Chronic mesenteric ischemia: Open surgery versus percutaneous angioplasty and stenting

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Objective: The aim of the study was to evaluate the safety and efficacy of percutaneous angioplasty and stenting (PAS) in comparison with traditional open surgical (OS) revascularization for the treatment of chronic mesenteric ischemia. Methods: Over a 3.5-year period, 28 patients (32 vessels) underwent PAS (balloon angioplasty alone, 5 [18%] of 28; angioplasty and stenting, 23 [82%] of 28) for symptoms of chronic mesenteric ischemia. These patients were compared with a previously published series of 85 patients (130 vessels) treated with OS (bypass grafting, 60 [71%] of 85; transaortic endarterectomy, 19 [22%] of 85; or patch angioplasty, 6 [7%] of 85).

Results: The PAS and OS groups were similar with respect to baseline comorbidities, duration of symptoms (median: 6.7 vs 10.5 months, P = .52), and the number of vessels involved, but the patients differed in their age at presentation (median: 72 vs 65 years, P = .005). Fewer vessels were revascularized per patient in the PAS group (1.1 ± 0.4) compared with the OS group (1.5 ± 0.6, P = .001). Overall, 85.7% (24/28) had one vessel and 14.3% (4/28) had two vessels revascularized in the PAS group versus 48.2% (41/85) with one-vessel and 47.1% (40/85) with two-vessel revascularization in the OS group. No difference was noted in the early in-hospital complications (median: 17.9% [PAS] vs 32.9% [OS], P = .12) or mortality rate (10.7% [PAS] vs 8.2% [OS], P = .71). A reduced length of hospital stay in the PAS patients did not attain statistical significance (median: 5 days [PAS] vs 13 days [OS], P = .08). Although the 3-year cumulative recurrent stenosis (P = .62) and mortality rate (P = .99) did not differ, the PAS treatment group had a higher incidence of recurrent symptoms (P = .001).

Conclusion: Although the results of PAS and OS were similar with respect to morbidity, death, and recurrent stenosis, PAS was associated with a significantly higher incidence of recurrent symptoms. These findings suggest that OS should be preferentially offered to patients deemed fit for open revascularization. (J Vasc Surg 2001;33:63-71.)

Atherosclerotic occlusive disease of the mesenteric circulation is an uncommon disorder that may culminate in fatal intestinal gangrene, if not detected and treated. Open surgical (OS) revascularization has been reported to have excellent symptomatic cure and durability.1-5 Unfortunately, surgical revascularization is associated with perioperative complications in the range of 19% to 54%,1,4,5-8 with mortality rates ranging from 0% to 17%.1,18 Recent interest in minimally invasive endovascular therapy for atherosclerotic short-segment occlusive disease has extended to the management of chronic mesenteric ischemia.19-27 Proponents of percutaneous angioplasty and stenting (PAS) for symptoms of chronic mesenteric ischemia have noted lower complications rates in the range of 0% to 25%19-27 and a low peri- procedural mortality rate of 0% to 13%.19-27 However, most series of PAS for chronic mesenteric ischemia include small numbers with limited follow-up. Only one report was identified in which PAS (n = 8) was compared with OS (n = 9) to document the relative efficacy and long-term follow-up; once again, the small sample size negated the performance of statistical tests that would have been able to detect anything but a very strong association.23 Therefore, at present there is not enough evidence to conclusively determine the best form of therapy. The current study was undertaken to determine the role of PAS and OS in the management of patients with chronic mesenteric ischemia.

PATIENTS AND METHODS

Data retrieval. Patients treated with angioplasty with or without stenting for symptoms of chronic mesenteric ischemia were prospectively entered into an endovascular database. Patient demographics, details of treatment, and outcome were supplemented with retrospective chart reviews. All (n = 28) pre- and post-PAS angiograms were reviewed to establish the severity of stenosis and the number of vessels involved. Long-term follow-up was assessed by means of the patients’ symptoms and duplex scan evaluation of mesenteric flow. When necessary, patients were contacted by telephone and asked to return for duplex scan flow assessment. Repeat angiograms were obtained for new symptoms or evidence of recurrent stenosis on follow-up duplex scan evaluation. Information regarding OS patients was available from a series that previously was reported from the same institution in the Journal of...
A 2-tailed survival to first known recurrence of stenosis or symptoms. Kaplan-Meier analysis was used to estimate survival and values were used when data were nongaussian in distribution. Use of the Wilcoxon rank sum test, as appropriate. Median values were compared with a 2-sided analysis with each patient compared with 1.5 ± 0.6 (range, 1-3) vessels per patient. The mortality rate was not included in the evaluation of complications. The mortality rate was not included in the evaluation of complications, but was reported separately.

Diagnosis and treatment methods. The noninvasive laboratory criterion for an occluded mesenteric vessel was a clearly visualized vessel with no color flow or Doppler scan signal. Celiac artery stenosis of 70% to 99% was diagnosed if the peak systolic velocity was more than 250 cm/s with poststenotic turbulence. Superior mesenteric artery (SMA) or inferior mesenteric artery (IMA) stenosis of 70% to 99% was diagnosed when the peak systolic velocity was more than 275 cm/s with poststenotic turbulence. This was confirmed with a diagnostic angiogram before further treatment. Angiographic determination of the stenosis was done by comparing the area of maximum narrowing with the vessel beyond the site of stenosis. Technical success in the PAS group was defined as a residual stenosis < 30% or a residual pressure gradient of less than 10 mm Hg. Recurrent stenosis or occlusion was determined with duplex scan or angiographic assessment.

Statistical methods. Categoric variables in the PAS and OS groups were compared at baseline and postprocedure with either a χ² or Fisher exact test, and the continuous variables were compared with either a 2-sided t test or the Wilcoxon rank sum test, as appropriate. Median values were used when data were nongaussian in distribution. Kaplan-Meier analysis was used to estimate survival and survival to first known recurrence of stenosis or symptoms. A 2-tailed P value of .05 was considered significant for each hypothesis. SAS statistical software (SAS Institute, Inc, Cary, NC) was used for all analyses.

RESULTS

Patient demographics. Twenty-eight patients (32 vessels) were treated in the PAS group from February 1995 to June 1998, and 85 patients (130 vessels) were treated in the OS group from September 1977 to June 1997. There was a higher prevalence of smokers in the OS group (88% vs 61%, P = .002), and a higher proportion of patients in the PAS group had coronary artery disease (68% vs 33%, P = .001). Otherwise, there were no differences between the treatment groups (Table I). The preprocedural weight loss (pounds) did not differ between the groups, with a median of 25 lb (range, 15-60 lb) for the PAS group and a median of 30 lb (range, 3-100 lb) for the OS group (P = .94, Wilcoxon rank sum test). The duration of symptoms before presentation to the physician was also indistinguishable (PAS group: 6.7 months [range, 0-36 months]; OS group: 10.5 months [range, 0-64 months]; P = .52, Wilcoxon rank sum test).

Vessels involved. The celiac artery, the SMA, and the IMA were evaluated for the severity of stenosis on the basis of the lateral abdominal aortogram. The PAS patients had fewer occluded vessels than the OS patients (P = .001, Wilcoxon rank sum test). However, the total number of involved stenotic or occluded vessels per patient was similar between the groups, with a median of three vessels (range, 1-3) in each group (2.5 ± 0.6 [PAS]; 2.6 ± 0.5 [OS]; P = .71) (Table II).

Treatment modalities. In the PAS group, angioplasty combined with stenting was performed in 23 (82%) of 28 patients and angioplasty alone in 5 (18%) of 28. In this group, the brachial approach was used in 17 (61%) patients and the femoral approach in 11 (39%). Two of the brachial approaches were conversions after initial attempts to cannulate the mesenteric artery from a femoral approach. Balloon-expandable stents were used in 23 vessels, and self-expanding stents in three vessels; the remaining six vessels underwent angioplasty alone. Occlusions were more likely to be treated in the OS group, whereas most vessels were treated for stenosis in the PAS group. Recanalization was performed in only one (4%) of the 25 occluded vessels in the PAS group, compared with the treatment of 62 (51%) of the 122 occluded vessels in the OS group. The procedures performed in the OS patients include bypass grafting in 60 (71%) of 85 (retrograde bypass grafting, 40%; antegrade bypass grafting, 28%; reimplant and thrombectomy, 3%), evasion endarterectomy in 19 (22%) of 85, and patch angioplasty in 6 (7%) of 85.

Treatment outcome. Significantly more vessels were revascularized in the OS group compared with the PAS group (P = .001, Wilcoxon rank sum test). In the PAS group, 24 (85.7%) patients had only one vessel treated, and four (14.3%) patients had two vessels treated. In comparison, 41 (48.2%) OS patients had one vessel revascularized, 40 (47.1%) had two vessels, and three (4%) had three vessels (insufficient data, 1 patient). Overall, the PAS group had 1.1 ± 0.4 (range, 1-2) vessels treated per patient compared with 1.5 ± 0.6 (range, 1-3) vessels per patient in the OS group (P = .001; Table II).

There was a trend toward reduced length of hospital stay in patients who underwent PAS (median, 5 days) compared with the OS group (median, 13 days), but this was not statistically significant (P = .08). However, there was a greater variability in the PAS group (quartiles 0.5-43...
vs 9-20 for the OS group). Similarly, there was no difference in the overall incidence of perioperative complications (17.9% [PAS] vs 32.9% [OS], \( P = .12; \) Table III). Bowel gangrene occurred in two (7%) of 28 patients in the PAS group and in two (2%) of 85 in the OS group (\( P = .24 \)). Death in the PAS group was related to bowel gangrene and subsequent multisystem organ failure in two patients, and one other patient died because of myocardial infarction. Although there was no difference in the proportion of patients with at least one perioperative complication between the groups, the proportion with at least one systemic complication involving the cardiac, pulmonary, gastrointestinal, or renal system was higher in the OS group (19% [PAS] vs 40% [OS], \( P = .99 \)).

### Late follow-up

Follow-up data were collected for deaths, recurrent stenosis/occlusion, or recurrent symptoms. There was no survival difference at 3 years between the groups (81% [PAS] vs 71% [OS], \( P = .99 \); Fig 1). Survival data were available for as long as 13 years in the OS group (28%; 95% CI, 13%-43%) and to 5 years in the PAS group. The mean follow-up time was 5 years for the OS group and 2 years for the PAS treatment group. Among patients in the PAS group, the estimated Kaplan-Meier survival was 60% at 5 years (95% CI, 24%-96%), compared with 64% (95% CI, 53%-75%) in the OS group. Objective data for patency estimates were available in 19 (68%) patients in the PAS group (only 1 patient in the PAS group had a repeat angiogram) and for 54 (64%) patients in the OS group. At 3 years, occlusion and recurrent stenosis were documented in 27% (95% CI, 0%-55%) of the PAS group compared with 24% (95% CI, 14%-34%) of the OS group (\( P = .62 \); Fig 2). Among the PAS treatment group, vessels that underwent angioplasty only had two (33%) recurrent stenoses, and the those that underwent angioplasty with stenting had three (11.5%) recurrent stenoses/occlusions.

Patients were also questioned for evidence of recurrent symptoms. Among the PAS treatment group, 11 patients had recurrent symptoms. Four of the 11 patients underwent no further evaluation. The seven remaining patients underwent duplex scan or angiographic assessment. Only one of these seven patients had a recurrent lesion that was identified and underwent angioplasty again. The six other patients with no evidence of recurrent stenosis were followed up clinically. None of these patients had worsening of symptoms or acute mesenteric ischemia during the follow-up interval. On the contrary, in the OS group, recurrent symptoms coincided with objective evidence of graft or arterial occlusion in nine (90%) of 10 patients. Overall, cumulative recurrent symptoms at 3 years were more common in the PAS treatment group (34%, 95% CI 14%-54%) compared with the OS treatment group.
group (13%, 95% CI 6%-21%, $P = .001$; Fig 3). Most of the symptomatic recurrences in the PAS treatment group occurred within the first year; there was 28% recurrence at 1 year and 34% at 3 years. Subgroup analysis of 41 OS patients and 24 PAS patients with only a single vessel treated revealed no difference in patency ($P = .37$) or recurrent mesenteric symptoms ($P = .31$) at 3 years.

**DISCUSSION**

The goals of revascularization in patients with symptomatic chronic mesenteric ischemia are to relieve symptoms, improve the nutritional status, and prevent intestinal infarction. Prophylactic mesenteric revascularization rarely is performed in the asymptomatic patient undergoing an aortic procedure for other indications. However, the natural history of untreated chronic mesenteric ischemia may justify revascularization in some asymptomatic patients if the operative risks are acceptable. In the only available natural history study, 86% of patients with significant three-vessel arterial disease had mesenteric ischemia, had vague abdominal symptoms, or died. The first clinical presentation may be acute mesenteric ischemia.

**Fig 1.** Cumulative overall survival comparing OS treatment group with endovascular treatment group ($P = .99$; SE > 10 for PAS group beyond 4 years).

**Fig 2.** Cumulative patency comparing OS treatment group with endovascular treatment group ($P = .62$; SE > 10 for PAS group beyond 2 years).
in about 15% to 50% of the patients, with a mortality rate of 15% to 70%. Until recently, OS revascularization was the only available treatment for patients with chronic mesenteric ischemia. Complex anatomy, technical challenges encountered for OS exposure of the paravisceral aorta, and the physiologic changes often associated with surgical treatment in these patients have prompted interest in minimally invasive endovascular options.

The small sample size of PAS parallels the OS experience in the management of patients with chronic mesenteric ischemia. Because of the numerous causes for chronic abdominal pain, diagnosis is often difficult, and the treatment remains challenging whether performed percutaneously or operatively. Several years were required to collect a relatively small number of patients with chronic mesenteric ischemia in most reports; thus, no prospective, randomized trial of PAS versus OS is currently available regarding management.

In 1995, Rose et al published the only available retrospective comparison between the two treatment modalities. The initial technical success for PAS was a dismal 30% (with a residual stenosis < 30% as the end point) compared with 100% for the OS group. However, if a residual stenosis rate of < 50% was taken to be the end point, their primary technical success rate increased to 88%. The reported mortality rate (13% [PAS], 11% [OS]) and the nonfatal major complication rate (25% [PAS], 33% [OS]) were similar in both groups. More vessels were revascularized in the OS group compared with the PAS group. In the OS group, seven (78%) of the nine reported patients had two vessels revascularized compared with only one (13%) of the eight patients in the PAS group.

Long-term pain relief was only 67% at 9.2 months in the PAS group compared with 88% at 34.5 months in the OS group. These authors concluded that long-term symptomatic relief was superior in the OS group compared with the PAS group, possibly reflecting the number of vessels revascularized.

A summary of the data published over the last decade for the management of chronic mesenteric ischemia with either OS or PAS is given in Tables IV and V. Case reports and series with fewer than five patients were not included, because there may have been a bias toward publication of cases with favorable outcomes. Because OS revascularization has been traditionally used and is considered to be the criterion standard, the number of patients in OS studies (490 [OS]; 122 [PAS]) is larger and is associated with a longer period of follow-up (66 ± 27 months [OS] vs 27 ± 8 months [PAS]). The methods used for assessment of technical success were variable for the PAS group, and objective evidence for patency either was not uniformly available or was subject to variability in reporting standards.

Pain relief was considered the most important indicator of long-term success. Significantly more vessels were revascularized in the OS treatment group compared with the PAS treatment group: a mean of 49 ± 28 patients had 86 ± 53 vessels revascularized in the OS group versus 17 ± 7 patients with 23 ± 12 vessels revascularized in the PAS group (Tables IV and V). Overall, 1.8 vessels per patient were revascularized in the OS studies compared with 1.3 vessels per patient in the PAS reports. This may have resulted from preferentially treating stenosis rather than occlusions in the PAS cohorts. Endovascular recanalization of complete arterial occlusions is usually more challenging, resulting in a higher incidence of complications and often being associated with lower long-term patency.

In our current study, occlusions were more likely to be treated with open bypass grafting compared with PAS (PAS, 4%; OS, 51%). There was also a higher incidence of preprocedure arterial occlusions in the OS group, probably reflecting a selection bias toward OS therapy for this patient population.
In the summary of published trials, immediate pain relief was more likely in the OS treatment group (Tables IV and V) compared with the PAS patients (100% [OS] vs 79% ± 9% [PAS]). However, immediate relief of pain could conceivably be a result of the placebo effect of the procedure or of pain medications used in the postoperative period, both of which probably play a greater role in OS patients. During a mean follow-up of 66 ± 27 months, sustained freedom from recurrent symptoms was noted in 85% ± 12% of the OS patients compared with 72% ± 10% during a shorter period of follow-up (27 ± 8 months) in the PAS patients. In aggregate, complication rates (29% ± 12% [OS] vs 18% ± 15% [PAS]) and mortality rates (7% [OS] vs 4% [PAS]) were higher in the OS treatment group than in the PAS case reports.

Definitive conclusions cannot be inferred from the previous literature because of variable reporting standards. However, long-term pain relief has been universally reported to be better in the OS series. The possible reasons for a sustained freedom from recurrent symptoms are speculative. The number of vessels revascularized has often been reported to influence the long-term outcome. McAfee et al evaluated the results of total revascularization in comparison with incomplete revascularization. The 5-year survival rate for patients with three-vessel involvement who underwent three-vessel revascularization in this study was 73%, compared with 57% for two-vessel revascularization and 0% for one-vessel repair. Similarly, 5-year graft patency was better for complete revascularization (90%, 54%, and 0%, respectively). In our report, six patients in the PAS group had recurrent symptoms with no objective evidence of restenosis in the treated vessels. In comparison, nine of the 10 patients with recurrent symptoms in the OS group had objective evidence of restenosis in the treated vessels or graft conduits. Thus, recurrent symptoms in the PAS group may be related to progressive atherosclerotic narrowing of untreated vessels. Unfortunately, the follow-up evaluation often did not include objective evidence of patency in the untreated vessels. Thus, the “progressive stenosis of untreated vessels” hypothesis cannot be established. It is also possible that recurrent abdominal symptoms in the PAS treatment group may have been unrelated to progressive mesenteric arterial occlusive disease, especially because they were not associated with objective evidence of recurrent stenosis/occlusion.

Gentile et al reported their experience using isolated bypass graft to the SMA as being comparable to the success and durability of bypass grafts to multiple visceral vessels. The authors reported 4-year primary patency and

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**Table IV. Literature review of OS management of patients with mesenteric ischemia**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Pt no.</th>
<th>Vessels revascularized</th>
<th>Technical success</th>
<th>Immediate pain relief</th>
<th>Follow-up (mo)</th>
<th>Long-term pain relief</th>
<th>Complications</th>
<th>Mortality rate</th>
<th>Patency</th>
</tr>
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<tbody>
<tr>
<td>Kieny</td>
<td>1990</td>
<td>60</td>
<td>69</td>
<td>100%</td>
<td>NA</td>
<td>102</td>
<td>NA</td>
<td>NA</td>
<td>3.50%</td>
<td>75%</td>
</tr>
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<td>Cormier</td>
<td>1991</td>
<td>32</td>
<td>90</td>
<td>100%</td>
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<td>69</td>
<td>NA</td>
<td>NA</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>Cunningham</td>
<td>1991</td>
<td>74</td>
<td>194</td>
<td>100%</td>
<td>100%</td>
<td>71</td>
<td>86%</td>
<td>17.10%</td>
<td>12.20%</td>
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<tr>
<td>McAfee</td>
<td>1992</td>
<td>58</td>
<td>119</td>
<td>100%</td>
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<td>60</td>
<td>90%</td>
<td>41%</td>
<td>10%</td>
<td>90%</td>
</tr>
<tr>
<td>Calderon</td>
<td>1992</td>
<td>20</td>
<td>36</td>
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<td>100%</td>
<td>36</td>
<td>100%</td>
<td>20%</td>
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<td>100%</td>
</tr>
<tr>
<td>Christensen</td>
<td>1994</td>
<td>90</td>
<td>109</td>
<td>100%</td>
<td>NA</td>
<td>55</td>
<td>65%</td>
<td>NA</td>
<td>13%</td>
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<td>Gentile</td>
<td>1994</td>
<td>26</td>
<td>29</td>
<td>100%</td>
<td>100%</td>
<td>48</td>
<td>89%</td>
<td>NA</td>
<td>10%</td>
<td>89%</td>
</tr>
<tr>
<td>Johnston</td>
<td>1995</td>
<td>21</td>
<td>43</td>
<td>100%</td>
<td>NA</td>
<td>120</td>
<td>NA</td>
<td>19%</td>
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<td>86%</td>
</tr>
<tr>
<td>Mouwad</td>
<td>1997</td>
<td>24</td>
<td>38</td>
<td>100%</td>
<td>100%</td>
<td>60</td>
<td>78%</td>
<td>45%</td>
<td>4%</td>
<td>78%</td>
</tr>
<tr>
<td>Mateo</td>
<td>1999</td>
<td>85</td>
<td>130</td>
<td>100%</td>
<td>100%</td>
<td>36</td>
<td>87%</td>
<td>33%</td>
<td>8%</td>
<td>76%</td>
</tr>
</tbody>
</table>

Mean: 49 86 100% 100% 66 85% 29% 7% 86%

SD: 28 53 0 27 12% 12% 9%

NA, not applicable; OS, open surgical; Pt, patient.

**Table V. Literature review of endovascular management of mesenteric artery stenosis**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Pt no.</th>
<th>Vessels revascularized</th>
<th>Technical success</th>
<th>Immediate pain relief</th>
<th>Follow-up (mo)</th>
<th>Long-term pain relief</th>
<th>Complications</th>
<th>Mortality rate</th>
<th>Patency</th>
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</thead>
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<td>Matsumoto</td>
<td>1995</td>
<td>19</td>
<td>20</td>
<td>79%</td>
<td>63%</td>
<td>25</td>
<td>52%</td>
<td>32%</td>
<td>0</td>
<td>NA</td>
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<tr>
<td>Hallisey</td>
<td>1995</td>
<td>16</td>
<td>25</td>
<td>84%</td>
<td>81%</td>
<td>27.6</td>
<td>75%</td>
<td>6%</td>
<td>6%</td>
<td>75%</td>
</tr>
<tr>
<td>Allen</td>
<td>1996</td>
<td>19</td>
<td>24</td>
<td>95%</td>
<td>79%</td>
<td>39</td>
<td>79%</td>
<td>5%</td>
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<tr>
<td>Maspes</td>
<td>1997</td>
<td>23</td>
<td>41</td>
<td>90%</td>
<td>77%</td>
<td>27</td>
<td>75%</td>
<td>9%</td>
<td>0</td>
<td>88%</td>
</tr>
<tr>
<td>Nyman</td>
<td>1998</td>
<td>5</td>
<td>6</td>
<td>100%</td>
<td>80%</td>
<td>21</td>
<td>80%</td>
<td>40%</td>
<td>0</td>
<td>40%</td>
</tr>
<tr>
<td>Sheeran</td>
<td>1999</td>
<td>12</td>
<td>13</td>
<td>92%</td>
<td>92%</td>
<td>15.7</td>
<td>75%</td>
<td>NA</td>
<td>8%</td>
<td>74%</td>
</tr>
<tr>
<td>Present</td>
<td>2000</td>
<td>28</td>
<td>32</td>
<td>100%</td>
<td>NA</td>
<td>36</td>
<td>66%</td>
<td>18%</td>
<td>11%</td>
<td>73%</td>
</tr>
</tbody>
</table>

Mean: 17 23 91% 79% 27 72% 18% 4% 70%

SD: 7 12 8% 9% 8 10% 15% 4% 18%

NA, Not applicable; Pt, patient.

In the summary of published trials, immediate pain relief was more likely in the OS treatment group (Tables IV and V) compared with the PAS patients (100% [OS] vs 79% ± 9% [PAS]). However, immediate relief of pain could conceivably be a result of the placebo effect of the procedure or of pain medications used in the postoperative period, both of which probably play a greater role in OS patients. During a mean follow-up of 66 ± 27 months, sustained freedom from recurrent symptoms was noted in 85% ± 12% of the OS patients compared with 72% ± 10% during a shorter period of follow-up (27 ± 8 months) in the PAS patients. In aggregate, complication rates (29% ± 12% [OS] vs 18% ± 15% [PAS]) and mortality rates (7% [OS] vs 4% [PAS]) were higher in the OS treatment group than in the PAS case reports.

Definitive conclusions cannot be inferred from the previous literature because of variable reporting standards. However, long-term pain relief has been universally reported to be better in the OS series. The possible reasons for a sustained freedom from recurrent symptoms are speculative. The number of vessels revascularized has often been reported to influence the long-term outcome. McAfee et al evaluated the results of total revascularization in comparison with incomplete revascularization. The 5-year survival rate for
patient survival rates of 89% and 82%, respectively, and symptomatic improvement was noted in all patients available for follow-up. Similarly, a subgroup analysis of our patient population with single-vessel revascularization had no difference in long-term outcome between OS and endovascular treatment. This may be a reflection of the importance of SMA revascularization. All single-vessel recanalization in the PAS patients involved the SMA, further supporting the study on isolated SMA bypass graft as a durable option. However, multiple-vessel revascularizations were, overall, more durable (symptom-free interval) than solitary SMA revascularization.

The retrospective observational nature of the current study subjects it to numerous disadvantages. The treatments were not randomly assigned but individually selected, which resulted in some of the observed differences. This may not be easily detected. The type of treatment (PAS vs OS) was determined by a number of factors, including the skills available to the physician evaluating the patient. In addition, the sicker patients were more likely to have the less invasive procedure (PAS), and multivessel involvement more commonly had a surgical bypass graft. Moreover, the nonstandardization of treatments within both groups makes them an unsuitable comparison group. However, this is often the fundamental problem when dealing with rare diseases, such as chronic mesenteric ischemia.

Evidence-based medicine favors the use of the best available information when deciding on the most appropriate treatment for a particular condition. However, the evidence for the best treatment option for patients with chronic mesenteric ischemia is limited and controversial, especially since the introduction of endovascular options. Despite the minimally invasive nature of percutaneous endovascular techniques, major complications are not insignificant, and decreased flow to the mesenteric vascular bed can still result in a grave outcome. Although endovascular therapy may confer advantages with respect to length of stay and speed of recovery, on the basis of currently available data, the long-term durability (especially freedom from recurrent symptoms) of PAS is inferior to OS revascularization. Fully cognizant of the limitations of the current study, we recommend OS revascularization as the procedure of choice in patients as an acceptable risk for OS.

REFERENCES


was or the status of their arterial repair? developed symptoms to know what the status of the angioplasty did you perform another angiogram of these patients when they study. It sounds like you answered my first question, which was, the persistent or recurrent symptoms may be unrelated to the is a rarely diagnosed entity. This also brings up the possibility that plaints of abdominal pain. However, chronic mesenteric ischemia symptoms. resent nothing more than a failed angioplasty or “persistent” telephone communication only added to the confusion, as a recurrent symptoms did not coincide with recurrent stenosis. The group occurred within the first year. In addition, in many patients probability of open surgical revascularization, provided the with no or minimal endovascular skills would result in a higher of having an angioplasty. On the contrary, referral to a surgeon or an endovascular surgeon, the patient had a greater probability modality. If the patient was referred to an intervention radiologist of mesenteric arterial stenosis. In general, endovascular procedures are technically more challenging and riskier in patients with occlusions. Hence, patients with multivessel involvement, partic-ularly occlusions, were more commonly seen in the open surgical treatment group. As always, in diseases with multiple treatment options, the referral pattern also determined the therapeutic modality. If the patient was referred to an intervention radiologist or an endovascular surgeon, the patient had a greater probability of having an angioplasty. On the contrary, referral to a surgeon with no or minimal endovascular skills would result in a higher probability of open surgical revascularization, provided the patient was at an acceptable operative risk. To answer your second question. As you had correctly pointed out, a majority of the recurrent symptoms in the PTA group occurred within the first year. In addition, in many patients recurrent symptoms did not coincide with recurrent stenosis. The initial pain relief may have been related to the postprocedure pain medications and the placebo effect of the procedure. Follow-up telephone communication only added to the confusion, as a majority of the patients with “recurrent” symptoms said, “I don’t think I ever got better.” Hence, “recurrent” symptoms may rep-resent nothing more than a failed angioplasty or “persistent” symptoms. About 5% of all emergency room admissions are for complaints of abdominal pain. However, chronic mesenteric ischemia is a rarely diagnosed entity. This also brings up the possibility that the persistent or recurrent symptoms may be unrelated to the mesenteric occlusive disease.

Dr John J. Ricotta (Stony Brook, NY). That was a very nice study. It sounds like you answered my first question, which was, did you perform another angiogram of these patients when they developed symptoms to know what the status of the angioplasty was or the status of their arterial repair?

Dr Kasirajan. If patients developed recurrent symptoms, they initially had a duplex evaluation. Unfortunately, in the angioplasty group, the recurrent symptoms often did not coincide with recurrent stenosis. And if they did not have evidence of recurrent stenosis on the duplex evaluation, they did not undergo another angiogram. Dr Ricotta. Any information on stent versus PTA? You stented some of these people and some you didn’t.

Dr Kasirajan. On subgroup analysis, the numbers became very small. The incidence of recurrent stenosis in the angioplasty-alone group was 33%. And the angioplasty plus stenting group was 11%. But the numbers were too small to perform meaningful statistical analysis.

Dr Tako Ohki (New York, NY). I completely agree with your conclusion, number one, which is preferentially perform surgical bypass. And I also understand your observation in regard to the failure rate of the angioplasty.

I have a strong objection, however, to your conclusion num-ber two, which is when you perform angioplasty, revascularize as many vessels as possible. I think there is a tremendous leap between conclusion 1, observation 1, to conclusion 2 or recom-mendation 2. Once you start recanalizing occluded vessels endovascularly, then you’re going to start causing more harm than good. So I think you should stop at conclusion 1 and keep some reservation for angioplasty. If you start recanalizing every occluded SMA and celiac as you recommend, you can cause a lot of problems. What do you think about your conclusion 2?

Dr Kasirajan. Your point is well taken. Percutaneous multivessel angioplasty, especially in patients with occlusions, may increase the risk of complications and procedure-related mortality. My last rec-ommendation does not really apply to the angioplasty group but to the open surgical treatment group. We feel multivessel revascu-larization, when possible, should be attempted in all patients with chronic mesenteric ischemia. Numerous other authors have simi-larly demonstrated superior long-term patency, improved freedom from recurrent symptoms, and a possible survival advantage for multivessel revascularization, as opposed to solitary bypass.

Dr Yaron Sternbach (Rochester, NY). Congratulations, I think those are great data.

Can you tell us, were you successful in all the procedures that you attempted actually? And can you relate any of the recurrent symptoms perhaps either to the length of the lesion you were treating or to the length of the stent that you used? And to what diameter did you dilate each of these vessels?

Dr Kasirajan. Data were not collected on an intent-to-treat basis. This was a retrospective study; only patients who were recorded as having had a mesenteric angioplasty were available from our computer registry. It is possible we may have had a large subset of patients, where initial attempts to cross a stenosis or occlusion failed. Unfortunately, these would not have been recorded as a mesenteric angioplasty failure. This retrospective study does not represent an intent-to-treat analysis, and we may be underreporting our initial treatment failures for mesenteric angioplasty.

To answer your second question, we did not routinely record
the length of occlusion/stenosis or the length of the stents that we used. The majority of the stents used were balloon-expandable Palmaz stents. On a rough estimate, the SMA was dilated to approximately 6 mm and the celiac 8 mm. Particularly in the mesenteric circulation, initial undersizing of the balloon may be preferable to oversizing the balloon.

Dr John D. Edwards (Cincinnati, Ohio). The question is simple. The patients sounded sicker in the angioplasty group, but in fact, the lesions were probably simpler and more straightforward in the angioplasty group. So two died in surgery, and two died in angioplasty. The question obviously that we would like to know is, regarding the two that died of angioplasty or subsequent to it: would they have had a better result with surgery? Now, I know that’s impossible to answer, but we’d like your guess.

And then the second question I have for you is, this may be one of the areas—I think this is a very dangerous area. I think these are dangerous lesions to try to take on from an endovascular approach. And do you think that perfusion protection devices are going to come into vogue for carotids and renals? Do you think that maybe there’s a role in this, and do you think it might have saved those two bowel infarcts in the angioplasty group?

Dr Kasirajan. There were two bowel infarcts noted in the angioplasty group, one secondary to a dissection and the other probably related to downstream embolization. Both patients subsequently died. With improved techniques, better guidewire, and distal protection devices, we may, to a certain extent, be able to guard against distal embolization. However, the initial attempt to pass a guidewire across the stenosis/occlusion may in itself release embolic debris. Speaking futuristically, in a select subset of patients, the use of lower profile systems with better torque control may make mesenteric angioplasty a more attractive option, in comparison with the technically challenging open surgical methods.

Whether open surgery would have served those two patients better, as you have mentioned, is impossible for me to retro-predict; however, a dissection and a downstream embolization may have been easily avoided with open surgical techniques. Thank you.