and required higher-risk emergency bypass later.

Sufficient data exist to conclude that timing of surgery per se is clearly separate from the urgency of surgical intervention, although in most of the reviewed studies earlier surgery was performed because of emergent need in unstable patients. Patient numbers were consistently too small for identifying sizable cohorts of stable patients undergoing early (< 48 h) postinfarction CABG. Theoretically, aggressive preoperative stabilization may save lives as patients classified as urgent/emergent may be converted to the lower-risk elective category by medical management and mechanical ventricular assistance to optimize their preoperative condition.

Despite the lack of a conclusive paradigm, the weight of the evidence does not support CABG timing as an independent predictor of operative mortality. Of the above 11 studies published between 1984 and 2000, none identified timing of surgical revascularization as an independent risk factor for operative mortality. None of the 11 authors advocated significant

delays in CABG after acute MI, while many recommended early CABG to prevent the 2–5 fold increase in mortality associated with infarct extension. Opponents of early CABG have based their arguments on concerns for reperfusion injury, higher incidences of stroke, atrial fibrillation, acute renal failure, and perioperative MI noted in small subgroups of patients undergoing urgent/emergent surgery; however, such surrogate endpoints did not correlate directly with mortality in any study. There is little argument that delaying CABG in urgent/emergent patients after acute MI may increase their risk of infarct extension and clinical deterioration. The emergency status of surgery appears to be the unique factor distinguishing patients post MI from patients without MI undergoing CABG. Otherwise, established comorbidities of advanced age, ventricular function, symptomatic heart failure, female gender, and pulmonary status appear to confer risks to patients with acute MI similar to those in individuals without MI, while additional factors such as renal failure, hypertension, stroke, number of previous infarcts, and repeat surgery may also be important.

There are several potential advantages of early CABG. Reducing the time during which infarct extension or reinfarction might occur could preserve LV function, prolong survival, and improve quality of life. The time during which major mechanical cardiac complications (ventricular septal defect, papillary muscle rupture, free-wall rupture) and acute noncardiac sequelae (e.g., acute renal failure) could occur would likewise be reduced. A reduction in overall cost of care, though not addressed by the studies reviewed, might also be realized through shortening hospital stay and avoiding readmissions for subsequent surgery.

Conclusion

Based on this review, the studies appear to support an approach of medical stabilization for unstable patients post MI, using mechanical balloon counterpulsation and pharmacologic interventions, when possible, to convert high-risk, emergent operations to lower-risk, more elective procedures. Beyond this subgroup, patients with acute MI appear to differ little from patients with more stable coronary disease. Age, comorbidities, and ventricular function appear to be more important considerations than delays between infarction and coronary bypass. Earlier surgery does not appear to confer additional risk if patients can be adequately stabilized preoperatively and may reduce the risk of additional ischemic injury during a prolonged waiting period.

Future investigation via a prospective controlled trial is needed, comparing conventional decision processes with

those that center on factors identified in this review to provide a definitive answer to this important question.

References

1. Hochberg MS, Parsonnet V, Gilchinsky I, Hussain SM, Fisch DA, Norman JC: Timing of coronary revascularization after acute myocardial infarction. Early and late results in patients revascularized within seven weeks. *J Thorac Cardiovasc Surg* 1984;88:914–921
2. Katz NM, Kubanick TE, Ahmed SW, Green CE, Pearle DL, Satler LF, Rackley CE, Wallace RB: Determinants of cardiac failure after coronary bypass surgery within 30 days of acute myocardial infarction. *Ann Thorac Surg* 1986;42:658–663
3. Salem BI, Gowda S, Haikal M, Leidenfrost R, Cox JL, Ferguson T: Early percutaneous transluminal coronary angioplasty or coronary bypass surgery following thrombolytic treatment of acute myocardial infarction. *Chest* 1987;91:648–653
4. Kouchoukos NT, Murphy S, Philpott T, Pelate C, Marshall WG Jr: Coronary artery bypass grafting for postinfarction angina pectoris. *Circulation* 1989;79(Pt. 2):168–172
5. Kennedy JW, Ivey TD, Misbach G, Allen MD, Maynard C, Dalquist JE, Kruse S, Steward DK: Coronary artery bypass graft surgery early after acute myocardial infarction. *Circulation* 1989;79(suppl I):I-73–I-78
6. Floten HS, Ahmad A, Swanson JS, Wood JA, Chapman RD, Fessler CL, Starr A: Long-term survival after postinfarction bypass operation: Early versus late operation. *Ann Thorac Surg* 1989;48:757–763
7. Sintek CF, Pfeffer TA, Khonsari S: Surgical revascularization after acute myocardial infarction. Does timing make a difference? *J Thorac Cardiovasc Surg* 1994;107:1317–1322
8. Creswell LL, Moulton MJ, Cox JL, Rosenbloom M: Revascularization after acute myocardial infarction. *Ann Thorac Surg* 1995;60:19–26
9. Braxton JH, Hammond GL, Letsou GV, Franco KL, Kopf GS, Elefteriades JA, Baldwin JC: Optimal timing of coronary artery bypass graft surgery after acute myocardial infarction. *Circulation* 1995;92(suppl):II66–II68
10. Svensson LG, Cruz H, Sun J, D'Agostino S, Williamson WA, Shahian DM: Timing of surgery after acute myocardial infarction. *J Cardiovasc Surg (Torino)* 1996;37:467–470
11. Every NR, Maynard C, Cochran RP, Martin J, Weaver WD: Characteristics, management and outcome of patients with acute myocardial infarction treated with bypass surgery. *Circulation* 1996;94(suppl II):II-81–II-86
12. Wasvary H, Shannon F, Bassett J, O'Neill W: Timing of coronary artery bypass grafting after acute myocardial infarction. *Am J Surg* 1997;63:710–715
13. Deek RK, Schmitt TM, Ihrig TG, Sugimoto JT: Appropriate timing of elective coronary artery bypass graft surgery following acute myocardial infarction. *Am J Surg* 1998;176:581–585
14. Stone GW, Brodie BR, Griffin JJ, Grones L, Boura J, O'Neill WW, Grines CL: Role of cardiac surgery in the hospital phase management of patients treated with primary angioplasty for acute myocardial infarction. *Am J Cardiol* 2000;85:1292–1296