Hypothesis: We hypothesize that although rare true aneurysms of the celiac artery carry a definite risk for rupture, current indications for elective intervention remain elusive and management has varied. To assess indications, the risks of surgical repair, and the morbidity of rupture, we reviewed our experience.

Design: We undertook a retrospective medical chart review of all patients with true celiac arterial aneurysms from our institutions from January 1, 1980, through December 31, 1998. We excluded patients with thoracoabdominal aneurysms and pseudoaneurysms. We followed up patients via medical records and/or telephone calls to the patient or a relative.

Results: Of 306 patients with visceral arterial aneurysms, true celiac arterial aneurysms were identified in 18 (5.9%), including 12 men (67%) and 6 women (33%) with a mean age of 64.2 years. Twelve patients (67%) had concomitant associated aneurysms at the time of presentation (8 aortic, 2 renal, 1 popliteal, and 1 femoral). Aneurysm size ranged from 1.5 to 4.0 cm. Only 1 patient (6%) in our series presented with a ruptured aneurysm. Of the 17 patients with intact aneurysms, 9 (53%) underwent intervention, including revascularization in 8 (4 prosthetic, 2 saphenous vein, and 2 primary arterioarterial anastomoses). There was no operative mortality. In follow-up, both saphenous vein grafts were found to be occluded at 1 and 6 months after operation. Among the 9 patients treated nonoperatively, 1 late rupture resulted in death. Eight patients (44%) were alive without symptoms after a mean follow-up of 91 months (range, 1-371 months).

Conclusions: Celiac arterial aneurysms are rare, but rupture occurs, and elective repair should be considered in good-risk patients with aneurysms of greater than 2 cm. An association with nonvisceral arterial aneurysms is frequent. Long-term results with prosthetic grafts have been excellent and should be the conduit of choice for noninfected aneurysms.

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Celiac Arterial Aneurysms

A Critical Reappraisal of a Rare Entity

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RESULTS

DEMOGRAPHICS AND COMORBIDITIES

Of 306 patients with the diagnosis of true visceral arterial aneurysms, 18 (5.9%) were identified with true aneurysms of the celiac artery. Of these 18, 12 (67%) were men and 6 (33%) were women. Seventeen (94%) of the 18 patients were white, and 1 (6%) was of Asian descent. Mean age at presentation was 64.2 years (range, 31-80 years). Only 1 patient (6%) had a ruptured aneurysm at initial presentation. No patient was diabetic or had endocarditis in this series. Two patients (11%) had hypercholesterolemia and 3 patients (17%) had severe chronic obstructive pulmonary disease. Fourteen patients (78%) had a positive smoking history. Two patients...
PATIENTS AND METHODS

We undertook a retrospective review of all patients with the diagnosis of visceral arterial aneurysms at the Mayo Foundation, including the Mayo Clinics at Rochester, Minn, Jacksonville, Fla, and Scottsdale, Ariz, from January 1, 1980, through December 31, 1998. All patients with true celiac arterial aneurysms were included for review and represent our study group. For all patients included for review, results of confirmational imaging studies verified the diagnosis. We excluded those patients with pseudoaneurysms and those with thoracoabdominal aneurysms that involved the celiac artery. We undertook a medical chart review for all patients, with particular attention to patient demographics, comorbidities, aneurysm characteristics and etiology, clinical presentation, diagnostic modalities, management, and outcome. Since this study represents a retrospective review, management of these aneurysms did not depend on a specific protocol, but on the physician’s preference and judgment. We performed long-term follow-up by means of medical chart review and/or direct telephone contact with the patient and/or a relative.

(11%) were receiving corticosteroids, and 1 patient (6%) was receiving estrogen replacement therapy. Six patients (33%) were receiving β-blockers at the time of presentation. None of the patients receiving corticosteroids, estrogen replacement therapy, or β-blockers presented with ruptured aneurysms, and none were found to have a rupture in follow-up.

Concomitant nonvisceral arterial aneurysms were seen in 12 patients (67%). The location of these aneurysms was aortic in 8 (44%), renal in 2 (11%), popliteal in 1 (6%), and femoral in 1 (6%). None of the patients in this series had a family history of aneurysmal disease.

CLINICAL PRESENTATION AND DIAGNOSIS

Of the 18 patients with celiac arterial aneurysms, only 1 patient (6%) presented with a ruptured aneurysm. This 56-year-old man with a 2.3-cm noncalcified aneurysm presented with intra-abdominal hemorrhage and was hemodynamically unstable. Of the remaining 17 patients who presented with intact aneurysms, 2 (12%) presented with abdominal pain and 2 (12%) presented with back pain. No patient had flank pain, pancreatitis, or any symptom suggestive of mesenteric ischemia. No patient in this series presented with primary thrombosis of the aneurysm. Thirteen patients (72%) were asymptomatic at the time of presentation.

Multiple imaging modalities were used to establish the diagnosis in these patients. The diagnosis was most commonly established by means of computed tomography (CT) (12 patients [67%]) (Figure 1). An additional 3 patients (17%) received a diagnosis by means of angiography (Figure 2). Two patients (11%) received a diagnosis by means of ultrasonography and 1 patient (6%), barium enema. No diagnosis was made by means of plain-film radiography, and all patients had the diagnosis established before any surgical intervention.

ANEURYSM CHARACTERISTICS

Seventeen (94%) of the 18 patients with celiac arterial aneurysms had solitary aneurysms. One patient (6%) had 2 aneurysms involving the celiac artery. Eight (44%) of the 18 patients had calcified aneurysms, and none presented with a rupture or were found to have a rupture during follow-up. Four patients (22%) had a thrombus within the aneurysm, but no emboli developed, and no patient presented with a thrombosed aneurysm during follow-up (mean follow-up, 91 months; range, 1-371 months).

The cause of the aneurysm was believed to be atherosclerotic in most patients. Seven patients (39%) had
pathologic changes suggestive of an atherosclerotic origin. Two patients (11%) had cystic medial dysplasia, and 1 patient (6%) had an unspecified collagen vascular disorder. Only 2 patients (11%) had an infectious cause. *Salmonella* was the primary organism in one patient and *Streptococcus* in the other. The remaining 6 patients (33%) had an unknown cause of their aneurysmal degeneration. In each of the patients with an unknown cause, speculation of an atherosclerotic process was entertained. In most of these patients, these atherosclerotic changes were believed to have developed as a secondary process. Aneurysm size was available in 14 patients (78%), and the mean size in our series was 2.3 cm (range, 1.5-4.0 cm).

**INTERVENTIONAL MANAGEMENT AND OUTCOME**

The decision to intervene in patients with a celiac arterial aneurysm depended on the physician’s judgment and preference. No specific protocol was followed in the management of these aneurysms. The patient who presented with a ruptured aneurysm died before completion of operative ligation of his aneurysm. Of the remaining 17 patients with celiac arterial aneurysms, 9 (53%) underwent elective intervention. The indication for intervention included symptoms of abdominal pain in 4 patients (24%) and a documented increase in size of the aneurysm in 2 patients (12%). The remaining 3 patients (18%) had nonspecific indications for intervention. Mean aneurysm size in the group undergoing intervention was 2.4 cm (range, 1.8-4.0 cm).

All 9 patients undergoing elective intervention underwent a transabdominal approach, with 8 (89%) undergoing concomitant revascularization. The remaining patient (11%) underwent successful ligation of the celiac arterial aneurysm without concomitant revascularization. Revascularization was performed using a prosthetic conduit in 4 patients (50%), a saphenous vein graft in 2 patients (25%), and primary resection with arterioarterial anastomosis in 2 patients (25%). No patient required bowel resection or any other concomitant surgical intervention.

We found no operative mortality in the group undergoing elective intervention. Ventral herniation of the abdominal wound developed in 2 patients (22%) in long-term follow-up. Although mesenteric ischemic symptoms did not develop in any patient, both patients undergoing revascularization with saphenous vein conduits were found to have occluded in follow-up at 1 and 6 months after intervention. Mean follow-up in those patients undergoing elective intervention was 98.6 months (range, 1.5-224 months).

**NONOPERATIVE MANAGEMENT AND OUTCOME**

Nonoperative management was chosen in 8 patients (44%). The decision to observe the aneurysm was primarily related to operative risk and the perceived risk for aneurysm rupture. All of these patients were asymptomatic. Four (50%) of the 8 patients undergoing nonoperative management were believed to be at too high a risk to undergo any type of intervention. One patient (12%) declined intervention. Mean size of the aneurysm in this group was 2.1 cm (range, 1.5-3.5 cm). Follow-up imaging studies were performed in all 8 patients (100%). Imaging consisted of CT in 6 patients (75%), ultrasonography in 1 (12%), and angiography in 1 (12%). No aneurysm was found to significantly enlarge during follow-up. One late rupture resulted in death during follow-up. This patient had declined repair and had a 2.5-cm aneurysm that ruptured at 61 months after presentation. Mean follow-up was 91 months (range, 1-371 months).

Although celiac arterial aneurysms are rare entities, they are more frequently encountered as our use of cross-sectional imaging increases. To our knowledge, no true incidence figures are available; however, aneurysmal degeneration of the celiac artery appears to be the fourth most commonly affected of the visceral arteries. The potential risk for rupture of these rare aneurysms has been reported to be quite low. However, most series are small and the true incidence of rupture remains elusive. Only 1 patient (6%) in our series presented with rupture and an aneurysm ruptured in only 1 patient (6%) during follow-up. This finding suggests that the incidence of rupture of these aneurysms is quite low. Other authors have made similar findings. The etiology of the aneurysm likely has an impact on the risk for rupture. Historically, infectious causes were most commonly encountered. However, recent series have shown that an infectious cause is uncommon. In light of this finding, most recent series confirm that the risk for rupture is small. In our present series, only 2 patients (11%) had an infectious cause. Neither patient presented with a rupture.

Although the risk for rupture of these rare entities appears to be low, the factors that might stratify that risk have not been identified. In our present series, comorbid conditions, aneurysm calcification, presence of thrombus, aneurysm size, and sex did not correlate with the risk for rupture. However, with so few numbers and only 1 patient presenting with a ruptured aneurysm, no meaningful statistical analysis is possible. Six patients (33%) were receiving β-blockers at the time of presentation and none presented with a rupture or were found to have a rupture in follow-up.

Concomitant nonvisceral arterial aneurysms have been previously reported to be a common finding in patients with celiac arterial aneurysms. Our current series found 12 patients (67%) with associated, nonvisceral arterial aneurysms. The incidence of concomitant aneurysmal disease in our population is higher than the 18% reported by Graham et al. Most of these aneurysms were atherosclerotic in origin, and none was related to a collagen vascular disorder. None of our patients had a positive family history of aneurysmal disease. Imaging performed to better elucidate nonvisceral aneurysms was the reason the celiac aneurysm was uncovered in most of these patients.

The diagnosis of celiac arterial aneurysm was most commonly established by means of CT. Twelve patients...
(67%) in this series had the diagnosis established using this modality. Most of the historical reports describe angiography as the most commonly used diagnostic tool. However, our use of cross-sectional imaging has greatly increased for the evaluation of aneurysmal disease and abdominal pain. With the advent of endoluminal grafting for the management of aortic aneurysmal disease, the use of adjunctive angiography has increased. This modality will continue to increase our ability to uncover celiac arterial aneurysmal degeneration.

In a previous series, most patients presented with symptoms related to infectious causes. However, in our series, 13 (72%) presented without symptoms. This is most likely related to the more thorough radiological imaging and the change in the etiology of these aneurysms.

Intervention in these patients should be performed selectively. However, most patients should undergo intervention. When rupture occurs, intervention is obviously mandatory to save the patient’s life. Simple ligation of the aneurysm with observation for ischemia is advocated by many authors to be the treatment of choice in patients with rupture. Reports in the trauma literature of ligation of the celiac artery have shown that it is well tolerated, with a low incidence of hepatic, splenic, or bowel ischemia. Expeditious intervention with control of hemorrhage is most prudent in these patients. Percutaneous transcatheter embolization has been reported by some authors; however, we have no experience with this procedure for the treatment of patients with celiac arterial aneurysms.

The ideal approach to management in the asymptomatic patient remains elusive. When rupture is not present, revascularization seems reasonable for selected patients in light of the high mortality encountered with rupture. Shumaker and Siderys reported the first resection with concomitant revascularization of a celiac arterial aneurysm in 1958. Although the criteria for appropriate patient selection has not traditionally included size, we believe that an aneurysm of greater than 2 cm warrants intervention in patients with reasonable risk levels. No patient in our series had a rupture of an aneurysm that was less than 2 cm in diameter. No definitive statement regarding management based on size can be made with such small numbers. Eight (80%) of the 9 patients undergoing elective intervention underwent subsequent revascularization. One patient (11%) underwent successful ligation of the aneurysm without concomitant revascularization. Of those undergoing revascularization, 4 patients (50%) had prosthetic grafts and 2 patients (25%) had saphenous vein conduits. Prosthetic grafts were more durable. Both saphenous vein grafts became occluded at 1 and 6 months postoperatively. Other authors have not reported a difference in patency when comparing these conduits for the management of celiac arterial aneurysmal disease. Although the risk for rupture appears to be low, the morbidity and mortality of elective intervention is likewise quite low. Owing to the inability to predict rupture accurately and the excellent results of intervention, we recommend intervention in all patients with aneurysms of greater than 2 cm who are considered to have reasonable operative risks.

Results of observation of patients with celiac arterial aneurysms have not been previously reported, to our knowledge. In our series, 8 patients (44%) were observed without any further intervention. The size of the aneurysm did not seem to be an important factor, since we found little difference in sizes between those undergoing intervention and those undergoing observation. No significant growth was seen in these patients when follow-up imaging studies were performed. However, some growth was seen in patients with outside studies, and subsequently elective intervention was undertaken at our institutions. One patient with a 2.3-cm aneurysm was found to have a rupture during follow-up at 61 months after presentation. No factors in that patient predicted the subsequent rupture.

Aneurysms involving the celiac artery are rare; however, they carry a small, but definite, rupture risk. Although the risk for rupture is small, it is unpredictable and the results of elective intervention have been excellent. An association with nonvisceral arterial aneurysms appears frequently. We recommend intervention with ligation and revascularization in all patients with reasonable risks and with aneurysms of greater than 2 cm. When revascularization is undertaken, superior patency appears to favor prosthetic conduits or primary arterioarterial anastomoses.

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REFERENCES

DISCUSSION
Mellick T. Sykes, MD, San Antonio, Tex: I must confess that I, like many vascular surgeons, secretly covet visceral artery aneurysms. Uncommon and dangerous, each of these—the splenic, the hepatic, the mesenteric, the celiac—has its own quirky natural history, its mysterious structural variations, and its own unpredictable behavior. The operation is anticipated with delight; the anatomy is beautiful but treacherous. Careful dissection is rewarded, and sloppiness punished by hemorrhage or ischemia. This, we feel, is what surgery should always be about.

Dr Stone and his colleagues have assembled what appears to be the largest single series of celiac artery aneurysms.
to date. This is a classic Mayo paper: crisp presentation, clear slides, and exemplary results with modest and well-supported conclusions. However, the series, although our largest, is small. The data must be parsed carefully to glean its value.

We are taught, as Dr Stone says, that (1) celiac aneurysms are uncommon but not rare. In a busy lifetime practice, we will see one or two but never be truly practiced in their treatment. (2) An increasing majority will present as asymptomatic, incidentally discovered lesions seen during cross-sectional imaging for other reasons, and (3) other aneurysms will be present in over half the patients, complicating therapy and perhaps taking greater priority.

What does this series say about therapy? The following guidelines are suggested. Observation is tempting but hazardous. Twelve percent or about 1 in 9 will rupture. Rupture is usually lethal. No predicted factors, including unchanged size, to date, have predicted freedom from rupture. Elective repair has excellent results with essentially no mortality in this and other series. In any reasonable-risk patient, therefore, elective repair seems advisable.

The authors mention several points which require clarification.

(1) Both saphenous vein reconstructions suffered early, albeit asymptomatic, thrombosis. For a mycotic aneurysm, would you ligate and hope for the best or use saphenous vein?

(2) If observation is chosen, intervention criteria are problematic, since no aneurysm in this series expanded; yet one ruptured and the patient subsequently died. What exactly do you tell the patients you are following? Although I, like you, will follow the patients, do your data support this at all?

(3) How did you come to the 2-cm criteria for resection, since rupture occurred twice in aneurysms only slightly larger than this? Would you be critical of a smaller threshold?

(4) Should we be tempted to try transcatheter embolization in the emergent or elective treatment of these lesions?

J. David Richardson, MD, Louisville, Ky: 1 repaired 1 celiac aneurysm with a saphenous vein graft and noted on follow-up that it was thrombosed. The patient died. Is that a competitive flow phenomenon or something intrinsic in the graft itself?

Dr Stone: Dr Sykes, thank you so much for your kind comments and your thoughtful questions. I share your feeling as far as visceral artery aneurysms are concerned. Most vascular surgeons would feel that way. Fortunately, as vascular surgeons, we get the opportunity to see patients electively, whereas our general surgical colleagues tend to handle them when they rupture.

Your first question regarding mycotic aneurysms: In a situation of that nature, I would ligate the aneurysm without revascularization. When you look at the historical series that have been reported with much higher incidences of infections, ligation alone was quite successful, so that would be my management option.

Secondly, what do I say to the patients observed? I am not exactly sure how to answer that. I guess at this particular point, I would prefer not to observe, but if I had that scenario, I would consider placing that patient on a β-blocker. I have no scientific evidence to support it, but I would follow the patient closely and continue to counsel them that perhaps intervention would be a wiser choice.

How did we arrive at the 2-cm guideline? It really was quite arbitrary, to be quite honest. Both patients that did rupture had aneurysms that were greater than 2 cm. In light of that, as well as the low risk for intervention, we feel that it is a reasonable size to consider for repair.

We have not had any experience with transcatheter embolization for celiac artery aneurysms. We have had experience with aneurysms involving the superior mesenteric artery. It is quite successful in our hands with the superior mesenteric artery, but we have not had experience with celiac artery aneurysms. Others have reported transcatheter embolization with good results.

In regards to Dr Richardson’s question, I share your sentiments about the saphenous vein graft. I do think there is the potential for competitive flow, but there also may be some kinking of the saphenous veins in that location which could lead to occlusion.

ARCHIVES OF INTERNAL MEDICINE


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Background: While the effectiveness of upper endoscopy has been established for acute nonvariceal upper gastrointestinal tract hemorrhage, its optimal timing has not been clearly defined. Early endoscopy has been advocated for its ability to achieve prompt diagnosis, risk stratification, and therapeutic hemostasis.

Objective: To determine whether early vs delayed endoscopy improves patient and economic outcomes for all risk groups with nonvariceal upper gastrointestinal tract hemorrhage.

Methods: A systematic review of 3 computerized databases (MEDLINE, HEALTHSTAR, and Cochrane Database of Systematic Reviews) was performed along with hand searching of published abstracts to identify English-language citations from 1980 to 2000.

Results: Twenty-three studies met explicit inclusion criteria. The highest-quality study examining outcomes in low-risk patients found no significant complications at 1-month follow-up for any outpatients managed with early endoscopy. The largest randomized trial of high-risk patients showed no mortality benefit but a significant decrease in transfusion requirements with early endoscopy. Seven of the 8 studies examining the effect of early endoscopy on length of stay as a measure of resource utilization demonstrated a significant reduction compared with that of delayed endoscopy. However, most included studies were found to suffer from 1 or more potentially significant methodologic shortcomings.

Conclusions: The overwhelming majority of existing data suggest that early endoscopy is safe and effective for all risk groups. The clinical and economic outcomes of early endoscopy should be confirmed in additional well-designed randomized controlled trials. Given the strength of the evidence, efforts to develop a more standardized and time-sensitive approach to acute nonvariceal upper gastrointestinal tract hemorrhage should be undertaken.

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