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Changing Nature of Endoleak in a Patient of Superior Mesenteric Artery Aneurysm Treated with Endovascular Stent Graft

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Abstract

A man in his early thirties with complaints of abdominal pain for 1 week was diagnosed with a fusiform, partially thrombosed aneurysm of the superior mesenteric artery (SMA), which was treated with an endovascular stent graft. Three months later, when the patient again presented with abdominal pain, there was an endoleak of type III as detected by computed tomography and digital subtraction angiography. This was treated by in-stent balloon angioplasty with complete resolution of the endoleak. The patient again presented 1 month later with abdominal pain, with a residual sac posterior to the stent, detected on digital subtraction angiography, which was confirmed to be type II endoleak as it was getting filled by one of the jejunal branches of SMA. This was treated by glue embolization of the patent component of the aneurysm after selectively cannulating the branch vessel. This case highlights changing nature of endoleak as a complication of SMA stenting.

Keywords
- SMA aneurysm
- stent graft
- endoleak

Introduction

Superior mesenteric artery (SMA) aneurysms are rare and account for 6.9% of all visceral artery aneurysms (VAAs).[1] SMA aneurysm can arise secondary to trauma, inflammation, or it can be idiopathic. Endovascular management of SMA aneurysms is not without complications, such as endoleaks. Here we discuss the complications and challenges of treating it.

Case Presentation

A man in his early thirties presented with abdominal pain for 1 week associated with nausea and vomiting. Pain was central in location and nonradiating in nature. There was no fever, diarrhea, history of trauma, tuberculosis, pancreatitis, cardiac diseases, or constitutional symptoms. There was no hemodynamic instability. There was a past history of appendectomy 15 years ago.

Serum C-reactive protein was raised to 94 mg/L (normal range: 0–5 mg/L). Hemoglobin and the total leucocyte count were normal. Ultrasound abdomen revealed a thick-walled cystic lesion with turbulent color flow and an intramural thrombus in the supraumbilical region. The patient underwent computed tomography of the abdomen with arterial and venous phases to delineate the anatomy for further management. Computed tomography revealed a partially thrombosed fusiform aneurysm of superior mesenteric

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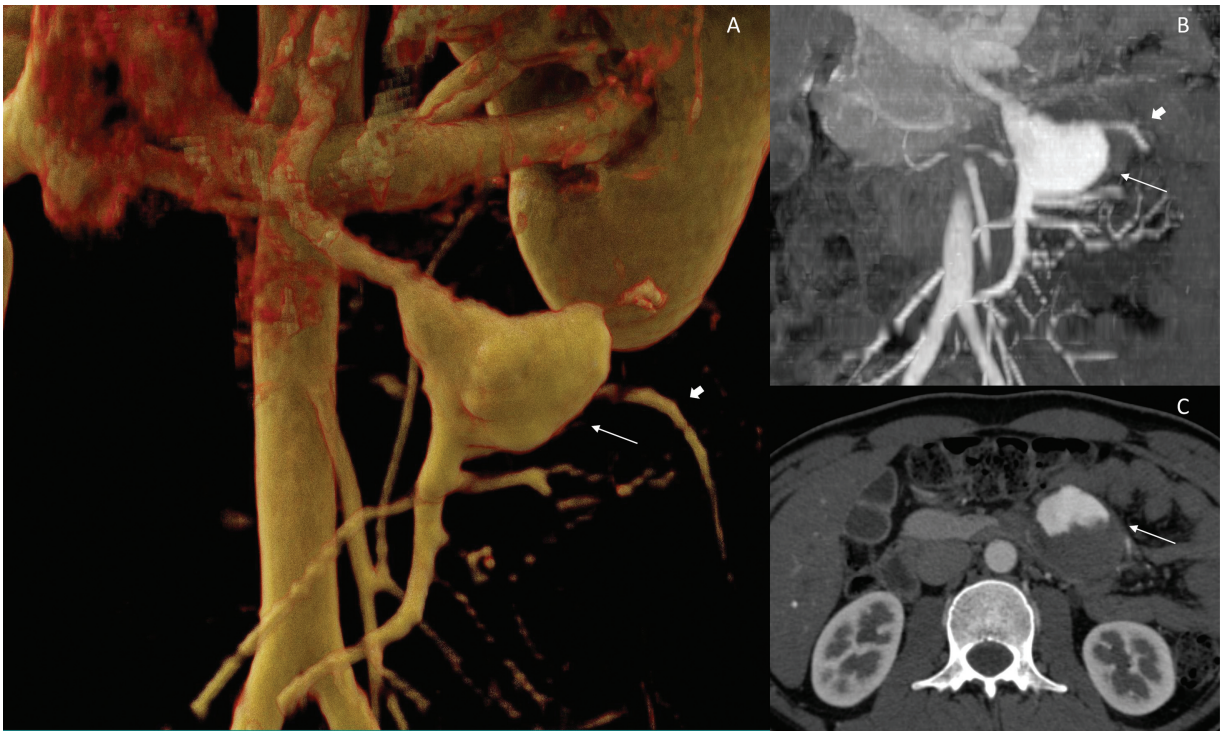

Fig. 1 (**A**) Cinematic volume rendered image showing superior mesenteric artery (SMA) aneurysm (shown by thin white arrow) with branch of SMA supplying aneurysm (shown by thick arrow). (**B**) Coronal maximum intensity projection reconstructed image showing aneurysm from SMA (shown by thin white arrow) with branch of SMA supplying aneurysm (shown by thick arrow). (**C**) Axial computed tomography arterial phase image showing partially thrombosed aneurysm (shown by thin white arrow) arising from SMA.

artery of total size 3.5 × 4.5 × 3 cm (in anteroposterior [AP] x trans X craniocaudal [CC] dimensions) and size of patent lumen 2.2 × 2.7 × 2.0 cm (in AP x trans x CC dimensions (►**Fig. 1A–C**). Neck of the aneurysm was 2.3 cm, and the distance of the origin of aneurysm from the SMA ostium was 5.5 cm. There was tapering of SMA across the aneurysm, with proximal SMA 8 mm and distal SMA 6 mm. In view of such an image morphology and raised C-reactive protein, possibility of mycotic aneurysm was considered. However, there was no history of fever. Echocardiography was done to rule out infective endocarditis, which was negative. Repeated blood cultures were also negative. So, finally, it was labeled as idiopathic. There was no imaging evidence of rupture or contrast extravasation. Few branches of SMA were seen supplying the aneurysm (►**Fig. 1A, B**). There was no hepatosplenomegaly, mesenteric, or retroperitoneal lymphadenopathy. The pancreas was normal in size and morphology. No signs of bowel ischemia were evident. Arch of aorta,

Fig. 2 (**A**) Superior mesenteric artery angiogram digital subtraction angiography image showing aneurysm (shown by thin white arrow). (**B** and **C**) Deployment of a distal balloon mounted stent (shown by thick arrow) with filling up of aneurysm sac (shown by thin white arrow).

Fig. 3 (**A**) and (**B**) Digital subtraction angiography (DSA) image showing deployment of a proximal balloon mounted stent overlapping stent (shown by thick arrow). (**C**) Post-superior mesenteric artery stenting DSA image showing no flow within the aneurysm.

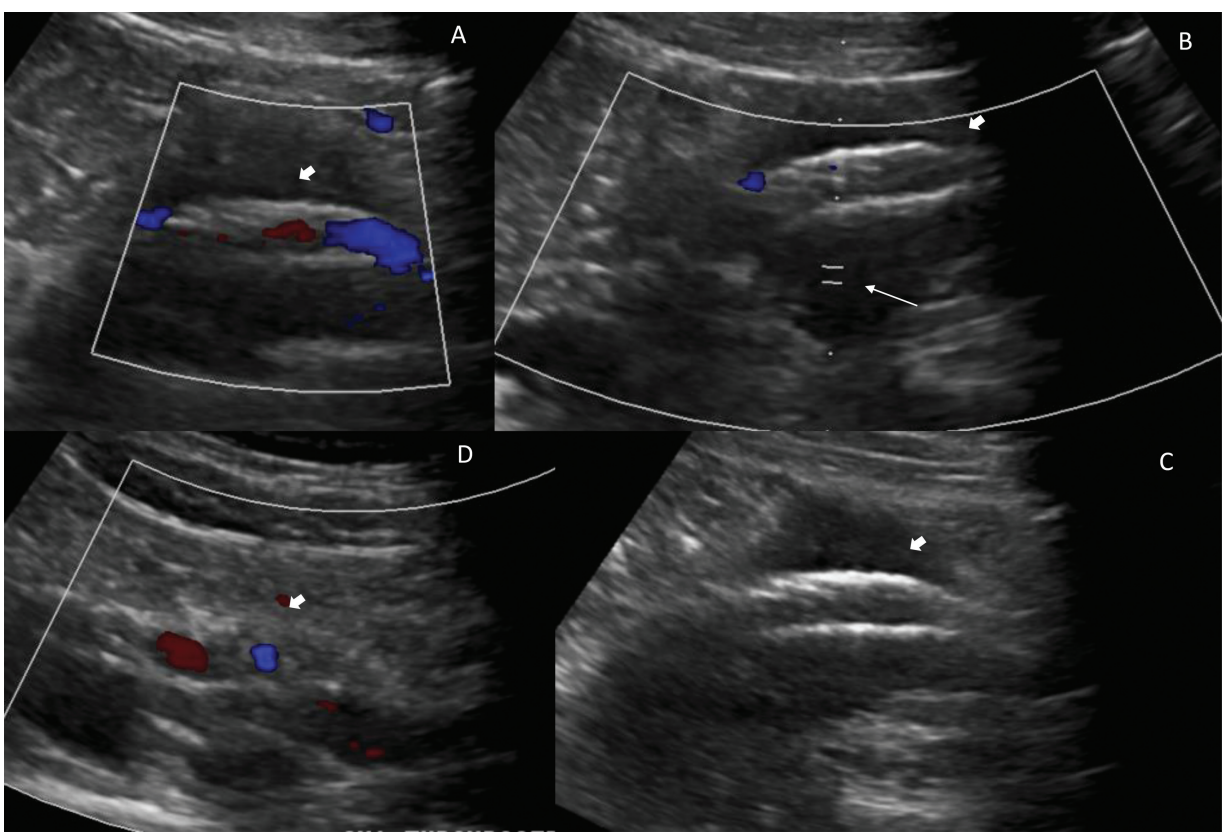

Fig. 4 (**A–D**) Day 1 duplex ultrasonography images showing patent stent (shown by thick arrow) within superior mesenteric artery with aneurysm entirely thrombosed aneurysm (shown by thin white arrow) with no patent lumen.

ascending and descending thoracic aorta were normal, with no evidence of wall thickening. Cardiac valves were normal in echocardiography. In view of the large size of the aneurysm in a symptomatic patient, intervention either in the form of surgery or endovascular intervention was considered. The advantage of surgical intervention in this young patient was sparing the need for long-term postprocedural antiplatelet medication. In either surgery or endovascular intervention, branches of SMA supplying the aneurysm segment would have been sacrificed. The advantage of

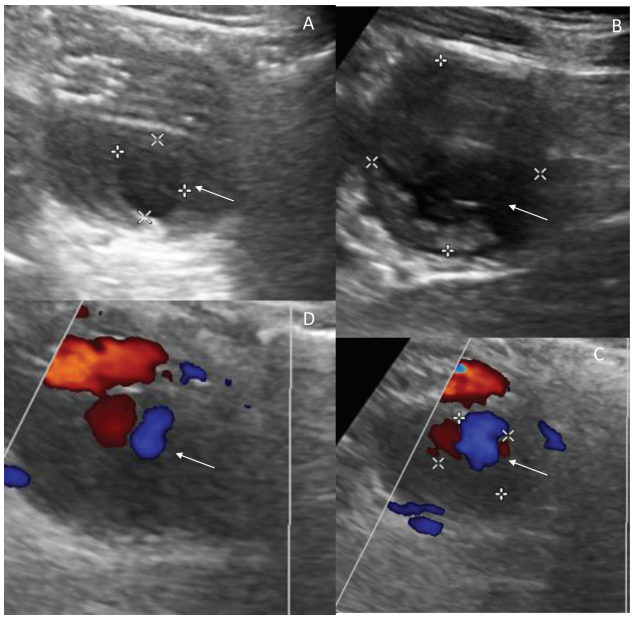

Fig. 5 Follow-up duplex (gray scale [**A** and **B**]) and color Doppler (**C** and D) ultrasonography 3 months after procedure showed patent lumen of aneurysm measuring ~ 1.5 × 1.6 cm (shown by thin white arrow).

endovascular intervention as compared to surgery is that it is a minimally invasive procedure with less periprocedure morbidity. Options of endovascular intervention included coiling of individual branches supplying the aneurysm or deployment of a covered stent across the aneurysm. In the first case, individual cannulation of multiple branches was difficult as there were at least four branches. Another option was to treat with an endovascular stent graft, which was not without known complications such as endoleak. After the patient was explained the options, the patient opted for endovascular intervention. Balloon-mounted covered stent was preferred over self-expanding stent because absolute precision was required during deployment in this case though compromising with less radial force in case of balloon-mounted stent. SMA was tapered across the aneurysm with diameter of proximal SMA being 8 mm and diameter of distal SMA being 6 mm. Due to unavailability of balloon-mounted single covered stent of tapered design, two overlapping stents were planned to be deployed. After the initial angiogram (►**Fig. 2A**) first distal stent of size 6 × 58 mm (LifeStream, bard) were deployed (►**Fig. 2B, C**), followed by deployment of proximal stent of 8 × 37 mm (LifeStream, bard) (►**Fig. 3A, B**) with adequate overlap of at least 2 cm. Postdeployment angiogram revealed no filling of aneurysm sac in either early or delayed phase (►**Fig. 3B, C**).

Follow-up ultrasound on postprocedure day 1 revealed the SMA aneurysm was entirely thrombosed with the patent stent (►**Fig. 4**). Follow-up at 7 days was the same with the subsidence of the patient's pain symptoms. After a 3-month follow-up, patient again complained of abdominal pain. Duplex ultrasound at that time revealed 1.5 × 1.6 cm-sized patent component showing color flow within the thrombosed sac (►**Fig. 5**). On digital subtraction angiography (DSA), done for confirmation and subsequent management, revealed there was angulation at the junction of two stents (►**Fig. 6A–C**) with immediate filling of the aneurysm from the junction of two stents, consistent with a diagnosis of type III endoleak (►**Fig. 6B, C**). Angioplasty was considered to properly realign the overlapping stents, using 5 mm sized balloon (►**Fig. 7A**). Postangioplasty angiogram revealed there is resolution of previously seen angulation and leakage of contrast (►**Fig. 7B, C**). Follow-up ultrasound postprocedure on day 1 and day 7 revealed entirely thrombosed SMA aneurysm with subsidence of patient's pain. After 1 month of balloon angioplasty, patient again complained of pain, and

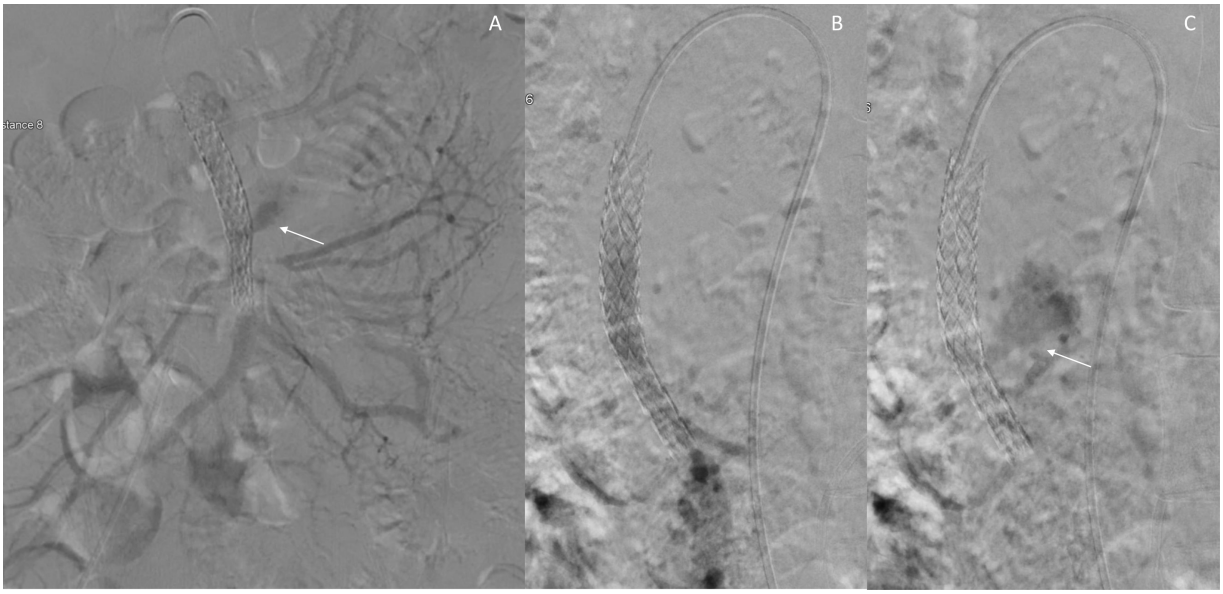

Fig. 6 (**A–C**) Digital subtraction angiography image showing angulation at the junction of two stents with immediate filling of aneurysm from junction of two stents.am

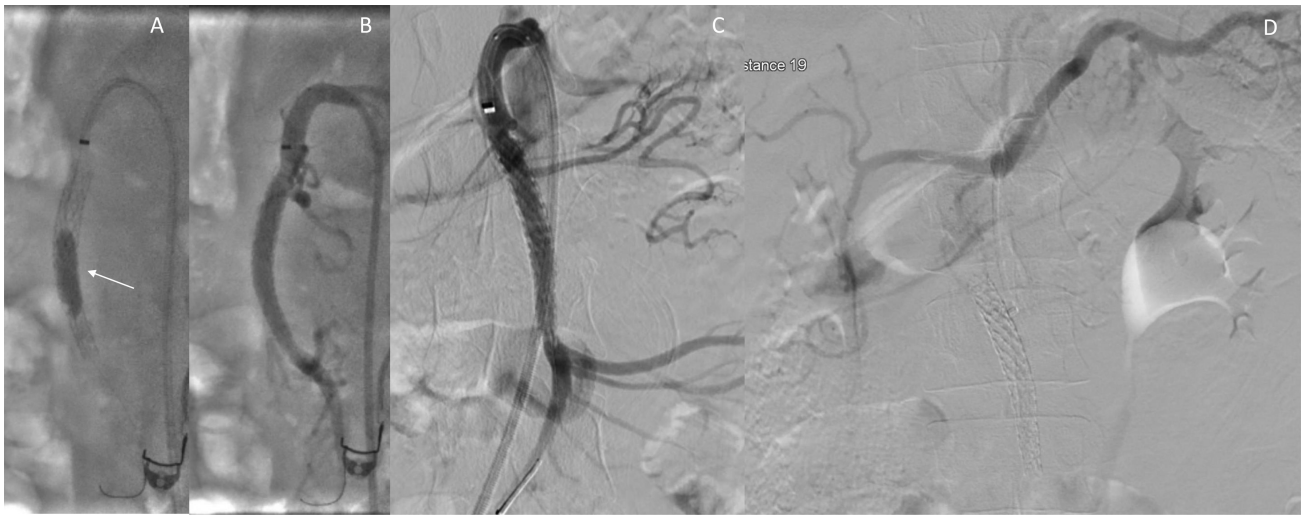

Fig. 7 (A) and (B) Fluoroscopic image showing in-stent balloon angioplasty of superior mesenteric artery (shown by thin white arrow) with optimal dilatation; (B) and (C) Postballoon angioplasty revealed no aneurysm.

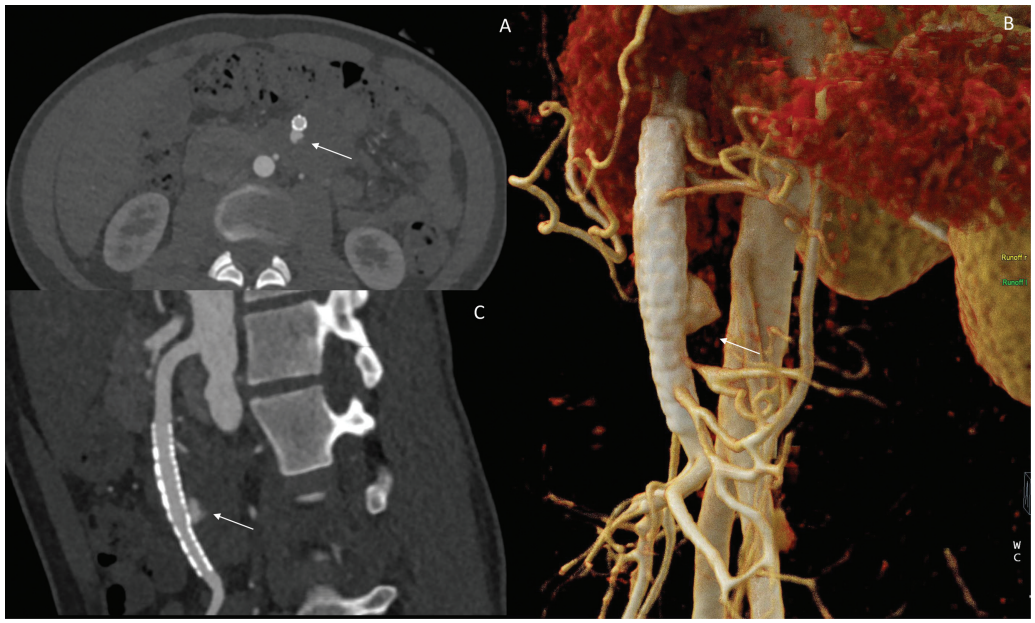

Fig. 8 (A) Axial computed tomography image showing small (~ 1.5 cm sized) patent component of aneurysm posterior and adjacent to the stent (shown by thin white arrow). (B) Sagittal cinematic volume rendered computed tomography image showing patent small component of aneurysm (shown by thin white arrow) posterior to the stent. (C) Sagittal maximum intensity projection reconstructed image along superior mesenteric artery shows patent stent with small (~ 1.5 cm sized) patent sac of the aneurysm (shown by thin white arrow) posterior and adjacent to the stent.

ultrasound at that time revealed approximately 1 cm sized patent component showing color flow within thrombosed sac. Computed tomography angiography at that time revealed patent stent within the SMA for a length of approximately 6 cm x 1.5 cm sized patent lumen posterior and adjacent to the stent (►**Fig. 8A, C**). On reconstructed computed tomography images, it appeared to be arising from the junction of two stents (►**Fig. 8B**); there was suspicion of either type II or type III endoleak. Delayed DSA image at this time revealed aneurysm being filled by one of the jejunal branches of SMA (►**Fig. 9A–C**). So, this was suggestive of type II endoleak. Selective cannulation of the branch of SMA supplying the sac was done using a 2.8 Fr Progreat microcatheter (►**Fig. 10A–C**). After placement of the microcatheter tip into the sac, diluting 0.5 mL of N-butyl cyanoacrylate glue (Nectaryl, Dr. Reddy Laboratories, Hyderabad, Andhra Pradesh, India) with ethiodized oil (Lipiodol, Laboratories, Guerbet, France) in 1: 5 dilution, embolization of the aneurysm sac (►**Fig. 10B, C**) was done. Postembolization angiography revealed no patent component within the sac (►**Fig. 11A–C**). Follow-up ultrasound revealed no flow within the thrombosed sac on postprocedure day 1, day 7, and 1 month. There was no complaint from the patient after 6 months follow-up.

Fig. 9 (**A**) Superior mesenteric artery (SMA) angiogram revealed patent stent within SMA. (**B–C**) Digital subtraction angiography image showing aneurysm sac filled up by SMA branch (shown by thin white arrow).

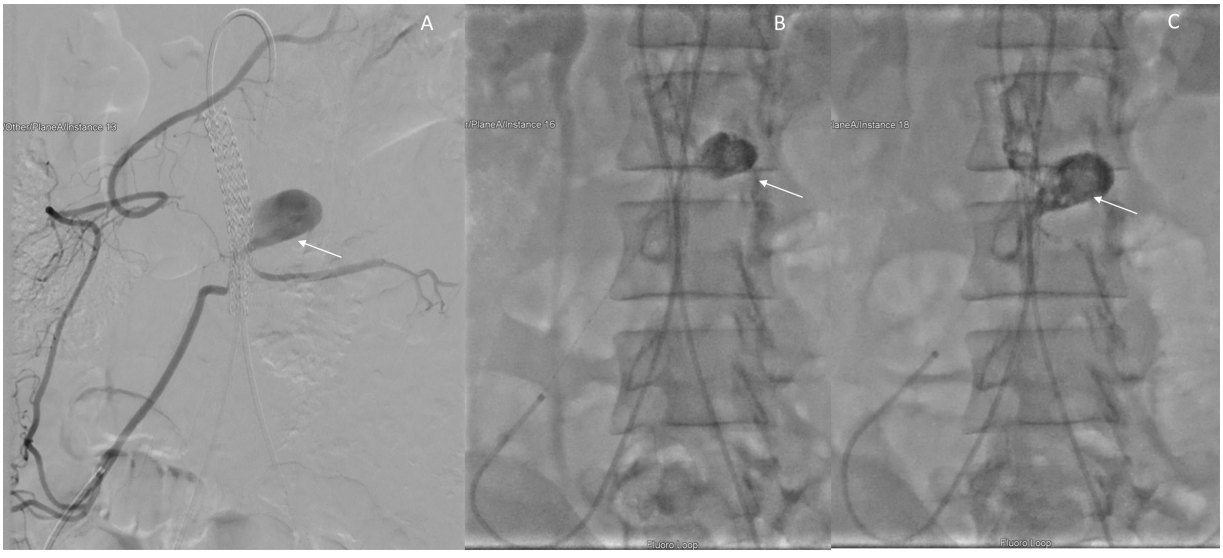

Fig. 10 (**A–C**) Microcatheter within aneurysm sac and injection of glue and lipiodol into the aneurysm sac and formation of glue cast (shown by thin white arrow).

This case underlines the importance of the optimal approach to the management of SMA aneurysm with surgery or endovascular treatment as options. SMA aneurysms are rare, and they account for 6.9% of all VAAs.[1] Rupture is the most common complication of SMA aneurysms.[2] SMA aneurysm can arise secondary to trauma, inflammation, or infection, or it can be idiopathic, as is our case. The most common symptom of visceral aneurysm is pain and hemorrhage.[2] In our case, the patient presented with abdominal pain. Conventional treatment of SMA aneurysms included excision of the aneurysm and SMA reconstruction.[3] Treatment options include surgical as well as endovascular. The treatment of choice is resection of aneurysms and reconstruction of the SMA. Surgical approaches mainly include ligation, aneurysmorrhaphy, and aneurysmectomy.[2] McGraw et al[4] reported the first case of covered stent placement in 1998 using an autogenous vein covered stent with a balloon-expandable Palmaz P294 stent.[4] From then on, use of covered stents in SMA aneurysm was in practice. Ideal characteristics of the covered stents included low profile, good trackability, appropriate size and length, and precision in deployment.[4] That's why balloon-mounted stent was preferred over self-expanding stents. Before endovascular management, branches supplying the aneurysm should be noted, as the use of a covered stent graft sacrifices these branches, thereby leading to bowel ischemia. In Mendonça et al's report, at least three jejunal branches were covered

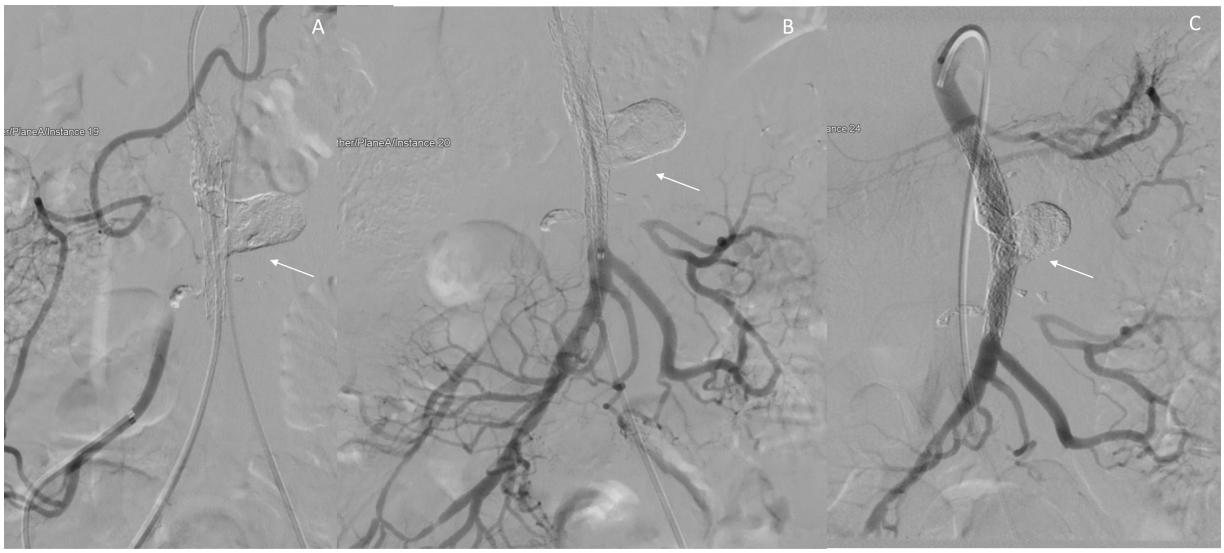

Fig. 11 (**A–C**) Postembolization digital subtraction angiography image showing glue cast formed within aneurysm sac (shown by thin white arrow) with patent stent within superior mesenteric artery.

without bowel ischemia.[5] Complications of SMA aneurysm by endovascular treatment included type I and II endoleaks, vasospasm, and infection.[4] Management of type I endoleak included 2nd overlapping covered stent,[6] whereas management of type II endoleak included thrombin injection with or without microcoil embolization.[4] Prophylactic embolization of a jejunal branch to prevent type II endoleak followed by deployment of second stent as a management of type II was also reported. The management of vasospasm includes secondary balloon angioplasty.[7] No type III endoleak has been reported in SMA aneurysms treated with a covered stent. Theoretically, the management of such a type of aneurysm includes a second overlapping stent graft.

In our case, initially it appeared that it was due to leakage from the junction of two stents, suggestive of a type III endoleak, as shown by DSA images. Postballoon angioplasty, there was no extravasation of contrast. However, there was a recurrence of symptoms. The DSA image clearly showed aneurysm filling in the delayed phase by jejunal branches of SMA, suggesting a type II endoleak. This case also highlights the importance of obtaining delayed DSA images to identify type II endoleaks, as Doppler is not a gold standard modality to rule out endoleaks.

IRB Approval, Consent Statement and Clinical Trial Registration

The Institutional Ethics Committee waived off the need for patient written informed consent.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethical Statement

All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Funding

None.

Conflict of Interest

None declared.

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