

Current results of open revascularization for chronic mesenteric ischemia: A standard for comparison

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Objective: Questions remain concerning the optimal site of graft origin and the extent of revascularization necessary to achieve excellent results for chronic mesenteric ischemia (CMI). Endovascular therapy also is performed for CMI. These factors prompted us to review our results to provide a current standard.

Methods: Ninety-eight patients who underwent operation for CMI from 1989 to 1998 were reviewed. Patients with acute ischemia and arcuate ligament syndrome were excluded.

Results: Seventy-six women (78%) and 22 men (22%), with an average age of 66 years (range, 36 to 87 years), participated in the study. Abdominal pain was present in 95 patients (97%), and weight loss in 92 patients (94%). The superior mesenteric artery was severely diseased (70% to 99% stenosis or occlusion) in 90 patients (92%), the celiac artery in 81 patients (83%), and both arteries in 76 patients (78%). Bypass grafts were performed in 91 patients (93%), 77 antegrade and 14 retrograde. Of the other seven patients, five had endarterectomies, one reimplantation, and one patch angioplasty. Multivessel reconstruction was performed in 79 patients (81%), and single-vessel reconstruction in 19 (19%). Twelve patients had concomitant aortic reconstruction. Three early graft thromboses were seen. Five hospital deaths occurred (5.1%); one case had concomitant aortic reconstruction (1/12 versus 4/86; $P =$ not significant). All five patients who died were older than 70 years (5/41 versus 0/57; $P = .011$). The median follow-up period was 1.9 years (range, 0 to 9.6 years). Follow-up was complete in all survivors. The 1-year, 5-year, and 8-year survival rates were 83%, 63%, and 55%, respectively. These rates were worse than the rates of the age-matched/gender-matched control subjects ($P < .001$). Survival was worse in patients greater than 70 years of age ($P = .0013$). Survival was unaffected by the number of vessels revascularized. The patients with retrograde grafts had decreased median survival rates (4.0 versus 5.7 years; $P = .026$), but they were older (75 versus 65 years; $P = .0013$). The 1-year and 5-year symptom-free survival rates were 95% and 92%, respectively. Symptoms recurred in six patients (6%); four had recurrent stenosis/occlusion and two had patent grafts. Symptom-free survival was unaffected by the number of vessels revascularized or by graft orientation.

Conclusion: Operation for CMI was successful for most patients, with low operative mortality and excellent long-term relief of symptoms. Selective concomitant aortic procedures did not increase mortality rates. The rate of symptomatic recurrences was not different for single-vessel versus multiple-vessel reconstructions or for antegrade versus retrograde grafts. Patients older than 70 years had increased operative mortality and decreased survival rates. Endovascular therapy may be appropriate for this subset of patients. (J Vasc Surg 2002;35:853-9.)

Chronic mesenteric ischemia (CMI) is a morbid disease that results from progressive stenotic disease of the mesenteric vessels. Atherosclerosis is the most common cause, with fibromuscular dysplasia, polyarteritis nodosa, and Takayasu's arteritis representing rare causes. CMI presents with postprandial abdominal pain, inanition, fear of food, and weight loss, as do many other abdominal and systemic illnesses. For that reason, diagnosis is often delayed. Untreated, the patients face severe malnutrition and death

from complications of acute mesenteric ischemia (AMI) on CMI. A 10-year review at the Mayo Clinic of patients with AMI showed that 43% of these patients had prior symptoms of untreated CMI.¹ A recent study from the Henry Ford Hospital reported that 52% of patients with AMI had symptoms of CMI.²

The mesenteric circulation is richly collateralized and arises from the celiac artery (CA), the superior mesenteric artery (SMA), and the inferior mesenteric artery (IMA). CMI is thought to be primarily a disease of the CA and SMA. Some authors have believed the celiac circulation is the more important vessel to reconstruct, and others the SMA.³ Nonetheless, concomitant stenotic disease of the CA and SMA has been shown to be prevalent in these patients,⁴ as is the case in this report. CMI is less frequently seen in patients with single-vessel disease.

Surgical treatment involves revascularization of the stenotic or occluded mesenteric vessels. Inflow may be from the supraceliac aorta (antegrade reconstruction) or from

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Competition of interest: nil.

Presented at the Twenty-fifth Annual Meeting of the Midwestern Vascular Surgical Society, Chicago, Ill, Sep 21-22, 2001.

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0741-5214/2002/\$35.00 + 0 24/6/123753

doi:10.1067/mva.2002.123753

the infrarenal aorta or the common iliac artery (retrograde reconstruction). Outflow may be to the celiac or more commonly to the SMA only (single-vessel repair) or to a combination of CA, SMA, and rarely IMA (multivessel repair). Controversy surrounds the issues of antegrade versus retrograde reconstruction and single-vessel versus multivessel repair. Short-term and mid-term (<5 years of follow-up) data show good results for open surgical revascularization in CMI, but long-term data (≥ 5 years of follow-up) are lacking.

Endovascular therapy also has been used to treat CMI. Although no prospective randomized control data are available, studies indicate that in the short term, percutaneous angioplasty with or without stenting is effective,^{5,6} although mid-term and long-term data are not available. The advantage of endovascular therapy is its minimally invasive nature. Its disadvantages are the need for reintervention and inferior durability.⁶ Data are lacking with regard to the most appropriate patient selective criteria for endovascular treatment of CMI.

To address these controversies, we reviewed our experience to determine whether antegrade or retrograde graft orientation and single-vessel or multivessel revascularization were associated with improved results. Factors associated with increased mortality and morbidity rates were determined to find patient subsets that might have benefitted from a less morbid procedure. Long-term follow-up data were analyzed to establish a surgical standard for comparison.

PATIENTS AND METHODS

The clinic records of all patients who underwent surgical treatment for atherosclerotic CMI between January 1, 1989, and December 31, 1998, were retrospectively reviewed. Demographic information, comorbid medical conditions, history and physical findings, diagnostic test findings, operative records, postoperative complications, and mortality were recorded. Follow-up data were abstracted from clinic records, letter survey, and telephone interview. Factors associated with survival were analyzed. Cause of death was determined from clinic records, autopsy findings, and death certificates. This study was approved by the Institutional Review Board of the Mayo Foundation.

For statistical analysis, association between postoperative mortality and risk factors was assessed univariately with two-sample *t* test, Wilcoxon rank sum test, and χ^2 test or Fisher exact test. Survival rate was estimated with the Kaplan-Meier method. Comparisons of survival curves were made with log-rank tests. A multivariate Cox proportional hazards model was constructed with factors found to be significantly associated with survival on univariate analysis. All tests were two-tailed. Tests were considered significant at a *P* value of less than .05.

RESULTS

Demographics, diagnosis, and operation. From January 1, 1989, to December 31, 1998, 98 patients, 76

Table I. Reconstruction

Type of surgery	No. of patients
Polyester graft	84 (85.7%)
Enderectomy	11 (11.2%)
Vein graft	6 (6.1%)
Reimplantation	6 (6.1%)
Patch angioplasty	3 (3.1%)
Polytetrafluoroethylene graft	1 (1.0%)
Single-vessel revascularization	19 (19.4%)
Two-vessel revascularization	77 (78.6%)
Three-vessel revascularization	2 (2.0%)
Antegrade configuration	77 (78.6%)
Retrograde configuration	14 (14.3%)

women and 22 men, with a mean age of 67 years (range, 37 to 87 years), underwent operation for CMI. The most prevalent risk factors were tobacco use in 81 patients (82%) and hypertension in 61 (63%). Coronary artery disease was present in 32 patients (33%), and 67 (68%) had symptomatic disease in another major vascular bed (coronary, cerebral, renal, peripheral). Abdominal pain was present in 95 patients (97%). Weight loss occurred in 92 patients (94%) and was greater than 10 pounds in 72 patients (73%). All patients were symptomatic of weight loss or abdominal pain. Average duration of symptoms was 15 months (range, 1 to 60 months). On examination, most patients were thin and 56 patients (57%) had epigastric bruits.

All patients underwent arteriography. SMA occlusion or critical stenosis (70% to 99%) was present in 90 patients (92%), CA occlusion or stenosis in 81 patients (83%), and critical disease of both CA and SMA in 76 patients (78%). Duplex ultrasound scan examination was performed in 38 patients and was consistent with arteriographic findings in 31 patients (82%).

Ninety-one patients (93%) underwent bypass grafting. Revascularizations were performed with polyester grafts in 86% (Table I). Six patients had vein bypass, and one had polytetrafluoroethylene grafting. In addition, endarterectomy was performed in five patients, reimplantation in one, and patch angioplasty in one. Bypass grafting was combined with endarterectomy in six patients, reimplantation in five, and patch angioplasty in one.

The SMA only was revascularized in 19 patients, 77 patients underwent two-vessel reconstruction (CA and SMA), and an additional two underwent three-vessel reconstruction (CA and SMA and IMA). Graft inflow was from the supraceliac aorta (antegrade) in 77 patients, from the infrarenal aorta in 11 patients, and from the right common iliac artery in three patients (retrograde). The right common iliac artery was chosen in these three patients because of dense supraceliac and infrarenal aortic calcification and a soft suitable donor site in the common iliac artery.

Twelve concomitant procedures were performed (Table II). Four AAA repairs and seven aortoiliac occlusive disease (AIOD) revascularizations were performed. Renal artery reconstruction was performed in one patient who

Table II. Concomitant procedures

	No. of patients
AAA repair	4 (28.6%)
Aortobiliac bypass	4 (28.6%)
Aortobifemoral bypass	3 (21.4%)
Renal revascularization	3 (21.4%)

AAA, Abdominal aortic aneurysm.

underwent AAA repair and in one of the patients who underwent aortoiliac occlusive disease reconstruction. In addition, one patient had concomitant renal artery reconstruction without aortic reconstruction.

Follow-up was available for a median of 1.9 years (range, 0 to 9.6 years). All living patients had clinic visit records or telephone questionnaires.

Perioperative mortality and morbidity. Three patients died within 30 days of operation. Two more died in the hospital at 44 and 48 days. Thus, the 30-day mortality rate was 3.1% and the in-hospital mortality rate was 5.1%. All hospital deaths occurred in patients older than 70 years ($P = .011$). Details are summarized in Table III. Cardiac ischemia was responsible for 60% of the in-hospital deaths. Concomitant procedures were not associated with an increased in-hospital mortality rate ($P =$ not significant). Twenty-one postoperative complications were seen. Ventilator dependence/tracheostomy and myocardial infarction were the most frequent complications (Table IV).

Survival. Thirty-one late deaths occurred (Table V). Information regarding cause of death was available for 24 patients. Most deaths were the result of cardiac causes (11 patients; 35%). Two patients died of bowel infarction. Survival rate at 1 year was 83%, at 5 years was 62%, and at 8 years was 55% (Fig 1). These rates were significantly worse than those of a matched Minnesota white control population ($P < .001$). Survival rate was worse for patients greater than 70 years of age ($P = .02$). Survival was unaffected by number of vessels bypassed or by graft orientation. The patients with retrograde grafts had decreased median survival (4.0 versus 5.7 years; $P = .026$), but they were older in comparison with those who received antegrade grafts (75 versus 65 years; $P = .0013$). When patients older than 70 years who underwent retrograde versus antegrade grafts were compared, no significant difference in survival was seen. Comorbid risk factors of current or past tobacco use, hypertension, and coronary artery disease did not have an impact on survival in univariate analysis.

Retrograde mesenteric reconstructions were performed in 11 patients who underwent concomitant aortic reconstruction and originated from the new infrarenal graft. Retrograde grafting from the common iliac artery was performed for three patients because of dense calcification of the supraceliac and infrarenal abdominal aorta. These patients had soft iliac vessels. Patients with retrograde grafts had a higher prevalence rate of hypertension compared with those with antegrade grafts (93% versus

57%; $P = .011$) and a lower prevalence of current or past tobacco use (57% versus 92%; $P = .002$).

Recurrence, pain relief, and weight gain. Symptom-recurrence free survival rate was 98% at 90 days, 95% at 1 year, and 92% at 5 years. Symptoms recurred in six patients and consisted of abdominal pain in all and weight loss in two. These symptoms were associated with restenosis in two patients who underwent percutaneous angioplasty of SMA stenoses with relief of symptoms. Occlusion of the SMA graft occurred in two patients. Of these, one patient, after a failed attempt at angioplasty, underwent two-vessel reconstruction with symptom relief. The second underwent patch angioplasty of the occluded SMA graft. Two patients with recurrent symptoms had patent grafts and were treated symptomatically. One of these patients was later found to have Crohn's disease and the other had continued pain despite normal findings on endoscopic and radiologic workup of the gastrointestinal tract. Both were alive at last follow-up.

During the follow-up period, 74 patients noted some or complete relief of abdominal pain out of 80 patients (93%) in whom this was charted or documented with survey, and 61 patients noted weight gain out of 71 patients (86%) with documented reference to weight change. In 12 patients, symptom relief was not positively documented in the chart or with survey and therefore was not included in the analysis.

Patency. Patency data were not uniformly available. In the 54 patients who underwent follow-up imaging study, restenosis of the CA or SMA graft occurred in 11 patients. Three patients had restenosis or occlusion of both CA and SMA, and all underwent revision. Five patients had restenosis of the CA only. All of these patients had two-vessel reconstructions, and none needed reintervention. Three patients had restenosis of the SMA only. One of these patients had a single graft to the SMA with a moderate stenosis and no symptoms. The remaining two patients had two-vessel reconstruction, and one underwent reintervention for symptoms. Reintervention was performed only for symptomatic patients. Symptomatic recurrences occurred when both limbs of a bifurcated graft became stenotic in three patients or when a single graft to an SMA became stenotic in one patient. Stenosis in one limb of a bifurcated graft did not result in symptoms in seven patients, and no reintervention was necessitated.

DISCUSSION

Earlier, it was our practice to perform concomitant aortic/renal reconstruction if the anatomy warranted.⁴ Thirty-six percent of the patients we operated on between 1981 and 1988 underwent concomitant aortic operation, and their operative mortality rate was 19%. Similarly, the group from the Cleveland Clinic report that concomitant aortic replacement was associated with an increase in major postoperative morbidity and mortality when those endpoints were considered together.⁷ Because of that earlier

Table III. In-hospital mortality

	<i>Age (y)</i>	<i>Gender</i>	<i>Procedure</i>	<i>Days to death</i>	<i>Cause of death</i>
1	88	Male	Aorto-CA graft	4	Cardiac arrest
2	74	Male	Aorto-CA-SMA graft	6	AMI
3	75	Female	Endarterectomy CA, SMA	12	Cardiac arrest
5	78	Female	Aortobiliac bypass, aorto-SMA bypass, reimplantation IMA	44	Cardiac arrest
4	75	Female	Endarterectomy CA, SMA	48	Multisystem organ failure

Table IV. Morbidity

<i>Complications (major)</i>	<i>n (%)</i>
Ventilation dependence/tracheostomy	6 (28.6)
Myocardial infarction	4 (19.0)
Thrombosis	3 (14.3)
Cardiac arrest	3 (14.3)
Wound dehiscence	2 (9.5)
Respiratory arrest	1 (4.8)
Renal failure/hemodialysis	1 (4.8)

Table V. Causes of late death (n = 31 patients)

<i>Cause</i>	<i>No. of patients</i>
Cardiac	11 (35%)
Unknown	7 (23%)
Cerebrovascular accident	3 (10%)
Cancer	3 (10%)
Bowel infarction	2 (6%)
Malnutrition	1 (3%)
Gastrointestinal hemorrhage	1 (3%)
Multisystem organ failure	1 (3%)
Renal failure	1 (3%)
Hepatitis	1 (3%)

experience, we have tried to limit the operations for patients with CMI to the mesenteric arteries, if possible. At times, because of the extent of supraceliac or infrarenal aortic disease and the pattern of disease, concomitant aortic repair is believed to be necessary. In this series, 12% of patients had concomitant aortic surgery and their mortality rate was no different than the other patients. Foley and colleagues³ have believed that concomitant aortic reconstruction with retrograde grafting does not increase morbidity or mortality rates. Our series would lend support to that. In the group of patients treated between 1981 and 1988, the concomitant aortic reconstructions were in addition to supraceliac repairs and were, therefore, not essential for the correction of the mesenteric disease. In these reported patients, concomitant aortic operation was performed to provide a source of inflow for infrarenal mesenteric reconstructions and was, thus, a necessary component of the repair. Thus, we believe *selective* simultaneous aortic reconstruction, done to provide mesenteric inflow, is safe and provides a necessary and excellent blood source for retrograde reconstructions. On the other hand, patients

who undergo supraceliac graft reconstructions who have aortic and renal disease are probably better treated with staged operations. Five patients in this series with supraceliac reconstructions subsequently underwent aortic/renal reconstructions, and all did well.

In the report from the institution 20 years ago, a high symptomatic recurrence rate was noted, at 26% overall.⁸ None of the grafts placed at the Mayo Clinic before 1981 were antegrade. Currently, 78% of the patients who undergo grafting (in addition to the patients who undergo endarterectomy) have reconstruction in an antegrade manner. The symptom-free survival rate at 5 years is 92%, and only 6% of patients have had recurrent symptoms (Fig 2). Attributing the reduction in recurrence to antegrade repair is impossible in a retrospective study, and certainly in two retrospective studies separated by 20 years. Nonetheless, we believe that prograde flow with its reduced turbulence, the decreased likelihood of graft kinking, and the usual nondiseased state of the supraceliac aorta contributes to improved patency and symptom-free survival rates.

We were surprised and pleased to find infrarenal retrograde reconstructions worked as well statistically as the antegrade repairs. The patient longevity was not as great, but these were older patients. They did not die of mesenteric disease. We have concluded that both reconstructions, properly selected for the patient's general state of health and aortic anatomy, work well and provide excellent inflow, especially with infrarenal aortic reconstruction. A dogmatic adherence to one type of reconstruction over the other is probably less beneficial to these patients than an individualized approach. We favor the antegrade reconstruction for its theoretic advantages and because of its results in our hands. The group from Oregon has reported excellent results with retrograde reconstructions.³ Their willingness to provide excellent inflow with infrarenal grafting probably accounts for their results. In short, both methods will work in properly selected patients with appropriate attention to physiology and anatomy.

That report from the Mayo Clinic 20 years ago recommended complete revascularization (ie, two of two diseased vessels, three of three diseased vessels) and showed a linear correlation between recurrence and "incompleteness" of revascularization.⁸ Nonetheless, as stated previously, none of those reconstructions was antegrade. We maintained a degree of faithfulness to that concept of completeness (ie, reconstruction of the inferior mesenteric artery) for some years. However, that IMA reconstruction is not a necessary

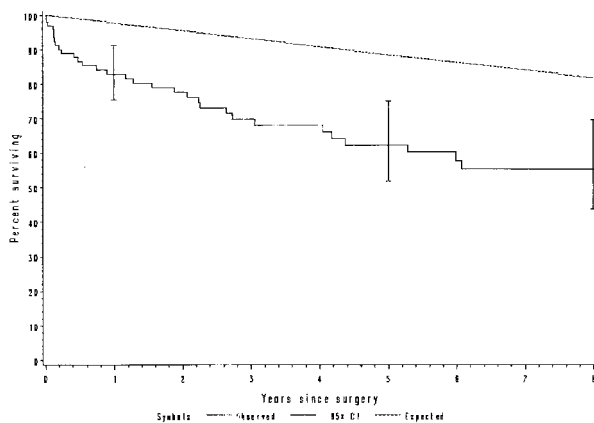


Fig 1. Survival rates.

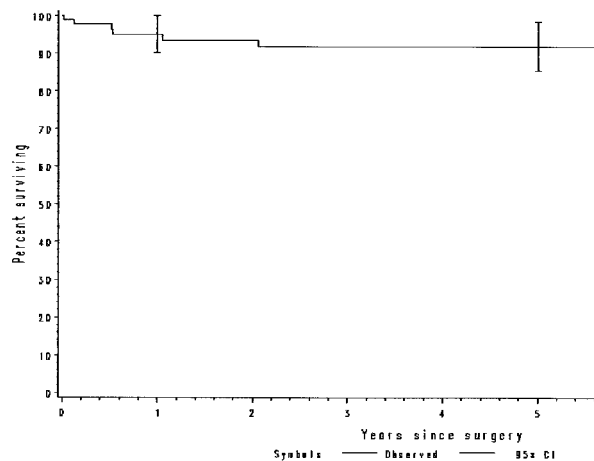


Fig 2. Recurrence-free survival rates.

component for successful and durable mesenteric reconstruction has become apparent. Further, with supraceliac repair, the addition of an IMA reconstruction necessitates concomitant aortic surgery. We do not, except in unusual cases, attend to the IMA in these patients. Similarly, the group from the Cleveland Clinic found that completeness of revascularization was associated with increased mortality and morbidity rates when these endpoints were considered together.⁷

Whether one-vessel (SMA) repair is as beneficial and durable as two-vessel reconstruction is, of course, debatable. The group from Oregon believe SMA reconstruction alone is all that is necessary. Many of their patients had AMI rather than CMI.³ For the patients with CMI, the addition of a celiac reconstruction, especially from the supraceliac aorta, provides a margin of safety should a late failing or failed graft occur. Both early and late graft thrombosis of a single SMA reconstruction is often catastrophic. Because the disease process involves multiple mesenteric vessels, we

believe that reconstruction should address both the involved CA and SMA in patients at good risk. Despite that bias, the results in the 19 patients for whom we performed single-vessel reconstruction only were not statistically different than those for the patients who underwent multiple-vessel repair.

Endarterectomy has been shown by the group of the University of California–San Francisco to be durable and an excellent option for these patients.⁹ Only five of our patients (5.1%) underwent endarterectomy alone. It is the operation of choice if the peritoneal cavity is contaminated and is preferable, especially in younger patients at good risk, to a bypass procedure if the supraceliac and the infrarenal aorta are heavily diseased because it provides the best source of inflow.

CMI, as all vascular disease, may be treated with endovascular methods. Kasirajan et al⁶ from the Cleveland Clinic found a higher symptomatic recurrence rate with their patients who underwent angioplasty/stenting at 3 years than in their patients who underwent open conventional repair and recommended that patients at good risk should be offered conventional revascularization. We agree with that recommendation but believe that patients at poor risk more than 70 years of age should be considered for endovascular repair as a potential first option. All our deaths occurred in this group. Three of our five patients with in-hospital deaths had undergone reconstruction of both of the celiac and the SMA, two with endarterectomy and one with grafting. In retrospect, these particular patients may have been better served with a more limited, or tailored approach, with infrarenal reconstruction of the SMA only. Patients at high risk, especially those patients greater than 70 years of age, should probably be regarded with an eye to infrarenal single-vessel reconstruction or to endovascular repair. The feasibility of either is, of course, dictated by aortic and mesenteric anatomy. Some of these patients would no doubt have difficulties in repair with endovascular techniques because of extensive severe atherosclerosis involving the aorta and the visceral vessels; nonetheless, these particular patients are poor candidates for conventional repair also. For them, the necessity for repeat angioplasty for recurrent stenosis may be more appealing than the alternative.

The mortality rate in our patients who underwent treatment before 1981 was 10%.⁸ That rate did not improve over the next 7 years; our report from 1988 had an 8.9% mortality rate.³ We have been gratified to find a 3.1% 30-day mortality rate and a 5.1% in-hospital mortality rate for this series of patients. For our patients, we believe that offering concomitant aortic/renal reconstructions to selected patients only rather than to all patients with involved pathologic aortic anatomy has helped improve results. Whereas 36% of patients were undergoing simultaneous aortic/renal repair in 1981 to 1988, only 12% are now. Other factors, such as preoperative coronary angioplasty, improved anesthetic and intensive care techniques, and experience over time have undoubtedly played contributing if unquantified roles.

Although our analysis did not indicate CAD as a significant independent risk factor, myocardial ischemia is the leading cause of both in-hospital and late deaths. It is a particularly vexing problem for patients with the worst of CMI because their mesenteric anatomy places them at high risk for bowel infarction after coronary artery bypass grafting. These cases remain problematic.

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Submitted Oct 9, 2001; accepted Feb 13, 2002.

DISCUSSION

Dr James Stanley (Ann Arbor, Mich). The results in certain subsets of these patients may vary, and such differences need to be accounted for when comparing one surgical technique with another. In the older than 70 years age group, how many had multiple-vessel versus single-vessel reconstructions? Single-vessel reconstructions may have been common in certain high-risk elderly patients. If such were the case, they would be at higher risk for early as well as late postoperative failures compared with younger patients undergoing multiple-vessel reconstructions. In particular, did the series' two patients with bowel infarctions and late deaths have single-vessel or multiple-vessel reconstructions? Our earlier University of Michigan experience and a prior report from the Mayo Clinic had a number of deaths, which were more common following single-vessel reconstructions. These patients clearly involute their collaterals, and if an acute graft occlusion occurs at a later time, the previously present collaterals are not there to protect the intestines.

A disproportionate number of women exist in this experience compared with that reported by others. Most other series have a less than 3:2 ratio of women to men, but there is nearly a 4:1 ratio of women to men in your experience. Did you have a bimodal distribution of women? In other words, did you have a group of younger women in the 45 to 50 year age group with isolated splanchnic arterial disease and then a group closer to 70 years of age, having what might be considered part of generalized cardiovascular arteriosclerosis? If you did, were the younger women extremely heavy smokers as has been reported by others?

Dr Woosup Park. In terms of the older patients, four received multiple-vessel reconstructions, and one received a single-vessel reconstruction. It is our bias to perform multiple-vessel bypasses when suitable. As to the age distribution, most of the female patients were older than 60. Eight of our patients were younger than 50. We excluded patients with arcuate ligament syndrome from this paper. Our sex distribution was 4:1 in favor of the women, and most were smokers with atherosclerosis.

Dr John Blebea (Hershey, Pa). This was a very nice presentation of an excellent experience with only a 5% mortality rate in this series of patients. I am intrigued because our own experience with reintervention is much higher than your 4%. Part of the reason may be that a lot of your stenoses, which were asymptomatic, did not have a secondary intervention. I have two questions.

First, what is your surveillance protocol? Do you have routine duplex follow-up in these patients, and at what intervals? There may be asymptomatic stenoses that you may not be detecting. Secondly, on such asymptomatic patients, what has been their prognosis and how much follow-up do you have of them? If you are doing either a single-vessel or two-vessel bypass and there is greater than 50% stenosis, we are a little hesitant just watching those asymptomatic patients and tend to intervene, especially if two out of two vessels are involved. What is your clinical protocol for that, and what followup do you have on these asymptomatic patients with stenoses?

Dr Park. Thank you for the excellent question, Dr Blebea. Follow-up imaging was not uniformly applied, particularly in the patients who lived far from the clinic, so patency data were not available. More recently, we have been following these patients with annual duplex or computed tomography.

In terms of the asymptomatic patients, we have found they remain symptom-free and die from causes not related to the gut. In our follow-up, we found that 10 of 31 late deaths were from cardiac disease, and the remainder died from other causes, with only two late bowel infarctions. In this particular experience, the reinterventions were for primarily the symptomatic patients.

Dr Timothy Hodges (Kansas City, Mo). I enjoyed your presentation very much. My question has to do with aortic source of inflow. Sometimes it is difficult to find a good aortic segment. If you have somebody who has infrarenal disease, which many of these patients do, would you recommend taking down the diaphragm in order to get a good segment of low thoracic or suprarenal aorta and adding that morbidity, or would you recommend replacing the infrarenal aorta and then doing the bypass off that graft?

Dr Park. In our earlier published series, concomitant aortic and renal reconstruction was performed when additional disease was found along with the suprarenal mesenteric reconstruction. Thirty-six percent of the patients in that series had this combined repair, and there was an associated 19% mortality. Now, the tendency is to stage the repairs if there are multiple loci of disease. If there is infrarenal disease and mesenteric disease, then we will do the aortic reconstruction and use the infrarenal aortic graft as the inflow source, and we have had excellent results.

Dr Robert McLafferty (Springfield, Ill). Given your conclusion that there is no difference in the outcome between multiple-vessel and single-vessel bypass, are you going to be recommending single-vessel bypass more often? Another paper published by the Oregon group looked at retrograde and single-vessel bypass with very, very comparable results to yours in terms of outcome.

Secondly, you mentioned that the retrograde bypass was associated with an increased mortality but that those patients were

older. Is that a univariate analysis? Did you do a multivariate analysis to look at what different significant univariate results came out positive?

Dr Park. In terms of multiple-vessel versus single-vessel reconstruction, our bias is that mesenteric ischemia often results from multivessel disease, and it is our feeling that these vessels should be reconstructed, and we have had equally good results compared with our single-vessel reconstructions. With regard to the second question, the data are presented from univariate analysis.

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- Author must be a Resident or Fellow on staff at an accredited vascular surgery program in the United States, Canada, or Mexico, with senior collaborators acting in a consultative capacity.
- Manuscripts must be postmarked no later than September 3, 2002. Selection results will be conveyed to all applicants by October 31, 2002.

RESEARCH REQUIREMENTS

- The research may be experimental or clinical in nature, dealing with some fundamental or clinical aspect of vascular surgery. Both basic and clinical research papers are especially encouraged.
- The manuscript must be an original, unpublished work (not submitted elsewhere for publication, except to the ACS Surgical Forum).
- The submission must be in English and include 1 copy of the typed manuscript and 1 original copy of illustrations (photographic prints or original computer-generated images). The manuscript must also be submitted electronically in Microsoft Word or PDF format on a PC computer disk or e-mailed to liebigfoundation@draxgroup.com. All submissions must comply with the Information for Authors of the *Journal of Vascular Surgery* and include an abstract of 250 words or less.
- Accompanying each submission should also be the following: a cover letter from the Resident or Fellow indicating the manuscript is to be considered for "The 22nd Annual William J. von Liebig Foundation Award for Residents, Fellows, and Mentors"; the author's full curriculum vitae; and a signed letter from the author's mentor attesting that the author performed all the essential parts of the experimental work reported.

SELECTION PROCESS

A select committee of vascular surgeons appointed by the Foundation will review the manuscripts submitted. 2002-2003 Committee Members include the following: Colleen M. Brophy, MD, Chairman; Elliot L. Chaikof, MD, PhD; Linda M. Graham, MD; William H. Pearce, MD; Michael Sobel, MD; Jean A. Goggins, PhD, Secretary; and Thomas C. Naslund, MD, SAVS Ex-Officio.

The first-prize winner will be a guest of The von Liebig Foundation, and the award will be presented at the annual meeting of the Southern Association for Vascular Surgery on January 15-18, 2003, at The Lowes Ventana Canyon Resort in Tucson, Arizona. Meeting expenses incurred by the winning author will be reimbursed according to the travel policy of the Foundation. The winning manuscript will be submitted to the *Journal of Vascular Surgery* or another publication of the author's choosing for consideration for publication. The William J. von Liebig Foundation reserves the right to withhold the granting of the award at the sole discretion of the Award Committee, whose judgment with respect thereto shall be final and conclusive.

HISTORY

Since the award's inception in 1982, 90% of previous award recipients have pursued careers in vascular or cardiothoracic surgical research. Thirteen recipients have become Fellows of the American College of Surgeons, three are associate members of the College, and one recipient is a Fellow of the American College of Cardiology. Two previous award winners are recipients of the von Liebig-supported Mentored Clinical Scientist Development Awards, and approximately 50% have become successful peer review funded researchers in vascular surgery. Past award winners include such well known researchers as Colleen Brophy, MD, Howard Greisler, MD, Michael Marin, MD, and Kenneth Ouriel, MD.

CONCLUSION

It is the desire of the Foundation to encourage the movement of technical innovation and relevant clinical findings from the laboratory to the vascular surgical community. It was Mr von Liebig's hope that those who pursue this award and those who win it will contribute to the advancement of medical care.

Further inquiries may be directed to the Foundation as follows:

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