Preoperative cardiac evaluation does not improve or predict perioperative or late survival in asymptomatic diabetic patients undergoing elective infrainguinal arterial reconstruction

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Objective: Patients undergoing infrainguinal arterial reconstruction frequently have increased cardiac risk factors. Diabetic patients are often asymptomatic despite advanced cardiac disease. This study investigates whether preoperative cardiac testing improves the outcome in diabetic patients at risk for cardiac disease.

Methods: We retrospectively reviewed all patients undergoing lower-extremity arterial reconstructions in a 32-month period from July 1999 to February 2002. Of the 433 patients identified undergoing 539 procedures, 295 had diabetes mellitus and considered in this study. The patients were stratified into two groups according to the present American College of Cardiology, American Heart Association (ACC/AHA) algorithm. We identified 140 patients with two or more of ACC (Eagle) criteria who met the inclusion criteria for a preoperative cardiac evaluation. These patients were separated into two groups: those undergoing a cardiac work-up (WU) according to the ACC/AHA algorithm and those not undergoing the recommended work-up (NWU). Outcomes included perioperative mortality, postoperative myocardial infarction, congestive heart failure, arrhythmia, and length of hospitalization. Significance of association was assessed by the Fisher exact test. Length of hospitalization was compared using the Kruskal-Wallis rank sum test. Survival data was analyzed with the Kaplan-Meier method.

Results: One hundred forty patients met the criteria for moderate risk. There were 61 patients in the NWU group and 79 in the WU group. Ten patients in the WU group underwent preoperative coronary revascularization (6 had percutaneous transluminal coronary angioplasty, 4 underwent coronary artery bypass grafting). There was no difference between perioperative mortality (WU, 1%; NWU, 2%; \( P = 1.00 \)) or in postoperative cardiac morbidity, including myocardial infarction, congestive heart failure, and arrhythmia requiring treatment (WU, 5%; NWU, 6%; \( P = .71 \)). There were no perioperative deaths and one episode of congestive heart failure in the group that had preoperative coronary revascularization. Median length of hospitalization was 10 days in the WU group and 8 days in the NWU group (\( P = .11 \)). Patient survival at 12 months for the NWU, WU, and revascularized groups was 85.3%, 78.5%, and 80.0%, respectively; 36-month survival was 73.6%, 62.9%, and 80.0%, respectively. The three survival curves did not differ significantly (\( P = .209 \)).

Conclusions: Preoperative cardiac evaluation, as defined by the ACC/AHA algorithm, does not predict or improve postoperative morbidity, mortality, or 36-month survival in asymptomatic, diabetic patients undergoing elective lower-extremity arterial reconstruction. These data do not support the current ACC/AHA recommendations as a standard of care for diabetic patients with an intermediate clinical predictor who undergo peripheral arterial reconstruction, a high-risk surgical procedure. (J Vasc Surg 2005;41:38-45.)

Peripheral artery disease (PAD) is a manifestation of systemic atherosclerotic disease. The presence of PAD increases the all-cause mortality rate by threefold and the cardiovascular mortality rate by nearly sixfold. Patients with diabetes mellitus have a greater incidence of PAD than nondiabetic patients. The incidence of coronary artery disease and stroke is increased in diabetic patients compared with age and sex-matched nondiabetic patients. Patients with diabetes mellitus also have a higher mortality from coronary heart disease than nondiabetic patients. On the basis of these data, patients with diabetes mellitus who undergo revascularization procedures for PAD are theoretically at increased risk for adverse cardiac events.

The American College of Cardiology (ACC) and the American Heart Association (AHA) recognize the theoretical increased risk for adverse cardiac events in diabetic patients undergoing vascular surgery. ACC and AHA have published extensive algorithms to risk-stratify patients having noncardiac surgery (Fig 1). Peripheral vascular procedures are considered high-risk procedures by the ACC/AHA guidelines. Step 6 of the ACC/AHA algorithm recommends that patients undergoing a high surgical-risk procedure with an “intermediate clinical predictor” such as diabetes have a cardiac evaluation. According to the present
algorithm, diabetic patients with PAD would warrant a preoperative cardiac evaluation prior to an infrainguinal arterial reconstruction.

Although it is obviously desirable to limit cardiac morbidity in patients having peripheral vascular procedures, it is not clear that a preoperative cardiac evaluation is effective to this end. No prospective randomized trial has been performed to assess the benefit of a preoperative cardiac evaluation, and only one randomized controlled trial has been initiated to evaluate the benefit of prophylactic coronary revascularization compared with best medical management.

The present study is a retrospective review of patients who had elective infrainguinal arterial reconstruction procedures. For the purpose of this study, we only considered asymptomatic patients. Also, we eliminated patients who required an emergent operation because the cardiac evaluation was often deferred owing to the life-threatening circumstances. We selected a group of patients with diabetes mellitus and PAD who were at high risk for cardiac morbidity and thus should show the greatest benefit from a cardiac evaluation.

METHODS

In compliance with the standards of the Institutional Review Board, we retrospectively reviewed the medical records of 433 consecutive patients undergoing 539 infrainguinal arterial reconstruction procedures at the Beth Israel Deaconess Medical Center during the 32-month period from July 1999 to February 2002. Data were prospectively entered into a computerized vascular registry. Additionally, electronic medical records and all clinic notes were reviewed retrospectively. For patients with multiple operations, only the index operation during this time period was considered. All procedures were performed by staff vascular surgeons, assisted by a vascular fellow or a general surgery resident. Patients routinely recovered in a vascular step-down unit before being transferred to the patient floor.

Only patients who had elective arterial reconstructions were considered in this study (step 1). Any patient with a major clinical predictor as defined by the ACC/AHA algorithm, including myocardial infarction (MI) within 1 month, unstable angina, decompensated congestive heart failure (CHF), severe valvular disease, or significant arrhythmias, was not included in this study because, according to the algorithm, they warranted a cardiac evaluation on the merit of their cardiac symptoms (step 4). Patients who received cardiac revascularization, including coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA), with or without stenting, within 5 years of their index operation outside of the context of a preoperative work-up were also excluded as they should not receive further cardiac evaluation according to the algorithm (step 2).

Peripheral vascular procedures are considered “high surgical-risk procedures” by the ACC/AHA guidelines. Patients with two or more of the Eagle criteria (age > 70, diabetes, angina, q wave on preoperative electrocardiogram [ECG], ventricular arrhythmia, and history of CHF) were considered to have an “intermediate clinical predictor.” Patients with an intermediate clinical predictor who require a high surgical risk procedure are recommended to have a preoperative cardiac evaluation. These patients were separated into two groups: those undergoing a cardiac work-up (WU) according to the ACC/AHA algorithm and those not undergoing the recommended work-up (NWU).

The Eagle criteria were used in place of intermediate clinical predictors in the present study. This substitution was made because the Eagle criteria encompass the intermediate clinical predictors; they are more stringent and less subjective. The criteria for diabetes, CHF, and angina are the same for both systems.

The Eagle criteria substitute q wave on preoperative ECG for past MI. This is a significant change, because only patients with documented, ECG evidence of past MI were considered to have an indication for cardiac evaluation. This eliminates the patients who might have had an MI of lesser clinical significance, such as a transient elevation of cardiac enzymes noted incidentally.

The Eagle criteria also include age greater than 70; this is a “minor clinical predictor” according to the ACC/AHA guidelines. Patients with peripheral vascular disease have poor functional capacity due to their disease process and their cardiac capacity is difficult to assess. Cardiac evaluation is also recommended for patients with a minor clinical predictor, poor functional status, and who are scheduled to have a high-risk procedure (steps 7 and 8).

A patient who underwent any diagnostic test designed to elicit ischemia or delineate anatomic defects in the coronary circulation was considered to have had a cardiac evaluation. These tests include stress ECG, stress echocardiography, stress tomoscintigraphy, and cardiac catheterization. All patients in both cohorts had a resting ECG performed as a component of the standard preoperative testing.

Demographic data and preoperative risk factors in our patient population, including age, hypertension, previous MI, CHF, serum creatinine level, and diabetes mellitus, were entered prospectively. The presence or absence of a Q wave on ECG and length of hospitalization were determined by retrospective chart review. Postoperative complications including MI and CHF requiring treatment were identified at clinical assessment and entered prospectively into the registry by staff, fellows, or residents.

The routine cycling of cardiac enzymes and postoperative ECG for asymptomatic patients are not part of the patient-care protocol. An ECG was only obtained if symptoms, including nausea, or a clinically significant change in hemodynamic parameters were present. Arrhythmia requiring treatment was also determined on retrospective chart review.

MI, CHF, and arrhythmia together were considered a combined cardiac morbidity endpoint. Perioperative mortality included fatality from any etiology within 30 days of the operation. Date of death was determined from both the
Social Security death index, data from our registry, and chart review. The cause of death was not always identified.

Statistical analysis was performed with STATA software (version 8.0, Stata Corporation, College Station, Tex). The association between perioperative mortality, cardiac morbidity, and cardiac evaluation was assessed using the Fisher exact test. Significance was considered for P values less than .05. Length of hospitalization was assessed using the Kruskal-Wallis rank sum test and associations were considered significant for P values less than .05. Survival analysis was performed with the Kaplan-Meier method and values were considered significant at P less than .05 (Cox-Mantel log-rank test).

RESULTS

We reviewed the records of 433 consecutive patients undergoing 539 infrainguinal arterial reconstructions, 259 of whom had diabetes mellitus. Of these patients, we identified 140 who had elective procedures, had not had a coronary revascularization procedure within 5 years, and met the ACC/AHA criteria for preoperative cardiac evaluation. Seventy-nine of these patients had the recommended preoperative cardiac evaluation (WU) and 61 did not have an evaluation (NWU).

In the WU cohort, 48 nuclear stress tests, 15 stress echocardiographs, and 5 ECG stress tests were performed. Eleven patients were directly referred for cardiac catheterization without a stress test. Preoperative evaluation resulted in cardiac catheterization in 19 patients. As a result of the preoperative cardiac work-up, 6 patients had PTCA preoperatively and 4 patients had a CABG procedure prior to their peripheral vascular reconstruction. The decision to pursue coronary revascularization was at the discretion of the cardiologist performing the procedure.

The NWU and WU groups were similar in proportion of men (72% and 72% respectively, P = .96), average age (72 and 71 years, P = .67), median serum creatinine level (1.2 and 1.0 mg/dL, P = .78), proportion on dialysis (11% and 16%, P = .40), proportion with a history of CHF (31% and 46%, P = .083), and number of Eagle criteria (2.5 and 2.7, P = .15). The WU group had significantly more patients with a prior MI (62% vs 44%, P = 0.036). Patient demographics are listed in Table I. All procedures were performed by five surgeons (Table II), with equal representation in each group (P = .117).

Perioperative cardiac morbidity and mortality was comparable in each cohort (Table III). Four patients in the NWU (7%) and WU (5%) cohorts had a postoperative MI, clinically significant CHF, or arrhythmia requiring treatment (P = 0.71). Postoperative mortality was similar in each group, with only one postoperative death in each cohort (NWU, 2%; WU, 1%; P = 1.00).

Length of hospitalization was measured from the time of admission to the hospital to the time of discharge. Length of stay ranged from 2 to 38 days (median 8) in the NWU cohort and 4 to 48 (median 10) in the WU group (P = .11).

Table I. Patient demographic data

<table>
<thead>
<tr>
<th>Demographics</th>
<th>No work-up</th>
<th>Work-up</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>61</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Male gender</td>
<td>44 (72%)</td>
<td>50 (73%)</td>
<td>.96</td>
</tr>
<tr>
<td>Eagle criteria</td>
<td>2.3 (0.8)</td>
<td>2.7 (0.8)</td>
<td>.15</td>
</tr>
<tr>
<td>Procedures performed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal bypass</td>
<td>45 (74%)</td>
<td>48 (78%)</td>
<td>.13</td>
</tr>
<tr>
<td>Proximal bypass</td>
<td>16 (26%)</td>
<td>17 (22%)</td>
<td>.52</td>
</tr>
<tr>
<td>Intermediate clinical predictors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angina</td>
<td>4 (7%)</td>
<td>11 (14%)</td>
<td>.16</td>
</tr>
<tr>
<td>Prior MI†</td>
<td>27 (44%)</td>
<td>49 (62%)</td>
<td>.036*</td>
</tr>
<tr>
<td>CHF</td>
<td>19 (31%)</td>
<td>36 (46%)</td>
<td>.083</td>
</tr>
<tr>
<td>Diabetes</td>
<td>61 (100%)</td>
<td>79 (100%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Renal insufficiency‡</td>
<td>8 (13%)</td>
<td>19 (24%)</td>
<td>.10</td>
</tr>
<tr>
<td>Dialysis dependent</td>
<td>7 (11%)</td>
<td>13 (16%)</td>
<td>.40</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>1.2 (1.1-1.8)</td>
<td>1.0 (0.7-9.3)</td>
<td>.78</td>
</tr>
<tr>
<td>Minor clinical predictors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>71.9 (10.1)</td>
<td>71.1 (11.1)</td>
<td>.67</td>
</tr>
<tr>
<td>Hypertension</td>
<td>44 (72%)</td>
<td>63 (80%)</td>
<td>.29</td>
</tr>
<tr>
<td>History of stroke</td>
<td>4 (7%)</td>
<td>17 (22%)</td>
<td>.014*</td>
</tr>
</tbody>
</table>

MI, Myocardial infarction; CHF, congestive heart failure.
†Prior myocardial infarction is defined either by patient history or pathological Q waves on preoperative electrocardiogram.
‡Renal insufficiency is defined as a baseline serum creatinine level > 2 mg/dL.

Table II. Patients receiving a preoperative cardiac evaluation by surgeon

<table>
<thead>
<tr>
<th>Surgeon</th>
<th>Work-up</th>
<th>No work-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeon A</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>Surgeon B</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Surgeon C</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Surgeon D</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>Surgeon E</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>61</td>
</tr>
</tbody>
</table>

Patient survival at 1 year was 85.3% and 78.5% for the NWU and the WU cohorts (Fig 2); survival at 36 months was 73.6% and 62.9%. Survival was significantly higher in the NWU cohort by Kaplan-Meier analysis (P = .044). Survival for the 10-patient cohort that had coronary revascularization subsequent to cardiac evaluation was 80% at both 12 and 36 months. Both patients who died in the revascularized group had had a PTCA prior to their peripheral vascular procedure. There was no difference in this survival curve from the WU or NWU survival curves (P = .209).

DISCUSSION

In the present study, we identified 140 asymptomatic diabetic patients undergoing elective infrapopliteal arterial reconstruction. These patients met the established ACC/AHA criteria for preoperative cardiac evaluation. On retrospective review, 79 patients had a cardiac evaluation as would be recommended by the ACC/AHA and 61 patients did not.
Table III. Postoperative mortality (a) and cardiac morbidity (b)*

<table>
<thead>
<tr>
<th></th>
<th>No work-up</th>
<th>Work-up</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No postoperative mortality</td>
<td>60</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Postoperative mortality</td>
<td>1 (2%)</td>
<td>1 (1%)</td>
<td>1.00</td>
</tr>
<tr>
<td>MI</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CHF</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Cardiac morbidity is presented both as a cumulative endpoint and as the incidence of the individual endpoints.

The preoperative cardiac evaluation did not improve perioperative mortality, perioperative cardiac morbidity, or late survival. The incidence of perioperative MI in this series is 1.4% for all patients, 1.6% for NWU patients, and 1.3% for WU patients. These data compare favorably with other cited rates of MI after infrainguinal bypass procedures.8,9 Despite this, patients in this series had a slightly higher incidence of postoperative adverse cardiac events than previously cited in our institution.10 This increase in incidence likely reflects a selection bias; this series only considered patients with two or more Eagle criteria.

Cardiac evaluation is not a benign procedure. At best, it delays time to operation and incurs a significant cost to the healthcare system. Additionally, a positive stress test frequently prompts a cardiac catheterization to localize anatomic defects in the coronary circulation. Cardiac catheterization is an invasive procedure that carries many risks. Angiography requires the administration of contrast material to patients who frequently have tenuous renal function. A 1% incidence of AV fistulae resulting from the groin puncture has been documented in the cardiology literature.11 Other less-common complications, including necrotizing fasciitis, have also been documented.12 If a defect is identified at cardiac catheterization, patients with PAD have greater morbidity and mortality rates associated with PTCA and CABG procedures than do patients without PAD.13,14

Screening stress tests, including exercise ECG stress test, stress echocardiography, and nuclear perfusion studies, are designed to identify hemodynamically significant lesions. However, primary MIs in ambulatory patients are most likely caused by stenoses of less than 50%. The likelihood of plaque rupture, thrombosis, and resulting MI is more closely related to the architecture and stability of the atherosclerotic plaque than the degree of stenosis that the plaque causes.13 Current screening tests often fail to identify the plaques that are most likely to cause MI. An autopsy series demonstrated a poor correlation between ischemic regions identified on stress echocardiography and the location of infarction.16

Nuclear imaging studies have been evaluated for their efficacy in predicting adverse cardiac outcomes. One series of more than 200 patients cites a sensitivity of 38% and specificity of 63% for the prediction of adverse cardiac outcomes.17 Back and colleagues18 evaluated the efficacy of cardiac stress imaging compared with angiography in predicting adverse cardiac outcomes. They demonstrated that three-vessel disease was an independent predictor of cardiac morbidity, whereas nuclear imaging failed to predict adverse outcomes.18

In addition to the potential complications associated with catheterization and the debatable reliability of noninvasive cardiac examinations, asymptomatic patients who are referred for cardiac evaluation might be deterred from having the indicated peripheral vascular procedure. The patients in this study were culled from our computerized vascular registry, which only collects data on patients who have had a vascular procedure. Patients who had a preoperative cardiac evaluation and did not have an infrainguinal reconstruction were not included in the present study. Based on an adverse cardiac evaluation, these patients might have been encouraged to have an amputation instead of the planned vascular reconstruction.

Alternatively, patients might have decided against further procedures after a long cardiac work-up. This is not an uncommon scenario; a series from a Veterans Administration (VA) hospital reports that as many as one fifth of patients deferred vascular surgery after a preoperative cardiac evaluation, despite potentially life-threatening abdominal aortic aneurysms.19

Finally, cardiac catheterization is not a benign procedure and is associated with some mortality. Obviously these patients were not included in the present study. Although there is a selection bias in the present study, it is conceivable that if all patients referred for cardiac evaluation were included in the analysis, the WU group would, in fact, have had more adverse outcomes than the NWU group.

The present study has several limitations. It is a retrospective study with the selection bias and reporting bias inherent in all retrospective studies. We identified patients whose comorbidities warranted a preoperative cardiac evaluation. These patients did or did not have the recommended evaluation, generally at the discretion of a consulting cardiologist. There was no randomization, and consequently, the two groups were not homogeneous. A significantly higher percentage of patients in the WU cohort had had a prior MI.

The number who met our inclusion criteria was relatively small—140 patients. Our evaluation began reviewing the medical records of 435 patients who had 539 consecutive infrainguinal arterial reconstruction procedures. Because of the small number of patients considered in this study, there is a possibility of type II error.

A preoperative cardiac evaluation might improve outcome either by providing a benefit from coronary revascu-
larization before the elective procedure or by inciting an improvement in medical management in the perioperative period. This improvement is reflected in the increased incidence of perioperative β-blockade in the patients in this study who had a perioperative cardiac evaluation (59% vs 77%, \( P = .021 \)).

After analyzing the patient data, we only identified 10 patients who had coronary revascularization as a direct result of a preoperative cardiac evaluation. These patients had a 1- and 3-year survival of 80%. This survival curve is not statistically improved from the survival curve of the group without a cardiac evaluation. Too few patients had a revascularization procedure in this series to determine if such a procedure actually improves late survival.

The patients who had preoperative coronary revascularization had either PTCA or a CABG procedure. It is important to consider these patients separately when determining outcomes associated with coronary revascularization. The method of revascularization is not of trivial concern. Presently, no prospective, randomized controlled trials have been published that demonstrate improvement in survival after coronary angioplasty in asymptomatic patients. Too few patients had a revascularization procedure in this series to determine if such a procedure actually improves late survival.

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Several factors contribute to the low incidence of postoperative events. In our institution, the surgical service has adopted a team approach to the care of the vascular patient and works closely with the cardiology service and endocrinologists from the Joslin Diabetes Center. This approach lends to better medical management, including consistent perioperative β-blockade, antiplatelet regimens, and tight glycemic control. In addition, the frequent use of pulmonary artery catheters and a specialized vascular nursing unit contribute to improved outcomes.

These data, together with the present study, challenge the validity of diabetes as an independent risk factor for adverse perioperative events. Algorithms that use diabetes mellitus alone as a criterion for a preoperative cardiac evaluation should be reconsidered.

To better evaluate the benefit or harm caused by subjecting patients to a preoperative cardiac evaluation, a larger, prospective randomized trial is needed. Such a study has not been performed. This investigation is among the largest series evaluating outcome data in patients receiving a preoperative cardiac evaluation. These data suggest that it is acceptable to offer patients infrainguinal arterial reconstruction without an antecedent cardiac evaluation. Because the ACC guidelines are well accepted, it is ethically difficult to obtain institutional review board approval to randomize at-risk patients to no work-up. Studies such as this should provide the evidence to support the needed, larger, prospective randomized trials.

**REFERENCES**


**DISCUSSION**

**Dr Carlos Donayre** (Los Angeles, Calif). Dr Monahan and colleagues have relied on their extensive experience with diabetic patients to address the ACC guidelines for preoperative cardiac evaluation in patients undergoing infrainguinal bypass.

I would like now to address the following: The cardiac evaluation was not uniform in patients undergoing revascularization and they underwent a variety of stress tests. Eighteen patients underwent cardiac catheterization. Eleven did so directly without any invasive workup at the discretion of the referring cardiologist. Generally, the decision to proceed with invasive workup was at the discretion of the referring cardiologist. Their practices varied greatly, especially throughout the time course that we studied.

Second, with respect to selection of anesthesia and periperaoperative beta-blockade, virtually all of the procedures were performed under general anesthesia. The issue of beta-blockade really strikes at the heart of the study. Preoperative cardiac evaluation can improve patient outcome by two methods: First, it could incite a more aggressive, more thorough medical management of the patient in the perioperative period, or it could lead to coronary revascularization, which may or may not provide a benefit. Our data don’t prepare me to speak to the latter. However, to the former, it’s our practice to aggressively manage these patients in the perioperative period. We adopt a team approach with cardiologists and endocrinologists from the Joslin Diabetes Center, and most all our patients have periperaoperative beta-blockade as well as treatment with antplatelet agents. We frequently use pulmonary artery catheters, and all our patients recover in a specialized vascular nursing unit that has been cited for low mortality rates in the past.

Finally, at present we do not have a uniform approach to preoperative cardiac evaluation for patients undergoing infrainguinal revascularization or aortic procedures.

**Dr Jerry Goldstone** (Cleveland, Ohio). I just wanted to amplify a little bit, because the previous discussant asked, really, my question regarding the anesthetic management. Was the anesthetic management uniform across the groups, or was the management of the patients who had had cardiac workup different from those who did not?

We have found that the anesthetic management is integral to the surgical management in our patients, and I think that may, in some ways, explain some of your data. You’ve partially answered the question already, but are there any other details about the anesthetic that you can provide?

**Dr Monahan.** It is our practice to perform these procedures under general anesthesia. Data from a prospective randomized trial performed at our institution involving over four hundred patients with invasive periperaoperative hemodynamic monitoring demonstrated no difference in periperaoperative mortality or cardiac morbidity in patients who had general, epidural, or spinal anesthesia.
Dr Richard Cambria (Boston, Mass). Nice job and an excellent series with excellent results, although I would just caution a bit in universally adopting your conclusion. Remember, firstly, that the Eagle criteria and the Annals of Internal Medicine paper that you showed from 1989 were developed in an era when event rates were substantially higher than your excellent results. As a matter of fact, in a previous report from our institution, the patient undergoing infragenual bypass surgery was the single highest risk group for perioperative cardiac event rates. The evolution of events in this group was often as high as fifteen percent. So your very low event rate has an impact, obviously, on your results and conclusions.

And secondly, by the time you stratified your groups, you had relatively small numbers; and a not unsubstantial percentage of your workup group, in fact, did have a coronary intervention. So the protective effect of that may explain the equivalent results in the two groups. I think most vascular surgeons have come around to the recognition that a patient with a pressing indication for lower extremity revascularization ought to have that revascularization with best medical management of their associated coronary disease. But I would caution throwing out the whole concept of cardiac evaluation in patients whose clinical profile clearly indicates that they need it, irrespective of the timing of an operation.

Dr Monahan. I completely agree with your comments. Patients whose clinical profile clearly indicated that they needed a cardiac evaluation were eliminated from our study group; any patient with a major clinical predictor was not considered in this study. Likewise patients undergoing emergent operation were not considered. The patients in this study met inclusion criteria largely because of their age and diabetes. The weight of these risk factors as proposed by Dr Eagle is debated amongst cardiologists. We are challenging the idea that age and diabetes alone should trigger a preoperative cardiac evaluation.

Additionally, of the ten patients in the work-up group who had preoperative coronary revascularization, there was one death in a patient who had had an angioplasty, which occurred at seventy-six days. The survival of these ten patients at one and two years was ninety percent at both time points, which by Kaplan-Meier analysis was not different from the two curves that I presented earlier. However, obviously, with only ten patients, there is potential for significant type-two error.

INVIDTED COMMENTARY

Joseph L. Mills, Sr, MD, Tucson, Ariz

Coronary artery disease (CAD) commonly lurs in patients with peripheral arterial disease (PAD), and the more severe the PAD the worse the CAD. Patients with unstable coronary syndromes, uncompensated congestive heart failure (CHF), uncontrolled arrhythmias, and severe valve disease (major predictors) require cardiac evaluation, regardless of whether a peripheral intervention is on the horizon. Absent major predictors, patients who require infrainguinal bypass to treat limb-threatening ischemia still constitute a group at high risk. The clinical conundrum remains: to what extent does one evaluate cardiac risk in patients who require infrainguinal bypass or, for that matter, any other peripheral arterial reconstruction?

The Deaconess group, with longstanding expertise in limb salvage surgery, takes issue with the “ACC/AHA Guideline on Perioperative Cardiovascular Evaluation for Noncardiac Surgery.” This document, based on expert, well-meaning opinion, but precious little hard evidence, suggests that all peripheral arterial operations are “high risk” and that at least preoperative noninvasive cardiac testing is required in such patients in the presence of intermediate predictors, such as mild angina pectoris, previous myocardial infarction, previous or compensated CHF, renal insufficiency, or diabetes mellitus.

The authors report a retrospective, nonrandomized study of 140 patients with diabetes undergoing infrainguinal bypass. Cardiac evaluation was performed at the discretion of the attending surgeon: 79 patients receiving cardiac evaluation constituted the workup group, and 61 patients underwent leg bypass with no cardiac workup. There was no difference in postoperative cardiac morbidity between the workup and no cardiac workup groups, and patient survival at 1, 12, and 24 months was identical. The authors conclude that mandatory preoperative cardiac evaluation, at least in patients with diabetes who require leg bypass, is unnecessary.

There are problems with the study. It is subject to type II errors because of small sample size and low event rate, and there is likely selection bias, inasmuch as significantly more patients in the workup group had a history of CAD, previous MI, or CHF. Nevertheless, I suspect the authors are correct. Noninvasive cardiac testing is flawed by low positive predictive value, and may lead to unwarranted interventions, such as percutaneous transluminal coronary angioplasty or coronary bypass, which have not been scientifically demonstrated to reduce MI or cardiac mortality in patients with PAD. There is, however, level I evidence that β-blockade is an effective strategy, even in patients at high-risk.

I suspect that the era of routine preoperative cardiac testing is at an end, because of its high cost and entirely unproved benefit on outcomes. We should routinely prescribe β-blockade, and perhaps also statin agents and angiotensin converting enzyme inhibitors in selected patients, and optimize medical management, and reserve detailed cardiac testing for patients with major predictors that warrant cardiac evaluation independent of the need for PAD intervention.

REFERENCE