International Journal of Surgery Case Reports 89 (2021) 106585

Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.elsevier.com/locate/ijscr

Case series

Management of huge splenic artery aneurysm with new hybrid procedure including endovascular and open surgical approach: Case series

Javad Salimi [a], Lale Foroutani [b], Seyed Amir Miratashi Yazdi [c,*]

[a] Professor of Surgery, Vascular & Endovascular Surgeon, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran
[b] School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
[c] Department of Surgery, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran

ARTICLE INFO

Keywords:
Splenic artery aneurysm
Huge aneurysm
Hybrid surgery
Case series

ABSTRACT

Introduction: Splenic artery aneurysms (SAAs) account for more than half of all visceral artery aneurysms. Small SAAs are usually asymptomatic, but giant aneurysms are more likely to cause symptoms and result in life-threatening complications; these aneurysms treatment can be challenging. Splenic artery aneurysms treatment includes laparotomy, laparoscopy, or endovascular techniques.

Case presentation: This case series reports the details of successful management of three patients with huge splenic artery aneurysms who underwent hybrid surgery, endovascular inflow control with a balloon, and open aneurysm resection.

Discussion: Although endovascular treatment options are increasingly favored, only selected aneurysms are suitable for these procedures, as marked tortuosity of the artery or SAA in the proximal splenic artery may not be suitable for endovascular management.

Conclusion: Open surgery escorted by endovascular techniques can be considered an ideal treatment of SAA in the proximal region of the splenic artery.

1. Introduction

The splenic artery aneurysm is defined as when a focal dilatation is observed, and its diameter is >50% of the normal vessel diameter [1]. Splenic artery aneurysms (SAAs) are the third most frequent intra-abdominal aneurysm and the most common (46–60%) of all visceral artery aneurysms. Although rare, SAAs can potentially be life-threatening due to spontaneous intraperitoneal rupture, rupture into the neighboring hollow organs, and fistulization into the pancreatic duct [2]. Most small SAAs are asymptomatic and are therefore diagnosed incidentally during radiologic investigations. In contrast, giant (≥5 cm) SAAs are symptomatic and can result in life-threatening complications [3].

Treatment of an SAA includes laparotomy, laparoscopy, or endovascular techniques [4]. Historically, surgery was the most utilized approach, depending on the patient's overall health condition and comorbidities. Recently, with the evolution of interventional angiography, most visceral aneurysms are treated by angiography [5]. However, only selected aneurysms are suitable for these procedures, as marked tortuosity of the artery or SAA in the proximal splenic artery may not be suitable for endovascular management [6,7].

The current study reports the details of successful management of three patients with huge splenic artery aneurysms. This case series has been reported in line with the PROCESS 2020 (www.processguideline.com) criteria [8].

2. Case presentation

2.1. Case 1

A 73-year-old man was referred to our surgery clinic because of upper left abdominal pain, dyspepsia, and fatigue with a 6-month duration. A contrast-enhanced computed tomography (CT) scan of the abdomen indicated the presence of a splenic artery aneurysm with the largest diameter of approximately 73 mm in proximal of the splenic artery (Fig. 1).

The procedure included a deflated balloon attached to a catheter passing over a guidewire into the splenic artery just before the aneurysm and then inflated to a fixed size (7 * 40 mm) as proximal control. Then in laparotomy, the distal part was ligated, and the proximal part, according

* Corresponding author at: Sina Hospital, Hassan Abad Square, Imam Khomeini Avenue, Post Box: 1136746911, Tehran, Iran.
E-mail address: amiratashi@sina.tums.ac.ir (S.A. Miratashi Yazdi).

https://doi.org/10.1016/j.ijscr.2021.106585
Received 7 October 2021; Received in revised form 4 November 2021; Accepted 9 November 2021
Available online 10 November 2021
2210-2612/© 2021 Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Fig. 1. Pretreatment contrast-enhanced CT is showing an aneurysmatic dilation (73 * 63 mm) in the proximal of the splenic artery.

to the inflated balloon, was found easily. After the balloon was deflated, the proximal part of the aneurysm was ligated, and the aneurysmal part was resected completely (Fig. 2). A repair of the splenic artery was done after resecting the aneurysm.

2.2. Case 2

A 56-year-old male who presented with a sudden onset of severe abdominal pain was referred to our hospital. His past medical history was unremarkable in computed tomography angiography (CTA), a giant proximal SAA was diagnosed (Fig. 3).

We considered endovascular treatment. Angiography was carried out, but because of arterial tortuosity, the wire did not pass through to

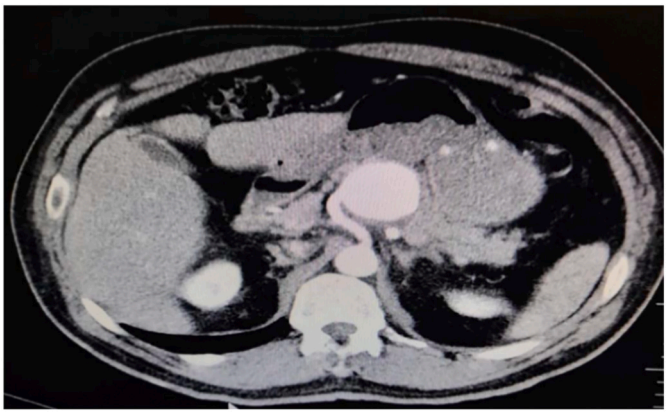

Fig. 3. A preoperative CT image shows a 6-cm splenic artery aneurysm.

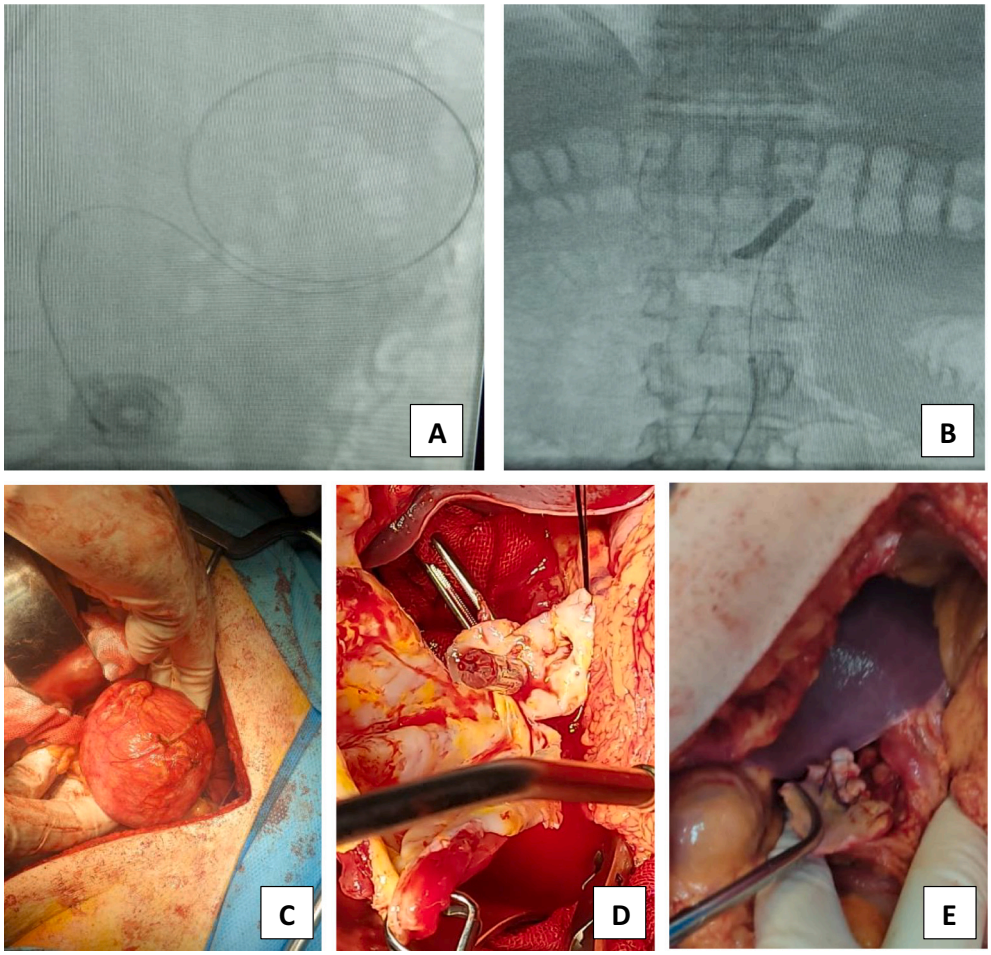

Fig. 2. (A) placement of the guidewire in the aneurysm sac for positioning of the balloon; (B) endovascular proximal inflow control with the balloon (7 * 40 mm); (C) exploring the pulseless aneurysm with laparotomy incision (midline incision); (D) opening of the aneurysm sac was performed (you can see the balloon inside of the aneurysm); (E) aneurysm resection and proximal and distal repair of the splenic artery.

the distal part of the artery; Hybrid surgery was the next plan. The balloon (7 * 40 mm) expanded in the proximal part of the aneurysm, then in laparotomy, the distal part was ligated, and the proximal part, according to the inflated balloon, was found easily (Fig. 4). After the balloon was deflated, the proximal part of the aneurysm was ligated, and the aneurysmal part resected completely (Fig. 5).

2.3. Case 3

The third case was a 52-year-old man with a huge splenic artery aneurysm that was found incidentally on imaging obtained for the evaluation of his back pain. Contrast-enhanced CT revealed an aneurysm in proximal of the splenic artery with a maximum diameter of 60 mm (Fig. 6). We proceeded to use the principles of both open and endovascular techniques; proximal control by balloon (Fig. 7) and open aneurysm resection.

All patients were discharged with no procedure-related complications.

3. Discussion

The incidence of splenic artery aneurysms is unclear, and various studies of autopsies and angiography indicate rates of 0.01 to 0.20% and 0.78 to 0.80%, respectively [9]. Dr. Chaer commented in the society for vascular surgery announcement, 'Nearly one-fourth of visceral artery aneurysms reported have presented with rupture and the mortality rate of these diagnosed ruptures is at least 10%, probably higher' [10].

SAAs have a female predominance and are four times more frequent in women, whereas giant SAAs are 1.78 times more frequent in men [11]. SAAs can be diagnosed at any age but are more commonly seen in the fifth and sixth decades with a mean age of presentation of 52 years [6]. As in the current case series, all patients were male with giant SAAs (>5 cm) with the age range of 52 to 73.

Although there is no consensus on the management of SAA patients, irrespective of the diameter, treatment is recommended for all symptomatic SAAs and all pseudoaneurysms as well as for asymptomatic patients with lesions ≥2 cm (due to high risk of rupture), who are pregnant or fertile, have portal hypertension or candidates of liver transplantation [12].

The most frequent management options for SAAs are medical treatment, close follow-up, open abdominal surgery, endovascular treatment (coil embolization or stent), and laparoscopic surgery [3,11]. Management of SAAs depends on various factors, including age, gender, aneurysm dimension, origin, and the severity of the clinical findings and their complications [10].

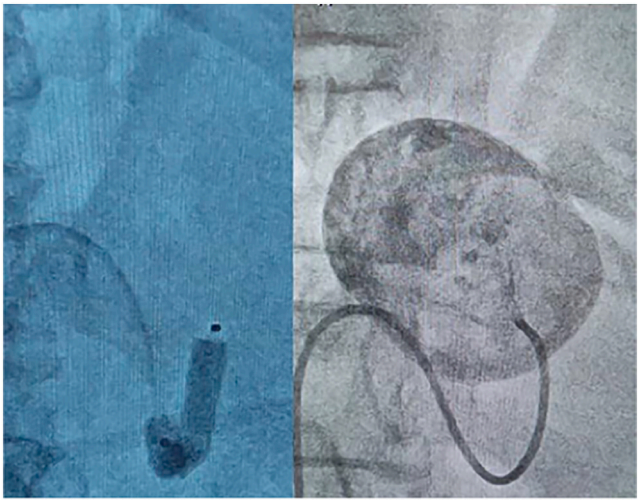

Fig. 4. Balloon proximal control.

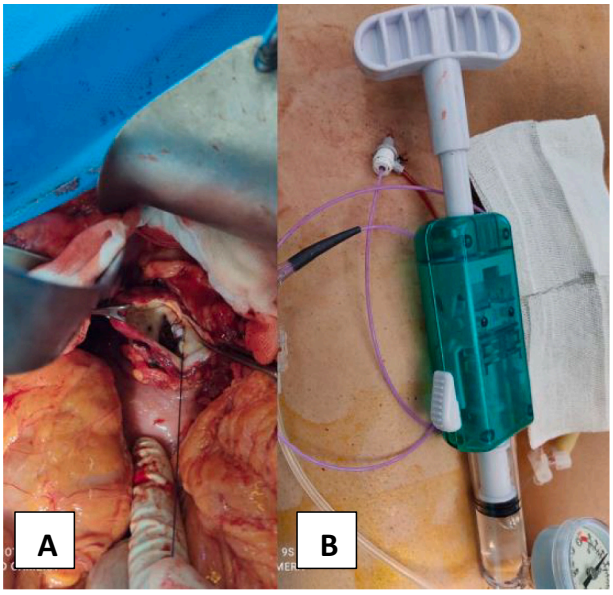

Fig. 5. Hybrid surgery: (A) aneurysm sac; (B) angiography sheath and inflator.

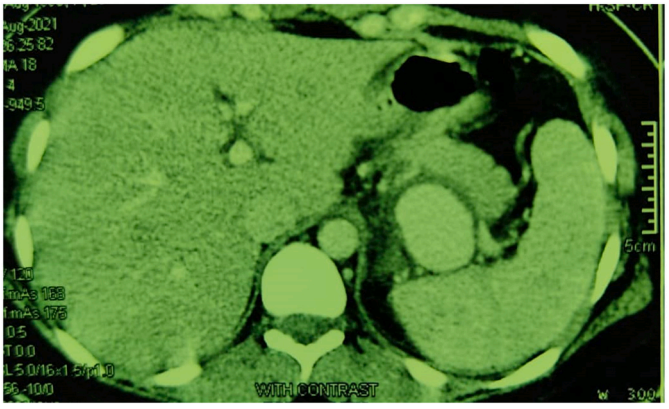

Fig. 6. CTA of case 3 shows the splenic artery aneurysm.

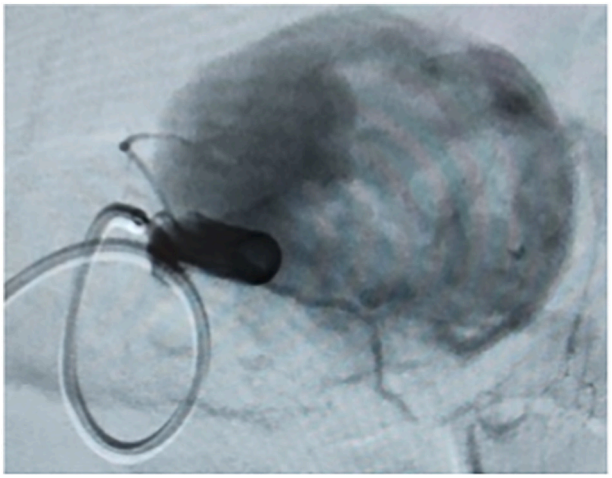

Fig. 7. Endovascular balloon occlusion for proximal control before open surgery (case 3).

Proximally located, elongated, and tortuous SAAs are suitable for aneurysmectomy and end-to-end reconstruction without splenectomy, though splenectomy might be added for lesions originating from the distal two-thirds of the splenic artery. For giant SAAs or cases where a simple aneurysmectomy is impossible due to dense strictures, preferred treatment options include an aneurysmectomy plus splenectomy, bipolar splenic artery ligation with or without aneurysmectomy, transaneurysmal splenic artery ligation, or distal pancreatectomy when necessary [12,13].

Endovascular treatment options, such as transcatheter embolization, percutaneous injection, and endovascular stent grafts are increasingly favored [14,15]. Embolization is the first option for asymptomatic lesions diagnosed incidentally, whereas transcatheter embolization is preferred in cases involving surgical technical difficulty and in patients at increased operative risk. The most frequent complications of transcatheter embolization are coil migration, aneurysm rupture, intestinal infarct, fever, splenic infarct, and abscess formation [16]. If embolization fails or is unsuitable, a percutaneous injection may be used, which involves direct coil application or thrombin injection into the lesion [14].

Most recently, endovascular stenting has been introduced as a treatment for SAAs. This minimally invasive technique preserves splenic perfusion by placing a stent (self-expanding and balloon-expanding) in the aneurysm without dilating the aneurysmatic segment and minimizes splenic infarction and abscess complications that occur with coil embolization. However, as with embolization, the application of this technique is limited by tortuous arteries, decreased artery dimensions, and the location of the lesion [17].

Endovascular procedures are still considered the first choice of treatment for splenic artery aneurysms in terms of perioperative mortality and short-term outcomes. However, open surgery has advantages for both long-term outcomes and re-intervention options during follow-up [18]. However, in tortuosity of the artery or SAA in the proximal splenic artery or when the endovascular techniques fail, open resection is considered an ideal treatment of SAAs [6,19].

Laparoscopic SAA excision is a minimally invasive alternative to open abdominal surgery, particularly during early pregnancy and with small lesions [3,7]. However, it is contraindicated in hemodynamically unstable patients or those at rupture risk and is not suitable for larger aneurysms and lesions with dense adhesions to surrounding tissues.

As we carried out and upon previous studies, aneurysmectomy can be performed safely [12]. Since the spleen has abundant collateral circulation, simple ligation of the main trunk of the splenic artery does not cause major complications, so in all of our patients with proximal part involvement, we resected the aneurysm without splenectomy. This method preserves the spleen, an important element of the immune system.

4. Conclusion

In this case series, we have shown that in selected high-risk patients with huge splenic artery aneurism, the hybrid operation of SAAs, using an endovascular balloon for inflow control and open resection, appears to be much safer and more effective.

After surgery, all three patients discharged with no procedure-related complications like splenic infarction and Regular follow-up indicated a satisfactory result. Long term results of any of these interventions remain unknown.

Consent

Written informed consent was obtained from the patient for publication of this case series and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

We declare on our honor that the ethical approval has been exempted by our establishment.

Funding

The authors report no external source of funding during the writing of this article.

Guarantor

Javad Salimi, Lale Foroutani, Seyed Amir Miratashi Yazdi.

Research registration number

This is not a First in Man study.

CRediT authorship contribution statement

All of the authors contributed to the case study, research, and writing of the manuscript.

Declaration of competing interest

The authors declare no conflicts of interest.

References

[1] 1. P. Abhari, S. Abhari, A. Jackson, A.S.Z. Moustafa, L. Mercer, M. Ashraf 19 (2019) (2019 Mar);
1. P. Abhari, S. Abhari, A. Jackson, A.S.Z. Moustafa, L. Mercer, M. Ashraf 19 (2019) (2019 Mar).
[2] G. Orsitto, F. Fulvio, A.G. Pinto, V. Turi, D. Tria, A. Venezia, C. Colucci, R. Castellana, C. Manca, Geriatric assessment of a giant splenic artery aneurysm accidentally diagnosed, Aging Clin. Exp. Res. 23 (5–6) (2011 Oct-Dec) 491–494.
[3] S. Yadav, P. Sharma, P.K. Singh, S. Punia, P. Desai, A.K. Anjan, S. Jain, Giant splenic artery aneurysm: a rare but potentially catastrophic surgical challenge, Int. J. Surg. Case Rep. 3 (11) (2012) 533–536.
[4] J. Salimi, Z. Omrani, R. Cheraghali, Splenic artery aneurysm, case series of seven patients, J. Surg. Case Rep. 2021 (3) (2021 Mar 25), rjab046.
[5] K.S. Madhusudhan, H.A. Venkatesh, S. Gamanagatti, P. Garg, D.N. Srivastava, Interventional radiology in the management of visceral artery pseudoaneurysms: a review of techniques and embolic materials, Korean J. Radiol. 17 (3) (2016 May-Jun) 351–363.
[6] S. Ali, V. Verma, R S, I. Wani, Giant splenic artery aneurysm: case report. ISRN Surg. 2011 (2011), 383450.
[7] Y.H. Wei, J.W. Xu, H.P. Shen, G.L. Zhang, H. Ajoodhea, R.C. Zhang, Y.P. Mou, Laparoscopic ligation of proximal splenic artery aneurysm with splenic function preservation, World J. Gastroenterol. 20 (16) (2014 Apr 28) 4835–4838.
[8] R.A. Agha, C. Sohrabi, G. Mathew, T. Franchi, A. Kerwan, O'Neill N for the PROCESS Group, The PROCESS 2020 guideline: updating consensus Preferred Reporting Of CasE Series in Surgery (PROCESS) Guidelines, Int.ernational Journal of Surgery 84 (2020) 231–235.
[9] Y. Yagmur, S. Akbulut, S. Gumus, F. Demircan, Giant splenic artery pseudoaneurysm: a case report and literature review, Int. Surg. 100 (7–8) (2015 Jul) 1244–1248.
[10] R.A. Chaer, C.J. Abularrage, D.M. Coleman, M.H. Eslami, V.S. Kashyap, C. Rockman, M.H. Murad, The Society for Vascular Surgery clinical practice guidelines on the management of visceral aneurysms, J. Vasc. Surg. 72 (1S) (2020 Jul) 3S–39S.
[11] S. Akbulut, E. Otan, Management of giant splenic artery aneurysm: comprehensive literature review 94 (27) (2015 Jul), e1016.
[12] P.K. Mishra, S.S. Saluja, A.K. Sharma, P. Pattnaik, Management of splenic artery aneurysm associated with extrahepatic portal vein obstruction, Hepatobiliary Pancreat. Dis Int. 11 (3) (2012 Jun) 330–333.
[13] U. Sachdev-Ost, Visceral artery aneurysms: review of current management options, Mt Sinai J. Med. 77 (3) (2010 May-Jun) 296–303.
[14] A.M. Góes Junior, A.S. Góes, P.C. de Albuquerque, R.M. Palácios, Sde C. Abib, Endovascular treatment of giant splenic artery aneurysm, Case Rep. Surg. 2012 (2012), 964093.

[15] G.Guang LJ, J.F. Wang, B.J. Wei, K. Gao, Q. Huang, R.Y. Zhai, Endovascular treatment of splenic artery aneurysm with a stent-graft: a case report, Medicine (Baltimore) 94 (52) (2015 Dec), e2073.
[16] G.A. Agrawal, P.T. Johnson, E.K. Fishman, Splenic artery aneurysms and pseudoaneurysms: clinical distinctions and CT appearances, AJR Am. J. Roentgenol. 188 (4) (2007 Apr) 992–999.
[17] Y. Al-Habbal, C. Christophi, V. Muralidharan, Aneurysms of the splenic artery - a review, Surgeon 8 (4) (2010 Aug) 223–231.
[18] W. Hogendoorn, A. Lavida, M.G. Hunink, F.L. Moll, G. Geroulakos, B.E. Muhs, B. E. Sumpio, Open repair, endovascular repair, and conservative management of true splenic artery aneurysms, J. Vasc. Surg. 60 (6) (2014 Dec) 1667–1676, e1.
[19] D. Parizh, S.A.R. Rizvi, E. Ascher, A. Hingorani, Hybrid approach with endovascular and open surgical techniques for challenging aneurysms, Vascular 26 (5) (2018 Oct) 564–567.