

# Retreatment of a recanalized splenic artery aneurysm using a low-profile microembolization platform

Julia Fayanne Chen, MD, MPH, James Danahey, BS, Uwe Fischer, MD, PhD, and Naiem Nassiri, MD, New Haven, Conn

## ABSTRACT

Recanalization of a splenic artery aneurysm owing to incomplete transcatheter coil embolization is uncommon. In addition to the challenges of inherent vessel tortuosity, reintervention via catheterization of the main splenic artery presents unique difficulties in navigating across potentially obstructive preexisting coils. We describe here the application of a low-profile microembolization platform, most commonly used in neurovascular interventions, in the treatment of a tortuous, expanding splenic artery aneurysm that had previously undergone failed coil embolization. (*J Vasc Surg Cases and Innovative Techniques* 2020;6:553-6.)

**Keywords:** Splenic artery aneurysm; Coil embolization; Microcatheter; Low profile; Neurovascular

Aneurysms involving the visceral arteries are rare, with a reported incidence of 0.01% to 0.2%. Of these, splenic artery aneurysms (SAA) are the most common, accounting for approximately 60% of aneurysms in this region.<sup>1,2</sup> Recent guidelines from the Society for Vascular Surgery recommend treatment of true aneurysms >3 cm, observation for stable asymptomatic aneurysms <3 cm, and treatment of pseudoaneurysms of any size.<sup>3</sup> Traditional open repair techniques include resection with revascularization, ligation, and end-organ resection, whereas more recent endovascular approaches use embolization and covered stenting. In a recent systemic review and meta-analysis, endovascular therapy for visceral artery aneurysms (VAAs) was associated with a shorter hospital stay and lower rates of cardiovascular complications.<sup>1</sup>

The reported success rate of transcatheter coil embolization for SAA ranges from 90% to 100%, but this can be complicated by tortuous anatomy of the splenic artery and redundancy of visceral vessels.<sup>4,5</sup> Dense coil packing is necessary to ensure that aneurysms do not recur owing to incomplete embolization or reperfusion of collateral arteries.<sup>6</sup> Endovascular

intervention after recanalization of a previously treated SAA can be challenging owing to the presence of existing coils.

We describe here the novel use of a low-profile microcatheter and microcoil system to navigate the challenging anatomy of a tortuous, expanding SAA that had previously undergone failed coil embolization. The patient consented to the publication of this report.

## CASE REPORT

**Presentation.** The patient is a 60-year-old multiparous female who presented with a recanalized, asymptomatic, rapidly expanding 3.5-cm SAA after a previous attempt at coil embolization at an outside facility approximately 3 years ago (Fig 1).

**Surgical technique.** The right common femoral artery was accessed and flush abdominal aortography performed, demonstrating widely patent celiac trunk ostium, superior mesenteric artery, and bilateral renal arteries. Notably, there was a large, partially coil-embolized SAA in the proximal to midportion of the splenic artery (Fig 2).

A 5F short sheath and a 5F C2 catheter were used to selectively engage the superior mesenteric artery. We performed arterial, visceral, and venous phase runs that showed no evidence of contribution to the aneurysmal degeneration that was noted in the splenic trunk (Fig 3, A).

The celiac trunk was catheterized using a SOS Omni catheter and selective angiography was performed, allowing us to confirm the extent and location of the SAA. We observed poor packing of the previously placed coils, but the visceral and venous phase runs were otherwise unremarkable, and no further aneurysms were noted. The splenic artery had a markedly tortuous course that included a 180° turn shortly after its origin (Fig 3, B). A 1.6 F Headway Duo microcatheter (Microvention, Inc, Aliso Viejo, Calif), in combination with an 0.014" Grand Slam guidewire (Asahi Intecc USA Inc, Tustin, Calif) allowed us to successfully track along the tortuous proximal curvature of

From the Division of Vascular and Endovascular Surgery, Department of Surgery, Yale University School of Medicine.

Author conflict of interest: N.N. is on the speakers' bureau and a consultant for Penumbra, Inc.

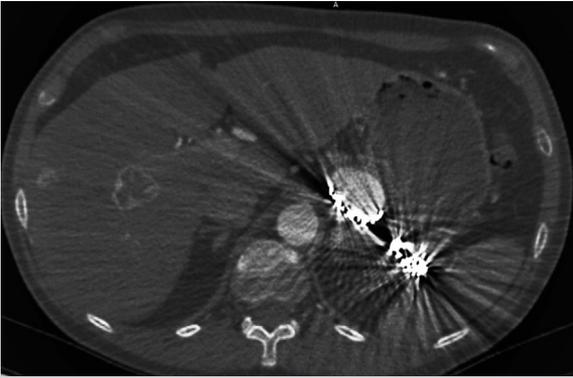
Correspondence: Naiem Nassiri, MD, Associate Professor of Surgery (Vascular), Yale School of Medicine, Yale New Haven Hospital, 330 Cedar Street, Boardman 204, New Haven, CT 06520 (e-mail: [naiem.nassiri@yale.edu](mailto:naiem.nassiri@yale.edu)).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

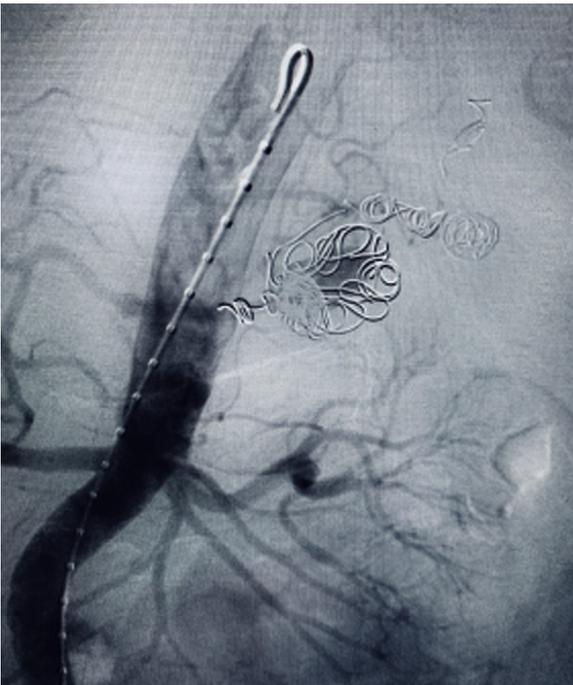
2468-4287

© 2020 The Authors. Published by Elsevier Inc. on behalf of Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.jvscit.2020.09.004>



**Fig 1.** Computed tomography angiography demonstrating filling of a 3.5-cm splenic artery aneurysm (SAA) with multiple previously placed embolization coils.



**Fig 2.** Abdominal aortography demonstrating contrast filling within the aneurysm sac of a partially coiled splenic artery, along with patent celiac, superior mesenteric, and bilateral renal arteries.

the splenic artery and advance past previously placed coils to properly position our system within the aneurysm sac (Fig 4, A). Mechanically detachable low-profile platform Ruby Coils and Packing Coils (Penumbra Inc, Alameda, Calif) were then deposited to partially fill the aneurysm.

The development of this initial foundation created adequate stability so that we could exchange for a sturdier platform for delivery of larger volume embolization coils. We first exchanged out the Grand Slam for a V-14 guidewire (Boston Scientific, Marlborough, Mass) followed by exchange of the 1.6 F Headway

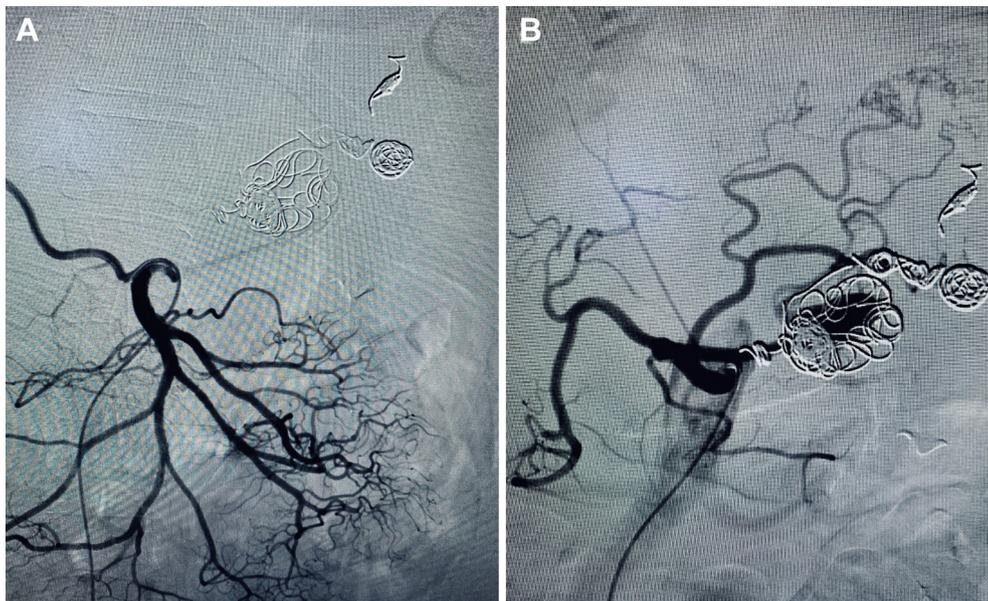
Duo for a 2.7 F high-flow Lantern microcatheter (Penumbra Inc.). We proceeded with dense packing of the remainder of the aneurysm sac using a combination of large-volume packing coils and soft Ruby coils (Fig 4, B). Completion angiography demonstrated complete exclusion of the aneurysm sac without any evidence of nontarget embolization or further recanalization of the aneurysm (Fig 5).

**Postoperative course.** The patient had no perioperative complications and was discharged home the same day. She was seen at 2-week follow-up without complaint.

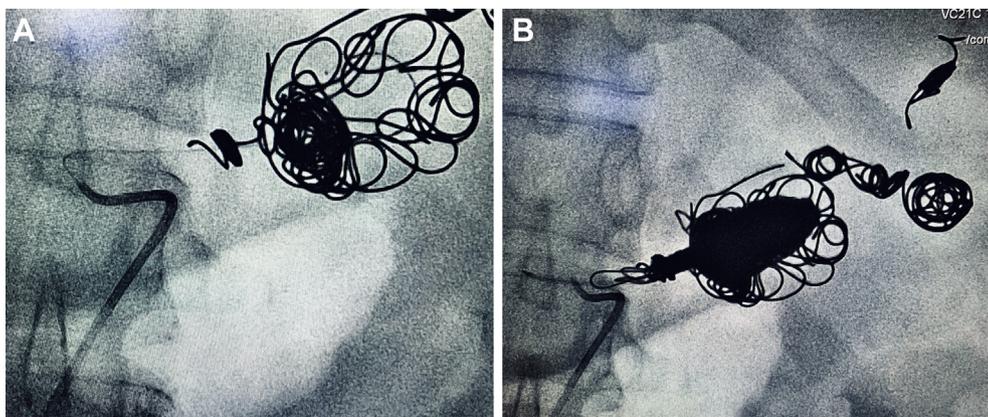
## DISCUSSION

Endovascular methods have become the preferred treatment modality for SAAs owing to their high success rates and low morbidity. Transcatheter embolization and stent grafting are the most commonly used techniques, although vessel tortuosity and aneurysm anatomy can be limiting factors in the efficacy of each of these methods. Aneurysm recanalization rates have been reported to be as high as 12.5%, most frequently owing to incomplete embolization or reperfusion of the aneurysm sac via collateral arteries, resulting in higher reintervention rates in patients undergoing endovascular compared to open repair.<sup>1,5,7,8</sup>

In the absence of collateral filling, a number of reports have specifically cited loose coil packing as a reason for aneurysm reperfusion.<sup>5,7,9</sup> Although there is growing evidence that dense coil packing is a safe and effective measure that is necessary to decrease the risk of aneurysmal recanalization, it may not always be feasible in the context of complex anatomy.<sup>10,11</sup> Previous reports have described the double microcatheter technique in managing severe tortuosity, where two microcatheters are inserted within a standard catheter and positioned in the proximal and distal ends of the aneurysm sac, and coils are alternately deposited from each catheter. This technique is widely used in the treatment of wide neck and irregularly shaped intracranial aneurysms and has also been described in the treatment of renal and visceral aneurysms.<sup>12-15</sup> Two features that compounded the challenging nature of our case were significant vessel tortuosity in addition to the existence of previous placed coils. Catheter positioning within the aneurysm sac is critical for deposition of additional coils for appropriately dense packing, but because embolization had been attempted previously, partial inflow obstruction made it particularly difficult to build and maintain a platform that would be adequately stable to deliver the quantity of coils required to completely exclude the aneurysm. To achieve this, we used the use of a 1.6 F microcatheter, the Headway Duo, most commonly used in neuroendovascular interventions. This particular device was chosen for its low profile and improved pliancy when compared with standard visceral platforms, making it better suited to track tortuous anatomy and navigate past previously



**Fig 3. (A)** Selective angiography of the superior mesenteric artery demonstrates no collateral filling into the splenic artery aneurysm (SAA). **(B)** Selective angiography of the celiac trunk demonstrates a markedly tortuous splenic artery course with a 180° turn, in addition to poor packing of previously placed coils.



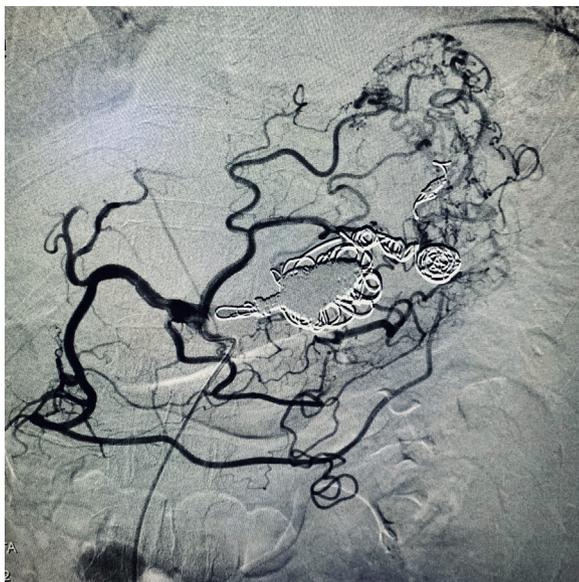
**Fig 4. (A)** Development of a microembolization platform using a SOS Omni catheter, a 1.6 F Headway Duo microcatheter, and an 0.014" Grand Slam guidewire allowed navigation across the 180° turn, past the previously placed coils, to properly position the system within the aneurysm sac. **(B)** Deposition of low-profile followed by large volume embolization coils allowed for dense packing of the aneurysm sac.

placed coils. After the initial deposition of a number of low-profile coils via this platform, we created adequate stability to exchange for the standard visceral platform to complete the task using larger volume coils.

Neurovascular interventional techniques have previously been applied to some facets of visceral artery management.<sup>16</sup> However, to our knowledge, the use of a neurovascular catheter and coil system in the treatment of a VAA has not been previously reported. Neurovascular hypercompliant occlusion balloons, stent scaffold-assisted embolization, and flow diversion techniques have been used in the treatment of VAAs with

documented success.<sup>17-20</sup> Further, the use of hydrogel-coated coils, originally developed for the treatment of brain aneurysms, have been used in the management of VAAs, high-flow vascular arteriovenous fistulae, and endoleaks after endovascular repair of thoracic and abdominal aortic aneurysms.<sup>21</sup>

This report contributes to the current literature demonstrating that neurointerventional platforms are suitable for adoption in peripheral and visceral arteries and may permit endovascular treatment of anatomically challenging and complex VAAs that would be otherwise inaccessible.



**Fig 5.** Completion angiography demonstrated complete exclusion of the aneurysm sac without any evidence of nontarget embolization or further recanalization of the aneurysm.

## REFERENCES

- Barrionuevo P, Malas M, Nejm B, Haddad A, Morrow A, Ponce O, et al. A systemic review and meta-analysis of the management of visceral artery aneurysms. *J Vasc Surg* 2020;72:40S-5S.
- Ferrero E, Ferri M, Viazzo A, Robaldo A, Carbonatto P, Pecchio A, et al. Visceral artery aneurysms, an experience on 32 cases in a single center: treatment from surgery to multilayer stent. *Ann Vasc Surg* 2011;25:923-35.
- Chaer RA, Abularrage CJ, Coleman DM, Eslami MH, Kashyap VS, Rockman C, et al. The society for vascular surgery clinical practice guidelines on the management of visceral aneurysms. *J Vasc Surg* 2020;72:3S-39S.
- Pulli R, Dorigo W, Troisi N, Pratesi G, Innocenti AA, Pratesi C. Surgical treatment of visceral artery aneurysms: a 25-year experience. *J Vasc Surg* 2008;48:334-42.
- Wang W, Chang H, Liu B, Wang W, Yu Z, Chen C, et al. Long-term outcomes of elective transcatheter dense coil embolization for splenic artery aneurysms: a two-center experience. *J Int Med Res* 2020;48.
- Pilleul F, Dugougeat F. Transcatheter embolization of splanchnic aneurysms/pseudoaneurysms: Early imaging allows detection of incomplete procedure. *J Comput Assist Tomogr* 2002;26:107-12.
- Yamamoto S, Hirota S, Maeda H, Achiwa S, Arai K, Kobayashi K, et al. Transcatheter coil embolization of splenic artery aneurysm. *Cardiovasc Intervent Radiol* 2008;31:527-34.
- Tulsyan N, Kashyap VS, Greenberg RK, Sarac TP, Clair DG, Pierce G, et al. The endovascular management of visceral artery aneurysms and pseudoaneurysms. *J Vasc Surg* 2007;45:276-83.
- Patel A, Weintraub JL, Nowakowski FS, Kim E, Fischman AM, Ellozy SH, et al. Single-center experience with elective transcatheter coil embolization of splenic artery aneurysms: technique and midterm follow-up. *J Vasc Interv Radiol* 2012;23:893-9.
- Yasumoto T, Osuga K, Yamamoto H, Ono Y, Masada M, Mikami K, et al. Long-term outcomes of coil packing for visceral aneurysms: correlation between packing density and incidence of coil compaction or recanalization. *J Vasc Interv Radiol* 2013;24:1798-807.
- Kingma KD, van der Linden AN, Roumen RMH. Rebleeding of a splenic artery aneurysm after coil embolisation. *Case Rep Surg* 2016;2016.
- Panagrosso M, Gregorio CD, Peluso A, Venetucci P, Buono G, Bracale UM. Double-microcatheter technique through tortuous anatomy for coil embolization of a saccular splenic aneurysm: a technical report. *Transl Med UniSa* 2020;21:31-4.
- Goto T, Shimohira M, Ohta K, Suzuki K, Sawada Y, Shibamoto Y. Combination of the double-microcatheter technique and triaxial system in coil packing for visceral and renal artery aneurysms. *Acta Radiol* 2019;60:1057-62.
- Shimohira M, Hashizume T, Ohta K, Suzuki K, Kurosaka K, Muto M, et al. Triaxial coil embolization using Guglielmi detachable coils with the voltage-dependent coil-detaching technique. *Acta Radiol* 2015;56:51-5.
- Baxter BW, Rosso D, Lownie SP. Double microcatheter technique for detachable coil treatment of large, wide-necked intracranial aneurysms. *AJNR Am J Neuroradiol* 1998;19:1176-8.
- Nassiri N, Huntress LA. Stent-assisted coil embolization of a symptomatic renal artery aneurysm at a bifurcation point. *Ann Vasc Surg* 2017;42:299.e11-4.
- Murray TÉ, Brennan P, Maingard JT, Chandra RV, Little DM, Brooks DM, et al. Treatment of visceral artery aneurysms using novel neurointerventional devices and techniques. *J Vasc Interv Radiol* 2019;30:1407-17.
- Maingard J, Kok H, Phelan E, Logan C, Ranatunga D, Brooks DM, et al. Endovascular treatment of wide-necked visceral artery aneurysms using the neurovascular Comaneci neck-bridging device: a technical report. *Cardiovasc Intervent Radiol* 2017;40:1784-91.
- Onal Y, Samanci C, Cicek ED. Double-lumen balloons, are they only useful in neurointerventions? Preliminary outcomes of double-lumen balloon-assisted embolization of visceral artery aneurysms. *Vasc Endovascular Surg* 2020;54:214-9.
- van Veenendaal P, Maingard J, Kok HK, Ranatunga D, Buckenham T, Chandra RV, et al. Endovascular flow-diversion of visceral and renal artery aneurysms using dual-layer braided nitinol carotid stents. *CVIR Endovasc* 2020;3:33.
- Ferral H. Hydrogel-coated coils: Product description and clinical applications. *Semin Intervent Radiol* 2015;32:343-8.

Submitted Aug 6, 2020; accepted Sep 15, 2020.