Coronary Artery Disease in Diabetic Patients With Lower-Extremity Arterial Disease: Disease Characteristics and Survival

A report from the Coronary Artery Surgery Study (CASS) registry

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OBJECTIVE — Patients who have diabetes and lower-extremity arterial disease (LEAD) are at an increased risk of dying from coronary artery disease (CAD). This study was undertaken to: *1*) define the clinical and arteriographic factors associated with LEAD among diabetic patients; 2) determine the long-term survival and predictors of mortality of diabetic patients with LEAD, compared to those without LEAD; and 3) determine if the presence of LEAD is an independent risk factor for mortality among diabetic patients with CAD.

RESEARCH DESIGN AND METHODS — A total of 263 diabetic patients from the Coronary Artery Surgery Study (CASS) registry with LEAD, who were ≥50 years of age, and who had arteriographically proven CAD, were identified and followed for a mean of 12.8 years. A total of 1,349 comparably aged diabetic patients from the CASS registry with CAD and no evidence of LEAD were followed for an equivalent period of time.

RESULTS — Compared with diabetic patients without LEAD, diabetic patients with LEAD were characterized by the presence of cerebrovascular disease, a high rate of current smoking, elevated systolic blood pressure, high grades of angina pectoris, and digitalis use. Severity of epicardial CAD and extent of CAD were not independent predictors of the presence of LEAD. On follow-up, diabetic patients with LEAD had significantly higher mortality (mostly cardiovascular) than diabetic patients without LEAD, with a median survival of 8.1 and 10.9 years, respectively. On multivariate analysis, age, the number of significantly narrowed coronary arteries, and the presence of left ventricular dysfunction predicted mortality in both subsets of diabetic patients. Among all the diabetic patients with CAD, the presence of LEAD was an independent risk factor for mortality.

CONCLUSIONS — Diabetic patients with LEAD have a higher mortality rate (mostly cardiovascular) than diabetic patients without LEAD, despite no apparent anatomic differences in the severity and extent of CAD. This suggests that factors associated with the presence of LEAD, other than the anatomy of the coronary circulation, may play a role in determining survival among diabetic patients with LEAD and CAD.

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Abbreviations: CABG, coronary artery bypass graft; CAD, coronary artery disease; CASS, Coronary Artery Surgery Study; CHF, congestive heart failure; CVA, cerebrovascular accident; IMA, internal mammary artery; LEAD, lower-extremity arterial disease; LV, left ventricular; PTCA, percutaneous transluminal coronary angioplasty; TIA, transient ischemic attack.

Patients with lower-extremity arterial disease (LEAD) have a 10-year reduction in life expectancy and a doubling of mortality, compared with individuals without LEAD (1–4). The primary cause of death is coronary artery disease (CAD), which accounts for more than 50% of mortality (5–11). Diabetic patients in particular are prone to the development of LEAD and concomitant CAD. In the Framingham Study, for example, diabetic patients were found to have a four- to sixfold increased prevalence of LEAD, compared with nondiabetic patients, and a two- to fourfold increased mortality rate, largely due to CAD (12–14). More information regarding the nature of CAD in this setting and its prognosis would therefore be of interest.

The following study, based on a cohort of the Coronary Artery Surgery Study (CASS) registry, was undertaken to clarify several points regarding CAD in diabetic patients with concomitant LEAD. The first was to describe the anatomic extent of CAD, compared with diabetic patients from CASS without evidence of LEAD, and to define the clinical and arteriographic factors independently associated with the presence of LEAD among diabetic patients. The second was to determine the survival over an average of almost 13 years of follow-up, compared with diabetic patients without LEAD, and to determine the factors predictive of mortality. The last was to determine if the presence of LEAD among diabetic patients with CAD was an independent risk factor for mortality.

RESEARCH DESIGN AND METHODS

— The Coronary Artery Surgery Study (CASS) is a multi-institutional research program consisting of a randomized trial of medical and surgical treatments of CAD and a registry of patients undergoing diagnostic coronary arteriography for the presence of suspected coronary artery disease. Details of the design, quality control, and data entry have been previously described (15). Between 1 July 1974 and 31 May 1979, a total of 24,959 patients (men, *n* = 18,894; women, *n* = 6,065) who underwent cardiac arteriography at 15 cooperating clinical sites were enrolled in the registry. The registry served as a repository for information on all consecutive patients who underwent coronary arteriography for the study and treatment of CAD at the participating sites. The registry was also the source from which candidates for the randomized trial were identified.

Only patients in whom the primary indication for coronary arteriography was suspected or proved CAD were included in the registry. Patients with normal coronary arteries were included in the registry. Patients studied because of the suspicion of CAD who were found to have another form of heart disease were excluded. Those who underwent coronary arteriography for the evaluation of other conditions, such as valvular heart disease, cardiomyopathies, and congenital heart disease, were also excluded even if subsequent evidence showed that CAD was a major clinical problem.

Enrollment in the registry was contingent on obtaining the patient's signed informed consent. Exclusion criteria included: inaccessibility to follow-up, substantial language barrier, referral to a CASS site expressly for surgery with coronary arteriography performed elsewhere, cardiomyopathy not due to ischemic heart disease, idiopathic hypertrophic subaortic stenosis, and significant valvular heart disease. Of the eligible subjects, 4% declined to participate in the study and an additional 2% were not enrolled for a number of reasons, such as medical emergency or unavailability of study personnel. Thus, 94% of eligible patients were enrolled.

Baseline history, physical, and laboratory information were collected from each patient at the time of entry into CASS at the participating clinical sites and were transmitted to the Coordinating Center at the University of Washington. Angina was graded according to the classification of the Canadian Cardiovascular Society (16) with a category added for angina unrelated to exertion. Unstable angina was defined as a change in the pattern of chest pain within 2 months before entry into the study. History of myocardial infarction required that the patient had been informed by the physician of a definite infarct. A history of cerebrovascular accident (CVA) or transient ischemic attack (TIA) required evidence or history of permanent or transient paralysis, respectively. Clinical variables related to left ventricular failure included a history of congestive heart failure (CHF) and the use of digitalis or diuretics.

More than 80% of the patients having arteriography in the registry for suspicion of CAD had chest pain as the predominant symptom. The rest had CHF, arrhythmia, noncardiac chest pain, fatigue, or were asymptomatic. Of those with angina pectoris, the majority had grades II and III. Unstable angina was present in ~50% of those with definite angina and in 30% of those with probable angina.

Disease of the proximal coronary vessels was defined by the presence on arteriogram of a lesion with at least 70% narrowing of the luminal diameter of the right coronary, left anterior descending coronary, or circumflex coronary artery. For the left main coronary artery, the threshold for disease was 50% obstruction. Left main coronary artery disease was classified as two-vessel disease if the coronary circulation was right-dominant (posterior descending artery arising from the right coronary artery) or as three-vessel disease if the coronary circulation was left-dominant (posterior descending artery originating from the left circumflex artery). As a measure of the extent and severity of CAD, the coronary vasculature was divided into 27 segments, and the total number of segments with narrowing of ≥50% was tabulated.

Arteriography revealed that 12% of men and 40% of women in the registry had normal coronary arteries. An additional 9 and 15%, respectively, had mild-to-moderate degrees of angiographic coronary disease. Thus, 79 and 45% of all registry men and women, respectively, had significant CAD (one vessel, two vessel, and three vessel disease: 21, 25, and 34% in men and 17, 14, and 14% in women). Left main artery disease was diagnosed in 9% of men and 4% of women.

Left ventricular cine-angiography was carried out in the 30° right anterior oblique projection. Systolic wall motion of the five left ventricular wall segments (anterobasal, anterolateral, apical, diaphragmatic, and posterobasal) was scored as follows: normal = 1; moderate hypokinesia = 2; severe hypokinesia = 3; akinesia = 4; dyskinesia = 5; and aneurysm = 6. The left ventricular wall motion score (LV score) is the sum of the segmental scores. A score of 5 indicates normal ventricular function. A score of ≥15 implies severely disturbed ventricular function and was encountered in 6% of registry participants; 47% of participants had normal LV wall motion. Ejection fraction was also calculated based on arteriography. An ejection fraction >0.5 occurred in 70.7% of the men and 85.5% of the women, whereas an ejection fraction of <0.3 occurred in 5.9% of the men and 2.6% of the women.

Special provisions were made during the recruitment phase for monitoring the interpretation of coronary arteriograms and the evaluation of ventricular motion. Techniques for measuring these variables were standardized and reviewed repeatedly at meetings of angiographers. Differences among angiographers in interpretation of percentage stenosis and the number of diseased vessels were low for good-quality films and diminished as the study progressed (17). By the end of enrollment, <3% of the original readings were deemed to be of inadequate quality, a level better than that reported in previous studies.

Assignment of patients to medical or surgical treatment in the registry was not randomized and was done on an individual basis by the treating physician. A number of dominant factors, however, were found to influence the assignment to surgery (18). These included the amount of myocardium believed to be at risk from lesions of the proximal vessels, the severity of angina, the number of operable lesions, changes in activity level, unstable angina, and the presence of left main artery obstruction or stenosis. The presence of LEAD did not influence the decision to operate.

Patient populations

Because the impact of diabetes on the prevalence of LEAD is greatest (in absolute terms) in older individuals (14,19,20), the present study is confined to individuals ≥50 years of age, most of whom would have had adult-onset diabetes.

There were a total of 12,538 patients in the CASS registry who were ≥50 years of age with at least one coronary segment that was occluded ≥50%. Of these, 1,612 (12.9%) were diabetic, as ascertained by patient self-report of insulin (19.4%) or oral hypoglycemic agent use (45.7%) or by a history of dietary intervention to control blood glucose (47.9%). Of these diabetic patients, 263 (16.3%) reported having pain in the calf muscles upon ambulation, which subsided with rest, having had prior vascular surgical repair, having been told of vascular disease in the past, or having absent pedal pulses on examination at the time of entry into the registry.

For the first part of this study, the 263 diabetic patients with evidence of LEAD and the 1,349 diabetic patients without evidence of LEAD were studied. Descriptive clinical and arteriographic features were derived. Factors independently associated with the presence of LEAD were derived by multivariate analysis.

For the second part of this study, survival over an average of almost 13 years of follow-up was calculated for the two groups and compared. Factors predictive of survival were estimated using multivariate analysis. The effects of coronary artery bypass graft (CABG) surgery versus medical therapy on survival were examined also (details of the follow-up time calculations have been previously published [21]).

Follow-up

Clinical follow-up was obtained through 1991 in all patients for a mean of 12.8 years (range, 0 to 15.9 years; one patient dying on the day of surgery). Information was collected primarily by telephone interview, via mailed questionnaire, or through the use of the National Death Index (22). In the event of a patient's death, a detailed report of the circumstances was filed based on hospital records or based on telephone interviews with treating physicians or family members. Of the patients, <2% were lost to follow-up. Deaths were classified as either cardiac or noncardiac. Cardiac deaths included causes directly or indirectly related to heart disease or to sudden unexplained death (occurring within 1 h of the onset of symptoms and generally before the availability of medical care). Noncardiac disease included diseases related to atherosclerosis, but not related to the heart, or to diseases unrelated to atherosclerosis.

Statistical analysis

Comparisons of discrete variables were performed using a χ^2 test, and continuous variables by a two-sample t test. All P values were two-tailed. Logistic regression analysis was used to determine variables associated with LEAD among all the diabetic patients. Survival curves were calculated by the life-table method and compared by generalized Wilcoxon's test (23). A Cox proportional-hazards model (24) was used to determine independent predictors of mortality using the following variables, which have been found to be predictive of survival in patients with CAD from previous CASS studies: number of diseased epicardial vessels, number of coronary occlusions, LV score, presence or absence of valvular heart disease, left main coronary artery disease, smoking, hypertension, systolic and diastolic blood pressure, sex, age, history of previous myocardial infarction, and congestive heart failure. In addition, a treatment variable (surgical versus medical) was added.

Table 1—*Descriptive features of diabetic patients with CAD, ≥50 years of age, with or without concomitant LEAD*

Characteristic	Diabetic patients with LEAD	Diabetic patients without LEAD
n	263	1,349
Age (years)	59.1 ± 5.9	59.2 ± 5.9
Sex (% male)	77.6	76.7
Race (% white)	97.0	96.5
Systolic blood pressure (mmHg)	138.6 ± 23.4	134.6 ± 21.1
Diastolic blood pressure (mmHg)	81.5 ± 13.8	80.0 ± 12.0
Cholesterol (mg%)	232.6 ± 53.7	227.0 ± 55.7
Family history of CAD (%)	44.1	40.2
Smoking status (%)		
Current	35.4	19.4
Former	45.2	46.8
Never	19.4	33.8
History (%)		
Prior myocardial infarction	45.9	47.2
Systemic hypertension	13.8	11.2
Left ventricular hypertrophy	4.4	4.6
Congestive heart failure	21.3	18.0
Cerebrovascular accident/ transient ischemic attack	14.1	3.8
Angina pectoris (%)		
No angina	7.6	12.6
Class I	1.1	3.4
Class II	16.0	20.8
Class III	38.8	34.7
Class IV	27.8	20.0
Nonexertional	8.7	8.5
Unstable angina (%)	41.8	36.9
Medications (%)		
Diuretics	37.9	34.6
Digitalis	34.7	26.8
Beta-blockers	50.0	49.7

Values are unadjusted for differences between groups.

RESULTS

Clinical and arteriographic variables

Baseline clinical variables for the diabetic patients with and without evidence of LEAD are shown in Table 1. These variables are descriptive and unadjusted for the many differences between the groups. Diabetic subjects with LEAD had a higher prevalence of current smoking, prior CVA/TIA, higher grades of stable or unstable angina pectoris, higher systolic blood pressure, and digitalis use, compared with diabetic patients without evidence of LEAD. They did not differ from them with respect to age, sex, race, diastolic blood pressure, total cholesterol, family history of CAD, history of hypertension, CHF, diuretic or beta-blocker use, or hypoglycemic agent use.

Arteriographically, diabetic patients with LEAD had a high prevalence of multivessel epicardial disease that was slightly greater (unadjusted for other factors) than that found in diabetic patients without LEAD (Table 2). The diabetic patients with LEAD also had a high total number of coronary segments with at least 50% narrowing. There was, however, no difference when

Table 2—*Angiographic features of diabetic patients with CAD, ≥50 years of age, with or without concomitant LEAD*

Characteristic	Diabetic patients with LEAD	Diabetic patients without LEAD
n	263	1,349
Number of significantly narrowed coronary arteries (%)		
0	3.8	3.9
1	12.2	20.0
2	28.1	25.7
3	55.9	50.4
Number of coronary segments with ≥50% diameter narrowing (%)		
1	4.9	8.8
2–5	48.7	50.7
6–10	42.2	36.7
11+	4.2	3.8
Degree of left main coronary artery stenosis (%)		
<30%	80.2	83.7
30–49%	6.5	4.2
50–69%	6.5	5.2
70–100%	6.8	6.9
Ejection fraction (mean ± SD)	56.2 ± 17.8	56.2 ± 16.8
LV score (%)		
5	27.6	30.5
6–10	37.4	37.2
11–15	24.1	22.8
16+	10.9	9.5

Values are unadjusted for differences between groups.

compared with diabetic patients without LEAD. Likewise, there was no difference between the two groups with regard to the degree of left main coronary artery stenosis, ejection fraction, or LV score.

Factors independently associated with the presence of LEAD among the diabetic patients are listed in Table 3. Cerebrovascular disease, current smoking, elevated systolic blood pressure, high degrees of angina pectoris, and digitalis use were significantly associated with the presence of LEAD. The degree of epicardial coronary disease, the diffuseness of CAD lesions, and indexes of left ventricular dysfunction (ejection fraction and LV score) were not independently associated with the presence of LEAD.

Comparison of survival rates

On follow-up, diabetic patients with LEAD had higher mortality rates than diabetic patients without LEAD: by 37.4% at 5 years (32.7% mortality for those with LEAD vs. 23.8% for those without LEAD), by 29.9% at 10 years (59.1 vs. 45.5%), and by 3.8% at 15 years (77.1 vs. 74.3%) (P = 0.0012, Wilcoxon's test for equality of survival curves; Fig. 1). Median survival for diabetic patients with LEAD was 8.1 years, compared with 10.9 years for those without LEAD. Cardiac disease accounted for 72.8 and 75.3% of all deaths, respectively, of which 12.5 and 7.3%, respectively, were sudden deaths.

Factors independently predicting mortality are shown in Table 4. For all the diabetic patients, age, multivessel epicardial coronary disease, poor myocardial contractility (the presence of CHF or ventricular wall motion abnormalities), and raised systolic blood pressure or history of hypertension were significantly related to mortality. The type of treatment for CAD was also of significance, with those undergoing CABG surgery having a 33% reduction in mortality, compared with those treated medically. The presence of LEAD was an independent risk factor for mortality, increasing mortality risk by 21%. Sex and smoking were not predictive factors in this model. When each of the diabetic subgroups was analyzed separately, the same pattern of predictive factors was found to be significant for those with or without evidence of LEAD.

CONCLUSIONS — In this study of consecutively enrolled patients with suspected CAD, we found that of those patients ≥50 years of age with arteriographically documented CAD, 12.9% had diabetes, of whom 16.3% had evidence of LEAD by history or physical examination. Thus, 2.1% of this cohort had both diabetes and LEAD. As the proportion of elderly individuals in the population increases and the number of individuals with adult-onset diabetes grows, it is reasonable to assume that more such patients will come to medical attention and the need for knowledge regarding their disease and treatment will grow.

The diabetic patients with LEAD in this study were found to have high degrees of angina pectoris, smoking, and evidence of cerebrovascular disease, compared with diabetic patients without evidence of LEAD. They were also found to have a high prevalence of multivessel epicardial CAD and a high number of lesions throughout the coronary vasculature. On multivariate analysis, however, the severity and extent of CAD were not found to be independently associated with the presence of LEAD. It was further found that the survival of diabetic patients with LEAD was worse than that of the diabetic patients without LEAD (the majority dying of CAD), even though the risk factors predicting mortality were very similar. This suggests that factors associated with the presence of LEAD, other than the anatomy of the coronary circulation and those factors measured here, may have played a role in determining survival. What these factors were is uncertain. One possibility is impaired coronary vasoregulatory control due to autonomic neuropathy (25) or to the deposition of advanced glycosylation endproducts secondary to prolonged duration of diabetes (26). Adult-onset diabetic patients with LEAD are known to have a longer duration of diabetes than diabetic patients without LEAD (27). It is also known that diabetic cardiovascular autonomic neuropathy is associated with sudden death, most probably from arrhythmias (25). Unfortunately, no information is available in the CASS registry to substantiate this supposition. It would, however, help explain the high proportion of sudden deaths occurring among the diabetic patients with LEAD.

Table 3—*Factors independently associated (logistic regression analysis) with the presence of LEAD in a cohort of diabetic patients with CAD*

Variable	Odds ratio (95% CI)	*P* value
CVA/TIA (yes vs. no)	1.96 (1.55–2.48)	<0.001
Smoking status		<0.001
Nonsmoker	1.00 (reference)	
Former smoker	0.97 (0.80–1.17)	
Current smoker	1.92 (1.56–2.36)	
Systolic blood pressure (per 5 mmHg change)	1.05 (1.02–1.08)	0.003
Angina pectoris		0.004
No angina	1.00 (reference)	
Class I	0.39 (0.14–1.07)	
Class II	1.04 (0.72–1.50)	
Class III	1.44 (1.06–1.95)	
Class IV	1.72 (1.24–2.40)	
Unrelated to exertion	1.29 (0.83–2.03)	
Digitalis use (yes vs. no)	1.23 (1.16–1.43)	0.005

It should also be noted that even though there were differences in survival between the diabetic patients with or without LEAD in the first 10 years of follow-up, the overall long-term prognosis for both groups of subjects was poor. Only ~25% of the entire diabetic cohort was alive at 15 years, thereby emphasizing the poor prognosis associated with CAD in diabetic patients in the era of CASS. To our knowledge, this is one of the few studies in which such long-term outcomes for diabetic patients with CAD have been reported. They are similar to the results reported by Smith et al. (28) from the Duke University Surgery Registry, which tracked diabetic patients for 19 years.

Limitations

Several limitations of this study should be noted. First, the results regarding the efficacy of surgical therapy, compared with medical therapy for CAD, were not based on randomized data. They are therefore open to question and should be interpreted with caution. Ideally, comparisons of outcomes between surgical and medical management of CAD are best done through randomized trials. The cost of such trials, however, is high and patients belonging to narrowly defined subgroups such as ours may not always be available in large enough numbers.

Second, the diagnosis of LEAD was ascertained in part by patient self-report of leg pain provoked by ambulation, being told of having vascular disease in the past, or by examination at the time of entry into the study. Such methods are imprecise and, when compared with more accurate tests (such as echo-doppler or angiography), lead to a high degree of misclassification (especially in diabetic patients [4,29–31]) and to the exclusion of patients who are asymptomatic. As such, some of the patients in this study may actually not have had LEAD, whereas others with true illness were inadvertently excluded. While this is true, the clinical characteristics associated with the present cohort (such as current smoking, elevated systolic blood pressure, and increased prevalence of CVA/TIA) are similar to those described in other studies of patients with LEAD who were diagnosed by more accurate means (32,33).

Lastly, CASS patients were recruited in the mid-to-late 1970s, at a time that would not reflect the many changes in medical and surgical management of CAD of the current era. In particular, percutaneous transluminal coronary angioplasties (PTCAs) were not available and internal mammary artery (IMA) bypasses were rarely performed dur-

Table 4—*Multivariate analysis (Cox proportional hazards regression) of factors independently predicting mortality in diabetic patients, ≥50 years of age, with or without concomitant LEAD*

	All diabetic patients	Diabetic patients with LEAD	Diabetic patients without LEAD
Age (per year)	1.04 (1.02–1.05)	1.03 (1.002–1.06)	1.04 (1.03–1.05)
Number of coronary occlusions (per one segment change, range 1–27)	1.05 (1.02–1.08)	—	1.06 (1.02–1.09)
Number of significantly narrowed coronary arteries			
0	1.0	1.0	1.0
1	1.58 (0.92–2.71)	2.69 (0.60–12.11)	1.38 (0.77–2.45)
2	1.98 (1.16–3.39)	4.03 (0.95–17.04)	1.72 (0.97–3.06)
3	2.36 (1.36–4.09)	6.90 (1.64–28.97)	1.89 (1.05–3.41)
Degree of left main coronary stenosis (%)	1.003 (1.001–1.005)	—	1.004 (1.001–1.007)
CHF (yes vs. no)	1.76 (1.49–2.07)	1.87 (1.25–2.80)	1.69 (1.41–2.02)
LV wall motion score (per one unit change, range 5–30)	1.09 (1.07–1.10)	1.06 (1.02–1.10)	1.09 (1.07–1.11)
LEAD (yes vs. no)	1.21 (1.02–1.44)	—	—
Hypertension (yes vs. no)	1.19 (1.04–1.36)	—	1.29 (1.11–1.49)
Systolic blood pressure (per 5 mmHg change)	1.02 (1.01–1.04)	1.04 (1.01–1.07)	—
Therapy (surgical vs. medical)	0.67 (0.58–0.78)	0.77 (0.55–1.07)	0.65 (0.56–0.76)
Valvular heart disease (yes vs. no)	—	2.67 (1.05–6.81)	—

Data are hazard ratios (95% CI).

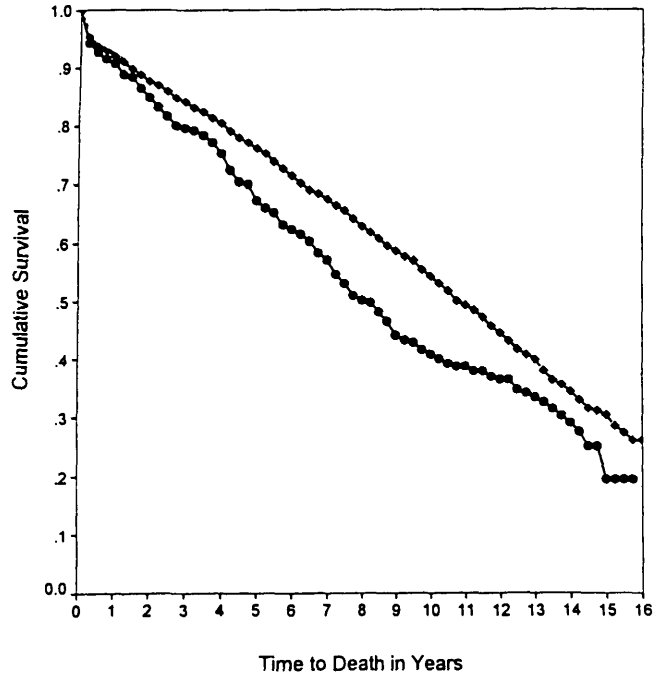

Figure 1—*Cumulative survival rates for diabetic patients with CAD, with (●) or without (◆) concomitant LEAD. All patients were ≥50 years of age and members of the CASS registry.*

ing the study period. Also, newer medications, such as ACE inhibitors, were not available during the early follow-up phase of this study. Given these changes, it is possible that the survival rates of the diabetic patients with or without LEAD may have changed considerably and, hence, that our results are no longer relevant to the current era. While these arguments are true, several arguments, we believe, still make our overall conclusions timely. First, despite the generally wide application of angioplasties in diabetic patients, restenosis rates remain high and their long-term efficacy has not been demonstrated (34). The recently reported Bypass Angioplasty Revascularization Investigation, for example, which compared PTCA with CABG surgery outcomes for CAD in patients from the late 1980s and early 1990s, showed decreased survival with PTCA in diabetic patients (35). Five-year survival rates for the diabetic patients treated by CABG in that study (80.6%) were only somewhat better than those of the diabetic patients without LEAD in our study (76.2%) who were treated either surgically or medically (though considerably better than the diabetic patients with LEAD [67.3%]). Second, despite the efficacy of IMA bypasses in improving survival after CABG surgery, their efficacy in improving long-term survival in diabetic patients has not been demonstrated. In the Duke University Surgery Registry (36), for example, which was carried out in the 1980s and in which 67% of the diabetic patients had IMA grafting, the 5-year survival rate for the diabetic patients was ~80%, similar to the 76.2% survival of diabetic patients without LEAD in this study of those treated surgically or medically. At 8 years of follow-up, overall survival among the Duke diabetic patients was ~65%, similar to the diabetic patients in CASS without LEAD (63.0%) (though better than the survival in the diabetic patients with LEAD [57.3%]). Whether IMA grafting will provide better long-term survival beyond this period of time, compared with our results, is unknown. Our results, therefore, seem to parallel the results of this more recent study and do not appear to be invalidated by the elapsed time from the inception of CASS. Lastly, our study offers the advantage of prolonged follow-up.

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