

Fatal Myocardial Infarction Following Lower Extremity Revascularization

Two Hundred Seventy-Three Patients Followed Six to Eleven Postoperative Years

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Routine preoperative coronary angiography has been recommended to all patients scheduled for elective lower extremity revascularization at the Cleveland Clinic since 1978. Patients found to have severe, correctable coronary artery disease (CAD) have been advised to undergo myocardial revascularization prior to surgical management of lower extremity ischemia in an attempt to reduce the incidence of fatal postoperative myocardial infarction. In order to provide an historic standard with which the results of this approach may eventually be compared, complete follow-up information has been obtained for 95% of 273 consecutive patients who underwent lower extremity revascularization between 1969 and 1973. Fatal myocardial infarction accounted for 52% of early postoperative deaths and occurred in 3.3% of the entire series. Among the patients who survived operation, the five-year mortality rate was 20% and the 11-year mortality rate was 40%. Complications of CAD caused 50% of the deaths that occurred within five years postoperatively and 55% of the deaths that have occurred within 11 years. The incidence of fatal myocardial infarction within five years after operation among patients who had preoperative evidence of CAD was statistically significant ($p < 0.01$).

CORONARY ARTERY DISEASE (CAD) is the most common cause of early postoperative death and late death following lower extremity revascularization procedures. According to several large published series,^{2,5-7,10,16,17,19,23} myocardial infarction is responsible for over 50% of all late deaths among patients who undergo aortoiliac or femoropopliteal reconstruction and occurs with even greater frequency among patients who have preoperative evidence of CAD. Previous reports from the Cleveland Clinic¹⁷ and by Szilagyi and associates²³ indicate that the five- and ten-year mortality rates exceed the incidence of graft occlusion following either aortofemoral or femoropopliteal bypass. DeWeese and Rob^{5,6} described similar

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results and advised earlier recognition and surgical treatment of CAD for patients who have advanced atherosclerosis requiring femoropopliteal bypass grafts for disabling claudication or severe lower extremity ischemia.

Several studies^{1,14,18} suggest that patients who have had previous direct myocardial revascularization sustain fewer cardiac complications after subsequent vascular and other major operations than would be anticipated even in the absence of known CAD. Since late postoperative cardiac complications appear to be particularly prevalent among patients who have lower extremity occlusive arterial disease, routine preoperative coronary angiography has been recommended to all patients scheduled for elective lower extremity revascularization at the Cleveland Clinic since 1978. As described in a previous report,⁹ severe, correctable coronary artery lesions were documented using this format in 54% of the patients with aortoiliac disease who had preoperative evidence of CAD and in 13% of those with no clinical indication of CAD. Elective myocardial revascularization was performed in 21% of the patients in this investigation, and 45 patients underwent aortoiliac reconstruction without operative mortality. During the same study period, 12% of patients scheduled for elective femoropopliteal or femorotibial bypass also required staged myocardial revascularization.

Because routine preoperative coronary angiography and, if indicated, myocardial revascularization continue to be recommended without prospective randomi-

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TABLE 1. *Indications for Operation*

Group	Patients	Indication for Operation					
		Claudication		Rest Pain or Tissue Necrosis		Popliteal Aneurysm	
		Number of Patients	Per Cent	Number of Patients	Per Cent	Number of Patients	Per Cent
Aortoiliac reconstruction	186	121	65	65	35	—	—
Femoropopliteal reconstruction	87	24	28	57	65	6	7
Total	273	145	53	122	45	6	2

zation to all patients under consideration for elective peripheral vascular operations at this institution, historic standards will be necessary to evaluate the effect of this approach on late survival. A previous publication⁸ described the influence of CAD upon survival of 343 patients who underwent abdominal aortic aneurysm resection at the Cleveland Clinic between 1969 and 1973. This report presents a series of 273 consecutive patients who required lower extremity revascularization during the same five-year period. Late follow-up information was obtained by telephone contact with each patient, a close surviving family member, or the referring physician and is complete for 95% of the patients.

Patient Information

The 273 patients in this series consisted of 200 men and 73 women with an age range of 29–79 years (mean: 57 years). Forty-seven patients (17%) were less than 50 years of age at the time of operation, 121 patients (44%) were 50–60 years of age, 89 patients (33%) were 60–70 years of age, and 16 patients (6%) were over 70 years of age. The mean follow-up interval was eight years.

The indications for operation are given in Table 1. One hundred eighty-six patients (68%) underwent some form of aortoiliac reconstruction consisting, in most instances, of either aortoiliac or aortofemoral Dacron bypass grafts. Eighty-seven other patients (32%) required femoropopliteal or distal revascularization with grafts of autogenous saphenous vein or prosthetic material. Disabling claudication was the indication for operation in 53% of the 273 patients comprising the entire series, while 45% of the patients had severe ischemia manifested by ischemic rest pain or tissue necrosis. The majority of femoropopliteal reconstructions were performed for limb salvage rather than for claudication alone, and six patients (2%) underwent femoropopliteal bypass because of the presence of popliteal artery aneurysms.

Atherosclerotic Risk Factors

One hundred fifteen patients (42%) were under medical treatment for hypertension or had blood pressure

measurements greater than 150/90 mmHg. Diabetes mellitus under medical treatment, an abnormal glucose tolerance test, or a fasting or two-hour postprandial blood glucose level greater than 120 mg/dl were present in 91 patients (33%). The serum cholesterol value (range: 106–455 mg/dl) was greater than 270 mg/dl in 45 patients (16%), and the serum triglyceride value (range: 55–650 mg/dl) was greater than 180 mg/dl in 90 patients (33%). An overwhelming majority of patients (320 patients, 85%) either smoked cigarettes or had discontinued their chronic use of cigarettes less than five years before their operations. Two or more risk factors were present in 145 patients (53%).

Preoperative Cardiac Status

No history of previous CAD symptoms or known cardiac disease could be elicited from 212 patients (78%). Information obtained from the remaining 61 patients, their families, or their referring physicians was consistent with previous myocardial infarction in 31 patients (11%), angina pectoris in nine patients (3%), congestive heart failure in three patients (1%), arrhythmia requiring medical management in one patient, and two or more of these factors in 17 patients (6%).

The preoperative electrocardiogram (EKG) was normal in 162 patients (59%). Previous myocardial infarction was documented by EKG evidence in 35 patients (13%), while 62 patients (23%) had ischemic myocardial changes within the ST-T segments. Three patients (1%) had arrhythmias on preoperative EKG tracings, and 11 patients (4%) had two or more abnormal EKG findings.

No statistically significant differences in the incidence of abnormal cardiac histories or EKG results could be identified between patients with aortoiliac disease and patients with femoropopliteal disease, or between patients who underwent operations because of claudication and patients who had ischemic rest pain or tissue necrosis. Considering those features which are most suggestive of CAD by history (previous myocardial infarction, angina pectoris) or by EKG findings (previous myocardial infarction, ischemic myocardial

TABLE 2. Fatal Postoperative Complications

Principal Cause of Death	Aortoiliac Reconstruction (186 Patients)		Femoropopliteal Recon- struction (87 Patients)		Total (273 Patients)	
	Number of Patients	Per Cent	Number of Patients	Per Cent	Number of Patients	Per Cent
Myocardial infarction	7	64	2	33	9	52
Pulmonary failure	1	9	1	17	2	12
Pulmonary embolism	1	9	0	—	1	6
Renal failure	1	9	0	—	1	6
Hemorrhage	1	9	0	—	1	6
Graft infection	0	—	1	17	1	6
Other	0	—	2	33	2	12
Total	11	100	6	100	17	100
Per cent of group		5.9		6.9		6.2

changes), 144 patients (53%) had no preoperative evidence of CAD, 18 patients (6%) had CAD by history alone, 68 patients (25%) had CAD on the basis of EKG findings alone, and 43 patients (16%) had CAD according to both history and EKG information.

Results

Postoperative Mortality

The principal causes of early postoperative death are given in Table 2. Seventeen patients (6.2%) died within 30 days of operation. The operative mortality rates were 5.9% following aortoiliac reconstruction and 6.9% following femoropopliteal bypass. Fatal myocardial infarctions occurred in 3.3% of the 273 patients in this study and accounted for 52% of all postoperative deaths, a figure representing four times the number of deaths caused by pulmonary failure, the next most common source of early mortality.

No postoperative deaths occurred among 45 patients who were less than 50 years of age, and only two deaths (1.2%) occurred among 166 patients who were less than 60 years of age. Fifteen (14%) of the 105 patients in this series who were older than 60 years of age died during the early postoperative period, and myo-

cardial infarctions were responsible for seven (47%) of the deaths in this age group.

Late Mortality Rate

Thirteen patients (4.8%) were lost to follow-up during the maximum observation interval of 11 postoperative years. The principal sources of late mortality among 256 patients who died in this series are given in Table 3. A total of 101 patients (39%) have died, and myocardial infarction was the principal cause of death in 56 patients (55%). Myocardial infarction was responsible for five times the number of late deaths produced by either of the next leading sources of late mortality, malignant neoplasm or stroke.

Complete life table data for the 256 patients who survived operation are given in Table 4. Fifty patients (20%) died within five years of operation. Myocardial infarction was the principal cause of death in 25 patients, accounting for 50% of the deaths and affecting 10% of the patients who survived lower extremity revascularization. Of the 206 patients who lived at least five years after operation, 51 patients (25%) have subsequently died within 5 to 11 years. Myocardial infarction was responsible for 31 (60%) of these deaths, affecting 15% of the five-year survivors. A total of 56 (22%) of the 256 operative survivors have had myocardial infarctions during the full follow-up interval of 11 years.

Graphic representation of life table data, including patients who died during the early postoperative period, is presented in Figure 1. The slope of the survival curve at the eleventh year following femoropopliteal bypass reflects four deaths in a group of 16 patients who were still eligible for consideration. Although the late survival following aortoiliac reconstruction appears to exceed that following femoropopliteal bypass, statistical analysis of survival curves³ did not confirm significant differences between these groups of patients. For example, life table survival at the sixth postoperative year for patients who underwent aorto-

TABLE 3. Causes of Late Mortality Among 256 Postoperative Survivors from One to Eleven Years after Operation

Principal Cause of Death	Number	Per Cent of Deaths	Per Cent of Operative Surgery
Myocardial infarction	56	55	21
Malignant neoplasm	11	11	4
Stroke	7	7	3
Chronic renal disease	4	4	2
Pulmonary embolism	3	3	1
Intestinal ischemia	1	1	0.5
Graft infection	1	1	0.5
Other	18	18	7
Total	101	100	39

TABLE 4. Complete Life Table Data for 256 Operative Survivors

Post-operative Year	Number of Patients Alive at Beginning of Year	Number of Patients Lost to Follow-up During Year	Number of Patients Observed for Only Part of Year	Number of Patients Exposed to Risk Dying During Year	Number of Patients Dying During Year	Proportion of Patients Dying During Year	Proportion of Patients Surviving Year	Proportion of Patients Alive to End of Year
1	256	1	0	255.5	6	.023	.977	.977
2	249	6	0	246	4	.016	.984	.961
3	239	1	0	238.5	9	.038	.962	.925
4	229	1	0	228.5	16	.070	.930	.860
5	212	1	0	211.5	15	.071	.929	.799
6	196	1	0	195.5	14	.072	.928	.742
7	181	1	33	164	9	.055	.945	.701
8	138	0	24	126	12	.095	.905	.634
9	102	1	33	85	11	.129	.871	.552
10	57	0	28	43	1	.023	.877	.484
11	28	0	24	16	4	.250	.750	.363

iliac reconstruction (0.718–0.854) was within two standard deviations of that for patients who had femoropopliteal reconstruction (0.544–0.752). Accordingly, subsequent life table data in this report incorporates all 256 patients who survived operation.

One hundred seventeen of the 256 operative survivors had some indication of CAD on the basis of the previous cardiac history or preoperative EKG findings, while 139 patients had no clinical evidence of CAD. Graphic representation of life table data for these groups is presented in Figure 2. The 5- and 11-year survival rates were 89 and 52%, respectively, for patients without evidence of CAD, and 69 and 26%, respectively, for patients suspected to have CAD. Differences in survival beyond five postoperative years between patients suspected to have CAD on the basis of preoperative history and EKG findings and those without clinical indications of CAD were statistically significant ($p < 0.05$).

Figure 3 presents graphic representation of life table data for 256 operative survivors in this series ac-

ording to whether preoperative evidence of CAD was present, together with similar information for a normal 1970 male population of the same age (57 years)²⁴ and for a group of 601 patients with known CAD documented by coronary angiography at the Cleveland Clinic which has previously been reported by Proudfit and associates.²⁰ Survival of patients who had no clinical indication of CAD at the time of operation was nearly identical to that of a normal male population throughout the first five postoperative years, and differences in late survival between these two groups never attained statistical significance during the maximum follow-up period. Late survival beyond the fifth postoperative year for patients in this series who were suspected to have CAD, however, was significantly worse than that expected for a normal population ($p < 0.05$). Moreover, there was no statistical difference in life table survival beyond the fourth postoperative year between patients suspected to have CAD in this series and those with proven CAD described by Proudfit.

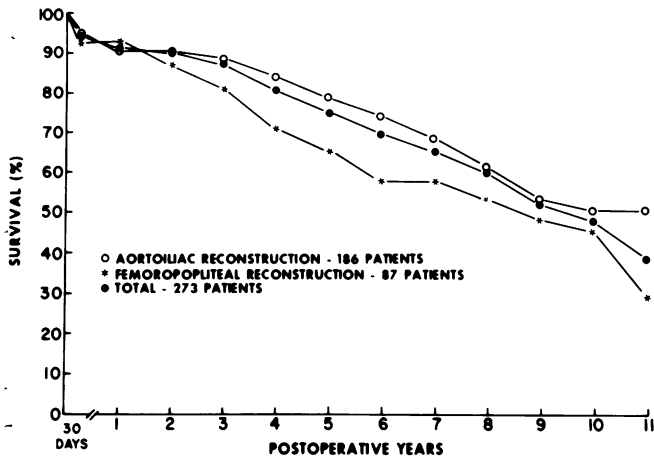


FIG. 1. Life table survival curves for 273 patients according to site of lower extremity revascularization.

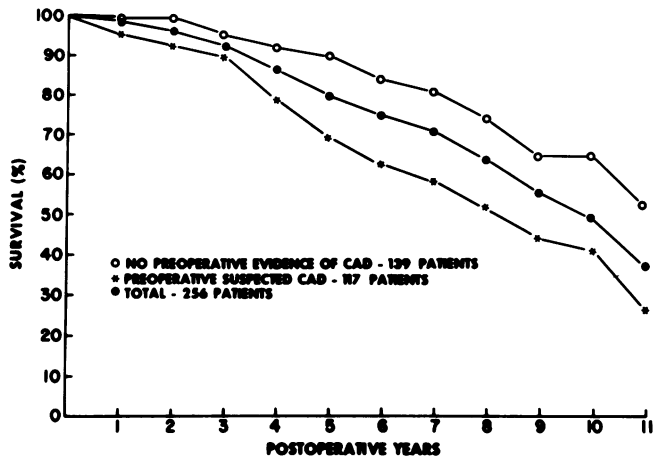


FIG. 2. Life table survival curves for 256 operative survivors according to preoperative cardiac status.

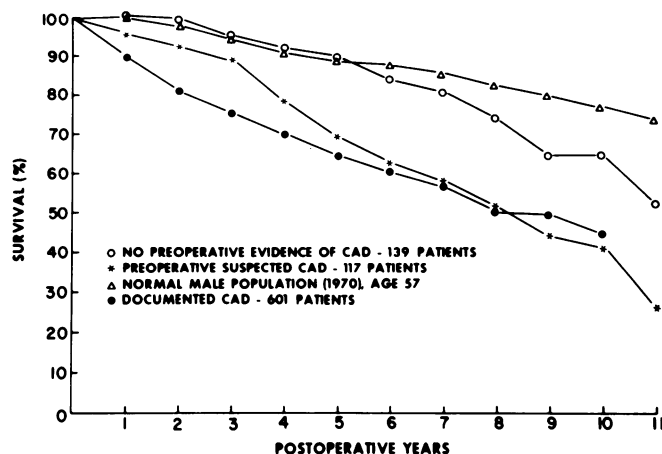


FIG. 3. Life table survival curves for 256 operative survivors according to preoperative cardiac status, in comparison with those of a normal male population²⁵ and a group of 601 patients with CAD documented by coronary angiography.²⁰

The influence of age at the time of operation on mortality rates and the incidence of fatal myocardial infarction is shown in Figure 4. As might be expected, advancing age was associated with higher late mortality rates from all causes, including CAD, but younger patients faced a substantial risk for fatal myocardial infarction as well. Of 45 patients under 50 years of age at the time of operation, myocardial infarction caused seven deaths (15%) within five years and nine deaths (20%) within 11 deaths. Fatal myocardial infarction was responsible for 57% of all deaths among the 166 patients who were less than 60 years of age.

Disabling claudication was the indication for lower extremity revascularization for 145 patients in this series. The postoperative mortality rate for this group was 3.4%, and the overall late mortality rate was 34%. Severe ischemia manifested by ischemic rest pain or tissue necrosis was the indication for operation in 128 patients. The postoperative mortality rate in this group was 9.4%, and the overall late mortality rate was 47%. The difference in late mortality rates was found to be significant ($p < 0.05$), but the incidence of fatal myocardial infarction for patients with claudication (17%) was comparable to that for patients with severe lower extremity ischemia (25%).

The preoperative cardiac status is correlated with the incidence of fatal myocardial infarction during the early postoperative and late follow-up periods in Table 5. Chi square analysis confirmed significant differences ($p < 0.01$) in the incidence of fatal myocardial infarction during the immediate postoperative period between patients with no preoperative evidence of CAD and those who had both a positive cardiac history as well as abnormal EKG findings. Statistical testing also determined ($p < 0.01$) that death from myocardial infarction within five years of operation was more likely to occur

among patients suspected to have CAD on the basis of either previous history or EKG findings. Differences in the incidence of fatal myocardial infarction were not statistically significant throughout the entire follow-up period only because of an increase in the number of deaths caused by CAD from 5 to 11 years postoperatively in the group without preoperative evidence of CAD. Overall, myocardial infarction accounted for 25 (60%) of 42 late deaths in this group and for 31 (52%) of 59 late deaths among patients suspected to have CAD.

Although atherosclerotic risk factors were not associated with significant differences in early postoperative mortality, diabetes mellitus had a statistically significant correlation with late mortality caused by myocardial infarction. Eighty-four diabetics and 172 nondiabetics survived lower extremity revascularization. Of these, 30 diabetics (37%) and 34 nondiabetics (20%) died within five years of operation ($p < 0.01$); myocardial infarction was the principal cause of death in 19 patients (23%) and 13 patients (8%), respectively ($p < 0.01$). The total 11-year mortality rate was 55% for diabetics and 33% for nondiabetics ($p < 0.01$), and the incidence of fatal myocardial infarction of 37% among diabetics was significantly greater ($p < 0.001$) than that among nondiabetics (15%).

Discussion

The results of this study suggest that late survival among patients who have any indication of CAD on the basis of previous cardiac symptoms or abnormal EKG findings at the time of lower extremity revascularization is much more closely comparable to survival demonstrated by patients with significant CAD documented by coronary angiography than to that of the normal population of the same age. Patients with preoperative evidence of CAD sustained a statistically signifi-

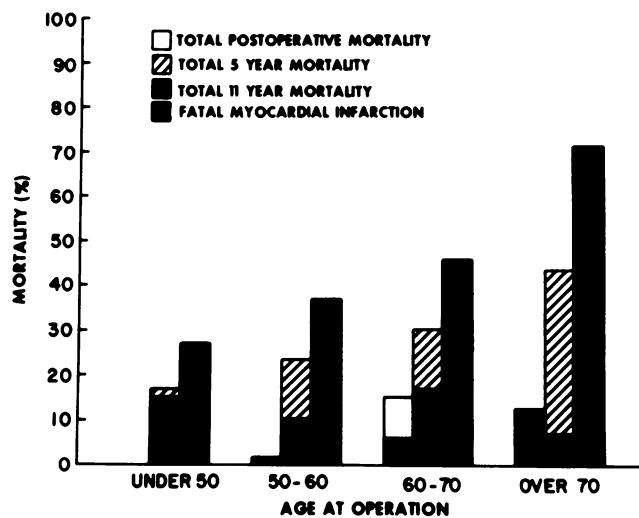


FIG. 4. Comparison of postoperative and late mortality for 273 patients according to age at the time of operation.

TABLE 5. Total Incidence of Fatal Myocardial Infarction According to Preoperative Cardiac Status (Late Incidence Calculated on the Basis of Operative Survivors)

Preoperative Cardiac Status	Patients	Fatal Myocardial Infarction			
		Postoperative		Late (1-11 Years)	
		Number of Patients	Per Cent	Number of Patients	Per Cent
Negative cardiac history and normal EKG	144	1	0.7	25	17.5
Previous myocardial infarction or angina by history alone	18	1	5.6	8	47.1
Previous myocardial infarction or myocardial changes by EKG alone	68	2	2.9	11	17.5
Positive cardiac history and abnormal EKG	43	5	11.6	12	31.6

cant number of fatal myocardial infarctions within five years of operation. Late deaths from complications of CAD appeared to be especially prevalent among diabetics and among patients less than 60 years of age. Myocardial infarction was the most common source of mortality in this series by severalfold, accounting for four times the number of early postoperative deaths caused by pulmonary failure and for five times the number of late deaths caused by malignant neoplasms. Even patients who had no preoperative evidence of CAD have eventually experienced a substantial number of cardiac complications. Although the operative mortality rate was low for patients without known CAD and five-year survival was similar to that of a normal population, 18% of these patients thus far have died between the sixth and the eleventh postoperative years. Sixty per cent of these deaths were caused by myocardial infarction.

Late survival in this series is comparable to that described for other series of patients who underwent lower extremity revascularization over a decade ago. Five-year and ten-year survival in this report was 79 and 54% following aortoiliac reconstruction, and 72 and 53% following femoropopliteal or distal bypass. Previous series presented by DeBakey and associates,⁴ Malone and associates,¹⁶ and Starrett and Stoney²² reported five-year survival following aortoiliac reconstruction of 58 to 80% and ten-year survival of 37 to 51%. Maini and Mannick,¹⁵ Reichle and associates,²¹ and Szilagyi and associates²³ described five-year survival following femoropopliteal bypass of 44 to 70% and ten-year survival of 23 to 54%. Others^{2,5,6,12} have concluded that certain preoperative atherosclerotic risk factors impose predictable limitations upon late survival. DeWeese and Rob^{5,6} found that myocardial infarction caused 60% of all late deaths following femoropopliteal bypass procedures and clearly demonstrated that patients who had preoperative evidence of CAD, diabetes mellitus, or multisegmental atherosclerotic lesions in the lower extremities had twice the late mortality rate of patients who did not have

these risk factors. The five- and ten-year mortality rates for patients in their series who did not have evidence of CAD were 35 and 62% whereas the five- and ten-year mortality rates for patients suspected to have CAD were 71 and 91%.

Previous publications from the Cleveland Clinic have demonstrated significant reduction in late survival following abdominal aortic aneurysm resection for patients who have preoperative evidence of CAD or diabetes mellitus,⁸ and following aortobifemoral arterial bypass for patients with multisegmental atherosclerosis of the lower extremities.¹⁷ Despite a difference in mean age of nine years, the incidence of late death from myocardial infarction among 343 patients who underwent aortic aneurysm resection at this institution between 1969 and 1973 is remarkably similar to that described in the present report of 273 patients who required lower extremity revascularization during the same study period. During a maximum follow-up interval of 11 years, fatal myocardial infarctions have occurred in 24% of operative survivors following aortic aneurysm resection and in 21% of those following lower extremity revascularization. Considering only patients who had no preoperative evidence of CAD, 16% of operative survivors from the aneurysm group have died with myocardial infarctions compared with 18% of patients with occlusive arterial disease. Among patients who were suspected to have CAD on the basis of preoperative history of EKG findings, 28% of patients in the aneurysm group have had fatal myocardial infarctions compared to 26% of those described in this report. Of a total of 616 patients who underwent aortic reconstruction or femoropopliteal bypass at the Cleveland Clinic between 1969 and 1973, myocardial infarction has been responsible for 41% of early postoperative deaths, affecting 4.9% of all patients, and for 47% of all late deaths, affecting 22% of all operative survivors.

As late follow-up information concerning patients with documented CAD who undergo direct myocardial revascularization with the use of coronary artery by-

pass grafts has been accumulated, several reports have implied that such patients sustain fewer cardiac complications after subsequent vascular and other major operations than otherwise would be expected.^{1,14,18} Crawford and associates¹ presented a series of 358 patients who underwent 484 subsequent operations at various intervals following direct myocardial revascularization, including 308 vascular procedures in 232 patients. Only four operative deaths (0.8%) occurred following the subsequent procedures, and only 12 patients (3%) died from cardiac causes within a five-year follow-up period. Convincing reports^{11,13} from medical centers with extensive experience with coronary artery bypass indicate that five-year survival rates of 90% or greater may be expected following direct myocardial revascularization, even in patients who previously had CAD involving multiple coronary arteries. In a representative group of 3000 patients who underwent direct myocardial revascularization at the Cleveland Clinic between 1971 and 1973, Loop and associates¹³ reported a 1% risk for postoperative myocardial infarction or death and a five-year survival of 92.2%.

While the operative risk of aortoiliac reconstruction may be reduced in selected patients by compromise procedures such as axillofemoral or femorofemoral bypass, such precautions alone will not influence the late incidence of fatal cardiac complications among patients with occlusive arterial disease. Accordingly, routine preoperative coronary angiography has been recommended to all patients under consideration for elective lower extremity revascularization at the Cleveland Clinic since 1978. Data concerning the incidence of significant CAD which may be detected using such an approach and the safety with which elective aortoiliac reconstruction may be performed following coronary artery bypass procedures in patients found to have severe CAD have previously been presented.⁹ Although late follow-up information is not yet available for patients whose management presently is determined with the use of routine preoperative coronary angiography, this report describes an historic standard with which these patients will eventually be compared in an effort to define those for whom preoperative coronary angiography is advisable for safe surgical management of lower extremity ischemia and improved late survival rates. The results of this report suggest that coronary angiography should be a serious consideration for all patients with preoperative coronary artery symptoms, abnormal EKG findings, or diabetes mellitus.

Acknowledgment

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the statistical analysis. Miss Linda Maljovec assisted in preparation of the manuscript.

References

1. Crawford ES, Morris GC, Howell JF, et al. Operative risk in patients with previous coronary artery bypass. *Ann Thorac Surg* 1978; 26:215.
2. Cutler BS, Thompson JE, Kleinsasser JL, Hempel GK. Autologous saphenous vein femoropopliteal bypass: Analysis of 298 cases. *Surgery* 1976; 79:325.
3. Cutler SJ, Ederer F. Maximum utilization of the life table method in analyzing survival. *J Chron Dis* 1958; 8:699.
4. DeBakey ME, Crawford ES, Morris GC, et al. Late results of vascular surgery in the treatment of arteriosclerosis. *J Cardiovasc Surg (Torino)* 1964; 5:473.
5. DeWeese JA, Rob CG. Autogenous venous bypass grafts five years later. *Ann Surg* 1971; 174:346.
6. DeWeese JA, Rob CG. Autogenous venous grafts ten years later. *Surgery* 1977; 82:775.
7. Duncan WC, Linton RR, et al. Aortoiliofemoral atherosclerotic occlusive disease: Comparative results of endarterectomy and Dacron bypass grafts. *Surgery* 1971; 70:974.
8. Hertzner NR. Fatal myocardial infarction following abdominal aortic aneurysm resection. Three hundred forty-three patients followed 6–11 years postoperatively. *Ann Surg* 1980; 192, 667.
9. Hertzner NR, Young JR, Kramer JR, et al. Routine coronary angiography prior to elective aortic reconstruction. Results of selective myocardial revascularization in patients with peripheral vascular disease. *Arch Surg* 1979; 114:1336.
10. Inahara T. Evaluation of endarterectomy for aortoiliac and aortoiliofemoral occlusive disease. *Arch Surg* 1975; 110:1458.
11. Kaiser GC, Barner HB, Tyras DH, et al. Myocardial revascularization: A rebuttal of the cooperative study. *Ann Surg* 1978; 188:331.
12. Kannel WB, McGee DL. Diabetes and cardiovascular disease: The Framingham study. *JAMA* 1979; 241:2035.
13. Loop FD, Cosgrove DM, Lytle BW, et al. An 11 year evolution of coronary arterial surgery (1967–1978). *Ann Surg* 1979; 190:444.
14. Mahar LJ, Steen PA, Tinker JH, et al. Perioperative myocardial infarction in patients with coronary artery disease with and without aorta-coronary artery bypass grafts. *J Thorac Cardiovasc Surg* 1978; 76:533.
15. Maini BS, Mannick JA. Effect of arterial reconstruction on limb salvage: A 10-year appraisal. *Arch Surg* 1978; 113:1297.
16. Malone JM, Moore WS, Goldstone J. Life expectancy following aortofemoral arterial grafting. *Surgery* 1977; 81:551.
17. Martinez BD, Hertzner NR, Beven EG. The influence of distal arterial occlusive disease on prognosis following aortobifemoral bypass. *Surgery* 1980; 88:795.
18. McCollum CH, Garcia-Rinaldi R, Graham JM, DeBakey ME. Myocardial revascularization prior to subsequent major surgery in patients with coronary artery disease. *Surgery* 1977; 81:302.
19. Perdue GD, Long WD, Smith RB, III. Perspective concerning aortofemoral arterial reconstruction. *Ann Surg* 1971; 173:940.
20. Proudfit WL, Bruschke AVG, Sones FM. Natural history of obstructive coronary artery disease: 10-year study of 601 non-surgical cases. *Prog Cardiovasc Dis* 1978; 21:53.
21. Reichle FA, Rankin KP, Tyson RR, et al. Long-term results of 474 arterial reconstruction for severely ischemic limbs: A 14-year followup. *Surgery* 1979; 85:93.
22. Starrett RW, Stoney RJ. Juxtarenal aortic occlusion. *Surgery* 1974; 76:890.
23. Szilagy DE, Hageman JH, Smith RF, et al. Autogenous vein grafting in femoropopliteal atherosclerosis: The limits of its effectiveness. *Surgery* 1979; 86:836.
24. Vital Statistics of The United States. Vol. 2, Section 5: Mortality. Part A, Life Tables, Tables 5–6, National Center for Health Statistics. Publ. No. HRA 75-1114.