Strategies for endovascular treatment of complicated splenic artery aneurysms

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ABSTRACT

Objective: Endovascular treatment (ET) is being increasingly used for splenic artery aneurysms (SAAs), but systematic treatment strategies have not been defined. We set out to investigate the optimal strategies for ET of complicated SAAs (CSAAs).

Methods: CSAAs were classified into three types: type I, rupture or impending rupture; type II, at the origin of the splenic artery; and type III, having an aberrant splenic artery from the splenomesenteric trunk (type IIIA) or celiacomesenteric trunk (type IIIB). SAAs treated at our center during the last decade were reviewed, and CSAAs were selected for analysis. Patients' demographics, clinical manifestations, aneurysm characteristics, ET strategies, and outcomes were analyzed.

Results: A total of 154 SAAs were identified, with 24 (15.6%) being CSAAs. Open surgery was employed in two patients, whereas 22 patients underwent ET. There were 3 patients with type I (type IIIA co-occurred in one of them), 5 with type II, and 15 with type III CSAAs. Treatment strategies included the following: immediate and thorough exclusion with embolization of the collaterals for type I; and dense embolization of the sac and outflow artery, with or without embolization of the inflow artery, or covered stent placement in the splenomesenteric trunk or celiacomesenteric, for types II and III. Technical success was achieved in 21 patients (95.5%). Mean follow-up was 33.7 ± 31.2 months (range, 1.5-117.0 months). The aneurysms remained completely thrombosed and unenlarged in 21 patients (95.5%). Reintervention was needed in one patient (4.5%) for persistent sac enlargement. The covered stent was asymptomatically occluded in one patient (11.1%). No hepatic or intestinal ischemia or death developed perioperatively or during the follow-up period.

Conclusions: With reasonable strategies toward the urgency and thoroughness needed for aneurysm exclusion as well as the anatomic challenges, ET appeared to be feasible, safe, and effective in the management of CSAAs. (J Vasc Surg 2018;■:1-8.)

Keywords: Aberrant splenic artery; Aneurysm; Rupture; Endovascular treatment

Splenic artery aneurysms (SAAs) are the third most common abdominal aneurysms after aortic and iliac artery aneurysms,[1] accounting for 60% of visceral artery aneurysms.[2] Treatment of SAAs has gradually evolved from surgical repair to endovascular treatment (ET), which has gained widespread acceptance as the first-line intervention for most patients because of its minimal invasion and shorter hospital stay.[3] The efficacy and strategy of ET for SAAs are influenced by the aneurysm's location and size, the nature of the aneurysm (intact or ruptured), and the congenital anatomic variations of the splenic artery (SA) or the celiac trunk. Considering these factors, complicated SAAs (CSAAs) were defined and classified mainly on the basis of a technical perspective of ET in this study. The investigation aimed to retrospectively analyze the respective strategies and outcomes of ET of CSAAs. To the best of our knowledge, studies on this subject are limited to isolated case reports.

METHODS

Patients. This study was approved by the Committee for the Protection of Human Subjects at Zhongshan Hospital, Fudan University. All patients participating in the study signed an informed consent document. A retrospective review was performed of patients with SAAs who were admitted to our hospital from April 2007 to April 2017. CSAAs were defined and classified into three types (Fig 1): type I, with rupture or impending rupture; type II, at the origin of the SA and close to the bifurcation of the celiac trunk; and type III, an aberrant SA originating from the splenomesenteric trunk (SMT; type IIIA) or celiacomesenteric trunk (CMT; type IIIB). The perioperative and follow-up outcomes of CSAAs treated by ET are presented for analysis in this paper. The patients' demographics, including sex, age, presenting symptoms, and comorbidities, and the endovascular strategies were recorded. Aneurysmal characteristics, including size, location, nature of the aneurysms, and anatomic variations, were also reviewed.

Therapeutic management. Indications for treatment included ruptured or symptomatic SAAs, presence of a

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pseudoaneurysm or mycotic aneurysm, SAAs in women of childbearing age, and asymptomatic SAAs of ≥2 cm in diameter. There were no absolute contraindications to ET; relative contraindications included hemodynamic instability that was unresponsive to resuscitation and required immediate surgical intervention, coagulopathy, impaired renal status, known allergy to contrast media, and infection within the target vasculature. In general, ET was considered the first-line approach in both selective and emergency cases. Endovascular procedures included coil embolization of the outflow artery of the aneurysm, aneurysm sac, inflow artery of the aneurysm, and collaterals feeding the ruptured sac whose inflow SA had already been occluded; covered stents were placed across the aneurysm and across the origin of the SA. The treatment of each CSAA patient included one or more of these procedures. The treatment strategy was based on CSAA types and the physician's preference. Strategies for repair were performed in accordance with the preoperative evaluation by computed tomography angiography (CTA), except in emergent situations. Technical success was defined as successful deployment of coils or covered stent as intended, with angiographic documentation of aneurysmal occlusion or sluggish flow under systemic heparinization.

Follow-up protocol. Patients were routinely followed up after ET by duplex ultrasound or CTA at 3, 6, and 12 months and annually thereafter. CTA was performed as the first-choice modality during the follow-up. Duplex ultrasound was a substitute for CTA in patients with impaired renal status. Even though the coil-induced artifact frequently influences the evaluation of sac perfusion, the maximal diameter of the aneurysm can be measured to assess the prognosis. Reinterventions, aneurysm exclusion, covered stent occlusion, recurrence, and presence of concomitant aneurysms in other vascular beds were recorded. After discharge, the patients with covered stents were administrated 75 mg/d of clopidogrel for 6 months and a lifelong regimen of aspirin (100 mg/d).

RESULTS

Clinical characteristics. A total of 154 patients with SAAs were identified from April 2007 to April 2017. Of these, 24 patients had CSAAs. Open surgery was employed in two patients, and the remaining 22 patients (12 [54.5%] male and 10 [45.6%] female; mean age, 52.8 ± 11.3 years [range, 35-74 years]) were treated with ET. The type distribution and clinical characteristics of the 22 CSAAs are shown in Table I. No aneurysms were found in other arteries. No history of bacterial endocarditis, vasculitis, or collagen vascular diseases was identified in these patients.

Procedures. CTA and selective SA angiography during ET were performed in all patients to establish the diagnosis and to evaluate the anatomic complexity of the SAA and SA variations. A single saccular aneurysm was found on the main trunk of the SA in all patients. The mean size of aneurysms was 3.5 ± 1.7 cm (range, 2.0-10.0 cm). All aneurysms were located at the proximal segment of the SA except for the ruptured aneurysm at the distal segment of the SA in patient 1. Elective ET was undertaken in 19 patients (86.4%). Emergency ET was performed only for type I CSAAs (patients 1, 2, and 13; Fig 2). A summary of the endovascular procedures performed in each patient is displayed in Table II. Technical success was achieved in 21 patients (95.5%), except in patient 11 (type IIIB), in whom ET was abandoned after considering the high risk of coil migration into the superior mesenteric artery (SMA) and the relatively small aneurysm size. Covered stents were used in nine patients (40.9%), including in patient 20, who had two overlapping endografts deployed. Coil embolization was used in all technically successful patients, except for patient 7, who received only a covered stent (Viabahn, 5 × 100 mm; W. L. Gore & Associates, Flagstaff, Ariz) in the SA. In patient 22, a coil migrated into the SMA and was retracted by a snare catheter. No intestinal ischemia developed perioperatively, and the SMA remained patent on CTA at 3 months.

Outcomes. Mean postoperative hospital stay was 4.0 ± 3.0 days (range, 1.0-15.0 days), and no intestinal, hepatic, or diffuse splenic infarction or death developed perioperatively or during the follow-up (mean, 33.7 ± 31.2 months; range, 1.5-117.0 months). Only one patient (patient 9; 4.5%) needed reintervention with secondary embolization of the sac because of its persistent perfusion 7 years after the primary ET. Occlusion of the covered stent was detected in one (patient 14; 11.1%) of nine patients 2 years after ET, but the patient remained asymptomatic because of abundant collateral perfusion (Fig 3).

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective single-center cohort study
- **Take Home Message:** Endovascular treatment of 22 complicated splenic artery aneurysms resulted in no mortality, technical success rate of 95.5%, reintervention rate of 4.5%, and asymptomatic thrombosis of a covered stent in 11.1%, at a mean follow-up of 34 months.
- **Recommendation:** This study suggests that complicated splenic artery aneurysms can be successfully managed by endovascular intervention.

DISCUSSION

Despite being the most common visceral artery aneurysms, SAAs, especially CSAAs, remain rare entities. A study by Stanley and Fry[4] found SAAs in 0.8% of 3600