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Endovascular treatment of celiac and mesenteric arteries stenoses: Applications and results

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Purpose: **To evaluate the safety and assess the role of endovascular therapy in a variety of conditions related to celiac and mesenteric vascular occlusive disease.**

Patients and methods: **Our retrospective study population included 25 consecutive patients (mean age, 66 years), in whom 28 procedures were performed on 26 stenosed or occluded mesenteric vessels (superior mesenteric artery [SMA] or celiac artery [CA]). Indications included chronic mesenteric ischemia (21 patients), including 2 patients who underwent stenting prior to a planned operative repair of a juxtamesenteric AAA. Three liver transplantation patients underwent stenting of an associated CA stenosis. One patient with a splenorenal bypass underwent stenting on an associated CA stenosis. The technical and clinical success rates and the incidence of complications were determined. Follow-up parameters included maintained patency on duplex sonography and sustained clinical benefit. The need for additional interventions was noted.**

Results: **All procedures but one were technically successful (96%). Major complications occurred in three patients (one transient contrast-induced nephrotoxicity and two pseudoaneurysms). Immediate clinical success was achieved in 22 patients (88%). The three clinical failures included two patients with an excellent angiographic outcome, but with single-vessel moderate severity disease. Survival table analysis of delayed clinical outcome showed primary and primary-assisted clinical benefits at 11 months of 85% and 91%, respectively. Primary and primary-assisted stent patencies, as assessed by duplex sonography and/or angiography, at 6 months were both 92%. Angiographically documented restenosis occurred in three patients. Restenosis in two patients with CA stents was due to extrinsic compression, and it was without symptoms in one patient and was treated satisfactorily by restenting in the other patient. Restenosis in one patient with an SMA stent was successfully treated by restenting.**

Conclusions: **Our experience suggests a potential role for endovascular therapy of celiac and mesenteric arterial occlusive disease in a variety of clinical scenarios, with a low incidence of complications and a high technical success rate. (J Vasc Surg 2003;38:692-8.)**

Balloon angioplasty and/or stenting has become an established treatment modality for arterial occlusive diseases in a variety of peripheral vascular beds.[1] However, the use of endovascular therapy in the mesenteric vasculature has not been as widely accepted. Results from earlier series reporting on the use of endovascular techniques in the management of mesenteric occlusive disease have indicated reasonable rates for technical success (79% to 100%) and short-term efficacy (63% to 100%), although most have indicated disappointing long-term efficacy (52% to 80%) when compared with open surgical reconstruction.[2-15] However, these endovascular data generally reflect early experiences, which may have been compromised by early generation devices and delivery systems. Moreover, most published series of endovascular mesenteric revascularization include a large proportion of balloon angioplasty procedures done alone without stenting. If one was to draw an analogy with the renovascular bed, where more recent literature suggests increasingly favorable technical success and improved long-term patency rates with the use of newer-generation stent technology,[16] it is reasonable to project a similar trend in outcomes of endovascular therapy in the mesenteric circulation beds.[17,18] The purpose of this study was to evaluate our current experience with endovascular stenting in the celiac and superior mesenteric arteries, using modern stent technology and delivery systems, to determine the safety and assess the role of endovascular therapy in a variety of conditions related to celiac and mesenteric vascular occlusive disease.

PATIENTS AND METHODS

Our study was a retrospective review of all patients in our institution who underwent attempted stent-assisted angioplasty of a mesenteric vessel from July 1999 through June 2002. Two patients who underwent balloon angioplasty alone without stenting were excluded. Twenty-five consecutive patients were identified (13 men and 12 women), in whom 28 procedures were performed on 26 individual vessels. This included two secondary interventions to treat one patient with restenosis and one patient who had prior unsuccessful stenting. The most frequent indication for intervention was chronic mesenteric ischemia, present-

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Table I. Demographics and clinical presentation of the patients

Age (y)	*M/F*	*Vascular risk factors*	*Intervention indications*	*Duplex follow-up (mo)*	*Angiographic follow-up (mo)*	*Clinical follow-up (mo)*
66.9 ± 10.9 range: 41–86 (n = 25)	M: 13 F: 12	DM: 5/25 Smoking: 15/25 HTN: 18/25 Hyperlipidemia: 16/25 CRI: 6/25	-Mesenteric angina: 15 -gastric angina: 1 -Ischemic colitis: 5 -Pre-AAA surgery: 2* -Liver transplant dysfunction: 3 -Renal dysfunction, s/p splenorenal bypass: 1 -Stent restenosis†: 2	Range: 1–32 Median: 9.5 Mean: 14.0 SD: 14.7 (n = 18)	Range: 3–31 Median: 14 Mean: 18.6 SD: 17.4 (n = 7)	Range: 1–35 Median: 11.5 Mean: 15.0 SD: 14.7 (n = 24‡)

DM, Diabetes mellitus; *HTN*, hypertension; *CR*, chronic renal insufficiency.

*Both patients also had suspected symptomatic mesenteric occlusive disease and although the procedure was performed primarily simplify the operative management of juxta-renal AAA.

†One liver transplant patient developed immediate CA stent restenosis. The other patient developed delayed SMA stent restenosis presenting with recurrent abdominal angina.

‡Excludes one patient who died 11 days postprocedure.

ing in 21 of our patients. Sixteen patients presented with abdominal angina, and five patients presented with lower gastrointestinal bleeding secondary to ischemic colitis. To simplify the operative approach, stenting of the superior mesenteric artery (SMA) and/or celiac artery (CA) was undertaken prior to elective operative repair of a juxtasuperior mesenteric artery abdominal aortic aneurysm (AAA) in two patients, who also had a history of postprandial abdominal pain. Three liver transplantation patients also underwent stenting of a celiac artery (CA) stenosis. One patient, with a patent splenorenal bypass graft, underwent stenting of a stenosed CA for control of recurrent hypertension. An endovascular approach was selected in these patients for a variety of reasons, including high risk for open surgery, reluctance to reoperate due to recent abdominal surgery, surgeon preference, or patient preference when the patient specifically requested an endovascular procedure when presented with the various options. Of note, during the same time period of the study, the two staff surgeons participating in the study (J.D.C., T.F.K) performed a total of eight open mesenteric revascularization procedures, of which six were elective aortomesenteric bypasses for chronic mesenteric ischemia and two were acute procedures in patients with acute mesenteric ischemia. The general demographic data, prevalence of vascular risk factors, and follow-up are listed in Table I.

The angiographic characteristics and distribution of the occlusive disease as well as the performed endovascular interventions are summarized in Table II. Eighteen patients had pre-procedure magnetic resonance angiograms (MRAs) or computerized tomographic angiograms (CTAs). Seventeen patients had a preprocedure ultrasound scanning examination with Duplex evaluation of the SMA and CA. Prior diagnostic conventional angiograms were available in only five patients, with the remaining patients undergoing the angiographic procedure with the intent to treat on the basis of a prior abnormal US or MRA/CTA studies.

Stent-assisted angioplasty was used in all patients. All procedures were performed percutaneously. A femoral approach was used for 21 procedures (75%), whereas a brachial approach (either primary or adjunctive) was used for 7 procedures. A preintervention aortogram was obtained in the lateral projections. An aortogram in the anteroposterior (AP) projection and selective angiogram of the SMA or CA vessels were then obtained on a selective basis. After traversal of the lesion with an appropriate catheter-guide wire combination, the lesion was predilated with a 3- to 4-mm-diameter low-profile angioplasty balloon, after which the stent was deployed in a standard manner. Postdilation to an appropriate diameter was routinely performed by using high-pressure inflation. A variety of both balloon-expandable and self-expanding stents were used (Table II). When ostial lesions were treated, care was taken to cover the ostium while avoiding more than 2-mm maximal prolapse of the stent into the aortic lumen. A completion angiogram was performed in the lateral projection, with selective angiography of the stented vascular bed. After removal of the hardware, hemostasis was achieved by manual compression in 16 procedures or by the use of a vascular closure device in the remaining procedures. All patients received 3000 to 7000 IU of heparin intraprocedurally. All patients were maintained on aspirin (81 or 325 mg daily) and clopidogrel (75 mg daily). The patients were followed up at various time intervals (usually 1 month, 3 months, 6 months, and then annually) both clinically and by duplex sonography.

Technical success was defined as a postintervention residual stenosis of ≤30%. Clinical outcomes were qualified as either good or poor, depending on the underlying disease process as follows: (1) abdominal angina: resolution or improvement of symptoms and weight gain; (2) liver transplantation: reversal of enzymatic and/or Doppler he-

Table II. Angiographic characteristics of occlusive disease, and the performed interventions

Disease distribution	Triple-vessel: 9 Double-vessel: 8 (CA + SMA: 3, SMA + IMA: 3, CA + IMA: 2) Single-vessel: 8 (SMA: 4, CA: 4)
Treated vessels	CA: 11 SMA: 18 One-vessel intervention: 27 Two-vessel intervention: 1
Lesion length (mm)	10.4 ± 6.2
Stenosis severity (%)	81.6 ± 12.9
Characteristics of treated lesions*	Atherosclerosis: 23 Extrinsic ligamentous compression: 2 Extrinsic compression by tumor: 1 Ostial stenosis: 20/28 Complex stenosis†: 7 Complete occlusions: 3
Postintervention residual stenosis (%)	10.4 ± 19.5
Stented segment length (mm)	20.5 ± 9.3
Stent diameter (mm)	6.5 ± 0.7 mm
Stent types and manufacturers	Palmaz (Cordis; Miami, FL): 2 *(P204M and P294; dilated to 6 mm)* Palmaz-Corinthian (Cordis; Miami, FL): 19 *(PC154, PC204, and PC294; dilated to 5-7 mm)* SMART/Precise (Cordis; Miami, FL): 5 *(20-40 mm lengths, 6-8 mm diameters)* Wallstent (Boston Scientific, Natick, MA): 2 *(20 mm length, 6 mm diameter)*

CA, Celiac artery; *SMA*, superior mesenteric artery; *IMA*, inferior mesenteric artery.
*There were 26 primary interventions and two secondary interventions in 25 patients.
†Complex stenosis referred to long stenosis (≥20 mm long), heavily calcified or severely irregular lesions.

modynamic abnormality; and (3) insufficient splenorenal bypass: control of hypertension. Clinical follow-up included assessment of the patient abdominal symptoms and weight. Duplex sonography follow-up consisted of color-flow and duplex examination of the CA and SMA. On delayed follow-up, sustained primary clinical benefit refers to a favorable clinical outcome without the need of further intervention, whereas sustained primary-assisted clinical benefit refers to the requirement of re-intervention(s) to maintain or restore clinical benefit. All outcomes were analyzed on an intent-to-treat basis.

Statistical comparison of the various variables was performed using SYSTAT 8.0 software (SPSS Inc, Chicago, Ill). Continuous numeric variables were compared by using the Student *t* test, whereas discrete numeric variables were compared by using the Mann–Whitney nonparametric test. The Pearson χ^2 probability test was used for comparing non-numeric categorical variables. Life-table analysis was performed by using GraphPad Prism software (Graph Pad Software, San Diego, Calif).

RESULTS

Technical success was achieved in all but one procedure (96%). The failed procedure occurred in a patient who presented with liver transplant malfunction. Angiography revealed a tight stenosis of the CA causing ischemia of the allograft. During the initial stenting procedure, there was a poor response after using a single balloon-expandable Corinthian stent. The almost immediate and nearly complete recoil of the lesion was thought to be due to extrinsic compression by the median arcuate ligament. The patient, who did not desire operative intervention, later underwent a second endovascular procedure with placement of an oversized Nitinol stent through the prior collapsed stent. Although a moderate residual stenosis persisted, the lumen was adequate to allow sustained improvement in the liver function tests and normalization of duplex ultrasound scanning parameters.

The immediate clinical outcome after intervention was classified as good in 22 patients (88%) and poor in 3 patients, including 2 who had a technically excellent angiographic outcome. Interestingly, both of the latter two patients had only moderate stenosis of the affected artery (SMA in one and CA in the other) and essentially a single vessel disease distribution, but underwent endovascular therapy nonetheless as a therapeutic trial after other pathoses had been excluded. One of these two patients who failed to improve with stenting went on to have a surgical bypass without improvement in her symptoms, and the other was eventually felt to have poor gastric emptying as a cause for his symptoms and underwent placement of a gastric pacemaker with some improvement. The liver transplant patient, who had an initial technically unsuccessful procedure, has already been mentioned.

Late clinical outcome (mean/median follow-up: 15/12 months) showed sustained primary clinical benefit in 20 patients (83%). Sustained primary-assisted clinical benefit was achieved in 22 patients (92%) (Fig 1). This included the one patient who had a suboptimal technical outcome after the initial procedure but improved after

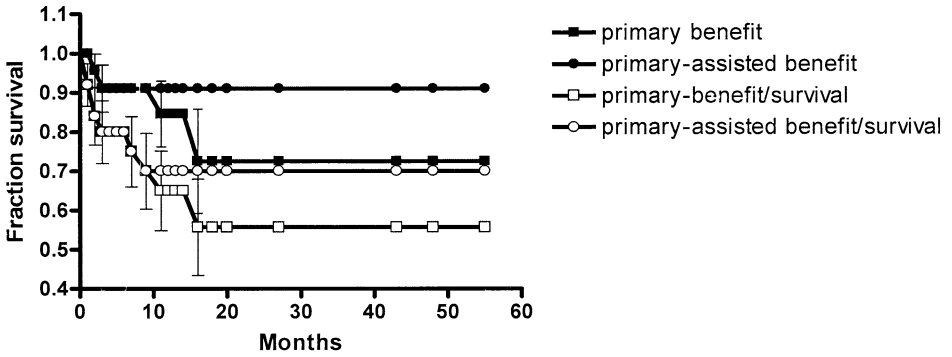

Fig 1. Primary and primary-assisted symptom-free patency after SMA and CA stenting. Presented in life-table format. Bars represent the standard error of the mean (SEM) values.

Table III. Changes in the angiographic and Doppler parameters of treated lesions

	Preintervention	*Immediate postintervention*	*P*	*Delayed postintervention*	*P*
% stenosis (angiography)	81.6 ± 12.9 (n = 28)	10.4 ± 19.5 (n = 28)	0.0001	20 ± 24.5 (n = 7)	NS
PSV (cm/sec)	379.7 ± 84.6 (n = 17)	227.3 ± 115.6 (n = 22)	0.0001	180.1 ± 83.8 (n = 18)	0.0001
RI[†]	0.59 ± 0.005 (n = 4)	0.74 ± 0.007 (n = 3)	0.024	—	—
Weight[‡] (Kg)	62.7 ± 14.5 (n = 14)	—	—	67.7 ± 16.4 (n = 14)	0.0002

P-values were generated by separate variance Student's *t* test for numeric variables and Fisher-exact test for collateral filling. The significance cutoff was $P < 0.05$. Paired samples *t* tests were used to compare weights.
*Collateral filling data were pertinent in 24 procedures.
[†]Refers only to the liver transplantation subpopulation.
[‡]Refers only to the abdominal angina subpopulation.

re-intervention, and another patient who presented with recurrent symptoms at 3 months after stenting of a proximal SMA stenosis and underwent successful restenting of a high-grade restenosis, resulting in resolution of symptoms. Both patients remained symptom-free and patent by duplex parameters 7 and 3 months later, respectively. There were no instances of symptomatic deterioration in any of the remaining patients with initial symptomatic improvement, on a mean follow-up of 15 months. This includes one patient with an occluded gastroduodenal artery and CA stenosis initially presenting with abdominal angina, who, despite an angiographically documented 70% restenosis due to uncovering of the stenotic lesion after distal dislodgement of the self-expanding stent on a follow-up angiogram 2 years later, did not have recurrence of his initial presenting symptoms.

Immediate post-procedural duplex ultrasound scanning evaluation was available in 22 patients. In 17 patients, both pre-intervention and post-intervention duplex studies were available and showed improvement of the duplex parameters in the treated vascular territory in 16 patients (94%) and no improvement in 1 patient who had a technically unsuccessful procedure. Delayed duplex follow-up data (mean/median follow-up: 14/9.5 months) was available in 18 patients, with stable to improved duplex parameters found in all (Table III). There was an excellent correlation between a good clinical response and improvement in the duplex parameters both post-procedurally and on the late follow-up (Russell and Rao binary similarity coefficient: 0.89 and 0.91, respectively). Long-term follow-up of primary and primary-assisted patency by means of duplex sonography and/or angiography is summarized in Fig 2.

A restenosis developed after three procedures (one immediate and two delayed). In one patient, as previously noted, an immediate restenosis occurred during the procedure due to elastic recoil of a balloon-expandable stent placed across a CA stenosis. A delayed restenosis developed after 2 of the remaining 27 successful procedures. One of the two delayed restenoses developed in a balloon-expandable stent 3 months after the primary procedure. The patient was symptomatic, prompting reintervention with stent placement, which resulted in symptom alleviation and normalization of Doppler parameters. In the other patient, a restenosis occurred at least 18 months after placement of a self-expanding stent across a CA stenosis. A prior angiogram had shown maintained patency, and the cause of restenosis appeared to be forward dislodgement of the stent, resulting in unmasking of the ostial CA stenosis. However, forward flow was maintained with a celiac artery PSV within the normal range, and the patient remained asymptomatic. As a result, no intervention was performed.

There were three significant complications in a total of 28 (10%) procedures (Society of Interventional Radiology

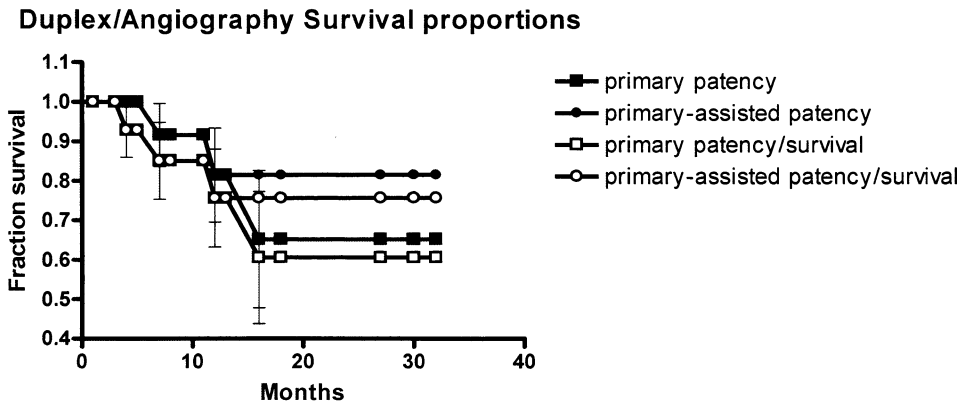

Fig 2. Primary and primary-assisted anatomic patency after SMA and CA stenting, using duplex sonography and/or angiography, presented in life-table format. Bars represent SEM values.

[SIR] class-C),[19] which included one patient who developed acute renal failure requiring additional hospitalization before resolution of the problem, and two patients with pseudoaneurysms (femoral artery in one, brachial artery in the other) who were managed by thrombin injection in one and surgical repair in the other.

Five of the patients died in the follow-up period. One death occurred 11 days postprocedure from pneumonia and multisystem organ failure in a patient who had advanced intra-abdominal carcinoid tumor. That patient also developed nonoliguric acute renal failure as a result of three consecutive iodinated contrast studies, including the intervention. His renal function was normalizing before discharge. He presented locally 3 days later and shortly after succumbed. The remaining four patients died at 12, 47, 76, and 92 weeks post-procedure, all from cardiopulmonary causes.

DISCUSSION

The technique of mesenteric percutaneous transluminal angioplasty as an alternative to surgical revascularization was first described in 1980.[20] However, the use of endovascular therapy in mesenteric vascular occlusive disease artery stenting has been mostly limited to a few series.[2,4,6,17,18] Recent studies have suggested an increasing role for the endovascular management of occlusive mesenteric vascular disease.[17,18] Our series is unique in that it only included patients treated with modern stent technology and delivery systems and followed for up to 35 months.

There was a high technical success rate, with the only failure related to immediate stent recoil due to an extrinsic compression. Favorable immediate clinical outcome occurred in 88% of treated patients. There were three failures attributable mostly to poor clinical and/or anatomic selection (moderate disease with other etiology for pain in two patients, or CA stenosis due to compression by the median arcuate ligament in one patient). Late clinical outcome at a mean follow-up of 15 months showed sustained primary clinical benefit in 83% of patients and sustained primary-assisted clinical benefit in 92% of patients. Only two late failures occurred in our series (3 and 18 months after the initial procedure, respectively), with one being symptomatic and responding well to a secondary endovascular intervention. There moderate-severity (SIR class-C)[19] complications occurred (10%), with only one requiring surgical intervention to repair a femoral pseudoaneurysm. There were no instances of acute stent rethrombosis. There was one post-procedure mortality occurring at 11 days from pneumonia and multisystem organ failure in a patient with advanced intra-abdominal malignancy.

The main Doppler parameter used to follow up the patients postprocedurally was the PSV. A significant decrease in PSV occurred after successful stenting and was sustained through the follow-up (Table III). Excellent correlation was present between a favorable clinical response and improvement in the duplex parameters, with an improvement in duplex parameters noted in 94% of patients immediately postprocedure. However, one should be aware of the possibility of a persistent elevation of the PSV after a technically and clinically successful procedure. This was encountered in three patients in our series (pre-intervention: 417 ± 29 cm/sec, postintervention 362 ± 37 cm/sec, $P = .11$). In all three, the completion angiograms showed a widely patent stent with excellent forward flow in the downstream vessels, and all experienced resolution of their pre-procedure symptoms. In these instances, the PSV was lower than the pre-intervention level, although it was still considered in the abnormal range (>275 cm/sec). In such instances, the most helpful maneuver is to sample the SMA beyond the stented area. Sustained high PSV along a long segment of the SMA may indicate hyperdynamic flow that can occur when a concomitant high-grade CA stenosis or occlusion is present with competent gastroduodenal collaterals. It is also important to perform these examinations in a fasting state to avoid the effects of postprandial hyperemia. By and large, the PSV is a sensitive follow-up parameter to detect restenosis in both asymptomatic patients or patients presenting with recurrent symptoms.

In the subpopulation of patients presenting with chronic mesenteric ischemia (21 patients), 9 patients had three-vessel disease, 8 had two-vessel disease, and 4 had one-vessel involvement of the SMA. Of those four patients, three with severe SMA stenosis responded well to stenting, whereas the remaining one (with only moderate SMA stenosis) did not improve.

All three patients with severe single-vessel SMA stenosis had complete and sustained resolution of their abdominal angina symptoms after endovascular stenting. The observation that a high-grade single-vessel stenosis involving the SMA may be significant and may represent an indication for intervention has been also noted by others.[17]

Intervention on single vessel disease may also be indicated in cases of liver transplantation with ischemic allograft dysfunction due to CA stenosis. The same logic could apply to renovascular ischemia in the presence of stenosis in the inflow of a splanchnic-renal bypass graft, as illustrated in another patient in our series.

In the presence of triple- or double-vessel disease, including the SMA, we typically preferentially treated the SMA. Alternatively, when SMA-CA disease is present with a stenosed CA and occluded SMA, the CA was treated. This approach resulted in a good clinical response in all but one patient with multivessel disease who underwent single vessel intervention. The exception was a patient with an occluded SMA and a moderate CA stenosis who underwent a technically successful CA stenting with persistent symptoms. That patient later underwent an aortomesenteric bypass with continued unabated symptoms now felt unlikely to be due to vascular insufficiency. In our opinion, given the favorable results achievable with a single vessel intervention, performing an additional vessel intervention could unnecessarily increase the risk of procedural complications.

Care must always be exerted before stenting a CA stenosis because of the possibility of technical or early clinical failures that can occur due to the presence of extrinsic compression at the level of the median arcuate ligament compression syndrome. These patients are typically younger, and the angiographic appearance of the lesions is usually typical. Therefore, when this condition is suspected, it is important to rule out dynamic compression of the celiac artery by obtaining inspiration and expiration lateral aortograms. Moreover, because of the risk of stent crushing due to repeated extrinsic compression, we believe balloon-expanded stents should be avoided unless one is confident about a purely atherosclerotic etiology for the stenosis. Self-expanding Nitinol stents are probably a more appropriate choice in this location given the metal's shape memory and ability to withstand repetitive compression stresses.

Our experience also demonstrated no difference in clinical outcome and patency rate between patients with simple stenotic lesions and those with occlusions or other complex vascular lesions (such as long-segment stenoses, irregular stenoses, and heavily calcified stenoses). Our series included three patients with total occlusion of the SMA in whom recanalization was attempted and was successful in all three. In our opinion, the decision to treat an occlusion should be based on necessity (for example, the presence of occlusion in both SMA and CA). Moreover, we would only attempt recanalization of an occluded mesenteric vessel when the lateral aortogram shows a clear stump marking the exact location of the occluded vessel.

Contraindications to endovascular revascularization in mesenteric ischemia include suspected acute bowel ischemia with evolving bowel necrosis, a known or highly suspected extrinsic compression as the underlying cause of the stenosis, or the presence of extensive or diffuse disease or stenosis involving the origin of major secondary branches, that could be better addressed by open reconstruction.

Although the numbers were too small to allow a meaningful analysis of significance, a poor clinical outcome appeared to be related to instances of single-vessel disease that were of only moderate severity ($\leq$60%). Conceivably, a normal duplex evaluation can further serve to assess the clinical relevance of a single-vessel stenosis. The presence of CA stenosis poses an inherently higher risk for immediate failure due to recoil, as well as for delayed failures due to metallic fatigue or dislodgement due to repetitive compression by the median arcuate ligament. This condition should be suspected in the younger patient without evidence of generalized atherosclerosis. When suspected, dynamic angiograms of the aorta in the lateral projection should be performed in both inspiration and expiration before committing the patient to stenting.

Our results support the versatility of stenting to manage a variety of conditions in the mesenteric circulation other than chronic mesenteric ischemia, including liver transplant graft malfunction and as an adjunct preoperative procedure in patients undergoing open repair for complex juxtamesenteric AAA. Stenting could also be used as a bailout modality in patients with renal bypasses based on the mesenteric circulation in the presence of proximal mesenteric vessel stenosis.

Although few would argue about the value of endovascular therapy in poor operative risk patients, the use of endovascular therapy in patients who are good operative candidates has been more debatable. Prior studies have compared open surgery with percutaneous angioplasty and stenting in the management of chronic mesenteric ischemia, with some concluding that surgical therapy should be preferentially offered to patients deemed fit for open revascularization.[3,4] The cumulative 5-year symptom-free survival for patients who undergo surgical treatment is reported to be 70% to 88%.[21,22] However, postoperative morbidity can occur in up 54% of patients, and the perioperative mortality rates have been reported as high as 17%.[23-25] Although follow-up in our series is limited, our results as well as the results from other recent series[17,18] suggest that the clinical efficacy and low complication rates of visceral arterial stenting, by means of modern devices and low-profile delivery systems, compare well with the known morbidity and mortality of open surgical management of occlusive mesenteric disease,[21,22] and support the selective

use of a primary endovascular approach. Recurrent disease after stenting can usually be successfully managed by endovascular means, and open surgery could be readily offered for immediate or delayed failures not amenable to endovascular treatment.

Although our initial results appear promising, they represent a limited single institution experience with rather short follow-up. Larger studies comparing stenting with open surgery for occlusive mesenteric arterial disease are needed to further define the role and indications of these modalities.

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