ORIGINAL ARTICLE

Endovascular and surgical management of splenic artery aneurysms

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ABSTRACT

BACKGROUND: Although true splenic artery aneurysms (SAA) are rare, due to advancements in imaging techniques, they are seen more frequently. The aim of this study is to present our strategy of managing patients with SAA.

METHODS: Retrospectively, 13 patients who were treated in a tertiary university care center between 2012 and 2020 were included. Their demographic, clinical information, and post-operative complications were analyzed.

RESULTS: Seven male and six female patients were evaluated between the ages of 27 and 73. The mean age was 49.8±13.2. The diameter of the aneurysm was between 17 and 80 mm with a mean range of 31.5±16 mm. Seven patients were treated with endovascular interventions (EV). Two patients were referred to surgery with failed attempt of EV, but patients refused surgery and were followed up consequently. Patients who had larger aneurysms with an increased risk of rupture underwent aneurysmectomy and splenectomy. Conservative management was decided on two patients initially: A patient who was previously operated on for a sigmoid colon tumor, and had an aneurysm size of 15 mm and another patient with a surgical history of thoracic aortic dissection with an aneurysm size of 18 mm. One patient who underwent surgery had post-operative pancreatic fistula and was treated with percutaneous drainage. The treatment of the remaining 12 patients was completed without any further complications.

CONCLUSION: Splenic artery aneurysm treatment should be individualized. Endovascular treatment can be considered for patients with stable aneurysms larger than 2 cm in the elective setting. Open surgical treatment should be considered in patients with ruptured SAA or hemodynamically unstable, complicated patients.

Keywords: Endovascular treatment; management; open surgery; splenic artery aneurysm.

INTRODUCTION

Visceral artery aneurysms (VAA) are uncommon pathologies, with incidence ranging from 0.1 to 2% in general.[1] About 25% of patients with VAA are admitted to emergency departments with rupture, and the mortality rate is 8.5%.[2] The most common VAA is a splenic artery aneurysm (SAA), which constitutes 60% of VAAs and is commonly observed in the sixth decade.[1,3] The pathophysiology is not exactly known but several findings such as loss of elastic fibers and smooth muscle, and defects in tunica media are detected in patients with SAA.[2]

The majority of patients with SAA are asymptomatic.[3] Sudden abdominal pain in the left upper quadrant with hemodynamic instability and gastrointestinal bleeding is usually seen in patients with SAA rupture. Although SAA is 4 times more frequent in female patients, the risk of rupture is 3 times higher in male patients.[1] The risk of rupture is associated with sex, size of the aneurysm, rate of growth, underlying disease, history of liver transplant, portal hypertension, and pregnancy.[4-6] Mortality rates are reported up to 25% (and up to 75% in pregnancy) therefore the patients with high risk factors for rupture should be treated promptly.[7]

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SAAs are mostly single, saccular shaped, located in bifurcation zones 74–87% in the distal third, 20–22% in the mid-third, and <6% in the proximal third of the splenic artery.[7,8] Visceral artery pseudoaneurysms should also be considered in the differential diagnosis which could occur due to iatrogenic injury, abdominal trauma, infection, pancreatitis, and, more uncommonly, peptic ulcer disease.[5,6]

With the improvement of imaging techniques, SAAs are being diagnosed even more frequently. Contrast-enhanced computer tomography (CT) or CT angiography is the most commonly used method for diagnosing SAAs although USG and magnetic resonance imaging can be used in pregnant patients or patients with contrast allergy.[6,9] Conventional angiography remains the gold standard that can be used for both diagnosis and treatment.[6]

In this paper, we present our experience treating 13 patients with SAAs in a tertiary care setting.

MATERIALS AND METHODS

The study procedure has been approved by the institutional review board (2023/873). Patients diagnosed with true SAA in a tertiary care center were retrospectively analyzed between January 2012 and January 2020. The patients with pseudoaneurysm of the splenic artery were excluded. A total of 13 patients were included. Demographic data of the patients including age, gender, size of the aneurysm, localization, etiological factors, comorbidities, clinical signs and symptoms, treatment choice, complications, morbidity, and mortality rates were analyzed.

RESULTS

A total of 13 patients met the inclusion criteria, true SAAs, three were male, and five were female. The age range between 27 and 73 years, and the mean age was 49.8±13.2 years. The diameter of the true SAA ranged from 17 mm to 80 mm, and the mean size was 31.5±16 mm. In these patients with SAA, management was evaluated under three main headings: endovascular intervention, surgery, and conservative follow-up. Table 1 summarizes management options for individual patients with SAA.

A total of seven patients underwent endovascular intervention (EV) treatment. Five of these patients were male, and two were female. The age range of patients who underwent EV treatment was 33–58 years, and the largest aneurysm diameters ranged from 21 mm to 34 mm. Two of these patients with SAA had known portal hypertension, and two had

Table 1. Management of different individual splenic artery aneurysms

Patient	Age	Gender	Size, mm (aneurysm)	Underlying etiology + comorbidities	Approach	Complication
1	73	Male	17	Operated sigmoid colon tumor	Conservative	No
2	62	Male	18	Thoracic aorta dissection	Conservative	No
3	65	Female	24		Failed EV→Declined surgery →Conservative	No
4	27	Female	26		Failed EV→ Declined surgery →Conservative	No
5	33	Male	34	Idiopathic portal hypertension+ tortuous multiple aneurysms	EV	No
6	39	Female	21		EV	No
7	58	Male	34		EV	No
8	42	Female	30	Diffuse atherosclerosis	EV	No
9	56	Male	25	Diffuse atherosclerosis + History of myocardial infarction	EV	No
10	42	Male	30	Portal hypertension	EV	No
11	53	Male	31	Blunt thoracic trauma	EV	No
12	50	Female	80		Surgery	Pancreatic fistulization and percutaneous drainage performed
13	48	Female	40		Surgery	No

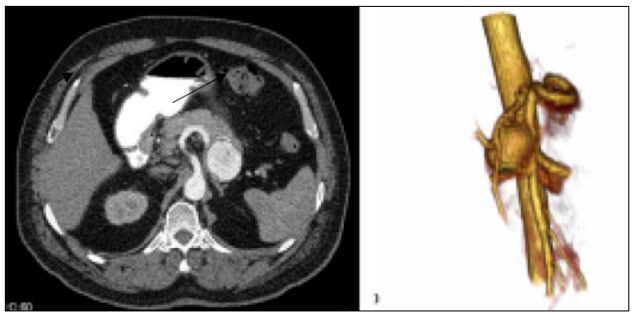

Figure 1. CT angiography and reconstruction of a splenic artery aneurysm.

extensive atherosclerosis. SAA was detected in the control tomography of a patient with a previous history of blunt thoracic trauma and in the abdominal US of 2 patients who did not have a specific complaint. CT angiography was performed on all patients (Fig. 1). Following CT confirmation, patients underwent EV treatment, and the interventions were successful (Fig. 2a). Control CTs confirmed successful embolization (Fig. 2b). No complications were observed in the median 5-year follow-up.

Two patients who were presented to the clinic with slight left upper quadrant pain were diagnosed initially with us. After CT angiography, SAAs of 24 and 26 mm were confirmed. Endovascular coil embolization was the initial management plan but failed. Surgery was subsequently recommended; the patients did not consent therefore managed conservatively. No further complications were developed in the follow-up. Initial conservative management was preferred in two patients who had surgical management history for a sigmoid colon tumor and a thoracic aortic dissection with aneurysm sizes of 17 and 18 mm, respectively with no further complications during the follow-up.

Open surgery was preferred for two SAAs (80 mm and 40 mm in size) in two female patients aged 50 and 48 with past medical histories significant for severe hypertension and

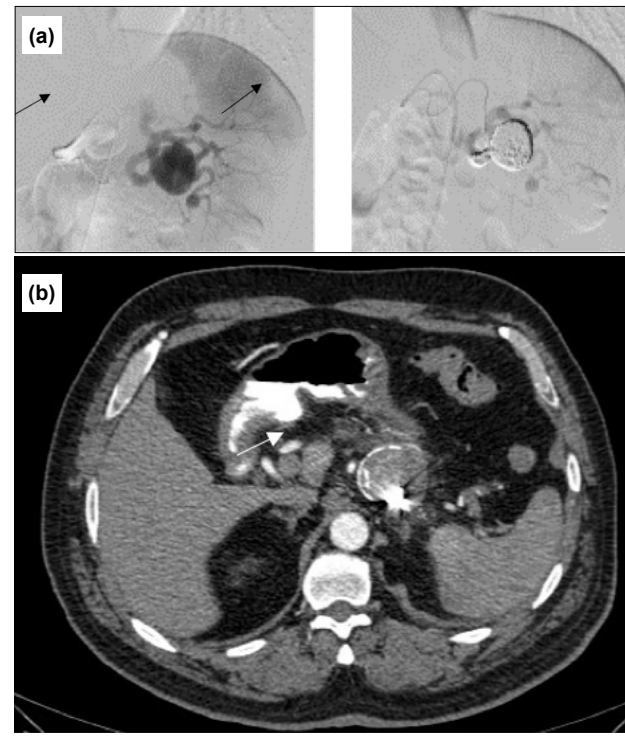

Figure 2. (a) Conventional angiographic image of a splenic artery aneurysm (SAA) pre- and post-coil embolization, **(b)** Control CT angiography of a SAA patient treated with coil emobilization (arrow).

arrhythmia. Aneurysmectomy and splenectomy were performed in both patients (Fig. 3). Postoperatively a pancreatic fistula developed in one of the patients which was managed with percutaneous drainage. No further complications developed during the follow-up.

DISCUSSION

In this article, we shared our experience regarding the management of 13 patients with SAA. Although most SAAs are asymptomatic, the consequences of a ruptured SAA are dire.

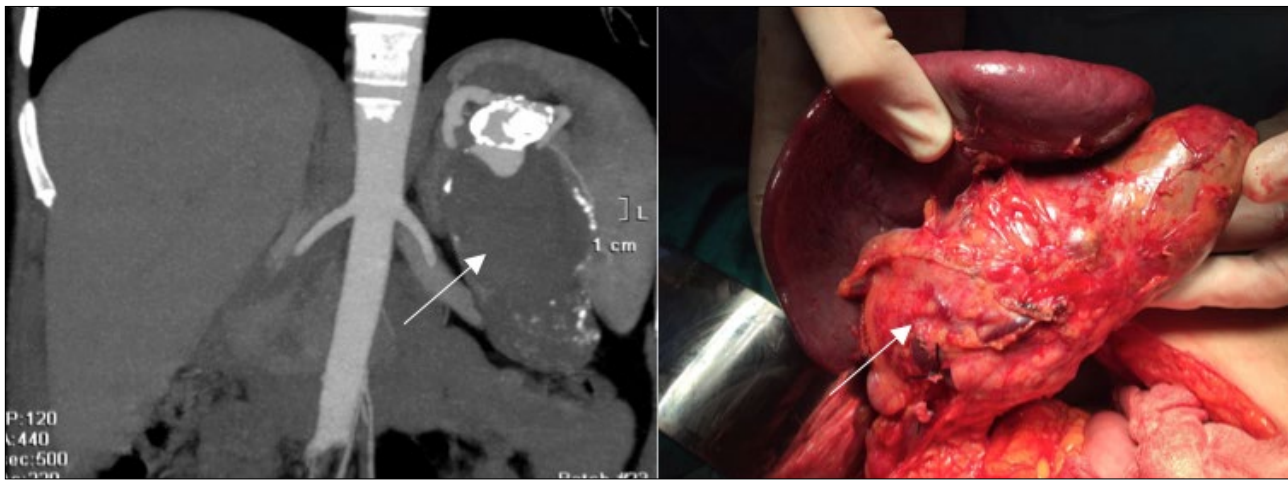

Figure 3. (a) CT image of a giant splenic artery aneurysm (SAA) **(b)** Intraoperative findings – aneurysmectomy with splenectomy. Arrows point to SAA.

Therefore, prompt diagnosis and management are critical. Treatment is required for patients with ruptured aneurysms, aneurysms >2 cm in diameter, symptomatic patients, pregnant patients and female patients of childbearing age, portal hypertension, and increase in size (0.5 cm/year). Endovascular and surgical (laparoscopic or open) management are possible, each having advantages or disadvantages in particular scenarios.[9-12] Treatment should be individualized considering size, localization of aneurysm, risk factors for rupture, patient age, operative risks, and arterial tortuosity.[6,8,9]

Endovascular (EV) management should be the first treatment of choice unless contraindicated, especially in SAAs location proximal and mid splenic artery and in patients with high perioperative risk who are difficult to manage surgically.[9,10] Coil embolization, covered stents, plug deployment, glue, endoluminal thrombin injection, polyvinyl alcohol, particles, and gel foam can be used in the EV approach.[12] The choice of EV intervention, embolization, or stenting, depends on the SAA's shape, size, and localization. The most common complication after EV repair is post-embolization syndrome (PES), which presents with fever, ileus, and abdominal pain. Pleural effusion and pancreatitis may also occur. PES was more common after treatment of SAAs, located in splenic hilus. In a meta-analysis by Hogendoorn et al. PES rate in patients who underwent EV repair was 25.1–30% in the literature.[13] Other complications of EV procedures are coil migration, distal infarction, abscess development, and uncommon, only rupture of the aneurysm. Despite successful angioembolization, recanalization has been reported in 12.5% of the patients who require reintervention.[9]

EV procedures are less invasive and preferable because of the shorter duration of hospital stay, lower risk of perioperative morbidity and mortality, and better quality of life in the perioperative period with reported success rates of 90–100%[2,10-12] In a meta-analysis of 1,321 true SAA patients, it was found that 511 (38.7%) patients underwent open repair (resection of the aneurysm with splenectomy in most patients, and reconstruction of the artery), 425 and 385 (29.1%) patients were treated with endovascular repair (embolization and stenting) showed better early outcomes for EV compared to open surgical repair. But open repair had fewer late complications and less need for reintervention.

For surgical repair, aneurysm resection with or without splenectomy, proximal and distal splenic artery ligation, and trans-aneurysmal arterial ligation can be considered.[9] If the SAA is proximally located resection, and end-to-end anastomosis can be done in most patients, preserving the spleen. In an aneurysm involving splenic hilum, splenectomy may be performed.[10] If the SAA is close to the pancreas, proximal and distal ligation is recommended. Conventional open surgical approaches should be performed in ruptured SAAs, hemodynamically unstable patients, and complicated SAAs.[9] Laparoscopic surgery can be considered in other scenarios where endovascular management is contraindicated or failed.[9,14-16] A prospective randomized controlled study that compared open and laparoscopic surgery to manage true SAAs included 29 patients over 10 years. Performed surgical procedures were aneurysmectomy with splenic artery ligation or end-to-end anastomosis. The conversion rate to open surgery was 13.3%. Shorter operation time, restarting oral diet quicker, early drain removal, shorter hospital stays, and less morbidity were observed in laparoscopic cases; major morbidity was seen in the open surgery group, and there was no mortality in both groups. No laparoscopic procedures were performed in our series. In giant SAAs larger than 5 cm and cases with comorbidities, staged management, surgery after embolization, can be utilized.[9]

In our study group, both EV and surgical approaches were utilized accordingly without any need for reintervention for patients with SAA. For the follow-up of the patients CT angiography or MRI should be performed yearly.[10]

CONCLUSION

Treatment strategies should be individualized for SAAs. EV procedures should be the first treatment choice in an elective setting when treatment is indicated. Conventional open surgical approaches should be performed in ruptured SAAs, hemodynamically unstable patients, and cases with complicated SAAs.

Ethics Committee Approval: This study was approved by the Istanbul University, Istanbul Medical Faculty Ethics Committee (Date: 19.04.2023, Decision No: 1735908).

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Authorship Contributions: Concept: F.Y.; Design: F.Y.; Supervision: F.Y., F.A.G.; Materials: F.Y., B.C.T., B.İ., A.F.K.G., B.S.; Data collection and/or processing: F.Y., B.C.T., İ.F.A., B.S., M.S.Ç.; Analysis and/or interpretation: F.Y., B.C.T., B.İ., B.S., F.A., A.F.H.G.; Literature search: F.Y., B.C.T., B.I., A.F.K.G., B.S., I.F.A.; Writing: F.Y., B.S.; Critical review: F.Y., F.A.G.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Splenik arter anevrizmalarında endovasküler ve cerrahi tedavi

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AMAÇ: Gerçek splenik arter anevrizması (SAA) nadir görülmesine rağmen, görüntüleme tekniklerindeki gelişmeler sayesinde daha sık karşımıza çıkmaktadır. Bu çalışmanın amacı kliniğimizde SAA tanısı alan hastalara tedavi yaklaşım stratejilerimizi sunmaktır.

GEREÇ VE YÖNTEM: Üçüncü basamak bir üniversite hastanesinde 2012-2020 yılları arasında gerçek SAA tanısı alan 13 hastanın özellikleri, tedavi yaklaşımları ve komplikasyonları retrospektif olarak değerlendirildi.

BULGULAR: Yaşları 27 ile 73 arasında değişen 7 erkek ve 6 kadın hasta değerlendirildi. Ortalama yaş 49.8±13.2 idi. Anevrizmaların çapları 17 mm ile 80 mm arasında idi ve ortalama çap 31.5±16 mm idi. Yedi hasta endovasküler (EV) yöntemle tedavi edilirken, 2 hastaya EV tedavinin başarısız olması nedeniyle cerrahi planlandı, ancak hastalar cerrahi tedaviyi kabul etmeyerek takip altına alındı. Anevrizma boyutları büyük olan ve rüptür riski yüksek olan iki hastaya anevrizmektomi ve splenektomi yapıldı. Sigmoid kolon tümörü nedeniyle ameliyat edilen ve anevrizma boyutu 17 mm olan bir hasta ve daha önce torasik aort disseksiyonu nedeniyle ameliyat edilip anevrizma boyutu 18 mm olan bir hastanın konservatif olarak takip edilmesine karar verildi. Ameliyat edilen bir hastada pankreas fistülü gelişti ve perkütan drenaj ile tedavi edildi. Diğer 12 hastada takipleri sırasında herhangi bir komplikasyon gelişmedi.

SONUÇ: Splenik arter anevrizması tedavisi bireysel olarak planlanmalıdır. Endovasküler tedavi yöntemleri hemodinamisi stabil olan 2 cm'den büyük anevrizmalarda elektif şartlarda ilk tedavi seçeneği olarak düşünülmelidir. Rüptüre SAA'larda, hemodinamik olarak stabil olmayan hastalarda ve komplike SAA'larda konvansiyonel açık cerrahi yaklaşım tercih edilmelidir.

Anahtar sözcükler: Açık cerrahi; hasta yönetimi; endovasküler tedavi; splenik arter anevrizması.

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