Case Report

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Successful Endovascular Embolisation of an Unusual Giant Pseudoaneurysm of the Middle Colic Artery

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Visceral artery pseudoaneurysms (VAPAs) are extremely rare and pseudoaneurysms in the superior mesenteric artery (SMA) and its branches, particularly the middle colic artery, are the rarest. These account for 6–8% of all VAPAs with an incidence of 0.01%. They can be associated with an inflammatory disease (such as pancreatitis), infection or arise as a post-surgical complication, but they can also be due to a traumatic damage to the artery caused by a full-thickness slit in the arterial wall. They can be asymptomatic or manifest with symptoms such as abdominal pain, nausea and vomiting, local pressure symptoms (such as a pulsatile mass or a bruit) and gastrointestinal bleeding. Imaging techniques play a key role in the diagnosis of VAPAs and angiography still represents the gold standard, although nowadays it has a pivotal role for treatment with the possibility to perform an endovascular embolisation. In fact, although rare, VAPAs are of clinical importance mainly because they can cause life-threatening intra-abdominal or retroperitoneal haemorrhage and so prompt treatments are crucial, whether they are symptomatic, haemorrhagic or incidentally found. In the past, surgery was the treatment of choice, but in recent years with the improvement and development of interventional vascular techniques, surgery has been replaced by transcatheter endovascular embolisation due to its low morbidity and mortality and high success rate. In this article, we report the case of an unusual giant spontaneous pseudoaneurysm of the middle colic artery in a patient with a scoliotic abdominal aortic aneurysm successfully treated by endovascular embolisation.

Keywords: *Visceral Artery Pseudoaneurysm; Endovascular Embolisation; Superior Mesenteric Artery*

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INTRODUCTION

Visceral artery pseudoaneurysms (VAPAs) are rare vascular entities with significant clinical consequences [1–3]. Splenic artery VAPAs are the most frequently reported followed by the gastroduodenal and the pancreaticoduodenal arteries [3–7]. Superior mesenteric artery (SMA) pseudoaneurysms, and those associated with distal branches of the SMA, are the least likely reported VAPAs [1,3–6]. They can be associated with an inflammatory disease, like pancreatitis, infection or arise as a post-surgical complication, but they can also be due to traumatic damage to the artery caused by a full-thickness slit in the arterial wall [2,4–6,8,9]. They can be asymptomatic or manifest with symptoms such as abdominal pain, nausea and vomiting, local pressure symptoms (like a pulsatile mass or a bruit) and gastrointestinal bleeding [3,4,5,6,8]. Imaging techniques, such as ultrasound, Doppler sonography and computed tomography (CT), play a key role in the diagnosis of VAPAs. Angiography still represents the gold standard, although nowadays it has a pivotal role for treatment with the possibility to perform an endovascular embolisation [7,10,11]. Although rare, VAPAs are of clinical importance mainly because they can cause life-threatening intra-abdominal or retroperitoneal haemorrhages and so prompt treatments are crucial for them all, whether they are symptomatic, haemorrhagic or incidentally found [2,12]. Historically, open surgery represents the gold standard treatment; however,

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endovascular techniques have proven to be an effective alternative treatment for VAPAs and today an endovascular approach is considered the treatment of choice and the first-line treatment in patients who are poor surgical candidates and/or have unfavourable anatomy [1,7,10,13–15]. In this article, we report the case of an unusual giant spontaneous pseudoaneurysm of the middle colic artery in a patient with a scoliotic abdominal aortic aneurysm, successfully treated by endovascular embolisation.

Ethical Approval and Informed Consent

Ethical approval was not required. Informed consent was not required. The information has been anonymised.

CASE REPORT

A 70-year-old woman presented to our emergency department for right upper-quadrant abdominal pain and a persistent feeling of pulsation in the periumbilical region. Her medical history was notable for pemphigus, associated with a not well-specified collagen disease, and osteoporosis; moreover, she revealed to be already affected by an abdominal aortic aneurysm. There was no history of hypertension, smoking, trauma, fever or abdominal or chest infections. Her general physical examination was unremarkable. She declared that she was not taking medications or anticoagulant therapy and her laboratory tests were normal. A contrast-enhanced CT scan was performed, confirming the presence of a scoliotic and stretched abdominal aortic aneurysm (Figure 1*a,b*), with maximum transverse diameters of 45 × 48 mm^2, part of its sac filled with thrombus and a patent lumen measuring 27 × 30 mm^2. It also revealed an incidental finding of a giant pseudoaneurysm of the middle colic artery (Figure 1*b,c*), the first right branch of the SMA (Figure 2*a,b*), with maximum transverse diameters of 83 × 60 mm^2 and a longitudinal diameter of 100 mm. After a multidisciplinary discussion, the emergency surgeon, the vascular surgeon and the interventional radiologist agreed to perform a selective angiographic study to better investigate the incidental finding and eventually perform a minimally invasive endovascular approach to the pseudoaneurysm. In the angiographic suite, a selective SMA angiography was performed through a standard percutaneous right transfemoral approach, employing a 6-Fr-long introductory catheter (55 cm Flexor Check-Flo Introducer, Cook Incorporated, Bloomington, IN, USA), because of the scoliotic and stretched course of the abdominal aortic aneurysm, and a 5 Fr Cobra catheter (Cook Incorporated, Bloomington, IN, USA), confirming the CT findings and showing a giant pseudoaneurysm of the middle colic artery (Figure 3*a*), with no evidence of out-flow vessels and with a short and narrow in-flow tract (Figure 3*b,c*). An endovascular exclusion of the pseudoaneurysm was performed by transcatheter

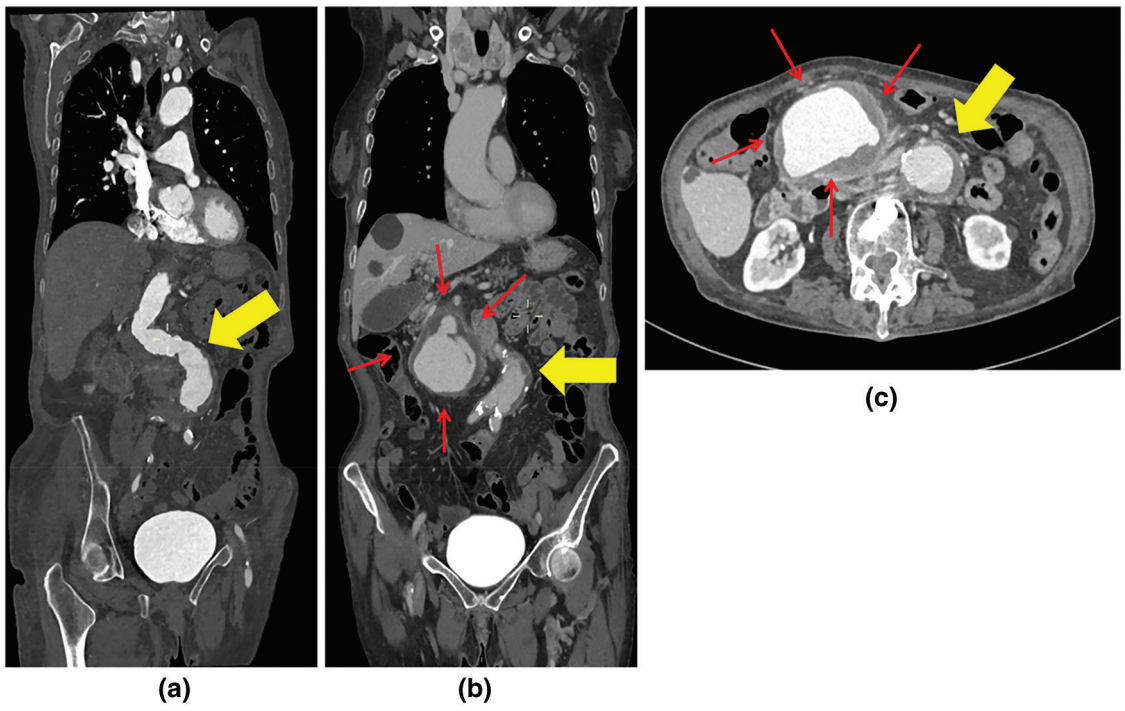

Figure 1 Preliminary CT scan. CT imaging showing coronal (**a**,**b**) and axial (**c**) reconstructions of a scoliotic and stretched abdominal aortic aneurysm (yellow arrows) with part of its sac filled with thrombus and the presence of a giant pseudoaneurysm of the middle colic artery (red arrows).

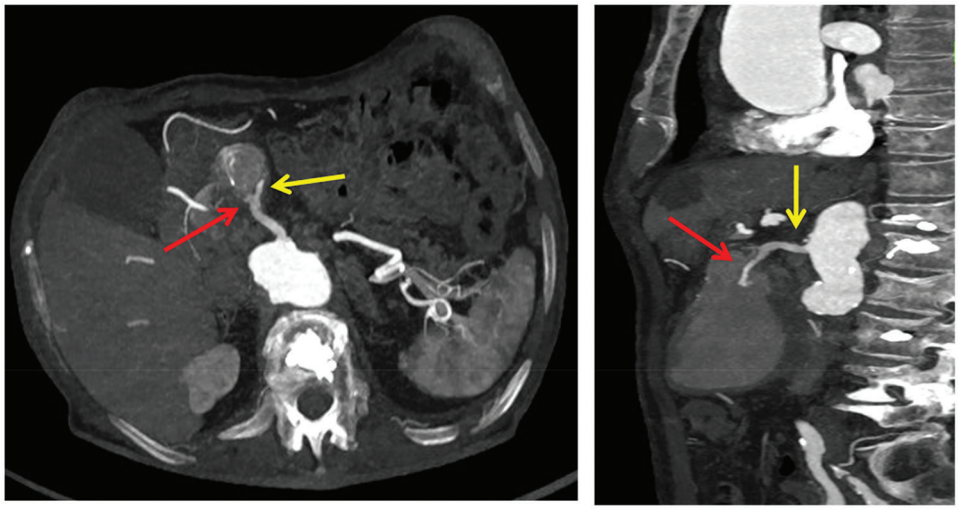

Figure 2 Preliminary CT scan. Maximum intensity projection (MIP) reconstructions showing the oblique axial (**a**) and sagittal (**b**) planes, the origin of the middle colic artery (red arrows) and in-flow tract of the giant pseudoaneurysm from the superior mesenteric artery (yellow arrows).

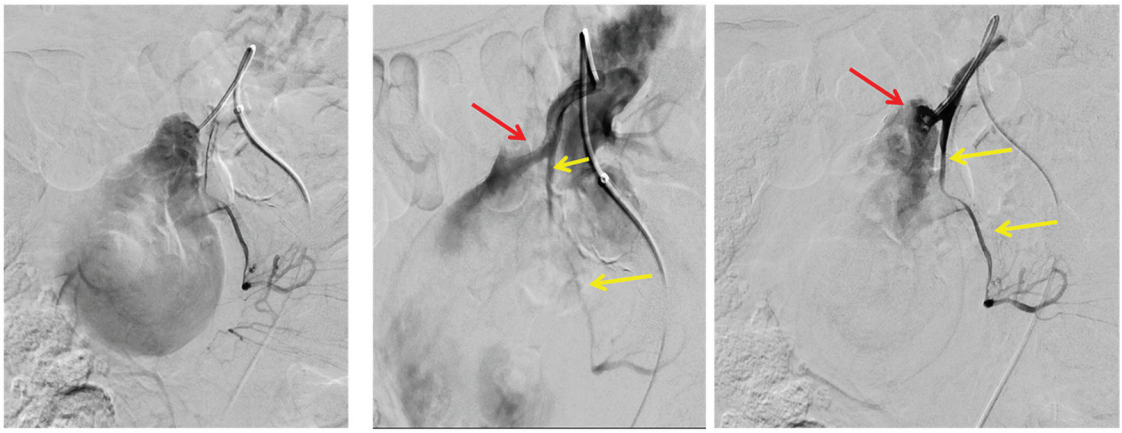

Figure 3 Digital angiography. Selective angiography of the superior mesenteric artery confirming the presence of a giant pseudoaneurysm (**a**) with no out-flow vessels and showing the origin of the middle colic artery (**b**,**c**) (red arrows) and in-flow tract of the giant pseudoaneurysm from the superior mesenteric artery (yellow arrows).

embolisation, releasing multiple coils (POD, Penumbra, Inc., Alameda, CA, USA; Ruby Coil, Penumbra, Inc., Alameda, CA, USA; Concerto, Micro Therapeutics Inc. d/b/a ev3 Neurovascular, Irvine, CA, USA) firstly into the pseudoaneurysm's sac, to create a solid scaffolding below, and then into its in-flow tract (Figure 4*a*) with coaxial technique, employing a microcatheter (Progreat 2.7 Fr, Terumo, Tokyo, Japan). Final angiography showed a complete exclusion of both the pseudoaneurysm and its in-flow tract (Figure 4*b*) together with patency of the SMA and its collateral branches. The patient was asymptomatic after the procedure and the technical success was confirmed by a contrast-enhanced CT scan performed 48 h later (Figure 5*a*,*b*), with neither evidence of revascularization of the pseudoaneurysm nor evidence of bowel ischemia; the patient was discharged 5 days after the embolisation. Six months after the procedure she is still asymptomatic and the endovascular embolisation has proven to be effective.

DISCUSSION

VAPAs are extremely rare, with splenic artery VAPAs being the most common [2,12]. Pseudoaneurysms of the SMA and its branches, particularly the middle colic artery, are the rarest, accounting for approximately

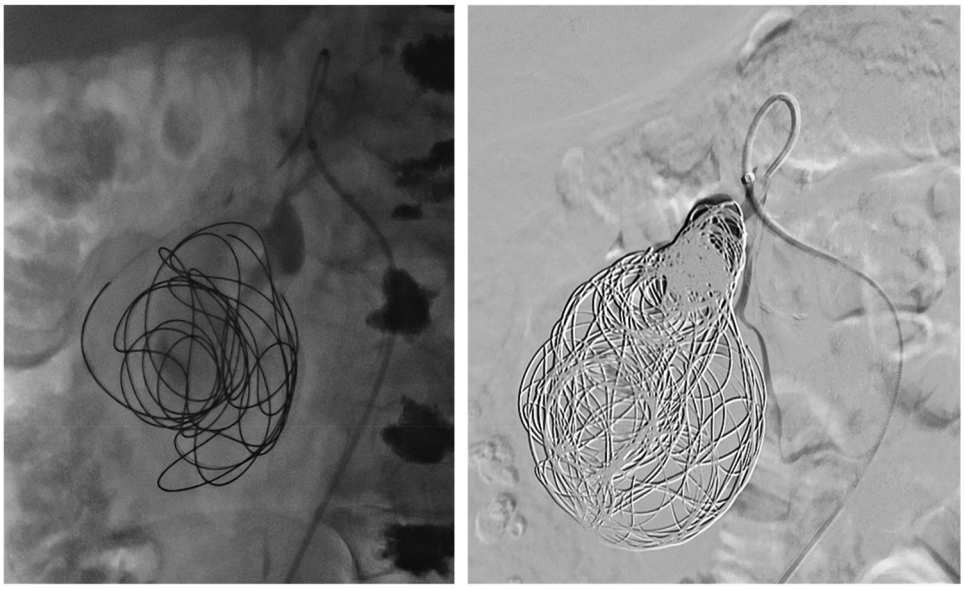

Figure 4 Digital angiography. Selective catheterisation, employing a microcatheter, of the pseudoaneurysm's sac (**a**) with subsequent endovascular embolisation releasing multiple metallic microcoils, firstly into the sac creating an underlying scaffold, and then into the in-flow tract of the giant pseudoaneurysm. Final angiographic control confirming successful endovascular exclusion of the pseudoaneurysm (**b**).

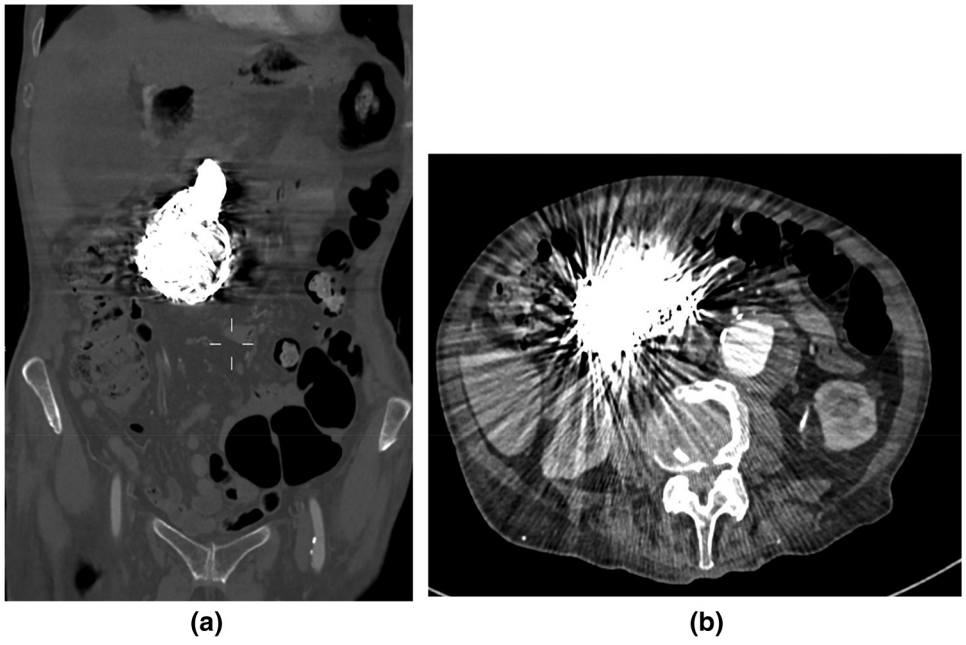

Figure 5 Follow-up CT scan performed 3 days after the procedure. CT imaging confirming, in coronal (**a**) and axial (**b**) reconstructions, successful endovascular embolisation with multiple metallic microcoils and no opacification of the giant pseudoaneurysm's sac and its in-flow tract.

6–8% of all VAPAs with an incidence of 0.01% [2,3,16,17]. True aneurysms involve all three layers of vessels, and most are asymptomatic, while false aneurysms or pseudoaneurysms are defined as a lack of complete arterial walls, which are lined by adventitia or by perivascular tissue. The rupture risk depends on the aneurysm sizes, shapes and locations, and pseudoaneurysms have a higher rupture risk compared to true

aneurysms [18,19]. Once ruptured, the reported mortality rate is up to 70% [18,20]. Vasculitis like polyarteritis nodosa, collagen vascular disorders like Ehlers-Danlos and Marfan's syndromes, and fibromuscular dysplasia are etiological factors associated with true SMA aneurysms, but the aetiology of VAPAs can be congenital, traumatic, due to infectious or inflammatory diseases (such as acute pancreatitis) or they can occur as post-surgical complications such as arterial dissection [4–6]. The most common cause of SMA pseudoaneurysms are represented by pancreatitis or trauma. The mechanism of vascular injury in pancreatitis involves pancreatic autodigestion enzymes being released into the perivascular space leading to enzymatic digestion of the arterial wall [2,21]. Rarer causes of SMA pseudoaneurysms include infective endocarditis or uncontrolled hypertension; in particular, visceral mycotic VAPAs are most commonly confined to the SMA and in 2.5–10% of cases they are associated with infective endocarditis [2,3,16,22]. In a reported SMA dissection case, another differential diagnosis is represented by segmental arterial mediolysis, a non-atherosclerotic, non-inflammatory arteriopathy of uncertain aetiology [18,23]. Imaging plays a key role in the identification of these conditions. The main diagnostic tools are ultrasound (US), Doppler US, contrast enhanced US (CEUS), CT and magnetic resonance imaging (MRI) [7,24–26]. Doppler US is the first choice for pregnant patients as it can be effective and sufficient, precisely depicting the location and the morphology of the false aneurysm in superficial anatomical districts. However, it has a lower accuracy in the abdomen because of intestinal bloating and has many limitations in emergency settings in non-collaborating patients. CEUS recently proved to be a powerful new tool for detecting false aneurysms, both for the first diagnosis in patients with a clinical suspicion and for follow-up after treatment, representing a faster, easier, cheaper, repeatable and, above all, valid and effective radiation-free imaging technique. CT angiography represents the current imaging technique of choice for diagnosis, showing the typical aneurysm body in the arterial phase as demonstrated in our case [7,24,26–29]. MRI proved to be more sensitive and specific; however, it is contraindicated for patients with pacemakers and metal prostheses, it is unsuitable for claustrophobic and respiratory distressed patients and its availability is still limited in emergency settings [7,24,27]. Although VAPAs of the SMA are very rare, their elevated risk of rupture (10–50%) and subsequent mortality (22–40%) make their prompt diagnosis and treatment mandatory [1,17,30]. In fact, the decreased integrity of the arterial wall makes VAPAs more prone to rupture than their true aneurysmal counterparts and can prove fatal [1,30]. Treatment options range from open surgery to endoscopic and endovascular procedures. Endovascular procedures are represented by coil embolisation or covered stent placement [2,21]. In the past, surgery was the treatment of choice for visceral artery aneurysms, but in recent years, with the improvement and development of interventional vascular techniques, surgery has been replaced by transcatheter endovascular embolisation due to its low morbidity and mortality and high success rate. In this way, an endovascular approach can be considered a safe alternative therapy to surgery [1,3,7,17,18,29,31–35]. These reasons informed our decision to perform endovascular embolisation to treat our patient. The target of the endovascular approach to pseudoaneurysms is both to fill the aneurysm's sac with embolic agents and to exclude the neck of the aneurysm from circulation [7,10,13–15]. The embolisation of the proximal and distal neck is the most commonly reported endovascular approach in such cases because it is necessary to exclude both in-flow and out-flow tracts to avoid the risk of later anterograde and retrograde reperfusion [7,36].

The most employed and effective embolic agent reported to successfully embolize the in-flow and out-flow tracts of the injured artery are metallic coils, which in most cases are sufficient and effective alone, as happened in our case in which we successfully employed only metallic coils for the embolisation [7,10,11,14]. In the reported case, the giant pseudoaneurysm had no out-flow vessels but a single in-flow tract represented by its neck. It suggested to us that the complete filling of both the sac and the neck with multiple metallic coils could be the right endovascular approach, especially with complete vascular exclusion and the sealing of its in-flow tract, to avoid the possibility that the pseudoaneurysm's sac could be afterwards exposed to the high pressure of the blood flow of the superior mesenteric artery, coming directly from the abdominal aorta, with the risk of recurrence of the pseudoaneurysm, due to eventual later deployment of the metallic coils, previously released, forward, into the fund of the sac [29]. In fact, these reasons are why we performed a packing of coils into the pseudoaneurysm's sac: to obtain an underlying solid scaffold, to allow a subsequent safe and effective packing of the too short and narrow in-flow tract, and to reduce the risk of late deployment of the coils released into the in-flow tract (into the giant pseudoaneurysm's sac) under the high pressure of mesenteric arterial blood flow. When embolisation is performed the weakness of the wall represents an additional problem to consider. This is because the fragility of the pseudoaneurysm may allow it to rupture during injection of the contrast agent or the chosen embolic agents when the catheter is wedged into the feeding vessel. In fact, a considerable increase in intra-aneurysmal pressure occurs when a notable amount of fluid is injected in a short time, such as during endovascular procedures. In this way, all the injecting pressure is transmitted to the aneurysm's wall and consequently rupture can occur [7,31,32]. Therefore, the advantage of transcatheter coil embolisation, with which no high pressure or large amount of fluid is

necessary during the procedure, is clear and well reported [7,31,37]. The reported rate of complications of endovascular embolisation is between 3% and 18%; the major complications are represented by intestinal infarct, infection, fever, dislodgement and migration of embolic agents, haematoma or pseudoaneurysm at the percutaneous arterial entry site and contrast induced acute renal failure [7,10,24,33,38–40]. In the reported case, there was a high risk of intestinal infarct, due to embolisation of the SMA and its main branches, because of eventual inadvertent migration and/or dislodgment of embolic material. However, the employment of a long introductory catheter, to preserve the stability of the endovascular approach, a microcatheter, to ensure the super selectivity of coiling, and the use of a mechanical embolic agent significantly avoided this risk and allowed us to perform a safe and effective embolisation.

CONCLUSIONS

Spontaneous VAPAs are extremely rare, especially pseudoaneurysms of the SMA and its branches; it is fundamental to urgently manage any VAPAs because of their high risk of rupture and the potential to be life threatening due to profuse haemorrhaging. In fact, it is important to remember that there is no correlation between the pseudoaneurysm size and its risk of rupture. Endovascular embolisation is a valid, minimally invasive, safe and effective alternative treatment to the traditional surgical approach with lower morbidity and mortality and high success rates, especially in those patients who are poor surgical candidates.

Ethics Statement

(1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
(2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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Author Contributions

All the authors substantially contributed to the study and manuscript writing.

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