

ORIGINAL ARTICLE

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Splenic artery aneurysm: Management of a rare entity in a series of patients**Server Sezgin Uludag¹, Deniz Esin Tekcan Sanli², Nazım Gures³, Ahmet Necati Sanli¹,
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**Abstract**

Splenic artery aneurysm (SAA) is a rare clinical condition; however, it can lead to life-threatening hemorrhages. Endoscopic and endovascular treatments or laparoscopic and open surgical approaches can be used for the treatment. On the grounds of its rarity, there are few series in the literature. We aimed to present our center's experience of splenic artery aneurysm management. Patients' data who were treated in our hospital between 2008 and 2019 due to splenic artery aneurysm was retrieved from the hospital's registry software. Patients' demographic data (age, gender); type, localization and the diameter of aneurysms and treatment methods applied were examined. There were 13 (10 females, 3 males) consecutive patients (mean age was 51.7±16.9 years) in the study. Aneurysms were located proximally in six patients, distally in six patients, and one patient had aneurysm both proximally and distally. Nine of the aneurysms were saccular and four were fusiform. Coil embolization was successful in one patient, splenic artery ligation was applied to six patients and splenectomy was performed in four patients. Two patients, in whom coil embolization failed, were included in the follow-up program since they were asymptomatic. Morbidity and/or mortality due to aneurysms were not seen in treated patients. Nowadays, endovascular interventions are the primary treatment option for SAAs. However, they do not apply to every patient and surgery may be necessary. While choosing the appropriate surgery, the primary goal should be minimally invasive procedures that require good laparoscopic experience. Isolated ligation of the splenic artery and protection of the spleen should be performed if possible.

Keywords: Splenic artery aneurysm, coil embolization, endovascular intervention, minimally invasive procedure**Introduction**

The normal diameter of the splenic artery is considered to be between 0.43 and 0.49 cm and an increase of 50% or more of the arterial diameter is regarded as an aneurysmatic dilatation [1]. Splenic artery aneurysms (SAAs) are the third most common intraabdominal aneurysms after aortic and iliac artery aneurysms and account for 60-70% of the visceral artery aneurysms [2]. Although the true prevalence of splenic artery aneurysm is unknown it is estimated to vary widely from 0.2% to 50% [2-6]. They can be associated with pancreatitis, trauma, peptic ulcer disease, atherosclerosis, fibromuscular dysplasia, pregnancy,

vasculitis, cirrhosis, portal hypertension [7,8]. They are usually smaller than 3 cm and asymptomatic, they are determined incidentally in radiological examinations; whereas, aneurysms over 5 cm are considered as giant aneurysms and usually cause symptoms including epigastric or left upper quadrant pain, feeling of fullness, loss of appetite, nausea, and vomiting. A pulsatile mass may be palpated in the left upper quadrant [9,10]. Those may be single or multiple, and peripheral calcification and mural-intramural thrombus may be present [11]. Although the risk of spontaneous rupture ranges between 2-10%, the risk of rupture is higher in cases associated with liver transplantation, pregnancy, and portal hypertension [12-14].

There are few series in the literature about this rare entity, which may also lead to life-threatening complications due to hemorrhage. In this study, we aimed to share the case series that we treated with various treatment approaches in our center.

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Material and Methods

The study protocol was approved by the local ethics committee (Date: 07.01.2021 No: 2567). The study complied with the Declaration of Helsinki. Patients treated due to the (SAAs) between 2008 and 2019 were included in the study. All demographic and medical data of the patients were examined. CT angiography was utilized after questioning for renal failure and contrast allergy in all patients to determine some features of aneurysms (localization, type, diameter, number).

Angiographic procedures were performed by the interventional radiology team. The angiographic embolization was achieved via an approach through the common femoral artery. All patients were heparinized (75 IU/kg). A long sheath was used if the tortuosity of the splenic artery prevented easy access. The aim of the embolization was to occluding the outflow tract, the aneurysm itself and the inflow tract. The angiographic endpoint was set to be the total occlusion of the aneurysm. The splenic artery itself was conserved in all of the patients and none of the coils migrated to the splenic or celiac arteries.

Surgical procedures were performed by the general surgery team. Vascular ligation with or without splenectomy was performed in patients with symptomatic multiple aneurysms or an aneurysm larger than 5 cm. Patients who were not considered for surgery were treated with interventional radiological methods. A consensus was reached on the technique of the treatment to be used depending on the location of the lesion, the age of the patient, operative risks, and clinical status.

Statistical analysis

Descriptive statistics were carried out, the mean and standard deviation was calculated for continuous variables, and frequencies and numbers for categorical variables. As the overall number of cases was relatively small, no inferential statistical analysis was undertaken.

Results

Thirteen patients were included in the study. Of the thirteen patients, ten were female and three were male. The mean age of the patients was 51.4 (40-67). Eleven of the patients had applied to the hospital because of their symptoms; in two patients SAA had been found incidentally by radiologic examinations. These two patients applied after radiological detection and without any symptoms; the other patients were symptomatic with the complaints of epigastric - left upper quadrant pain and/or palpitation, fullness.

CT angiography revealed a distally located aneurysms in six patients and a proximally located aneurysm in six patients. One patient had both proximal and distal aneurysms on the splenic artery. Nine patients had saccular (Figs. 1a, 1b, 1c) and four had fusiform aneurysms. The mean aneurysm diameter was 4.47 cm (between 1.3 and 13 cm).

Coil embolization was attempted in five patients (Figs. 2a, 2b, 2c), however only one of them was successful. Two patients in whom coil embolization failed were followed up, isolated splenic artery ligation (SAL) was performed on the other two. No complications developed during the two-year follow-up in two patients with failed coil embolization.



Figure 1a A smooth contoured, spherical aneurysm with heterogeneous enhancement at the level of the distal pancreatic corpus, at the posterior adjacent of the stomach fundus in axial sections on CT angiography images



Figure 1b. In coronal sections, the aneurysm appears to originate from the splenic artery

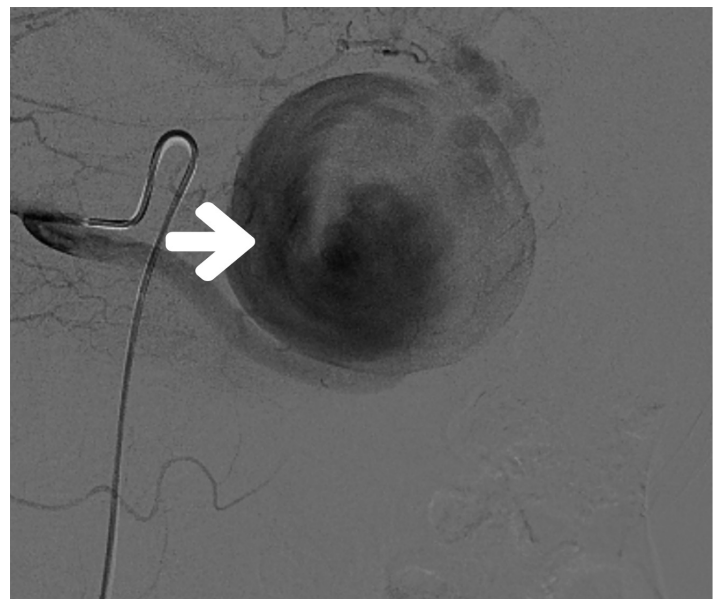


Figure 1c. DSA image, turbulent flow in the giant aneurysm cavity by intra-arterial bolus contrast injection

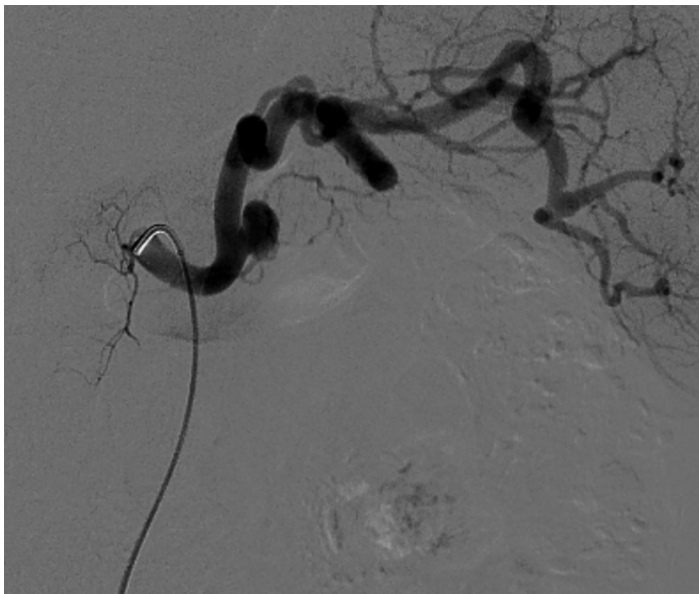


Figure 2a. The splenic artery appears to be quite long and tortuous, and a proximal splenic artery aneurysm that is smooth contoured, 20x18 mm in size on DSA images obtained by selective catheterization of the splenic artery



Figure 2b. Reference image in control graphs after embolization with the coil



Figure 2c. No intraluminal filling in the aneurysm cavity is observed after contrast injection

Six patients underwent SAL in total. Two of them were patients with failed coil embolization. SAL was performed in laparoscopic surgery in one patient and open surgery in five patients. Postoperative complications were not observed in patients undergoing SAL and their follow-up was uneventful. Four patients underwent splenectomy. One of them was the patient who developed splenic necrosis after applying SAL. Splenectomy was preferred because of a giant aneurysm in two patients and both distal and proximal aneurysms in one patient. Postoperative complications were not seen in patients who underwent splenectomy. The picture of the splenectomy specimen of a patient with splenectomy is shown in Fig. 5. Demographic features and medical data of the patients (previous/concomitant significant diseases, operations) types-locations-diameters of the aneurysms, and treatment modalities are shown in Table1.

Discussion

SAA is the most common type of visceral aneurysm. Saccular and fusiform types are available. In our study, eight patients had a saccular type aneurysm. SAAs are rare vascular disorders that are generally small in size and asymptomatic. The diameter of the aneurysms of the patients in this study was 4.47 cm. There has been an increase in the incidence of SAAs detected by the widespread use of radiological imaging methods with other indications. As with all vascular pathologies, the gold standard in the diagnosis of SAA is angiography, which has both diagnostic and therapeutic advantages. In this study, all patients were evaluated by CT angiography. Although various symptoms may be seen depending on the location and size of the aneurysm, the most feared and mortal complication is rupture of SAAs leading to massive intrabdominal bleeding [15,16]. Two patients were asymptomatic. The risk of rupture of splenic artery aneurysms ranges from 2% to 37%, with the mortality rate approaching 90% when untreated. Mortality did not develop in any of the patients. Treatment indications vary according to age, gender and symptoms. The treatment modality for SAA depends on the age of the patient, the location of the lesion, and clinical status. Six of the patients in this study had an aneurysm located in the proximal, six in the distal, and the proximal and distal. For patients over 60 years with no symptoms and with aneurysms smaller than 20 mm in diameter, conservative management with CT scans annually is advocated [17]. Treatment should be considered in patients with liver transplantation or portal hypertension, symptomatic, young or pregnant patients, in aneurysms greater than 2 cm since there is a high lifetime risk of rupture.

Although there is no standard approach in the follow-up and treatment of splenic artery aneurysms, it has been reported that asymptomatic, small (<2.0 cm), densely calcified aneurysms will not grow significantly over time and can be followed up effectively with serial imaging because they have a negligible risk of rupture [18]. Asymptomatic aneurysms larger than 2 cm should be treated due to the risk of rupture. Symptomatic aneurysms in pregnant women or those planning a pregnancy, in patients with portal hypertension, or liver transplantation candidates should be treated. However, since the probability of rupture of pseudoaneurysms is high regardless of the size, treatment should always be planned [19]. Surgical or endovascular methods are used in the treatment.

Table 1. Demographic features and medical data of the patients

Age	Gender	Location and type of aneurysm	Diameter (cm)	Comorbidity		Treatment
48	F	Prox, Sac	1.3	Preeclampsia	Coil Tri	Follow-up
45	F	Dist, Sac	4.5	-	Coil Tri	Follow-up
51	F	Dist, Fus	2	IgG4 Deficiency		SAL
55	F	Dist, Fus	9	HT	Coil Tri	SAL
42	M	Prox, Sac	4	Portal HT,Cir		SAL (Lap)
42	F	Dist, Sac	3	Pancreatitis		SAL
67	M	Dist+Prox Sac	2+3	PKD, HT, CAD		Splenectomy
56	F	Prox, Fus	13	-		Splenectomy
66	F	Prox, Sac	2.2	HT		Splenectomy
64	F	Dist, Sac	10	HT,BPH		Splenectomy
40	F	Prox, Sac	4	PTC	SAL Tri	SAL
40	F	Dist, Sac	1.3	SLE		Coil Emb
53	M	Prox, Fus	3.3	Portal HT, Cir, Pancreatitis	Coil Tri	SAL

F: Female, M: Male, Sac: Saccular, Prox: Proximal, Dist: Distal, Fus:Fusiform,HT: Hypertension, Cir: Cirrhosis, PKD: Polycystic Kidney Disease, CAD: Coronary Artery Disease, BPH: Benign Prostatic Hyperplasia, PTC: Papillary Thyroid Carcinoma, SLE: Systemic Lupus Erythematosus, Angio: Angiography, SAL: Splenic Artery Ligation, Lap: Laparoscopic, Coil Emb: Angiographic Coil Embolization, Coil Tri: Coil Embolization Tried/Failed, SAL Tri : Splenic Artery Ligation Tried/Failed

Among the endovascular treatment methods, aneurysm embolization, stent-graft, or bare-metal stent placement into the aneurysm lumen are the methods used today. Transarterial embolization of pseudoaneurysm using coils, detachable balloons, thrombin injections, or gel foam is the first-choice treatment if the patient is hemodynamically stable with a high success rate. Centers with high case numbers where endovascular therapy is applied report successful results in visceral aneurysms. They also reported that in their series, they applied the endovascular treatment to nearly half of the patients with visceral aneurysms and their technical success rates were over 90% [20-23]. The fact that they have high experience in endovascular interventions and appropriate selection of cases are effective factors in this success. They also report that success rates have increased with an increasing number of cases [20,21]. Rarely, recanalization after endovascular embolization has been reported, so a CT exam at 1 and 6 months after interventional treatment is advised. In these cases, whom the endovascular intervention is unsuccessful, surgical treatment or follow-up without any other treatment can be selected according to size and symptomatology [24]. In our series, in accordance with the literature, coil embolization was tried on almost half of the subject group (five out of thirteen); however, it was successful only in one patient.

This is mandatory that patients for surgical treatment must be

selected carefully since the operative mortality rate is 0.5% with the elective repair. When embolization is contraindicated by the proximity of the aneurysm to the spleen (with the risk of splenic infarction) or when the aneurysm is not suitable for endovascular treatment (such as large size, wide neck, thin walls, marked tortuosity of the splenic artery) surgical approach should be adopted [25]. The options are open or laparoscopic surgery with ligation of the splenic artery, excision of the aneurysm with reanastomosis of the artery, or splenectomy with the removal of the aneurysm.

Aneurysms located in the proximal or middle third of the splenic artery may be treated with simple excision, with proximal and distal ligation of the artery with splenic preservation. Resection of the aneurysm with splenectomy may be performed for aneurysms located in the distal third.

Since patients are at an increased risk for infection and thrombosis after splenectomy, spleen preservation by preserving the vasa brevia should be the first surgical goal. Although good results have been reported with laparoscopic aneurysmectomy of SAA [25-27], simple ligation of the splenic artery may be the primary surgical choice and can be performed laparoscopically. Partial splenectomy may be considered in cases with partial circulatory insufficiency in the spleen during surgery. Splenectomy is indicated in cases with multiple aneurysms or distal hilar location and when the aneurysm

is large and complicated [28-30]. Thus, in accordance with the literature, we evaluated the option of splenic artery ligation primarily for cases that are not suitable for endovascular treatment. We performed splenectomy in four patients who developed necrosis in the spleen after ligation or were not suitable for ligation.

There are some limitations of our study. In our retrospective study, the incidence of rupture was not evaluated in cases with splenic artery aneurysm. Besides, the follow-up processes and standardization of the patients who were followed up or undergoing surgical/endovascular treatment were not included in the study.

Conclusion

Nowadays, endovascular interventions are the primary treatment option for SAAs. However, they do not apply to every patient, and surgery may be required. Even though the long term results of open surgery are excellent, perioperative mortality is higher. While choosing the appropriate surgery, the primary target should be minimally invasive procedures that require good laparoscopic experience. Isolated ligation of the splenic artery and protection of the spleen should be performed if possible.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

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Ethical approval

The study protocol was approved by Cerrahpasa Medical Faculty Ethics Committee (Date: 07.01.2021 No: 2567).

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