From the Society for Vascular Surgery

Natural history and management of splanchnic artery aneurysms in a single tertiary referral center

Young Erben, MD,[a] Adam J. Brownstein, BA,[b] Sareh Rajaee, MD,[a] Yupeng Li, PhD,[c] John A. Rizzo, PhD,[b,c] Hamid Mojibian, MD,[d] Bulat A. Ziganshin, MD, PhD,[b,e] *and* John A. Elefteriades, MD,[b] *New Haven, Conn; Stony Brook, NY; and Kazan, Russia*

ABSTRACT

Objective: Splanchnic artery aneurysms (SAAs) are rare, and little is known about their natural history and management. We reviewed our single-center experience in managing this population of patients.

Methods: A retrospective review of the Yale radiologic database from January 1999 to December 2016 was performed. Only patients with an SAA and a computed tomography scan of the abdomen were selected for review. Demographics of the patients, aneurysm characteristics, management, postoperative complications, and follow-up data were collected. Our primary outcomes included aneurysm growth rate and risk of rupture in those patients managed nonoperatively and morbidity and mortality of those SAA patients who underwent operative intervention.

Results: There were 122 patients with 138 SAAs identified; 77 were male (62%), with a mean age of 66 years (range, 25-94 years). On computed tomography, 56 (45%) had previously diagnosed or concomitant aneurysms elsewhere. Of the patients managed nonoperatively, 101 patients (79%) had 108 SAAs; in the operative intervention group, 25 (21%) patients had 30 SAAs. The mean overall vessel diameter was 1.76 ± 0.83 cm. The diameter of observed and operatively repaired SAAs was 1.58 ± 0.56 cm and 2.41 ± 1.23 cm, respectively ($P = .00001$). Mean follow-up was 50 ± 42 months for nonoperative management without any adverse events related to SAA, including 10 patients with SAA >2.0 cm. The mean observed growth rate for SAA was 0.064 ± 0.18 cm/y. All symptomatic patients who presented with severe abdominal pain (n = 11 [44%]) underwent operative intervention. Five patients presented with a ruptured SAA (3.6%; range, 2.3-5.0 cm); all of them except one underwent operative intervention. Other indications for repair included large size in seven, rapid growth in two, other open abdominal surgical procedures in two, multiple aneurysms in one, and desire to pursue fertility treatment in one. Operative repair included 14 (56%) endovascular embolizations and 11 (44%) open abdominal operations. After endovascular embolization, two patients underwent abdominal operation for hemorrhage and splenectomy. Open repairs included bypasses in six, splenectomy in two, resection in two, and plication in one. Two patients had postoperative acute kidney injury that resolved and one died of multisystem organ failure. One bypass occluded without sequelae. On multivariable regression analysis, female sex ($P = .02$) was associated with faster growth rate, and a history of smoking ($P = .04$) was associated with slower growth rate.

Conclusions: It seems reasonable to observe asymptomatic patients with an SAA <2.0 cm because of the slow growth rate (0.064 ± 0.18 cm/y) and benign behavior. When intervention is needed, both open and endovascular options should be considered. (J Vasc Surg 2018;■:1-9.)

Based on autopsy reports, the prevalence of splanchnic artery aneurysms (SAAs) may be as high as 10%.[1] Splanchnic arteries include the celiac artery, superior mesenteric artery, and inferior mesenteric artery and all of its branches.[2] It is important to recognize SAAs because up to 25% may be complicated by rupture, which has an estimated mortality rate between 25% and 70%. There are only a handful of series reporting SAAs, and most recommend early operative intervention without any natural history data to support their contention.[3-7] Three large series to date report the importance of operative intervention in the presence of pseudoaneurysms and branch vessel aneurysms.[2,8,9] Corey et al[2] recently reported that 91% of small SAAs (<25 mm) remain stable in size and therefore may not require frequent surveillance imaging. Given the paucity of data on the management of SAAs, we sought to review our single-center experience with this population of patients. Our aim was to report the natural history of

From the Section of Vascular and Endovascular Surgery,[a] Aortic Institute at Yale-New Haven Hospital,[b] and Section of Vascular Interventional Radiology,[d] Yale School of Medicine, New Haven; the Department of Economics and Department of Family, Population and Preventive Medicine, Stony Brook University, Stony Brook[c]; and the Department of Surgical Diseases #2, Kazan State Medical University, Kazan.[e]

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Correspondence: John A. Elefteriades, MD, Aortic Institute at Yale-New Haven Hospital, Yale University School of Medicine, 789 Howard Ave, Clinic Bldg CB317, New Haven, CT 06519 (e-mail: john.elefteriades@yale.edu).

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Table I. Comorbidities and clinical presentation of the patients

Characteristic	Total patients (N = 120)	Patients undergoing operative intervention	Patients managed nonoperatively	*P*
Demographics				
Age, years, mean ± SD (range)	66 ± 14 (29-94)	58 ± 16 (25-79)	68 ± 12 (29-94)	<.00001
White race	109 (89)	21 (84)	88 (91)	.465
Male	77 (63)	14 (56)	63 (65)	.487
Presentation				
Asymptomatic	111 (91)	14 (56)	97 (100)	<.0001
Symptomatic	11 (9)	11 (44)	0 (0)	<.0001
Comorbidities				
Hypertension	79 (68)	17 (71)	62 (67)	.811
Smoking history	59 (56)	11 (50)	48 (57)	.632
Hyperlipidemia	56 (49)	8 (33)	48 (53)	.111
CAD	25 (22)	2 (9)	23 (25)	.096
CKD	19 (16)	1 (4)	18 (20)	.117
Diabetes mellitus	17 (15)	1 (4)	16 (18)	.118
Atrial fibrillation	16 (14)	4 (17)	12 (13)	.741
COPD	13 (11)	0 (0)	13 (14)	.067
History of stroke or TIA	9 (8)	1 (4)	8 (9)	.682
CHF	8 (7)	1 (4)	7 (8)	1
History of MI	7 (6)	1 (4)	6 (7)	1
PAD	5 (4)	1 (4)	4 (4)	1
Connective tissue disorder (Ehlers-Danlos syndrome)	1 (1)	0 (0)	1 (1)	1

CAD, Coronary artery disease; *CHF*, congestive heart failure; *CKD*, chronic kidney disease; *COPD*, chronic obstructive pulmonary disease; *MI*, myocardial infarction; *PAD*, peripheral arterial disease; *SD*, standard deviation; *TIA*, transient ischemic attack.
Values are reported as number (%) unless otherwise indicated.

SAAs and the outcomes of those SAAs treated in an open or endovascular fashion.

METHODS

Cohort of patients. We identified all patients with SAAs at Yale-New Haven Hospital from January 1, 1999, to December 31, 2016. Patients were identified from the Yale radiology database through specific search terms and by *International Classification of Diseases, Ninth Revision* disease codes 442.84 (visceral aneurysm), 442.83 (splenic artery aneurysm), and 442.89 (aneurysm of other specified artery). Furthermore, only those patients with a computed tomography (CT) scan were included in the study. Data collection included details of each patient's clinical presentation, comorbidities, management, and follow-up data as identified through retrospective chart review (Table I). Our primary outcomes included aneurysm growth rate and risk of rupture in those patients managed nonoperatively and morbidity and mortality of those SAA patients who underwent operative intervention. Consent of individual patients for study inclusion was not obtained or required, and this study received approval from the Yale Institutional Review Board (HIC# 1411014866) as a retrospective chart review.

Definitions. An aneurysm of the splanchnic arteries was defined as a lesion that is 1.5 times the size of the native vessel on axial imaging, reported by our radiologists. The decision for intervention was based on the individual surgeon's preference. Patients were considered lost to follow-up if they did not undergo any additional CT imaging after the initial diagnostic cross-sectional study.

Acute kidney injury was defined using the Kidney Disease: Improving Global Outcomes definition. This includes an increase in serum creatinine concentration by ≥0.3 mg/dL within 48 hours, an increase in serum creatinine concentration ≥1.5 times baseline, and a urine volume <0.5 mL/kg/h for 6 hours.

Imaging data and growth rate calculation. CT scans were used to determine the size and location of the SAA. Aneurysm diameter was determined by directly measuring aneurysm size from outer wall to outer wall. Observed growth rate was calculated for all patients with two CT scans as follows: (diameter at last CT scan − diameter at initial CT scan)/time interval between CT scans. Also, a statistically estimated growth rate for SAA was calculated with an instrumental variables approach. The estimates were obtained by means of regression analysis in which aneurysm growth followed

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