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Case Report

Transcatheter arterial embolization of a type 2 endoleak through the dorsal pancreatic artery after the hybrid repair of a thoracoabdominal aortic aneurysm: A case report ☆

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ABSTRACT

An 83-year-old woman with a history of hybrid repair of thoracoabdominal aortic aneurysm presented with enlargement of the aneurysm due to a type 2 endoleak from the celiac artery. The endoleak cavity was accessed via the dorsal pancreatic artery, and embolization using N-butyl cyanoacrylate and coils was successfully performed. When celiac artery branches are embolized during hybrid repair of a thoracoabdominal aortic aneurysm, attention should be paid to the dorsal pancreatic artery to appropriately determine which branches are to be embolized, because a nonembolized dorsal pancreatic artery may lead to type 2 endoleaks.

Introduction

Treating a thoracoabdominal aortic aneurysm (TAAA) is a major surgical challenge, and conventional open repair is associated with high perioperative morbidity and mortality [1,2]. Hybrid repair is an alternative approach involving open extra-anatomic bypass and endovascular exclusion of the aneurysm [3]. Only a few reports have described the percutaneous treatment of a type 2 endoleak (T2EL) after hybrid repair [4–6]. Therefore, this report adds to the literature by describing our experience with a T2EL after hybrid TAAA repair.

Case report

Our patient was an 83-year-old woman with a history of multiple aortic vascular surgeries. In chronological order, the pa-

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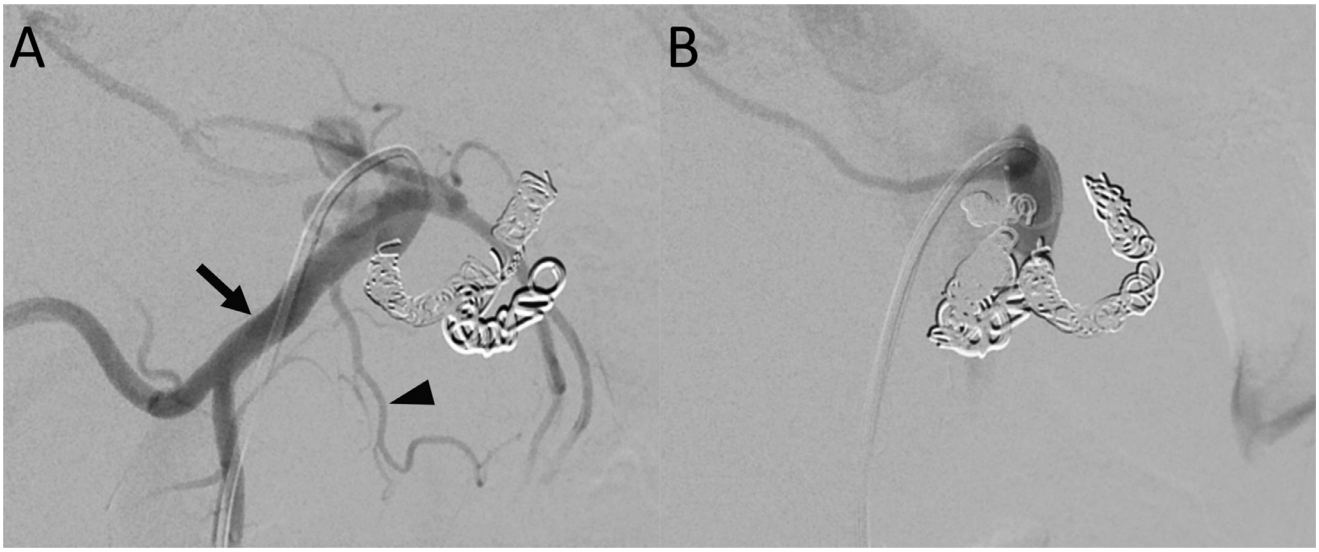

Fig. 1 – Angiography of the celiac artery during embolization of the celiac artery branches. (A) Angiography of the celiac artery after embolization of the splenic artery shows the common hepatic artery (arrow), left gastric artery, right inferior phrenic artery, and dorsal pancreatic artery (DPA) (arrowhead). The DPA originates from the proximal part of the common hepatic artery. (B) Angiography of the celiac artery after embolization of the common hepatic and left gastric arteries shows the right inferior phrenic artery. The DPA does not appear opacified despite being unembolized.

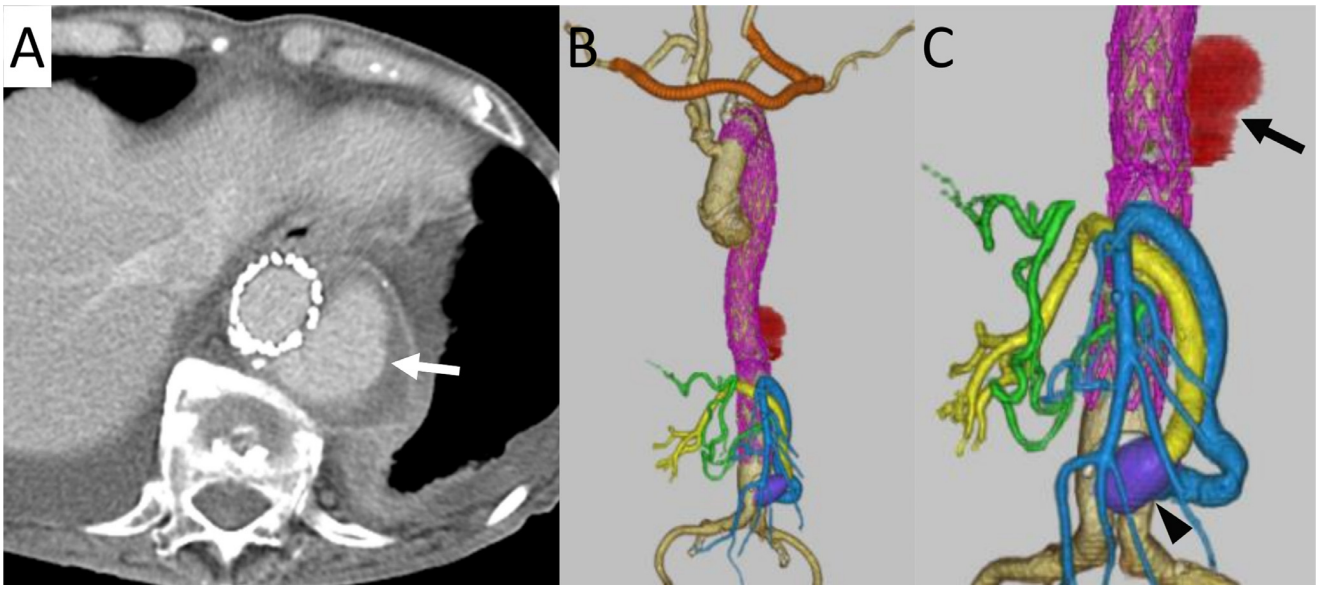

Fig. 2 – Contrast-enhanced computed tomography (CT) before transarterial embolization of a type 2 endoleak. (A) An axial CT image of the upper abdomen shows an endoleak (arrow). (B, C) An anterior view of three-dimensional CT showing (B) an overview of the patient's vascular anatomy and (C) a magnified and rotated view of the abdominal portion. The following are visible in (B) and (C): the axillo-axillary and left common carotid artery bypass (orange); aortic stent grafts (pink); the proximal end of the aortic stent grafts is positioned just distal to the origin of the aortic vascular graft branch, which communicates with the brachiocephalic artery. The distal end is positioned just proximal to the trunk (purple, arrowhead) from which the right renal and superior mesenteric artery bypasses originate; contrast enhancement diagnosed as an endoleak (red, arrow); the right renal artery and its bypass (yellow); the superior mesenteric artery and its bypass (blue); and the hepatic arteries, gastroduodenal artery, pancreatic arcade, and inferior pancreaticoduodenal artery (green). The arteries of the pancreatic arcade are dilated due to celiac artery branch embolization. The celiac artery, embolized celiac artery branches, and their adjacent structures cannot be adequately visualized due to severe metal artifacts from the coils.

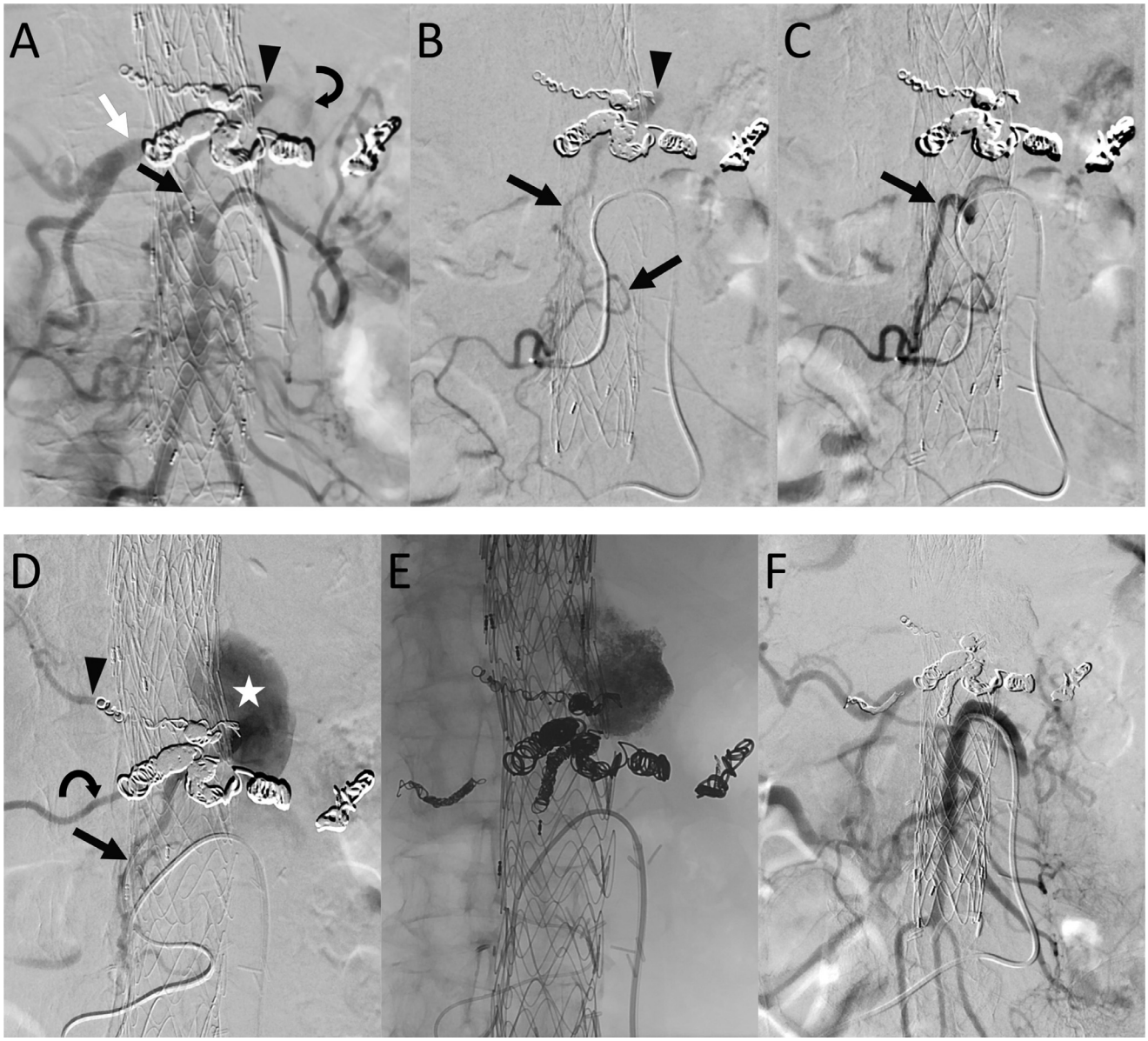

Fig. 3 – Angiography during embolization for a type 2 endoleak. (A) Angiography of the superior mesenteric artery shows enhancement of the celiac artery (arrowhead) and endoleak cavity (curved arrow), confirming the type 2 endoleak diagnosis. It was uncertain whether the endoleak was through the common hepatic artery (white arrow) or the dorsal pancreatic artery (DPA) (black arrow). (B) An early-phase image of the right colic artery angiography shows the DPA (arrows) and celiac artery (arrowhead). (C) A late-phase image of the right colic artery angiography shows retrograde enhancement of the middle colic artery (arrow). (D) Angiography of the DPA (arrow) shows the endoleak (star), the right inferior phrenic artery (arrowhead), and a small artery to the liver (curved arrow). (E) Radiography after embolization shows N-butyl cyanoacrylate in the endoleak cavity and coils in the DPA and the small artery. (F) Angiography after embolization shows no endoleak.

tient underwent surgeries for aortic dissection, TAAA rupture, and enlarged TAAA, as described in detail below. Eleven years prior to presentation, she underwent total arch replacement for type A aortic dissection. Five years prior to presentation, the dissecting TAAA ruptured, and she underwent thoracic endovascular aortic repair (TEVAR). The stent grafts (Zenith TX2: Cook Medical, Bloomington, IN) were placed so that the distal end was just above the origin of the superior mesenteric artery (SMA), covering the origin of the celiac artery. To prevent T2EL from the celiac artery, the branches of the celiac artery were embolized before stent graft placement. Selection of the dorsal pancreatic artery (DPA) was challenging, and it was expected that the unembolized DPA would not lead to T2EL after the embolization of the common hepatic artery from which the DPA originated; therefore, the DPA was not selectively embolized. In fact, the artery did not remain enhanced after embolization of 3 branches of the celiac artery; the splenic, common hepatic, and left gastric arteries (Fig. 1). Four years prior

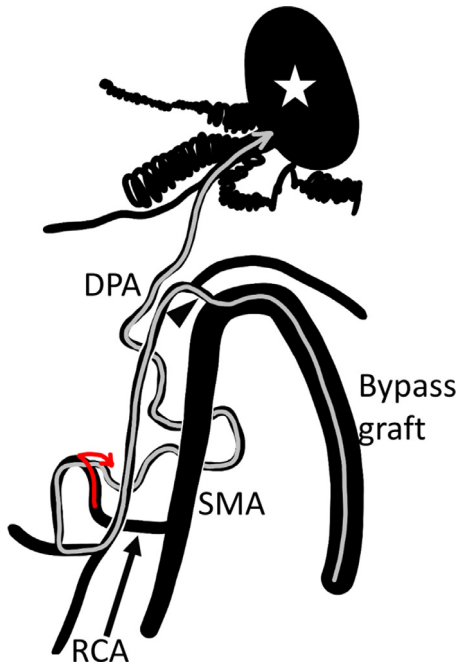

Fig. 4 – A schematic illustration of the embolization procedure. The curved gray line with an arrow depicts the access route to the endoleak cavity (star). The catheters are advanced from the superior mesenteric artery to the endoleak cavity via the middle colic artery and DPA. Owing to the narrow angle (red arrow) between the right colic artery and the DPA, the DPA was accessed through the middle colic artery instead of from the right colic artery. DPA, dorsal pancreatic artery; RCA, right colic artery; SMA, superior mesenteric artery.

to presentation, the TAAA had enlarged, and a one-stage hybrid repair was performed. The surgical procedure included insertion of an infrarenal aortoiliac graft and 2 bypass grafts (one for the SMA and the other for the right renal artery). The origins of the SMA and right renal artery were ligated. The left kidney was atrophic; thus, a bypass to the left renal artery was not performed. The endovascular procedure included placement of 2 thoracic stent grafts (Relay: Terumo Aortic, Sunrise, FL). The proximal part of the first stent graft was placed on the distal part of the stent graft inserted during the previous TEVAR procedure. The second stent graft was positioned inferior to the first one, with the proximal end in the first stent graft and the distal end on the infrarenal aortic graft.

A present-day computed tomography (CT) examination revealed TAAA enlargement and an endoleak at the upper abdomen level (Fig. 2). T2EL was the suspected cause of enlargement; thus, angiography and embolization were planned. The procedure was performed under local anesthesia and moderate sedation. The right femoral artery was punctured, and a 5-F guiding sheath (Parent Plus 45: Medikit, Tokyo, Japan) was advanced to the SMA bypass graft. Angiography of the SMA revealed enhancement of the celiac artery and endoleak cavity (Fig. 3A). The celiac artery was thought to be enhanced via the common hepatic artery or DPA. The gastroduodenal artery was selected by a microcatheter via the pancreaticoduodenal arcade. Angiography of the gastroduodenal artery showed enhancement of the distal part of the common hepatic artery. However, an endoleak was not detected because the proximal part of the common hepatic artery was occluded due to multiple previously placed coils. Angiography of the right colic artery using a 5-F cobra catheter showed the celiac artery and endoleak cavity through the DPA (Fig. 3B). Retrograde enhancement of the middle colic artery was also observed (Fig. 3C). Since the angle between the right colic artery and DPA was narrow, we advanced a microcatheter from the middle colic artery to the DPA. Angiography of the DPA revealed T2EL and enhancement of the celiac artery, right phrenic artery, and a small artery that had anastomosed with the right hepatic artery (Fig. 3D). The small artery was embolized with microcoils. The microcatheter was advanced into the endoleak cavity, and N-butyl cyanoacrylate mixed with iodized oil was injected to embolize the endoleak cavity and celiac artery. The ratio of N-butyl cyanoacrylate to iodized oil was 1:5, and 5 mL of the mixture was used. Then, the DPA was embolized with microcoils (Fig. 3E). Angiography of the SMA revealed no enhancement of the celiac artery or endoleak cavity. Figure 4 illustrates the embolization procedure. No complications were observed, and a contrast-enhanced CT exam 8 days later showed no endoleaks.

Discussion

T2EL can occur after hybrid TAAA repair caused by retrograde flow through the intercostal, celiac, splenic, and aberrant left gastric arteries [5,7]. In previous studies, T2EL from the celiac artery occurred when the celiac artery was not ligated or ligated distally [4,7]. In this case, the celiac artery branches were embolized during TEVAR, but an endoleak occurred through an unembolized DPA after hybrid repair. The DPA is one of the major collateral pathways to the celiac artery branches from the SMA in patients with celiac artery stenosis [8]. Therefore, we suspect that the DPA may serve as a major collateral pathway to the celiac artery from the SMA when T2EL occurs through the celiac artery.

In this case, the DPA originated from the common hepatic artery. Furthermore, after embolizing the common hepatic artery, angiography of the celiac artery indicated that the DPA was not opacified. However, after hybrid TAAA repair, the DPA became a collateral pathway to the celiac artery, causing T2EL. We estimated that blood flow to the DPA from the celiac artery decreased to a certain extent because of the coils in the parent artery, but it was not occluded enough to prevent future endoleaks. Thus, if the DPA had been selectively embolized, T2EL could have been avoided. Consequently, the DPA should be carefully evaluated when celiac artery branches are occluded in hybrid TAAA repair.

When the DPA functions as a collateral artery from the SMA in patients with celiac artery stenosis, it communicates with the SMA or its branches, such as the jejunal artery, the inferior pancreaticoduodenal artery, or the middle colic artery [8]. In this patient, communication was observed through the right and middle colic arteries, and the DPA was approachable via these 2 routes. Although the right colic artery route

was shorter than the middle colic artery route, we selected the middle colic artery route because the angle between the right colic artery and DPA was narrow. Selecting the most appropriate route is important when more than 1 artery is available during T2EL embolization.

Conclusions

A T2EL may occur after hybrid repair of a TAAA by retrograde flow from the celiac artery through the DPA. Therefore, the DPA should be given special attention when determining which celiac artery branches to embolize after hybrid repair.

Patient consent

Written consent for publication was obtained from the patient.

REFERENCES

[1] Coselli JS, LeMaire SA, Preventza O, de la Cruz KI, Cooley DA, Price MD, et al. Outcomes of 3309 thoracoabdominal aortic aneurysm repairs. J Thorac Cardiovasc Surg 2016;151(5):1323–37. doi:10.1016/j.jtcvs.2015.12.050.

[2] Moulakakis KG, Karaolanis G, Antonopoulos CN, Kakisis J, Klonaris C, Preventza O, et al. Open repair of thoracoabdominal aortic aneurysms in experienced centers. J Vasc Surg 2018;68(2):634-45 e12. doi:10.1016/j.jvs.2018.03.410.

[3] Riambau V, Bockler D, Brunkwall J, Cao P, Chiesa R, Coppi G, et al. Editor's Choice - management of descending thoracic aorta diseases: clinical practice guidelines of the European Society for Vascular Surgery (ESVS). Eur J Vasc Endovasc Surg 2017;53(1):4–52. doi:10.1016/j.ejvs.2016.06.005.

[4] Heye S, Vaninbroukx J, Daenens K, Maleux G. Transcatheter embolization of a type II endoleak after hybrid repair for thoracoabdominal aortic aneurysm. J Vasc Interv Radiol 2011;22(3):379–84. doi:10.1016/j.jvir.2010.11.004.

[5] Tshomba Y, Melissano G, Logaldo D, Rinaldi E, Bertoglio L, Civilini E, et al. Clinical outcomes of hybrid repair for thoracoabdominal aortic aneurysms. Ann Cardiothorac Surg 2012;1(3):293–303. doi:10.3978/j.issn.2225-319X.2012.07.15.

[6] Mussa FF, Maldonado TS, Schwartz CF. Percutaneous embolization of patent intercostal artery causing persistent type II endoleak and sac enlargement of thoracoabdominal aneurysm 2 years after hybrid repair. J Thorac Cardiovasc Surg 2012;144(4):e102–6. doi:10.1016/j.jtcvs.2012.06.056.

[7] Bischoff MS, Geisbusch P, Kotelis D, Muller-Eschner M, Hyhlik-Durr A, Bockler D. Clinical significance of type II endoleaks after thoracic endovascular aortic repair. J Vasc Surg 2013;58(3):643–50. doi:10.1016/j.jvs.2013.03.026.

[8] Song SY, Chung JW, Kwon JW, Joh JH, Shin SJ, Kim HB, et al. Collateral pathways in patients with celiac axis stenosis: angiographic-spiral CT correlation. Radiographics 2002;22(4):881–93. doi:10.1148/radiographics.22.4.g02jl13881.