Robotic system-assisted endovascular treatment of a dissection-related pseudoaneurysm of the celiac axis secondary to fibromuscular dysplasia

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Spontaneous celiac artery dissection caused by fibromuscular dysplasia is rare. Subsequent thrombosis and occlusion of the celiac trunk can result in intestinal ischemia and hepatic failure. We describe a case of spontaneous celiac artery dissection with an associated pseudoaneurysm caused by fibromuscular dysplasia, extending into the common hepatic artery. An endovascular intervention featuring robotic-assisted celiac artery cannulation with stent-assisted coil embolization resulted in successful treatment. (J Vasc Surg Cases 2016;2:145-8.)

Spontaneous celiac artery dissection caused by fibromuscular dysplasia (FMD) is a rare entity.[1] The condition can be asymptomatic, but the most common presenting symptom is abdominal pain.[1-3] We describe robotic-assisted endovascular treatment of a pseudoaneurysm secondary to spontaneous celiac artery dissection. The patient consented to the publication of this report.

CASE REPORT

An 81-year-old woman presented to our institution because of abdominal pain radiating to the back for 5 months. The patient was empirically prescribed a proton pump inhibitor; however, her symptoms did not subside. She denied any history of trauma. She was normotensive and afebrile. Physical examination revealed mild epigastric tenderness. Results of laboratory tests, including a complete blood count, liver function, and metabolic profiles, were within normal limits. Computed tomography angiography revealed a spontaneous celiac artery dissection with an associated pseudoaneurysm (Fig 1). The pancreas, aorta, and superior mesenteric artery appeared normal. Given her symptoms, age, and comorbidities, angiography was performed in hopes of treating the aneurysm endovascularly. Angiography showed a spontaneous celiac artery dissection extending into the common hepatic artery (HA) with an associated 1.0- × 2.0-cm pseudoaneurysm (Fig 2). Both renal arteries were patent, but there was a typical string of beads appearance of the right renal artery and irregularities in the right HA, compatible with FMD. After selection of the celiac artery with a 5F Cobra 2 catheter, a 0.035-inch stiff wire was positioned distally in the common HA. Multiple attempts were made to advance a vascular sheath into the origin of the celiac axis (to achieve stability at the target site and to guide subsequent treatment) but failed as a result of her steeply angulated celiac axis. The decision was made to stop the procedure and to repeat with robotic assistance. During this attempt, the 9F Magellan robotic system (Hansen Medical, Mountain View, Calif) was used in combination with a 0.035-inch hydrophilic-coated guidewire (Glidewire; Terumo, Somerset, NJ) to catheterize the celiac axis. The ability to manipulate the angle and shape of the robotic system facilitated engagement of the orifice of the celiac axis to achieve better stability (Fig 3, *A*). Once the robotic 9F catheter was in place, the 0.035-inch guidewire was exchanged for a stiff guidewire (TAD-2; Abbott Vascular, Santa Clara, Calif) for better support. This was followed by the deployment of a 7- × 37-mm balloon-expandable bare-metal stent (Express LD; Boston Scientific, Natick, Mass) across the dissected segment of the celiac artery as well as the neck of the pseudoaneurysm (Fig 3, *B*). Follow-up angiography showed persistent filling of the pseudoaneurysm through the stent. A microcatheter was subsequently advanced into the pseudoaneurysm through the interstices of the stent, and stent-assisted coiling was performed with detachable coils (Interlock coils; Boston Scientific; Fig 3, *C* and *D*). Completion angiography demonstrated flow into the distal arteries with absent flow into the pseudoaneurysm sac (Fig 3, *E*). Postoperative computed tomography angiography after 1 month confirmed patency of the celiac axis and the distal arteries with persistent exclusion of the coiled aneurysm.

DISCUSSION

FMD registry data recently demonstrated that aneurysm and dissection are relatively uncommon, being identified in 17.0% (n = 76) and 19.7% (n = 88), respectively.[4] Among these patients, the aneurysm and dissection in the celiac artery were found in 15.8% (n = 12) and 2.3% (n = 2), respectively. The prevalence of celiac artery dissection caused by FMD may have been underestimated.

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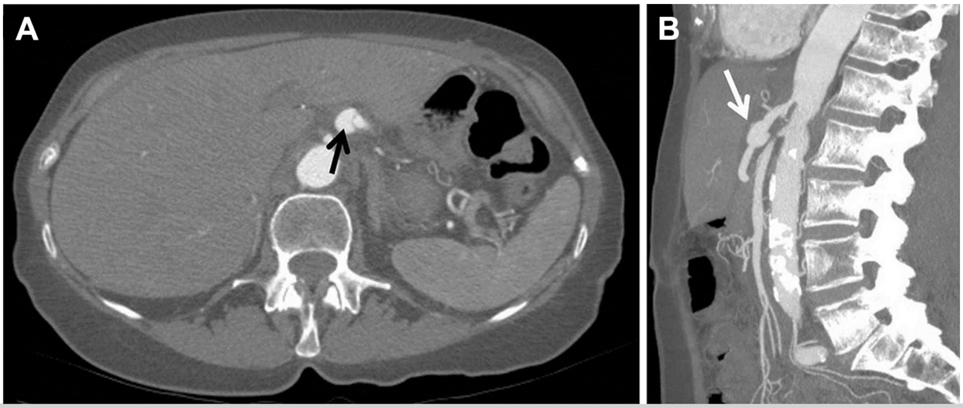

Fig 1. Preoperative computed tomography cross sections in axial **(A)** and sagittal **(B)** views demonstrate the double-lumen sign of the celiac artery dissection (*black arrow*) and the celiac artery dissection with an associated pseudoaneurysm (*white arrow*).

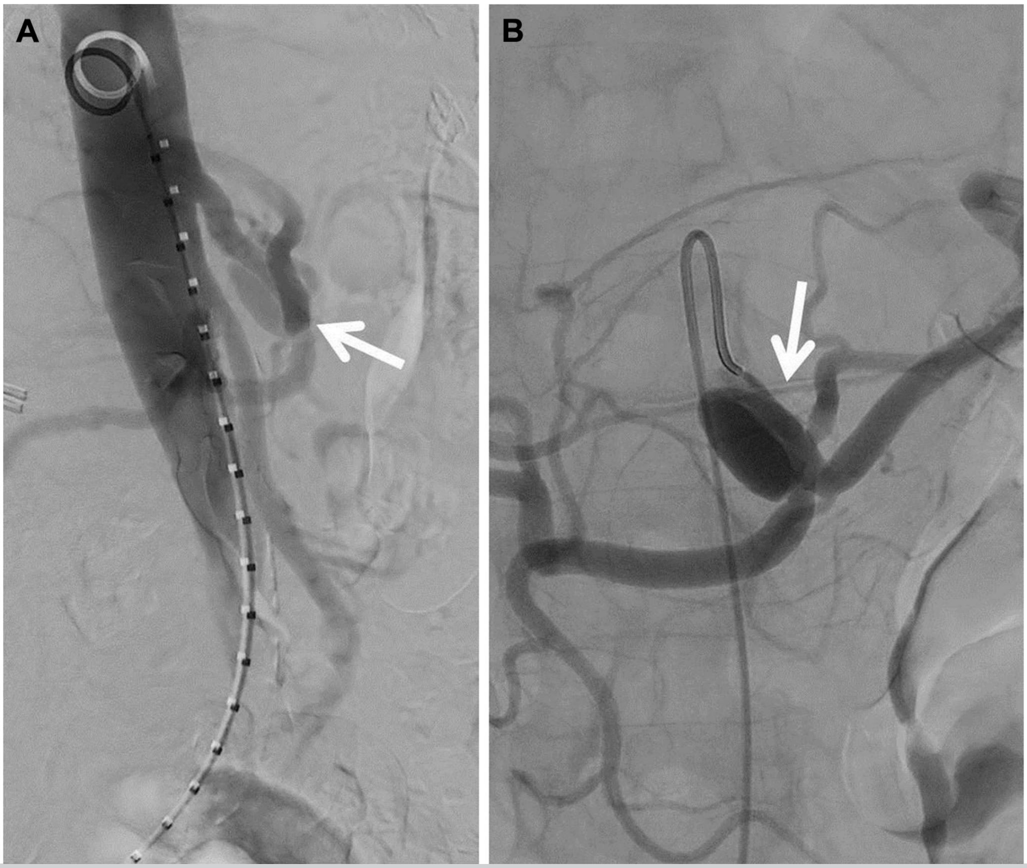

Fig 2. Aortogram **(A)** and selective angiogram **(B)** of the celiac axis showing the spontaneous celiac artery dissection with associated pseudoaneurysm (*arrow*).

There are several reports of celiac artery dissection believed to be secondary to FMD that occurred in patients without atherosclerotic risk factors or trauma.[5-7] Celiac artery dissection may be asymptomatic, which may be explained by the good collateral flow through the superior mesenteric artery as well as continued portal vein blood supply to the liver.[8,9]

There has been no consensus on the optimal management strategy for celiac artery dissection.[10] Conservative treatment might be appropriate for some asymptomatic uncomplicated patients in whom there are no signs of ruptured celiac artery branches or mesenteric ischemia.[11] On the contrary, symptomatic or complicated patients may be treated with surgery or endovascular therapy.

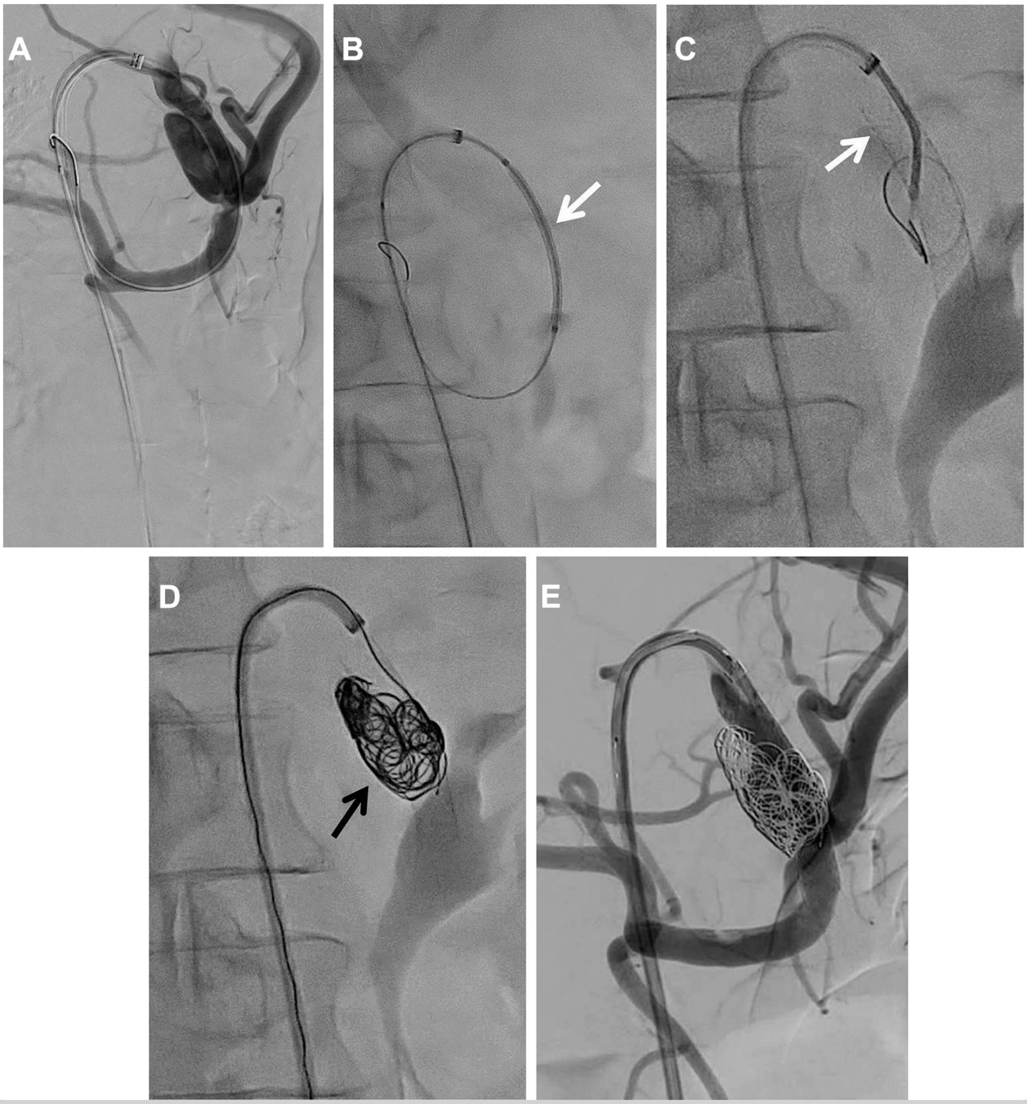

Fig 3. Robotic system enhances the cannulation at the orifice of celiac trunk and maintains stability **(A)** during passage of stiff wires and stent (*arrow*, **B**). Coil packing embolization was performed with stent-assisted technique **(C)** because of persistent filling of the pseudoaneurysm. After a microcatheter was advanced through the interstices of the stent, the pseudoaneurysm was coil embolized (*arrow*, **D**). Completion angiography demonstrated good flow into the distal arteries with nearly absent flow into the pseudoaneurysm sac **(E)**.

Surgery may be a means of treating the complications of celiac artery dissection; the long-term anatomic results are good, and most surgical techniques are well known.[6,7,10] Recently, endovascular therapy has had a progressively increasing role in managing this challenging pathologic process.[2,12-15] Because endovascular therapy has potential advantages including faster recovery and fewer complications compared with surgery, it is a reasonable alternative in patients with symptomatic or complicated celiac artery dissection.

In this case, the presence of a wide neck to the pseudoaneurysm precluded coil embolization alone as this would have resulted in coil prolapse into the flow lumen. Covered stent placement from the celiac origin to the common HA was considered; however, this would have resulted in occlusion of the origins of both the left gastric and splenic arteries. The stomach is well collateralized, and sacrifice of the left gastric artery would have been inconsequential. The spleen would have received collateral flow from the gastroduodenal artery through the gastroepiploic arterial arcade; this may not have been sufficient to prevent a splenic infarct with resultant potential for abscess formation. Stent-assisted coiling was considered the ideal solution as it allowed preservation of all outflow branches while excluding flow into the pseudoaneurysm sac.

Robotic-assisted procedures use two coaxial catheters as well as a guidewire that can be precisely steered remotely to facilitate catheterization and endovascular intervention.[16] The robotic system is designed to facilitate the operator's ability to manipulate and to position catheters into vessels to create a stable platform for imaging and intervention.[16,17] Although clear indications for the applications of robotic technology have yet to be defined in the endovascular arena, several articles have documented its clinical use for navigation of tortuous anatomy and catheterization of challenging vessels that may be difficult with manual techniques in the aorta and periphery.[18-20] Presently, there is a 10F and 9F robotic catheter system with a coaxial 5F "leader" catheter as well as a 6F system. Nevertheless, the 9F and 10F systems require larger vascular access to then allow the delivery of 6F and 7F devices through the robotic catheters, respectively. In addition, the size of the robotic catheter allows potentially multiple wires and balloons if needed for complex embolization. In this specific case, the robotic catheter was thought to offer a large number of variable catheter shapes with operator-determined stiffness that offer advantages over sheaths with a controllable bendable tip. The angle to treat from an upper extremity approach may have been more favorable for the celiac catheterization. However, treatment from this approach would have been limited because of the necessary sheath diameters and stability required. More investigations are required to quantify the advantages of robotic-assisted catheterization over conventional manual catheterization in endovascular visceral procedures.

CONCLUSIONS

Spontaneous celiac artery dissection with an associated pseudoaneurysm could be the first clinical finding in a patient with FMD. Endovascular techniques are feasible, minimally invasive treatments for this disease entity. This case highlights the use of a robotic endovascular system to assist in therapy for a visceral aneurysm that was unsuccessful using conventional manual catheterization.

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