Staged triple endovascular approach for repair of aortocaval fistula secondary to ruptured abdominal aortic aneurysm

Molly McDonald, DO, Eric Robinson, MD, MSc, *and* Harmandeep Singh, MD, FACS, RPVI, *New York, NY*

ABSTRACT

A primary aortocaval fistula (ACF) is a rare complication of abdominal aortic aneurysms caused by erosion of the aortic wall into the vena cava. It is more frequently observed in the setting of ruptured abdominal aortic aneurysms and presents a unique challenge for vascular surgeons. Both open and endovascular techniques exist, with the main differences being perioperative mortality and recurrence rates. We present a case of an ACF diagnosed intraoperatively, which persisted after endovascular aneurysm repair in conjunction with a type II endoleak. We applied a unique staged, triple endovascular approach to close the ACF via caval and aortic exclusion of inflow and outflow vessels. (J Vasc Surg Cases Innov Tech 2023;9:101335.)

Keywords: Abdominal aortic aneurysm; Aortocaval fistula; Endoleak; Endovascular repair of abdominal aortic aneurysm

A primary aortocaval fistula (ACF) is a rare complication of abdominal aortic aneurysms (AAAs), secondary to erosion of the aortic wall into the adjacent vena cava.[1] The incidence of primary ACFs in the setting of AAAs has been estimated at 1%, and increases to ~6% in ruptured AAAs.[2,3] The sequelae of untreated ACFs include sudden death from high-output cardiac failure, lower extremity ischemia from steal phenomenon, and, rarely, paradoxical pulmonary embolism from thrombus dislodgement and travel.[4,5] The mortality rates range from 7% to 50% according to multiple studies, making early detection and treatment paramount.[3]

Multiple treatment modalities are available for ACF. Endovascular repair has been increasingly used in recent years, with a variety of approaches described in case reports.[6] Compared with open repair, endovascular repair is associated with lower early mortality and higher recurrence rates.[7] Endovascular treatments include device implantation within the aorta or the inferior vena cava (IVC) to exclude the fistula.[1] More recently, novel uses of preexisting devices have been applied in difficult cases.[8]

Persistent ACF in the setting of prior endovascular aneurysm repair (EVAR) can be complicated by an associated type Ib or type II endoleak, which can also be treated at the time of ACF repair.[3,9] In this setting, the presence of the ACF can prevent aneurysm sac growth but can also lead to high-output cardiac failure if left untreated. We present a case of an asymptomatic ACF associated with a type II endoleak that persisted after EVAR performed to treat a ruptured AAA. We ultimately used a staged, triple endovascular approach to treat the ACF and associated type II endoleak.

CASE REPORT

The patient provided written informed consent for the report of his case details and imaging studies. The clinical and procedural details are described in accordance with published reporting standards.[10,11]

Patient characteristics. A 67-year-old man presented to the emergency department with sudden-onset right abdominal and flank pain radiating to the back of 12 hours' duration. He had a history of myocardial infarction, coronary artery disease after placement of three stents, 81 mg of daily aspirin, chronic obstructive pulmonary disease, hypertension, hyperlipidemia, and prior smoking with a 42 pack-year history (quit >10 years prior). The physical examination revealed an obese man with palpable central and peripheral pulses, no palpable abdominal mass (due to body habitus), and tenderness in the right lower quadrant. The vital signs included an initial blood pressure of 98/50 mm Hg and heart rate of 80 beats/min. Permissive hypotension was allowed. His family history was notable for a father with a ruptured AAA.

Diagnostic assessment. Computed tomography angiography (CTA) of the abdominal aorta with intravenous contrast demonstrated an 11.2-cm infrarenal AAA extending to the iliac bifurcation with right retroperitoneal hemorrhage and no signs of active extravasation. No evidence was found of an ACF on initial imaging (Fig 1). The findings were consistent with contained rupture of an infrarenal AAA, and endovascular repair was planned.

Endovascular technique. The patient provided written informed consent for emergent EVAR, which was performed via bilateral percutaneous groin access. An Endurant stent graft was deployed (main body, 28 × 103 × 14 mm; left iliac limb extension, 16 × 20 × 140 mm; right iliac limb extension,

From the Division of Vascular Surgery, Department of Surgery, Mount Sinai South Nassau, Mount Sinai Health System.

Correspondence: Molly McDonald, DO, Division of Vascular Surgery, Department of Surgery, Mount Sinai South Nassau, Mount Sinai Health System, 1425 Madison Ave, L4-30, New York, NY 10029 (e-mail: molly.mcdonald@snch.org).

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

https://doi.org/10.1016/j.jvscit.2023.101335

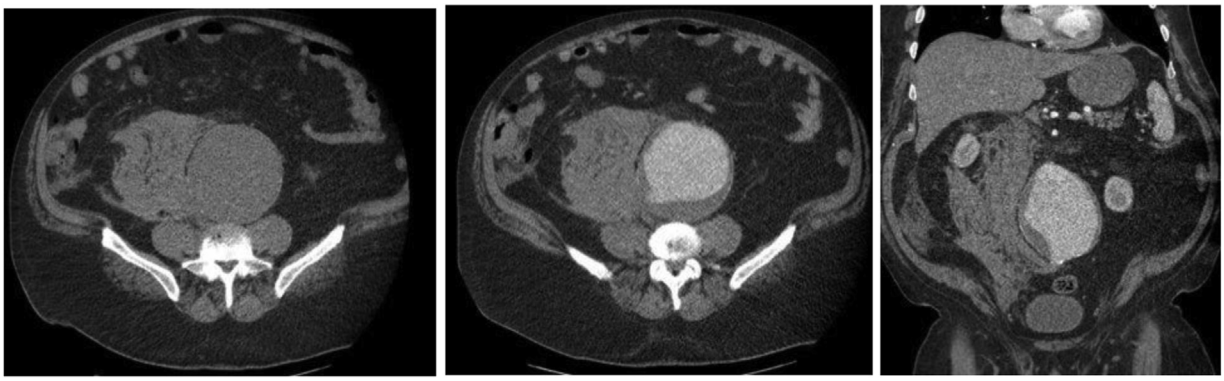

Fig 1. Preoperative computed tomography (CT) scan without contrast (**Left**) and axial (**Middle**) and coronal (**Right**) computed tomography angiography (CTA) scans demonstrating a ruptured abdominal aortic aneurysm (AAA) without evidence of an aortocaval fistula (ACF).

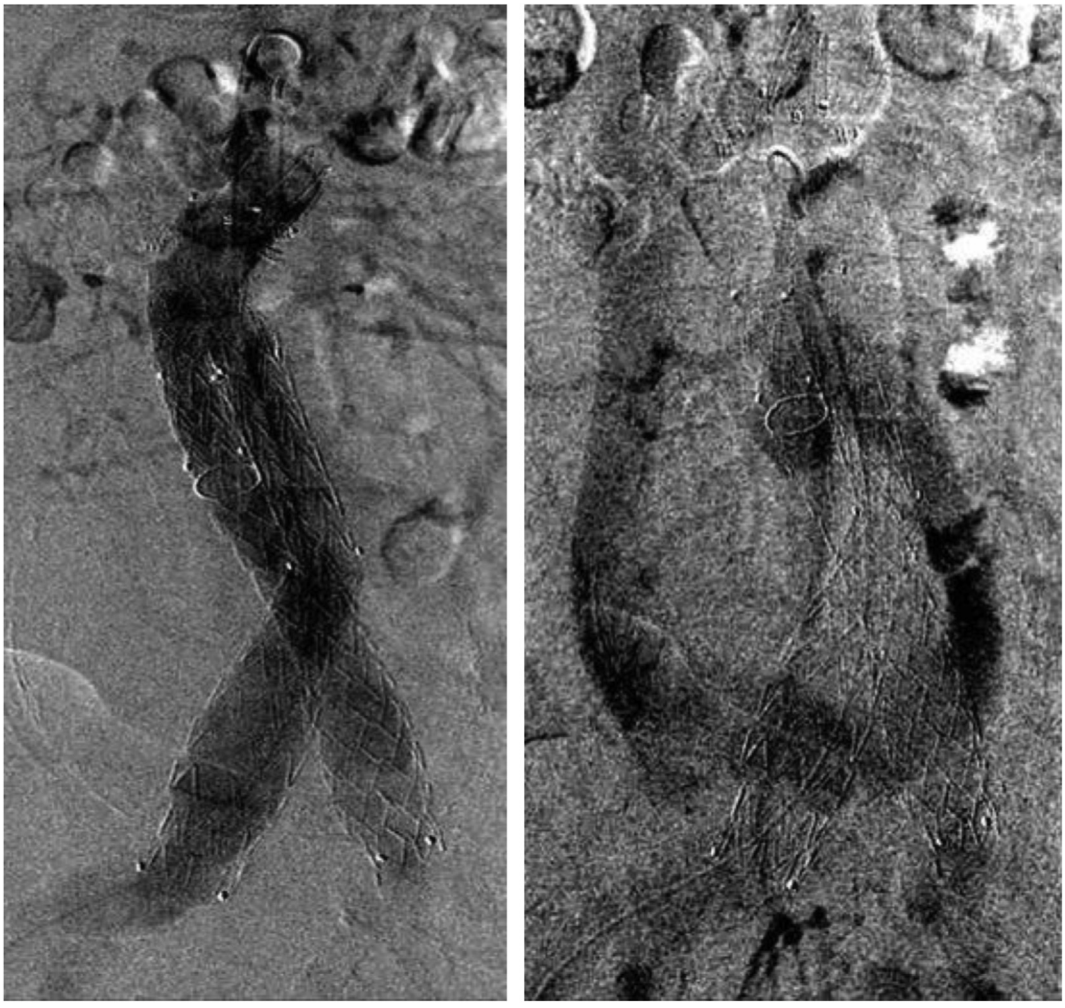

Fig 2. Completion aortogram demonstrating endovascular aneurysm repair (EVAR) with resolution of a type Ia endoleak (**Left**) and visualization of a type II endoleak and aortocaval fistula (ACF; **Right**) with outflow to the inferior vena cava (IVC).

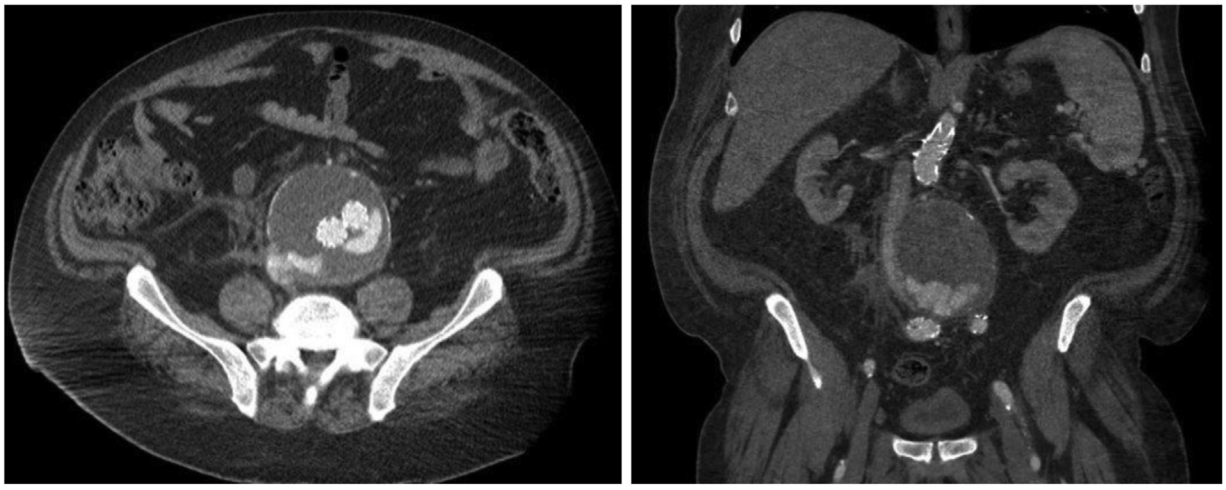

Fig 3. Computed tomography angiography (CTA) at 30 days after endovascular aneurysm repair (EVAR) demonstrating a persistent aortocaval fistula (ACF) with early opacification of inferior vena cava (IVC).

16 × 24 × 140 mm). A completion aortogram showed a type Ia endoleak, which was repaired with Heli-FX EndoAnchors (Medtronic). A subsequent aortogram showed a type II endoleak with an ACF (Fig 2). Due to hemodynamic instability, the patient was taken to the intensive care unit for resuscitation. The rest of his postoperative recovery was uncomplicated, and the patient was discharged to a rehabilitation facility.

A 30-day postoperative triple-phase CTA demonstrated a 10.3-cm residual aneurysm sac with persistence of a type II endoleak and an ACF (Fig 3). A follow-up echocardiogram demonstrated no evidence of high-output heart failure, with normal left ventricular function, no signs of increased right atrial filling pressure, and physiologic collapse of the IVC. ACF repair was then planned.

A subsequent abdominal aortogram after 30 days revealed filling of the aneurysm sac from lumbar branches and the inferior mesenteric artery (IMA), with outflow through the ACF to the IVC. The IMA was accessed via the superior mesenteric artery and arc of Riolan, and the lumbar arteries were accessed via the right hypogastric artery. Embolization of the IMA inflow was performed using two AZUR coils (12 mm × 38 cm; Terumo Interventional Systems) and of the lumbar branches using two 5 mm × 16 cm and 4 mm × 13 cm coils. Terumo AZUR coils (two 20 mm × 50 cm; two 20 mm × 40 cm; four 18 mm × 36 cm; and four 16 mm × 39 cm) were then deployed within the aneurysm sac. Completion aortogram showed a faint but persistent ACF (Fig 4). Because of radiation safety, we planned to bring the patient back to the operating room for complete coil embolization of the sac at a later date for definitive repair.

Six weeks later, the patient was brought to the operating room. Right common femoral vein access to the IVC was obtained, and the aneurysm sac was accessed via the ACF. Terumo AZUR helical HydroCoils (two 20 mm × 39 cm; two 16 mm × 32 cm; two 13 mm × 24 cm; one 10 mm × 19 cm; one 6 mm × 17 cm; and one 12 mm × 20 cm) were deployed within the aneurysm sac through the ACF. The completion aortogram showed resolution of the ACF. Two weeks after the procedure, a repeat CTA demonstrated continued resolution of the ACF (Fig 5).

DISCUSSION

Approximately 80% of all primary ACFs occur in the setting of ruptured AAAs, and each case presents a unique challenge for vascular surgeons.[12] Even when asymptomatic, the potential for sudden cardiac death secondary to high-output cardiac failure exists.[13] Most ACFs described in literature have been diagnosed by preoperative imaging using CTA and are therefore treated during the initial AAA repair.[1] In our patient, the ACF was visualized intraoperatively and was not visualized on preoperative CTA. We did not proceed with targeted treatment of the ACF intraoperatively due to patient instability, considering that one of the modalities of treating ACF is an aortic stent graft.

On postoperative imaging, no increase in the aneurysm sac diameter was noted in the setting of a type II endoleak, likely due to the presence of the ACF. Some literature suggests a potentially beneficial aspect of ACF in this setting, in which favorable remodeling of the aneurysm sac and a decrease in sac diameter have been observed.[14,15] However, no long-term data are available to support nonoperative management of a persistent ACF. In the case of spontaneous or intentional thrombosis of the ACF, a sudden rupture of an enlarging aneurysm sac has been documented when a type II endoleak persists.[16] If an endoleak is treated without subsequent treatment of the ACF, the low-pressure outflow provided by the venous capacitance of the IVC could theoretically decrease success of endoleak treatment.

As endovascular repair is becoming more standard for cases of ruptured AAA repair, it is critical to

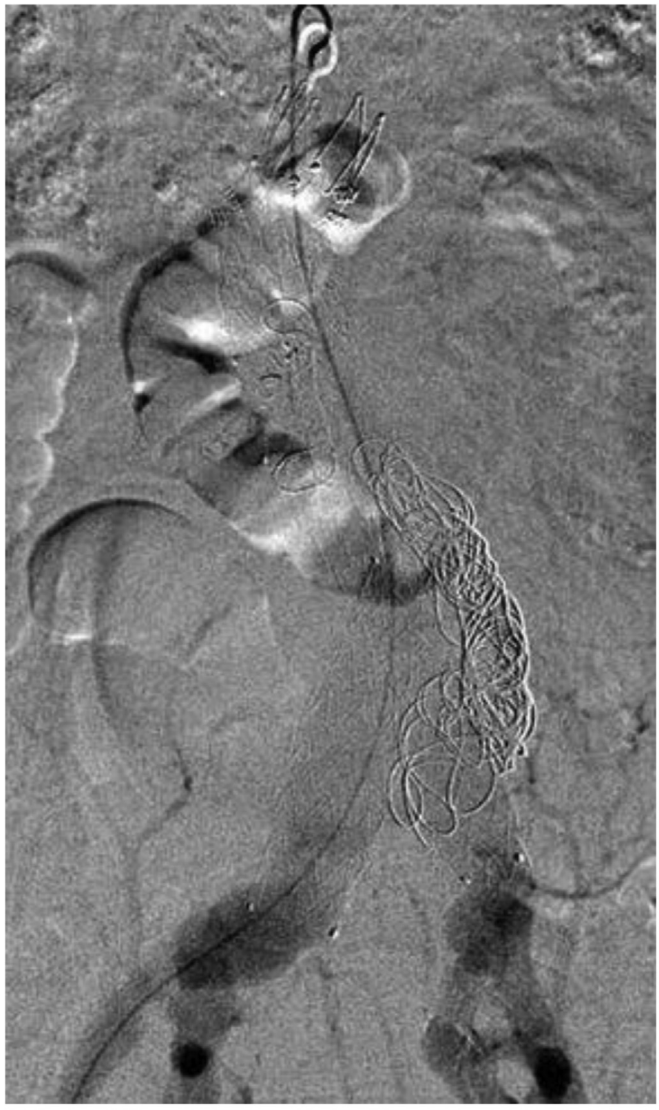

Fig 4. Completion aortogram after coil embolization of lumbar and inferior mesenteric artery (IMA) inflow to aneurysm sac showing faint persistence of aortocaval fistula (ACF) with contrast flow to inferior vena cava (IVC).

determine effective strategies for ACF repair in this small subset of the patient population. Endovascular techniques described in the literature range from either individual aortic or caval exclusion grafts, combined aortic and caval exclusion grafts,[17] and various approaches to embolize the aneurysm sac to effectively close the ACF and associated endoleak, which is present in 50% of ACF cases.[7] In our patient, we ultimately used a triple endovascular approach via the aorta and caval systems to effectively embolize both the ACF and the type II endoleak after initial EVAR.

CONCLUSIONS

This case demonstrates the safety and tolerability of a staged approach for the management of ACF in the setting of ruptured AAA. Such a strategy obviates the need for general anesthesia and could decrease the risk of hemodynamic instability associated with complete ACF repair. Our study contributes to the growing literature of triple (aortic, mesenteric, lumbar) approaches and other complex multistep approaches to the management of ACF that have been described.[17-19] No complications with our patient have been reported to date at 13 months after the initial EVAR.

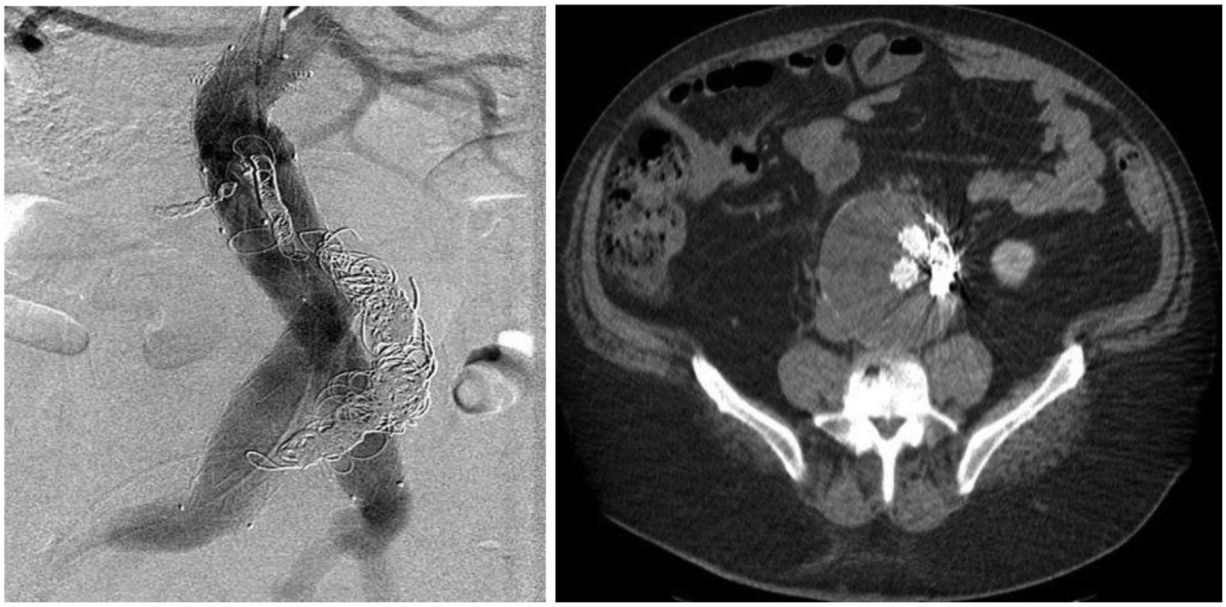

Fig 5. Completion aortogram (**Left**) and computed tomography angiography (CTA; **Right**) at 2 weeks after definitive aortocaval fistula (ACF) repair, still showing nonopacification of the inferior vena cava (IVC).

DISCLOSURES

None.

REFERENCES

1. Dakis K, Nana P, Kouvelos G, et al. Treatment of aortocaval fistula secondary to abdominal aortic aneurysm: a systematic review. Ann Vasc Surg 2023;90:204-17.
2. Patelis N, Giagkos GC, Maltezos K, Klonaris C. Aortocaval fistula: an unusual complication of ruptured abdominal aortic aneurysm. BMJ Case Rep 2018;2018:bcr2018224998.
3. Mouawad NJ, Quarrie R, Starr J. Acute aortocaval fistula secondary to Chronic type 1 B abdominal aortic aneurysm endoleak. Int J Angiol 2020;29:52-4.
4. Laporte F, Olivier A, Groben L, Admant P, Aliot E. Aortocaval fistula: an uncommon cause of paradoxical embolism. J Cardiovasc Med (Hagerstown) 2012;13:68-71.
5. De Rango P, Parlani G, Cieri E, et al. Paradoxical pulmonary embolism with spontaneous aortocaval fistula. Ann Vasc Surg 2012;26:739-46.
6. Ueshima E, Yamaguchi M, Muradi A, et al. Management of type II endoleak after endovascular repair of arteriocaval fistula complicating aortoiliac aneurysm: case report and literature review. J Vasc Interv Radiol 2014;25:1809-15.
7. Orion KC, Beaulieu RJ, Black JH 3rd. Aortocaval fistula: is endovascular repair the preferred solution? Ann Vasc Surg 2016;31:221-8.
8. Lee P, Sheehan BM, Gordon I, et al. Novel utility of amplatzer septal Occlusion device to Treat persistent aortocaval fistula following ruptured endovascular aortic aneurysm repair (rEVAR). Ann Vasc Surg 2020;65:283.e7-11.
9. De Boodt H, Pardon HE, Gellens P, Maleux G, Marrannes J. Balloon-assisted transcaval embolization of a type II endoleak associated with an aortocaval fistula after endovascular aortic repair. J Vasc Surg Cases Innov Tech 2020;6:447-9.
10. Chaikof EL, Blankensteijn JD, Harris PL, et al. Reporting standards for endovascular aortic aneurysm repair. J Vasc Surg 2002;35:1048-60.
11. Johnston KW, Rutherford RB, Tilson MD, Shah DM, Hollier L, Stanley JC. Suggested standards for reporting on arterial aneurysms. Subcommittee on reporting standards for arterial aneurysms, ad hoc Committee on reporting standards, Society for vascular surgery and North American Chapter, International Society for Cardiovascular surgery. J Vasc Surg 1991;13:452-8.
12. Petrov I, Tasheva I, Stankov Z, Polomski P, Georgieva G, Marinov K. Uneventful follow-up 2 Years after endovascular treatment of a high-flow Iatrogenic aortocaval fistula causing pulmonary hypertension and right heart failure. Methodist Debakey Cardiovasc J 2019;15:152-5.
13. Cruz-Utrilla A, Pozo E, LaRocca G, Ferrández-Escarabajal M, Filgueiras-Rama D. Acute coronary syndrome secondary to aortocaval fistula. JACC Case Rep 2019;1:67-9.
14. Greenfield S, Martin G, Malina M, Theivacumar NS. Aortocaval fistula, a potentially favourable complication of abdominal aortic aneurysm rupture in endovascular repair. Ann R Coll Surg Engl 2020;102:e180-2.
15. van de Luijtgaarden KM, Bastos Gonçalves F, Rouwet EV, Hendriks JM, Ten Raa S, Verhagen HJ. Conservative management of persistent aortocaval fistula after endovascular aortic repair. J Vasc Surg 2013;58:1080-3.
16. Fujimiya T, Seto Y, Ishida K, Takase S, Satokawa H, Yokoyama H. Impending rupture of abdominal aortic aneurysm due to spontaneous obstruction of aortocaval fistula after endovascular abdominal aortic aneurysm repair. J Vasc Surg Cases Innov Tech 2021;7:219-22.
17. ElKassaby M, Alawy M, Zaki M, Hynes N, Tawfick W, Sultan S. Total endovascular management of ruptured aortocaval fistula: technical challenges and case report. Vascular 2014;22:306-9.
18. Chung SA, Reid CM, Bandyk DF, Barleben A, Lane JS 3rd. Staged hybrid endovascular repair of a ruptured abdominal aortic aneurysm with aortocaval fistula. Aorta (Stamford) 2015;3:25-9.
19. Massmann A, Fries P, Kubale R, Seidel R. Multiple treatment approaches following incomplete endovascular closure of abdominal aneurysm rupture-related aortocaval fistula. EuroIntervention 2018;14:836-7.

Submitted Jun 21, 2023; accepted Sep 12, 2023.