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Endovascular treatment of splenic artery aneurysms

Robert Juszkat[1], Marek Winckiewicz[2], Fryderyk Pukacki[2], Grzegorz Oszkinis[2], Zbigniew Krasiński[2], Michał Goran Stanišić[2], Wacław Majewski[2]

[1] Department of Radiology, Karol Marcinkowski Medical University in Poznan, Polska
[2] Department of General and Vascular Surgery, Karol Marcinkowski Medical University in Poznan, Polska

Author's address: Robert Juszkat, Department of Radiology, Karol Marcinkowski University of Medical Science, ul. Długa 1/2, 61-848 Poznań, e-mail: robertju@wp.pl

Summary

Background: Aneurysms of visceral arteries, including splenic artery, are relatively rare vascular pathology. Currently they are diagnosed more and more commonly due to widespread application of imaging procedures in diagnostics of other abdominal conditions. Splenic artery aneurysm develops often asymptomatically, and its rupture is associated with a high mortality rate. Hence, elective treatment of such aneurysms is suggested as a prophylaxis of the rupture.

Material/Methods: This report contains presentation of treatment outcome of nine patients with splenic aneurysms (10 aneurysms) treated in the years 2001-2006. In eight cases the treatment involved endovascular placement of metal embolisation coil into the aneurysm sac. In one female patient with two splenic artery aneurysms, following dissection of the proximal aneurysm and end-to-end anastomosis of the artery, the latter was repaired endovascularly in a delayed procedure.

Results: In none of the described cases any serious complications were observed. Complete occlusion of the aneurysm lumen following endovascular procedure was observed in 7 of 9 cases (77.8%). Moreover, we managed to spare the spleen in all the described cases.

Conclusions: Endovascular techniques provide a good alternative for open surgery in treatment of the splenic artery aneurysm, although the latter is still the treatment of choice in cases of rupture of visceral artery aneurysm.

Key words: spleen • aneurysm • embolisation • endovascular treatment

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Background

Splenic artery aneurysms provide 60% of all the visceral artery aneurysms [1, 2]. They are mostly true aneurysms, and occur in multiplicity in as much as 30% of the cases [1, 3]. Such aneurysms may develop at any age, but they occur mostly within the 5th and 6th decade of life [3].

The literature contains descriptions of many cases of development of visceral artery aneurysms in patients with portal hypertension and multiparous women, and of rupture of such aneurysms during pregnancy and perinatal period [3]. Moreover, atherosclerosis is considered another etiological factor of visceral aneurysms [2-4].

Visceral aneurysms often have asymptomatic course, being detected during diagnostic imaging procedures, although in some patients they may manifest themselves as undefined epigastric pain [3, 5]. Some of them are diagnosed only during the autopsy following sudden aneurysm rupture and patient's death due to hypovolaemic (haemorrhagic) shock [6, 7]. Large aneurysms of the splenic artery (over 2 cm in diameter) are an indication for open surgery or endovascular treatment, due to high risk of rupture [3].

The aim of this report is to present experience of our centres in endovascular treatment of the splenic artery aneurysms.

Materials and methods

Nine patients (7 women and 2 men) hospitalised in the Department of General and Vascular Surgery of the Poznań University of Medical Science in the years

Table 1. Splenic artery aneurysms.

No.	Sex	Patient age	Aneurysm localisation	Aneurysm size	Treatment method
1	F	23	Splenic artery, hilus	16 mm	Endovascular embolisation
2	F	29	Splenic artery, hilus	16 mm	Endovascular embolisation
3	F	24	Splenic artery, hilus	13 mm	Endovascular embolisation
4	F	43	Splenic artery, medium portion	21 mm	Endovascular embolisation
4	F	37	Splenic artery, hilus	18 mm	Endovascular embolisation
5	M	29	Splenic artery, hilus	23 mm	Endovascular embolisation
6	F	60	Splenic artery, 2 aneurysms (proximal section and hilus)	25 x 20 mm 15 mm	Combined treatment (endovascular and open surgery)
7	F	47	Splenic artery, hilus	26 mm	Endovascular embolisation
8	M	34	Splenic artery, hilus	19 mm	Endovascular embolisation
9	F	39	Splenic artery, hilus	17 mm	Endovascular embolisation

Figure 1. **A**. Splenic artery aneurysm located in the splenic hilus. **B**. The same patient. Microcatheter introduced into the aneurysm sac. **C**. Post-embolisation status of the aneurysm.

2001-2006 underwent endovascular treatment of their splenic artery aneurysms. The patients' age varied from 23 to 60 years (mean age 40.5). A short description of all the patients is presented in Table 1. Eight patients were determined with single splenic aneurysm, whilst one female patient with two aneurysms, one in proximal segment, and the other within the splenic hilus. In the eight patients diagnosed with single aneurysms, 7 occurred in the splenic hilus, and one in medium portion of the artery.

All patients underwent abdominal sonography, angio-CT and arteriography (DSA). DSA examination was performed using Seldinger technique, with catheterisation of the abdominal aorta and then, selectively, the visceral trunk. The aneurysm was determined in three various projections, including precise determination of its size and ratio of diameter of the aneurysm to this of its neck. (Fig. 1a).

All endovascular procedures were performed under local anaesthesia through femoral access by 6F introducer (Balton) placed in the common femoral artery. The visceral trunk and then the splenic artery were catheterised using 0.35 guidewire (Terumo) and 5F femoral-renal catheter or 5F Cobra catheter (Balton). Next microcatheter Vasco 10 or 14 (Balt) was introduced into the aneurysm through femoral-renal catheter or 6F Casasco guiding catheter (Fig. 1b).

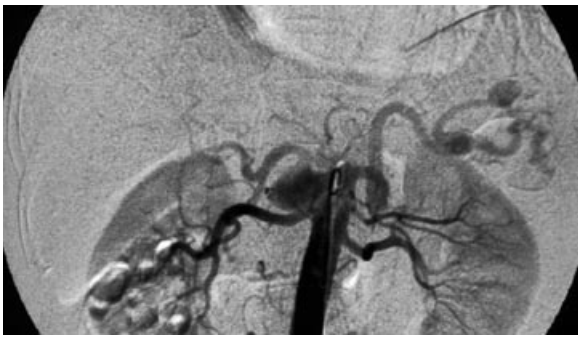

Figure 2. DSA examination of the abdominal aorta.

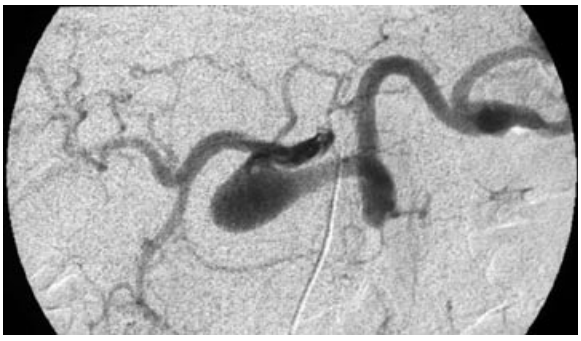

Figure 3. Selective examination of the visceral trunk. Spindle-shaped aneurysm in proximal section of the splenic artery.

The microcatheter was introduced on J-type guidewires of 0.07-0.09 in diameter (Balt). By means of the microcatheter, platinum coils of diameter adequate to the aneurysm size were placed into the aneurysm sac, until the aneurysm was completely shut off from the circulation (Fig. 1c).

All the aneurysms were treated using a system of embolisation coils (Balt) detached mechanically or hydraulically, and compatible with the microcatheter. MDS 3D or helical embolisation sets of various thicknesses (0.010", 0.014" and 0.018") were used. In the case of hydraulically detached coils, following placement of the coil into the aneurysm sac and ensuring that its position is appropriate, the coil was detached from the guide by pressure of column of normal saline administered to the internal canal by a special syringe attached to the other end of the guide. Volume of saline used for the coil detachment was approx. 0.10-015 mL. Following the coil detachment in the aneurysm sac, the guide was removed from microcatheter. In case of mechanically detached coils, the coil was detached by putting it out from the microcatheter and its 90° rotation. During the embolisation patients were routinely administered IV heparin bolus of 5,000 IU. Moreover, the macro- and microcatheter were flushed with heparin/normal saline solution (1,000 IU/litre).

The female patient with two splenic artery aneurysms detected already by sonography was managed in a slightly different way. Angiography confirmed the presence of a large spindle-shaped aneurysm of 2 cm in diameter involving 2.5 cm of proximal portion of the splenic artery and a smaller one, of 1.5 in diameter, in a distal portion (within the splenic hilus) (Fig. 2 and 3). The patient was initially qualified for surgical treatment. During the surgery, significant elongation of the splenic artery with a balloting aneurysm located approx. 1 cm off the origin from the visceral trunk (Fig. 4) was revealed. The aneurysm was excised and the artery was connected by end-to-end anastomosis (Fig. 5). Due to technical problems with approaching the splenic hilus, further surgery was abandoned and endovascular repair of the peripheral aneurysm was scheduled to be performed later. The patient was re-hospitalised in three months and transcutaneous endovascular embolisation of the left splenic aneurysm was performed according to the above-described procedure (Fig. 6 and 7).

Efficiency of the endovascular procedures was assessed on a short-term basis, based on the lack of blood inflow to the aneurysm, position of the embolisation coils in the aneurysm sac and blood flow through the splenic artery and its branches.

Results

All the endovascular procedures were performed without complications. In seven cases complete embolisation of the aneurysm was obtained and no blood inflow to the aneurysm was observed after the procedure. In two cases partial embolisation of the aneurysm neck was performed;

Figure 4. The same patient, intraoperative picture. Aneurysm within proximal section of the splenic artery.

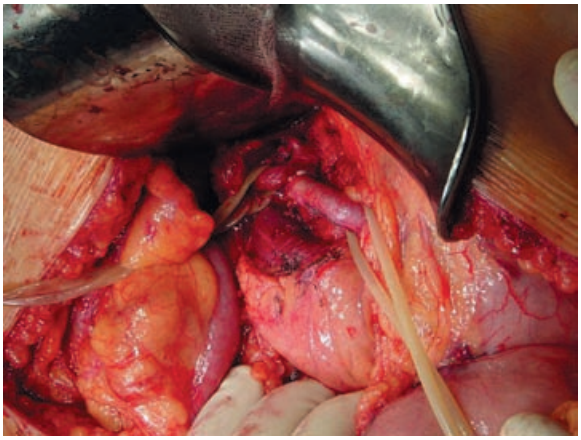

Figure 5. Intraoperative picture. Post-excision aneurysm status and end-to-end anastomosis of the splenic artery.

Figure 6. The same patient. DSA examination: selective examination of the visceral trunk following surgical treatment.

Figure 7. Post-embolisation status of the aneurysm by means of MDS coils.

in one case due to unfavourable aneurysm sac/neck ratio (> 1.5), while in the second due to technical problems with the placement of subsequent coils.

In all cases check-up angiography performed immediately after the procedure revealed unobstructed blood flow through the splenic artery and its branches. No coil migration to the vessel or splenic artery spasm was observed. Also no bleeding from the aneurysm sac during the embolisation was observed in any of our cases.

Discussion

Aneurysms of visceral arteries are relatively rare vascular pathology, revealed in 0.05-1.6% of post mortem examinations [8]. Splenic artery aneurysms are the most common among all the visceral aneurysms [9]. They provide up to 70% of all the visceral artery aneurysms, according to an assessment of a large patient group [10]. They used to be detected extremely rarely, but nowadays more and more commonly, as a casual discovery during imaging diagnostics of other abdominal conditions [10]. Splenic artery aneurysms may not only occur in multiplicity, but sometimes in association with aneurysms of other visceral or renal, aortic or intracranial arteries [10-13]. They occur more frequently in women than in men, with the ratio amounting even up to 3:1 [10, 14-15]. Atherosclerosis, traumas, infections, vascular inflammation and dysplasia, as well as intra-arterial administration of cytotoxic drugs are considered their etiologic factors [4-5, 13]. Certainly, patients with hepatic cirrhosis and portal hypertension provide a group of particularly high risk of development of visceral aneurysms [5, 8, 15-16], where splenic artery aneurysms may reach particularly large size [16]. In cirrhotic patients they may occur even with the absence of other symptoms of portal hypertension, such as oesophageal varices [8]. Other cause of the development of splenic artery aneurysms is acute or chronic pancreatitis, but in this case the aneurysms are mostly false [17]. However, majority of the reports concerning splenic artery aneurysms does not analyse their character. The division of the aneurysms into true and false ones is not made either [10].

Visceral aneurysms are often featured with asymptomatic course (it may refer to more than 90% cases), and even now they happen to be diagnosed after sudden death caused by its rupture [6-7,10]. The risk of rupture of splenic artery aneurysm is estimated for 2-36% within the whole life [1, 5, 18], while mortality following such an event for over 25% [5, 178-20]. Splenic artery aneurysms that occur during pregnancy, when many of them manifest themselves, as well as symptomatic and false aneurysms, and those of diameter exceeding 2 cm are considered to be potentially threatened with rupture [5, 7, 9, 14].

There is a wide range of diagnostic examinations used in diagnosis of splenic artery aneurysms, such as Doppler sonography, computed tomography (CT) and angiography (DSA). Angiography is currently a gold standard, as it allows not only diagnosing and planning the treatment, but also enables endovascular repair [17].

Most of the authors advocate invasive treatment of the visceral aneurysms, as a rupture prevention [12], which particularly concerns the above-mentioned conditions, considered to be of high risk of rupture [3, 9]. To date, surgical removal of the aneurysm has been a standard management; however, surgical treatment commonly consists in splenectomy and ligation of the splenic artery [3, 16], which some authors consider a gold standard of treatment of such aneurysms [21]. Among other procedures performed in such cases, excision of aneurysm along with reconstruction of the splenic artery by end-to-end anastomosis, and sparing the spleen seems to be the optimal one. The method is preferred in our centre, being particularly successful with the aneurysm located in proximal portion of the splenic artery [9]. The situation is different in case of rupture of splenic artery aneurysm, where splenectomy and ligation of bleeding splenic artery are often a life-saving procedure [22]. In such circumstances, we prefer primary open surgery, usually involving also splenectomy. Other authors have similar experience [10, 23], and one of the research groups described the spleen loss in 100% of emergency procedures associated with the aneurysm rupture, and only in 28% of elective procedures [10].

Recently, increasing number of procedures is performed by laparoscopy 21,24-25], what results in earlier mobilisation of patients after the procedure, shortening of the hospitalisation period and reduced need for post-operative analgesics [21]. The method is also frequently applied to ligation of the splenic artery, sometimes associated with splenectomy [1, 13, 25], which, in our opinion, does not seem to be an optimal treatment method for the patient .

Also, endovascular repair of splenic artery aneurysms by coil embolisation or stent-graft implantation becomes more and more popular [26]. The first endovascular methods consisted in occluding the splenic artery or in direct embolisation of the aneurysm sac. The procedure involved selective catheterisation of the splenic artery or aneurysm sac with concomitant placement of cyanoacrylate adhesive (NBCA), Gelfoam (gel sponge) or platinum coils [1, 19, 25]. On the other hand, Davies et al. applied embolisation with the concomitant use of histoacrylate adhesive, lipiodol and coils [20]. However, the methods in question involved complete obstruction of the blood flow through the vessel. Currently used endovascular methods allow to completely stop blood inflow to the aneurysm with the splenic artery kept patent even in 75-83% of the patients [17, 2]. Also, these methods have gained advocates, being the methods of choice in treatment of uncomplicated visceral artery aneurysms [27].

Endovascular application of stent-grafts is the most up-to-date therapeutic approach used in clinical practice, as first such reports were published in 2001 [9]. The method, similarly to other endovascular procedures, is characterised by high therapeutic efficiency and low mortality, and its additional unquestionable value is the possibility of sparing the spleen, even with aneurysm located close to the splenic hilus [26]. However, embolisation may pose a risk of embolism in organs supplied by a given artery, due to occlusion of the primary vessel and sacrificing small collateral vessels, which may show signs of splenic infarction or abscess [13, 18, 23], while application of stent-grafts does not pose such a hazard, maintaining patency of the vessel [9,28]. Endovascular procedures may also be combined with open surgical techniques, as presented in one of the cases described in this paper. We have not found similar way of treatment in the available literature. Such combined surgical and endovascular management should be limited to the cases of multiple aneurysms, where one of them is located close to the splenic hilus. This location of the aneurysm poses an increased risk of the spleen loss during classical surgery; hence, in our opinion endovascular techniques should be reserved for such cases.

In our material, splenic artery aneurysms were occluded by means of coils, which enabled maintaining patency of the vessel and sparing the spleen together with its function. The endovascular procedure also produced low surgical injury. In the authors' opinion, in each case of elective treatment of splenic artery aneurysm, an attempt should be made to spare the spleen.

While classical techniques of surgery of splenic artery aneurysm may be applied in most cases and, in fact, it still is, attempts should be made to spare the spleen even in more difficult cases. Endovascular methods may provide a good supplementation for open surgery of splenic artery aneurysms in these particular clinical cases.

Moreover, we share the opinion postulated previously that final selection of method of treatment of patients with splenic artery aneurysm (endovascular or open surgery) should depend on the mode of the procedure, anatomical conditions, aneurysm size, as well as skills and experience of the treatment team [18, 23].

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