EJVES Vascular Forum (2024) 61, 16–19

CASE REPORT

Giant Coeliac Artery Aneurysm Treated with a Hybrid Approach: A Case Report

Kazuyoshi Matsubara, Ryosuke Taniguchi [*], Takuro Shirasu, Kazuhiro Miyahara, Yasuaki Mochizuki, Toshio Takayama, Katsuyuki Hoshina

Division of Vascular Surgery, Department of Surgery, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan

Introduction: Coeliac artery aneurysms are rare and have a high mortality rate when ruptured. Although they are often asymptomatic, treatment is recommended for patients with true coeliac aneurysms >2.5 cm, noted enlargement, or associated symptoms. Less invasive endovascular treatment is predominantly performed for coeliac artery aneurysms, while open surgery is preferred for patients with compression symptoms. Here, a case of symptomatic giant coeliac artery aneurysm that was successfully treated with hybrid surgery is reported.
Report: A 73 year old man was referred with continuous epigastric discomfort and loss of appetite for two weeks. Abdominal ultrasound and computed tomography revealed a 12 cm aneurysm of the coeliac artery. The splenic and common hepatic arteries were severely distorted and compressed by the aneurysm, making their origins unclear. Considering the risk of rupture, semi-urgent surgery was performed with interruption of the inflow and outflow arteries using open and endovascular techniques together with aneurysmorrhaphy. Vascular reconstruction was omitted because abundant collateral flow to the liver and spleen was confirmed on angiography.
Discussion: With the hybrid approach, aneurysmorrhaphy was performed safely with minimal incision and dissection. Short term outcomes were satisfactory, with complete resolution of compression symptoms and remarkable sac shrinkage at 12 months. Owing to the possibility of the pancreaticoduodenal arcade developing as a collateral pathway, periodic surveillance for de novo aneurysms is warranted.

Article history: Received 12 June 2023, Revised 15 October 2023, Accepted 21 November 2023,
Keywords: Aneurysmorrhaphy, Case report, Compression symptom, Giant coeliac artery aneurysm, Hybrid surgery

INTRODUCTION

Coeliac artery (CA) aneurysms are rare, accounting for only 4% of visceral artery aneurysms.[1] In some cases, they are associated with non-specific symptoms such as nausea, vomiting, loss of appetite, and abdominal pain, but are often asymptomatic and found incidentally on ultrasound or computed tomography (CT).[2,3] Since the development of CT, an increasing number of CA aneurysms have been detected incidentally. Due to the mortality risk in cases of rupture, treatment is recommended for true CA aneurysms >2.5 cm, aneurysms showing an obvious increase in size, or with associated systemic symptoms.[3] Endovascular treatment (EVT) is less invasive than open surgery; thus, it is considered the first line option for CA aneurysms.[3,4] In contrast, open surgery, namely aneurysmorrhaphy or aneurysmectomy, is more effective in easing the symptoms caused by aneurysm compression. Here, a case of a giant CA aneurysm accompanied by compression symptoms is presented. As technical challenges were anticipated with open surgery alone, a hybrid approach was adopted and satisfactory results were achieved. Informed consent for publication was obtained from the patient. This case report has been reported in line with the PROCESS guideline.

CASE REPORT

Presentation

A 73 year old man (height, 160 cm; weight, 58 kg; body mass index, 22.7 kg/m^2) was referred with persistent epigastric discomfort and loss of appetite for two weeks. There was a history of diabetes mellitus and habitual smoking but no trauma or family history of vascular disease. Laboratory data on admission showed Stage 3a chronic kidney disease (estimated glomerular filtration rate, 46.0 mL/min/1.73 m^2). Abdominal ultrasound detected a giant CA aneurysm. CT angiography from the chest to the pelvis was immediately carried out for further information. It revealed the giant

* Corresponding author. Division of Vascular Surgery, Department of Surgery, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8655, Japan.
E-mail address: rtaniguchi80@gmail.com (Ryosuke Taniguchi).

https://doi.org/10.1016/j.ejvsvf.2023.11.005

aneurysm with a maximum diameter of 12 cm (Fig. 1A). In addition, development of the pancreaticoduodenal arcade, and a contrast free projection suggesting retrograde blood flow from the aneurysm to the aorta, were observed (Fig. 1B). No other aneurysms were detected. On 3D CT angiography, the splenic artery (SA) and common hepatic artery (CHA) were severely distorted and compressed by the aneurysm, making their origins unclear (Fig. 1C). Considering the risk of rupture, semi-urgent surgery was conducted six days after admission. As the patient had compression symptoms, aneurysmorrhaphy was deemed necessary. However, there was concern that the large size of the aneurysm might impede normal surgical procedures, especially in securing the inflow artery. After a thorough departmental review, a hybrid approach was proposed.

Surgical technique

The operation was performed in a hybrid operating room and the procedure time was five hours and 26 minutes.

Through a 15 cm upper midline laparotomy, a first attempt to secure the outflow vessels, the CHA and SA, was made. The hepatogastric ligament was incised, and the CHA was identified. However, there was difficulty locating the SA because of severe distortion and poor operative field due to the giant aneurysm. An endovascular procedure was performed to avoid unexpected injury to the aneurysm. The right common femoral artery was punctured. Initial angiography revealed retrograde blood flow from the superior mesenteric artery (SMA) to the proper hepatic artery via the pancreaticoduodenal arcade and the splenic artery via the dorsal pancreatic artery (Fig. 2A). Subsequent angiography after clamping the CHA demonstrated similar and adequate perfusion to the liver and spleen. Therefore, reconstruction of the CA branches was deemed unnecessary. The left gastric artery (LGA) was successfully selected via the CA using a 0.018 inch microcatheter (Excelsior 1018; Stryker, Kalamazoo, MI, USA) and a 0.016 inch guidewire (Meister GW; Medikit, Tokyo, Japan). The LGA was embolised with 0.018 inch coils (Interlock; Boston Scientific, Natick, MA, USA). However, the origin of the SA was difficult to visualise using fluoroscopy. The proximal CA was embolised with an 8 mm vascular plug (Amplatzer Vascular Plug II; Abbott Vascular, Santa Clara, CA, USA). The orifice of the CA was covered further by deploying two 28.5 mm × 33 mm aortic stent grafts (Excluder, PLA280300J; W. L. Gore, Flagstaff, AZ, USA). Then, a surgical approach was used. The SA was successfully identified and encircled through further dissection of the aneurysm. Both the CHA and SA were ligated and transected at their origins. After confirming decreased aneurysm wall pressure, the aneurysm was opened. Subtle but persistent bleeding from the CA orifice was observed, and the orifice was closed using 3—0 polypropylene sutures. After achieving complete haemostasis, aneurysmorrhaphy was performed. Extension of the initial upper midline incision below the umbilicus was not necessary. Completion angiography revealed abundant collateral flow from the SMA to the liver and spleen (Fig. 2B). Fig. 2C illustrates the details of the hybrid procedure.

Post-operative course

The patient was cured of the initial symptoms, had an uneventful course, and was discharged 10 days after surgery. Histopathological examination revealed medial degeneration of the aneurysm wall. Follow up CT showed remarkable shrinkage of the remaining aneurysm. The maximum diameter of the aneurysm decreased from 9.4 cm at post-operative day 7, to 5.4 cm at post-operative month 6, to 3.5 cm at post-operative month 12 (Fig. 3). No *de novo* visceral artery aneurysms were detected.

DISCUSSION

A case of a giant CA aneurysm is reported. By making the best use of open surgery and endovascular treatment, a safe and minimally invasive aneurysmorrhaphy was achieved.

In cases where the CA aneurysm is large, the larger size may generate additional challenges for both open surgical and endovascular approaches. With open surgery, it is difficult to secure both the inflow and outflow vessels. A giant aneurysm restricts the operative field and distorts the

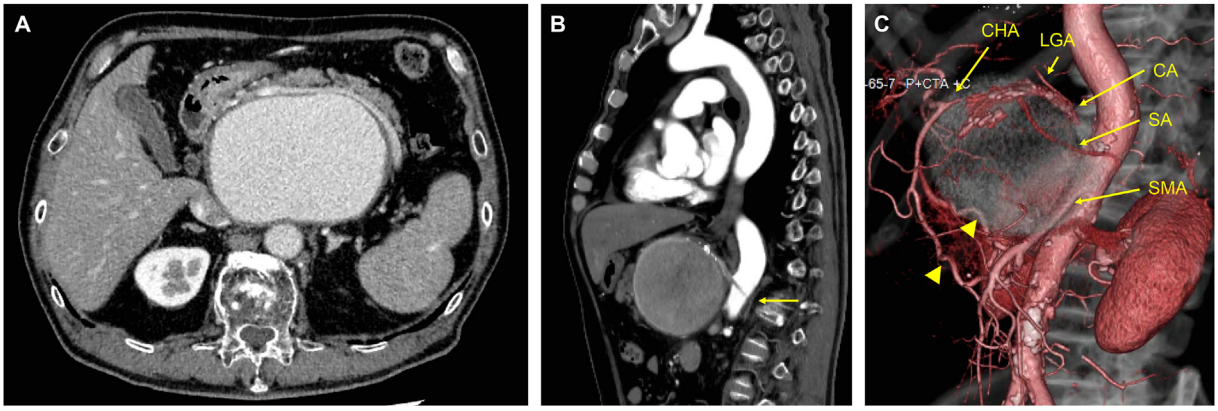

Figure 1. (A) Late phase computed tomography angiography (CTA). A giant coeliac aneurysm, 12 cm in maximum diameter, is observed. Adjacent organs are highly displaced due to the aneurysm. (B) Early phase of CTA (sagittal view). Contrast free projection suggesting retrograde blood flow from the aneurysm to the aorta (arrow). (C) 3D CTA. The splenic artery (SA) and common hepatic artery (CHA) are severely distorted and compressed by the aneurysm. Their origins are difficult to identify. Development of the pancreaticoduodenal arcade is demonstrated (arrowhead). CA = coeliac artery; LGA = left gastric artery; SMA = superior mesenteric artery.

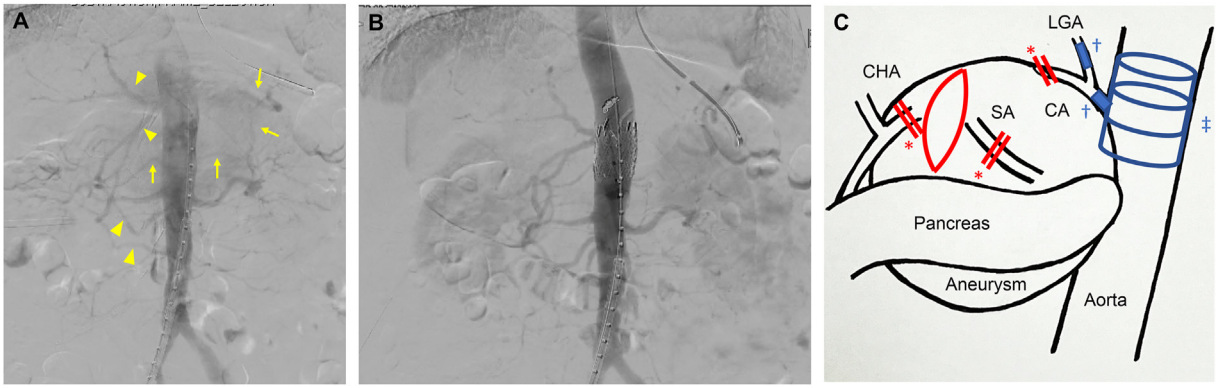

Figure 2. (A) The initial angiography. Retrograde blood flow to proper hepatic artery via the pancreaticoduodenal arcade (arrow head) and to the splenic artery (SA) via the dorsal pancreatic artery is well shown (arrow). (B) Completion angiography. Complete exclusion of the aneurysm is achieved. Abundant collateral flow from the superior mesenteric artery (SMA) to the liver and the spleen is confirmed. (C) Illustration of the hybrid procedure. The endovascular procedure is coloured in blue and the surgical one in red. The red circled aneurysm wall was resected via aneurysmorrhaphy. CA = coeliac artery; LGA = left gastric artery; CHA = common hepatic artery. *Ligation. †Embolisation. ‡Stent graft. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

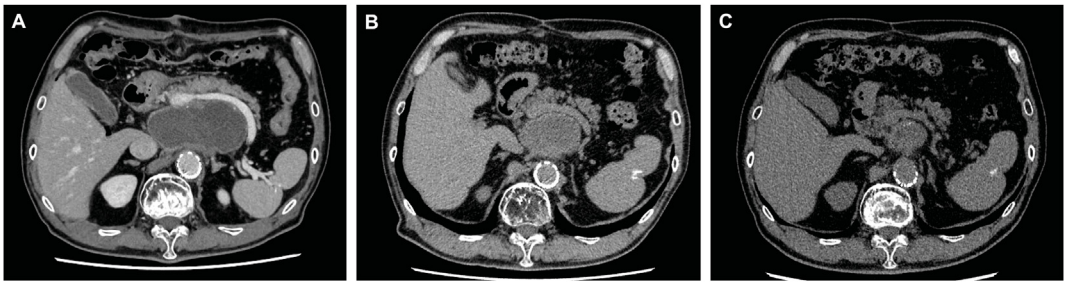

Figure 3. Post-operative computed tomography (CT) scans obtained at six month intervals demonstrated remarkable aneurysm shrinkage. (A) Late phase of CT angiography on post-operative day 7. The remaining aneurysm is successfully isolated with no detectable endoleak. Maximum diameter 9.4 cm. (B) CT at post-operative month 6. Maximum diameter, 5.4 cm. (C) CT at post-operative month 12. Maximum diameter, 3.5 cm.

branching vessels; a larger incision and more extensive dissection are required to address this problem, which increases the risk of unexpected bleeding or unintentional organ damage, especially to the pancreas. However, the endovascular approach also poses several challenges. First, it is uncertain whether the compression symptoms will improve with embolisation. Sac shrinkage of visceral artery aneurysms after EVT is uncommon.[5] Second, the selection of each vessel involved would be technically challenging if they were tortuous because of aneurysm compression. It is difficult to differentiate the origin of each vessel branching from the aneurysm because the optimal angulation must be determined three dimensionally. Finally, packing a large aneurysm would require an enormous number of coils, which is unfavourable in terms of cost.

In the current case, aneurysmorrhaphy was thought to be inevitable for eliminating the compression symptoms, considering the size of the aneurysm. However, the risk associated with open surgery was perceived to be high; therefore, hybrid surgery was performed and the proximal CA was secured using an endovascular approach. The dissection of the aneurysm was limited to areas cranial to the pancreas to avoid pancreatic injury. As for the vessels distal to the CA, the ventral vessels, CHA and SA, were identified and ligated, and the dorsal vessel, LGA, was embolised. Even if either approach failed to access the distal vessels, direct closure of their orifices during aneurysmorrhaphy would have been possible as a bailout following the endovascular exclusion of the proximal CA. Additionally, decompression of the aneurysmal sac enabled safe dissection and mobilisation of the aneurysm, thereby avoiding unintentional bleeding. As a result, the need for incision and dissection was minimised. Moreover, as complete exclusion of the aneurysm could be confirmed directly during aneurysmorrhaphy, there was little risk of recanalisation associated with an endovascular approach alone.

Reportedly, three cases of CA aneurysms >10 cm in size have been treated with coil embolisation.[6–8] One was asymptomatic,[6] and the other two were symptomatic, presenting with abdominal pain[7] and post-prandial nausea.[8] The latter patient developed recurrent symptoms six weeks after the first embolisation because of recanalisation. The size of the aneurysm remained unchanged. The patient underwent two stage redo coil embolisation and subsequent open surgery. Little is known about the outcomes of EVT for giant visceral aneurysms, and it remains unclear whether the rupture risk during the interval is tolerable in an EVT preceding strategy.[9]

The rate of visceral ischaemia associated with CA embolisation without arterial reconstruction is 9%.[10] Pre-operative or intra-operative angiography is often used to evaluate the collateral flow between the CA and SMA. In the present case, intra-operative angiography demonstrated good collateral flow to the liver and spleen via the SMA, thereby sparing the need for vascular reconstruction. Also, no post-operative vaccination or antibiotic cover for asplenia were conducted. Although there are no reports of pancreaticoduodenal artery (PDA) aneurysm formation after CA embolisation, CA embolisation without arterial reconstruction may increase the risk of PDA aneurysm formation due to an increase in flow volume through the collateral pancreaticoduodenal arcade. In the present case, the pancreaticoduodenal arcade had already developed because the origin of the CA was compressed by the aneurysm. Considering the possibility of further remodelling after complete CA embolisation, periodic follow ups are mandatory.

In conclusion, aneurysmorrhaphy of a giant CA aneurysm was safely performed with minimal incision and dissection using a hybrid approach. Short term outcomes were satisfactory, with complete resolution of compression symptoms and remarkable sac shrinkage at 12 months.

FUNDING

None.

CONFLICT OF INTEREST

None.

ACKNOWLEDGEMENTS

We would like to thank Editage (www.editage.com) for English language editing.

REFERENCES

1 Kwong JM, Rockman CB, Kashyap VS. Splanchnic artery aneurysms. In: Sidawy AN, editor. *Rutherford's vascular surgery and endovascular therapy*. 9th ed. Philadelphia: Elsevier; 2019. p. 1109—20.
2 Shanley CJ, Shah NL, Messina LM. Common splanchnic artery aneurysms: splenic, hepatic, and celiac. *Ann Vasc Surg* 1996;**10**: 315—22.
3 Björck M, Koelemay M, Acosta S, Goncalves FB, Koelbel T, Kolkman JJ, et al. Editor's Choice — management of the diseases of mesenteric arteries and veins: clinical practice guidelines of the European Society of Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2017;**53**:460—510.
4 Barrionuevo P, Malas MB, Nejim B, Haddad A, Morrow A, Ponce O, et al. A systematic review and meta-analysis of the management of visceral artery aneurysms. *J Vasc Surg* 2020;**72**:40S. —45S.
5 Tulsyan N, Kashyap VS, Greenberg RK, Sarac TP, Clair DG, Pierce G, et al. The endovascular management of visceral artery aneurysms and pseudoaneurysms. *J Vasc Surg* 2007;**45**: 276—83.
6 Xiao N, Mansukhani NA, Resnick SA, Eskandari MK. Giant celiac artery aneurysm. *J Vasc Surg Cases Innov Tech* 2019;**5**:447—51.
7 Vitale G, Simoncini F, Bracale UM, Bergamaschi G. Endovascular management of a giant celiac artery aneurysm. *Intern Med* 2012;**51**:671—2.
8 Smet N, Buimer T, Van Meel T. Combined endovascular and surgical treatment of a giant celiac artery aneurysm with consequent gastric outlet obstruction: a case report and literature review. *Acta Chir Belg* 2023;**123**:422—6.
9 Tipaldi MA, Krokidis M, Orgera G, Pignatelli M, Ronconi E, Laurino F, et al. Endovascular management of giant visceral artery aneurysms. *Sci Rep* 2021;**11**:700.
10 King RW, Gedney R, Ruddy JM, Genovese EA, Brothers TE, Veeraswamy RK, et al. Occlusion of the celiac artery during endovascular thoracoabdominal aortic aneurysm repair is associated with increased perioperative morbidity and mortality. *Ann Vasc Surg* 2020;**66**:200—11.