

Vascular and Endovascular Surgery

<http://ves.sagepub.com>

Surgical Versus Endovascular Reconstruction for Chronic Mesenteric Ischemia: A Contemporary UK Series

Robert S. M. Davies, Michael L. Wall, Stanley H. Silverman, Malcolm H. Simms, Rajiv K. Vohra, Andrew W. Bradbury and Donald J. Adam

Vasc Endovascular Surg 2009; 43; 157 originally published online Dec 16, 2008;
DOI: 10.1177/1538574408328665

The online version of this article can be found at:
<http://ves.sagepub.com/cgi/content/abstract/43/2/157>

Published by:



<http://www.sagepublications.com>

Additional services and information for *Vascular and Endovascular Surgery* can be found at:

Email Alerts: <http://ves.sagepub.com/cgi/alerts>

Subscriptions: <http://ves.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations <http://ves.sagepub.com/cgi/content/refs/43/2/157>

Surgical Versus Endovascular Reconstruction for Chronic Mesenteric Ischemia: A Contemporary UK Series

Robert S. M. Davies, MRCS, Michael L. Wall, MRCS,
Stanley H. Silverman, FRCSEng, Malcolm H. Simms, FRCS,
Rajiv K. Vohra, PhD, FRCSEd, FRCSEng,
Andrew W. Bradbury, BSc, MBA, MD, FRCSEd, and
Donald J. Adam, MD, FRCSEd

Objective: To assess the outcome of surgical (SR) and endovascular (ER) reconstruction for chronic mesenteric ischemia (CMI). **Methods:** Retrospective review of consecutive patients who underwent SR or ER for CMI in 3 UK vascular surgery units between 1996 and 2006. Early (<30 days; technical success, morbidity, mortality, length of hospital stay) and late (>30 days) outcomes (symptom recurrence, vessel/graft patency, reintervention, mortality) were assessed. **Results:** A total of 27 patients underwent 32 reconstructions (SR = 17, ER = 15). A total of 44 of 56 (79%) diseased arteries underwent SR (n = 26; bypass = 24, reimplantation = 2; occlusion = 16, stenosis = 10) or ER (n = 18; stenosis = 16, occlusion = 2). Perioperative

mortality for SR and ER was 6% and 0%, respectively ($P \geq .99$). Hospital stay was shorter following ER (mean, 4.3 vs. 14.2 days, $P = .0003$). Mean (range) follow-up for SR and ER was 34 (1-94) and 34 (0-135) months, respectively. At 2 years, SR demonstrated superior secondary patency (100% vs. 65%) and clinical patency (100% vs. 73%). **Conclusions:** Surgical mesenteric reconstruction is associated with significantly longer hospital stay, but superior long-term outcome compared to endovascular reconstruction.

Keywords: chronic mesenteric ischemia; endovascular; surgical

Introduction

It is estimated that 1 in 6 people older than 65 years of age have significant atherosclerotic disease

From the University Department of Vascular Surgery, Heart of England NHS Foundation Trust, Birmingham, United Kingdom (RSMD, AWB, DJA); Department of Vascular Surgery, University Hospital Birmingham NHS Foundation Trust, Birmingham, United Kingdom (RSMD, MLW, MHS, RKV); and Department of Vascular Surgery, Sandwell and West Birmingham Hospitals NHS Trust, Birmingham, United Kingdom (SHS).

The authors declare no conflict of interest.

Address correspondence to: Robert S. M. Davies, Department of Vascular Surgery, University of Birmingham, Netherwood House, Solihull Hospital B91 2JL, United Kingdom; e-mail: RSMDavies@hotmail.com.

affecting the mesenteric arteries.¹ Progression to chronic mesenteric ischemia (CMI) occurs in less than 7% of these individuals, particularly those with multivessel disease.^{2,3} Since the first successful superior mesenteric endarterectomy reported by Shaw et al in 1958, surgical mesenteric reconstruction (SR) has become the standard treatment for CMI, despite often considerable perioperative morbidity and mortality.⁴⁻¹⁰ Furrer et al reported the first successful percutaneous mesenteric angioplasty in 1980 since when endovascular mesenteric reconstruction (ER) has become an accepted treatment option.¹¹ Although ER has lower perioperative mortality and morbidity compared to SR, the reported long-term symptom relief and survival free from reintervention are inferior.^{5,12-18} Careful review of the

English language literature reveals only 5 studies, all from North America, comparing SR and ER for CMI.^{5,18-21} The aim of this study was to report the contemporary results of SR and ER performed in 3 UK vascular surgical units, with particular emphasis on long-term symptomatic relief and vessel patency.

Methods

A retrospective review of consecutive patients who underwent elective SR or ER for CMI in the Vascular Surgery Units at the Heart of England NHS Foundation Trust (HoE), University Hospital Birmingham NHS Foundation Trust (UHB), and Sandwell and West Birmingham Hospitals NHS Trust (SWB) between 1996 and 2006 was performed. Patients were identified through vascular registries, individual and hospital operative logbooks, and radiological records.

Case notes were reviewed and the following clinicopathological data were retrieved: patient demographics, medical comorbidity, clinical presentation, diagnostic investigations, indications for intervention, and surgical or/and endovascular operative records. Patients undergoing concomitant procedures were included in the study if the primary presenting symptoms were due to CMI.

Early (within 30 days of the index procedure) outcome including technical success, reintervention, major morbidity, mortality, and length of hospital stay were analyzed. Late (greater than 30 days of the index procedure) outcome including symptom recurrence, vessel/graft patency, reintervention, and mortality were assessed.

Data were collected on preprocedure and follow-up imaging: duplex ultrasound, percutaneous angiography (PA), computed tomographic angiography (CTA), or magnetic resonance angiography (MRA). A diseased artery was defined as >50% stenosis. Vessel/graft stenosis was defined as radiographic evidence of >50% stenosis. Alive patients were contacted, where possible, to assess for recurrence of symptomatology that was defined as the return of the presenting symptoms.

Statistics

Differences between patient characteristics were assessed using Fisher exact test for categorical

variables and 2-sample *t* test or Wilcoxon rank sum test for continuous variables. Primary and secondary patency, clinical patency (asymptomatic), patient survival, and patient survival free from reintervention rates were calculated using the Kaplan-Meier method on "an intention to treat" basis. For the purpose of analysis, the SR cohort included both primary reconstructions and those who had secondary SR after previous ER. Comparison was made using log-rank tests and stratified univariately for covariables. A probability value of less than .05 was considered statistically significant.

Results

Patient Population

A total of 27 patients with 56 diseased mesenteric arteries underwent 32 mesenteric arterial reconstructions. In all, 17 SRs (UHB = 12, HoE = 4, SWB = 1) were performed in 17 patients (6 men; mean age 70, range 43 to 80 years) with 38 diseased vessels. All patients presented with abdominal pain and significant weight loss. In addition, 6 (35%) patients had 1 or more concomitant presenting symptoms that included diarrhoea, sitophobia, and/or nausea/emesis. A total of 15 ERs (HoE = 7, UHB = 5, SWB = 3) were attempted in 15 patients (7 men; mean age 68, range 43 to 86 years) with 28 diseased vessels. All patients presented with abdominal pain and weight loss, and 4 (27%) patients had 1 or more concomitant symptoms. Preoperative comorbidities and anatomical distribution of mesenteric disease did not differ between the 2 groups (Tables 1 and 2).

Procedural and Early Outcome

Surgical reconstruction. In all, 17 (12 primary) SRs were performed in 17 patients with 38 diseased vessels. A total of 26 of 38 (68%) vessels underwent SR (bypass grafts = 24, vessel reimplantation = 2; mean [range] 1.53 [1 to 3] reconstructed vessels per patient). In all, 16 (62%) vessels were occluded and 10 (38%) significantly stenosed. Of 17, 9 (53%) SRs used a retrograde bypass approach, 7 (41%) an antegrade bypass approach and 1 used both antegrade and retrograde approaches. Mesenteric reconstruction was combined with aorto-bifemoral bypass in 2 patients, straight graft infra-renal abdominal aortic

Table 1. Patient Demography and Comorbidities

Characteristics	Endovascular (n = 15)	Open (n = 17)	P Value
Age	68 ± 14	70 ± 10	.109
Female	8	11	.72
Cardiac disease	4	1	.161
PVD	5	12	.745
Renal disease	3	1	.319
Smoking	13	14	1
COPD	1	0	.468
Previous abdominal surgery	2	4	.659
Hypertension	6	9	.502
DM	1	1	1
Hyperlipidaemia	3	3	1

NOTES: DM = diabetes mellitus; COPD = chronic obstructive pulmonary disease; PVD = peripheral vascular disease.

aneurysm repair in 1 patient, and aorto-bi-iliac artery bypass in 1 patient. Bypass conduit was basilic vein in 6 (35%) reconstructions, prosthetic in 6 (35%), and long saphenous vein in 5 (29%; nonreversed = 2, reversed = 3; Table 3).

A total of 13 (76%) patients required postoperative admission to the intensive care unit (ICU); mean (range) length of ICU stay was 5.7 (1 to 14) days. Three (18%) patients required a tracheostomy secondary to ventilator dependence, 2 (12%) required reoperation for wound dehiscence, and 1 (6%) developed paroxysmal atrial fibrillation. The 30-day mortality rate was 6%; 1 patient died 9 days postoperatively secondary to pneumonia and multiple organ failure; patent SR at time of death. The mean (range) length of postoperative hospital stay was 14.2 (6 to 31) days. All patients who survived surgery were asymptomatic at 30 days postoperatively.

Endovascular reconstruction. A total of 15 ERs were attempted in 15 patients with 28 diseased vessels. Of 28, 18 (64%) vessels underwent attempted ER; mean (range) 1.2 (1 to 2) reconstructed vessels per patient. In all, 16 (89%) vessels were significantly stenosed and 2 were occluded. A greater number of occluded vessels were treated by SR compared with ER ($P = .0014$). Endovascular reconstruction was technically (<30% residual stenosis) and clinically successful in 14 (93%) patients who had 15 treated vessels.

An attempted angioplasty of a flush superior mesenteric artery (SMA) occlusion failed due to inability to cannulate the vessel; this patient was

Table 2. Anatomical Distribution of Mesenteric Arterial Disease

Distribution of Arterial Disease	Endovascular (n = 15)	Surgical (n = 17)	P Value
CA + SMA + IMA	6	8	
CA + SMA	1	5	
CA	3	1	
SMA	5	3	
Mean number of vessels involved	1.867 ± 0.99	2.235 ± 0.83	.26

NOTES: CA = coeliac artery; IMA = inferior mesenteric artery; SMA = superior mesenteric artery.

discharged and readmitted 1 week later for SR (antegrade bypass from the supraceliac aorta to the coeliac artery [CA] and SMA). One CA intervention was a partial success but complicated by intraprocedural stent dislodgment that required surgical retrieval from the external iliac artery. Despite this, the CA angioplasty demonstrated improved intraluminal diameter with <30% residual stenosis. Another patient had a successful CA stent but attempted SMA angioplasty failed due to inability to cannulate the vessel (Table 4).

Mean (range) length of hospital stay was 4.3 (1 to 26) days; 1 patient remained in hospital for 26 days for social reasons. No patients required admission to the ICU. Mean hospital stay was significantly shorter following ER compared to SR ($P = .0003$). Intensive care unit admission was significantly more likely following SR compared to ER ($P = <.0001$; Table 5).

At 30 days postprocedure, 12 of 14 (86%) patients who had undergone successful ER were asymptomatic. Two (15%) patients who had undergone successful ER underwent SR within 30 days of the index ER secondary to symptomatic vessel occlusion (antegrade bypass from the supraceliac aorta to the coeliac artery and SMA; and retrograde bypass from common iliac artery to SMA). There was no 30-day mortality.

Follow-up

Mean (range) follow-up for SR and ER was 34 (1 to 94) months and 34 (0 to 135) months, respectively. A total of 73% of ER and 88% of SR had objective assessment of their reconstruction following hospital discharge. Four SRs required a total of 5 reinterventions (SR = 3 and ER = 2) secondary to graft

Table 3. Surgical Reconstruction Performed

Sr	Inflow Vessel	Outflow Vessel	Graft	Number of Arteries Revascularized	Concomitant Procedure
1	Right EIA	SMA	Reversed LSV	1	N
2	Supraceliac aorta	CHA	Reversed LSV	2	N
	Left CIA	SMA			
3	Infra-renal aorta	SMA	Nonreversed LSV	2 ^a	IMA ^a reimplantation, aorto-bi-femoral bypass
4	Infra-renal aorta (straight graft AAA repair)	SMA	Nonreversed LSV	1	AAA repair
5	Infra-renal aorta (prosthetic)	SMA	Reversed LSV	1	Aorto-bi-femoral bypass
6	Supraceliac aorta	SMA	Basilic vein	1	
7	Supraceliac aorta	SMA	Basilic vein	1	N
8	CIA	SMA	Basilic vein	1	N
9	Supraceliac aorta	CHA	Basilic vein	1	N
10	Right CIA	ICA	Basilic vein	1	N
11	Supraceliac aorta	CA	Basilic vein	2	N
		SMA			
12	Supraceliac aorta	CA	Prosthetic	2	N
		SMA			
13	Right EIA	SMA	Prosthetic	1	N
14	Supraceliac aorta	CA	Prosthetic	3	N
		SMA			
		IMA			
15	Right limb of aorto-bi-iliac graft	SMA	Prosthetic	2	Aorto-bi-iliac bypass
		IMA			
16	Supraceliac aorta	CA	Prosthetic	2	N
		SMA			
17	Infra-renal aorta	SMA	Prosthetic	2 ^b	IMA ^b reimplantation

NOTES: CA = coeliac artery; CHA = common hepatic artery; CIA = common iliac artery; EIA = external iliac artery; ICA = internal carotid artery; IMA = inferior mesenteric artery; LSV = lesser saphenous vein; SMA = superior mesenteric artery; N = None.

^{a,b} Concomitant procedure.

stenosis (n = 2), graft occlusion (n = 2), and anastomotic stenosis (n = 1). The mean (range) time to first reintervention was 20.5 (7 to 47) months. Seven ERs required a total of 7 reinterventions (SR = 5, ER = 2) secondary to vessel occlusion (n = 5), vessel dissection (n = 1), and symptom recurrence (n = 1). The mean (range) time to first reintervention was 13 (0 to 35) months.

The 1- and 2-year primary SR patency rates were 83%. There was a statistically significant improvement in primary patency associated with retrograde approach and ≥ 2 vessels revascularized (retrograde vs. antegrade [$P = .03$]; ≥ 2 vessels vs. 1 vessel reconstruction [$P = .03$]). There was no significant difference depending on graft material (prosthetic vs. vein, $P = .111$). The 1- and 2-year primary ER patency rates were 65% and 54%, respectively. There was

Table 4. Endovascular Reconstructions Performed

Endovascular Procedures Performed	Number
PTA + stenting	
CA	3 (1 partial failure ^a)
SMA	3
PTA	
CA + SMA	1
CA	2
SMA	4 (1 complete failure ^b)
Combination	
CA stent + SMA PTA	2 (1 partial failure ^c)

Abbreviations: CA, coeliac artery; PTA, percutaneous transluminal angioplasty; SMA, superior mesenteric artery.

^a Stent deployment failure.

^b Failure to selectively catheterize SMA.

^c Complete CA PTA and stent success, failed SMA PTA.

Table 5. Perioperative Outcomes

	ER	SR	P Value
Mean number of vessel revascularized	1.2 (1-2)	1.5 (1-3)	.169
30-day complication ^a	7% (1/15)	35% (6/17)	.088
30-day reintervention ^b	20% (3/15)	0%	.092
30-day mortality	0%	6% (1/17)	>.999
Mean length of hospital stay	4.3 (1-26)	14.2 (6-31)	.0003
Mean length of ICU stay ^c	0	4.4 (0-14)	<.0001

NOTES: ER = endovascular reconstruction; ICU = intensive care unit; SR = surgical reconstruction.

^a Excluding reinterventions.

^b Excluding nonrevascularization operation.

^c Overall.

no significant difference depending on stent insertion (angioplasty + stent vs. angioplasty alone; $P = .088$) or number of vessels revascularized (≥ 2 vessels vs. 1 vessel; $P = .92$). There were no differences in primary ($P = .11$) patency rates at 1 and 2 years between SR and ER.

The 1- and 2-year secondary SR patency rates were 100%. There was no significant difference depending on graft material, anatomical approach, or number of vessels revascularized. The 1- and 2-year secondary ER patency rates were 65%. There was a statistically significant improvement in secondary patency with stent insertion (angioplasty + stent vs. angioplasty alone; $P = .042$). There was no significant difference depending on the number of vessels revascularized. There was improved secondary patency rates at 1 and 2 years following SR compared to ER ($P = .0061$).

The 1- and 2-year clinical SR patency rates were 100%. There was no significant difference depending on number of vessels revascularized, graft material, or anatomical approach. The 1- and 2-year clinical ER patency rates were 73%. There was no significant difference depending on stent insertion or number of vessels revascularized. There was improved clinical patency rates at 1- and 2-years following SR compared to ER ($P = .014$).

The 1- and 2-year patient survival rates for primary and secondary SR were 88% and 72%, respectively, compared to 100% and 86% for primary ER, respectively ($P = .84$). The 1- and 2-year survival rates free from reintervention for primary and secondary SR were 82% and 75%, respectively. The 1- and 2-year survival rates free from reintervention for primary ER were 73% and 53%, respectively. There was no significant difference depending on the type of reconstruction ($P = .26$).

Univariate analysis did not demonstrate any correlation between preoperative comorbidities detailed in Table 1 and primary, secondary, clinical, or patient survival free from reintervention rates for SR or ER.

Discussion

To our knowledge, the current report represents the only European series comparing SR and ER for patients with CMI. The principal findings of the current study were that SR was associated with (a) low periprocedural morbidity and mortality rates, similar to ER, (b) longer hospital stay and greater ICU requirement than ER, and (c) superior long-term clinical patency than ER. These findings are consistent with those in 4 contemporary series from North America with a total of 312 patients; no significant difference in periprocedural mortality rates^{5,18,20,21} was demonstrated between SR and ER, but SR was associated with superior primary,⁵ secondary, and clinical patency rates^{5,18,20} (Table 6).

The number of vessels requiring reconstruction to ensure symptomatic relief is controversial. Sivamurthy et al found ≥ 2 vessels reconstruction was associated with improved symptomatic relief ($P = .02$).²⁰ McMillan et al, in a cohort of 25 patients (38 bypasses), reported that multiple vessel bypasses is associated with an increased number of asymptomatic graft occlusions.²² In contrast, the Mayo clinic reported survival and symptom recurrence to be unaffected by the number of vessels undergoing SR in a cohort of 98 patients.⁹ Foley et al reported comparable long-term results following single vessel bypass grafting to the SMA as with multiple vessel SR.²³ In the current series, ≥ 2 vessels reconstruction

Table 6. Perioperative and Long-term Outcome Results of Studies Comparing Surgical Versus Endovascular Reconstruction for Chronic Mesenteric Ischemia

Author (Year)	Vessels				Mean Follow-up		Primary Patency		P Value		Secondary Patency		Clinical Patency		P Value		Periop Mortality		P Value		Patient Survival		P Value
	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR	ER	SR			
Biehl ²¹	23	26	47	30	.001	10	25	75% NA	NA	NA	NA	NA	NA	NA	NA	NA	0% 8%	0% 8%	0.276	NA	NA	NA	NA
Sivamurthy ²⁰	19	41	23	67	.076	NA	NA	83% 68%	.23	(6 months)	NA	NA	NA	59%	20%	.0004	16% 24%	16% 24%	NA	NA	63% 62%	0.69	(3 years)
Atkins ⁵	31	49	42	88	.001	15	42	58% 90%	.<.001	(1 year)	69%	87%	.003	83%	61%	.02	3% 2%	3% 2%	0.74	0.28	88% 74%	0.28	(2 years)
Kasirajan ¹⁸	28	85	32	130	.001	24	60	NA	NA	NA	73%	76%	.62	87%	66%	.001	11% 8%	11% 8%	0.71	0.99	81% 73%	0.99	(3 years)
Rose ¹⁹	8	9	9	16	NA	9.2	34.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	13% 11%	13% 11%	NA	NA	NA	NA	(3 years)
Current study	15	17	18	26	.169	34	34	54% 83%	.11	(2 years)	65%	100%	.0061	100%	73%	0.014	0% 6%	0% 6%	>.1	0.84	86% 72%	0.84	(2 years)

NOTES: ER = endovascular reconstruction; NA = not available; SR = surgical reconstruction.

was associated with improved primary patency but no improvement in secondary or clinical patency rates in the SR cohort.

Some authors have suggested improved symptomatic recurrence, survival, and graft patency rates with reconstruction of all 3 diseased mesenteric vessels.^{22,24,25} The benefits of such complete reconstruction may however be offset by an increased perioperative complications and mortality.¹⁰ Because of the current study's power limitation, statistical analysis regarding the effect of number of vessels revascularized stratified for the number of vessels involved in both groups is negated.

To date, only 1 comparative study has demonstrated improved primary and secondary patency with SR compared to ER,⁵ while others have reported similar patency rates.^{18,20,21} In the current study, SR and ER for CMI had similar primary patency rates, but improved secondary patency rates were seen in the SR cohort. The main limitation of reported studies is the lack of an objective assessment of the reconstruction during follow-up. Atkins et al had radiographic follow-up data in 65% and 59% of ER and SR cases, respectively, while the Cleveland clinic series had follow-up data in 68% of ERs and 64% of SRs.^{5,18} In our series, 73% of ERs and 88% of SRs had radiographic follow-up data available for analysis. Despite issues of primary and secondary patency, the most important clinical outcome in this group of patients is clinical patency, synonymous with symptomatic relief. In the current study, the 2-year clinical patency rates after SR and ER were 100% and 73%, respectively, which compares well with those reported from North America.^{5,18,20}

The inherent weakness of many studies, including the current series, is the significant increased severity of the mesenteric arterial disease treated by SR compared to ER. Two studies have failed to demonstrate a significant difference in clinical outcome or patency rates following ER for occlusive disease compared to stenotic disease, but both studies were limited by the small numbers of occluded vessels.^{15,26} In the current series, there was a tendency toward increased periprocedural reintervention following ER compared to SR but this did not correlate with the extent of atherosclerotic disease. One third of patients who underwent primary ER ultimately required SR. Previous endovascular intervention did not appear to complicate subsequent SR.

The authors recognize that the relative low case-load of the current study makes subgroup analysis

in a group of heterogeneous patients difficult to interpret and multivariate analysis invalid. Despite this, the excellent immediate and late outcomes of the current study compare favorably with the high-volume North American series.

In summary, SR and ER have similar early morbidity and mortality. An improved clinical patency was noted in SR in contrast to ER. Although ER may be an acceptable first-line treatment option in appropriately selected patients, a third of these patients may ultimately undergo SR.

Acknowledgments

The authors wish to thank Mr C. Hunter and Mr S. Rai for help with data collection.

References

1. Hansen KJ, Wilson DB, Craven TE, et al. Mesenteric artery disease in the elderly. *J Vasc Surg.* 2004;40:45-52.
2. Wilson DB, Mostafavi K, Craven TE, Ayerdi J, Edwards MS, Hansen KJ. Clinical course of mesenteric artery stenosis in elderly americans. *Arch Intern Med.* 2006;166:2095-2100.
3. Thomas JH, Blake K, Pierce GE, Hermreck AS, Seigel E. The clinical course of asymptomatic mesenteric arterial stenosis. *J Vasc Surg.* 1998;27:840-844.
4. Shaw RS, Maynard EP 3rd. Acute and chronic thrombosis of the mesenteric arteries associated with malabsorption; a report of two cases successfully treated by thromboendarterectomy. *N Engl J Med.* 1958;258: 874-878.
5. Atkins MD, Kwolek CJ, LaMuraglia GM, Brewster DC, Chung TK, Cambria RP. Surgical revascularization versus endovascular therapy for chronic mesenteric ischemia: a comparative experience. *J Vasc Surg.* 2007;45: 1162-1171.
6. Jimenez JG, Huber TS, Ozaki CK, et al. Durability of antegrade synthetic aortomesenteric bypass for chronic mesenteric ischemia. *J Vasc Surg.* 2002;35:1078-1084.
7. Modrall JG, Sadjadi J, Joiner DR, et al. Comparison of superficial femoral vein and saphenous vein as conduits for mesenteric arterial bypass. *J Vasc Surg.* 2003;37: 362-366.
8. Cho JS, Carr JA, Jacobsen G, Shepard AD, Nypaver TJ, Reddy DJ. Long-term outcome after mesenteric artery reconstruction: a 37-year experience. *J Vasc Surg.* 2002;35:453-460.
9. Park WM, Cherry KJ Jr, Chua HK, et al. Current results of open revascularization for chronic mesenteric ischemia: a standard for comparison. *J Vasc Surg.* 2002;35: 853-859.

10. Mateo RB, O'Hara PJ, Hertzner NR, Mascha EJ, Beven EG, Krajewski LP. Elective surgical treatment of symptomatic chronic mesenteric occlusive disease: early results and late outcomes. *J Vasc Surg.* 1999;29:821-831.
11. Furrer J, Gruntzig A, Kugelmeier J, Goebel N. Treatment of abdominal angina with percutaneous dilatation of an arteria mesenterica superior stenosis. Preliminary communication. *Cardiovasc Intervent Radiol.* 1980;3:43-44.
12. Silva JA, White CJ, Collins TJ, et al. Endovascular therapy for chronic mesenteric ischemia. *J Am Coll Cardiol.* 2006;47:944-950.
13. Brown DJ, Schermerhorn ML, Powell RJ, et al. Mesenteric stenting for chronic mesenteric ischemia. *J Vasc Surg.* 2005;42:268-274.
14. AbuRahma AF, Stone PA, Bates MC, Welch CA. Angioplasty/stenting of the superior mesenteric artery and celiac trunk: early and late outcomes. *J Endovasc Ther.* 2003;10:1046-1053.
15. Sharafuddin MJ, Olson CH, Sun S, Kresowik TF, Corson JD. Endovascular treatment of celiac and mesenteric arteries stenoses: applications and results. *J Vasc Surg.* 2003;38:692-698.
16. Matsumoto AH, Angle JF, Spinosa DJ, et al. Percutaneous transluminal angioplasty and stenting in the treatment of chronic mesenteric ischemia: results and longterm followup. *J Am Coll Surg.* 2002;194(1 suppl): S22-S31.
17. Steinmetz E, Tatou E, Favier-Blavoux C, et al. Endovascular treatment as first choice in chronic intestinal ischemia. *Ann Vasc Surg.* 2002;16:693-699.
18. Kasirajan K, O'Hara PJ, Gray BH, et al. Chronic mesenteric ischemia: open surgery versus percutaneous angioplasty and stenting. *J Vasc Surg.* 2001;33:63-71.
19. Rose SC, Quigley TM, Raker EJ. Revascularization for chronic mesenteric ischemia: comparison of operative arterial bypass grafting and percutaneous transluminal angioplasty. *J Vasc Interv Radiol.* 1995;6:339-349.
20. Sivamurthy N, Rhodes JM, Lee D, Waldman DL, Green RM, Davies MG. Endovascular versus open mesenteric revascularization: immediate benefits do not equate with short-term functional outcomes. *J Am Coll Surg.* 2006;202:859-867.
21. Biebl M, Oldenburg WA, Paz-Fumagalli R, McKinney JM, Hakaim AG. Surgical and interventional visceral revascularization for the treatment of chronic mesenteric ischemia—when to prefer which? *World J Surg.* 2007;31:562-568.
22. McMillan WD, McCarthy WJ, Bresticker MR, et al. Mesenteric artery bypass: objective patency determination. *J Vasc Surg.* 1995;21:729-740.
23. Foley MI, Moneta GL, Abou-Zamzam AM Jr, et al. Revascularization of the superior mesenteric artery alone for treatment of intestinal ischemia. *J Vasc Surg.* 2000;32:37-47.
24. Hollier LH, Bernatz PE, Pairolero PC, Payne WS, Osmundson PJ. Surgical management of chronic intestinal ischemia: a reappraisal. *Surgery.* 1981;90: 940-946.
25. McAfee MK, Cherry KJ Jr, Naessens JM, et al. Influence of complete revascularization on chronic mesenteric ischemia. *Am J Surg.* 1992;164:220-224.
26. Sheeran SR, Murphy TP, Khwaja A, Sussman SK, Hallsley MJ. Stent placement for treatment of mesenteric artery stenoses or occlusions. *J Vasc Interv Radiol.* 1999;10:861-867.

For reprints and permissions queries, please visit SAGE's Web site at <http://www.sagepub.com/journalsPermissions.nav>.