

# A hybrid procedure for middle colic artery aneurysm complicated by chronic juxtarenal segmental aortic occlusion

Kazumasa Hanada, MD, Toshio Takayama, MD, PhD, Takayoshi Sasaki, MD, Ryosuke Taniguchi, MD, PhD, and Katsuyuki Hoshina, MD, PhD, *Tokyo, Japan*

## ABSTRACT

Here we describe a hybrid procedure, that is, a combination of open isolation and coil embolization, to treat a saccular middle colic artery aneurysm deep behind the pancreas. The middle colic artery provided the collateral blood flow necessary to bypass a chronic segmental aortic occlusion. For preservation of the collateral vessels, we surgically excluded and bypassed the aneurysm and then performed endovascular embolization of the pancreaticoduodenal arteries flowing into the aneurysm, resulting in complete isolation of the aneurysm without jeopardizing blood flow. This hybrid procedure for visceral artery aneurysms can be effective when the collateral vessels need to be preserved. (*J Vasc Surg Cases and Innovative Techniques* 2019;5:327-31.)

**Keywords:** Visceral artery aneurysm; Open and endovascular repair; Aortic occlusion

Visceral artery aneurysms (VAAs) are uncommon (0.01%-2.00%) but potentially life-threatening if a rupture occurs. Although VAAs have traditionally been managed medically or surgically, endovascular treatment (EVT) is becoming more common with the development of endovascular techniques and devices.<sup>1-3</sup> VAAs sometimes occur in the visceral arteries needed to provide the collateral blood flow to bypass an occlusion, particularly chronic aortic occlusions. In such cases, hyperdynamic flow in the collateral vessels can expand the aneurysm further.<sup>4</sup> Here we describe an open endovascular repair for a middle colic artery aneurysm (MCAA) in a patient with a chronic juxtarenal segmental aortic occlusion. The patient consented to publication of the details and images pertaining to her case.

## CASE REPORT

A 66-year-old woman was admitted to our department for investigation and treatment of a 30-mm saccular MCAA located deep behind the pancreas. Six years earlier, she had a systemic workup for colon cancer. A screening computed tomography (CT) scan with contrast incidentally found the abdominal aortic occlusion and this aneurysm, which then measured 25 mm in diameter. Open ileocecal resection was performed for the cancer with no recurrence thereafter.

The patient had no abdominal symptoms at the time of presentation to our department. A contrast-enhanced CT scan showed that the abdominal aorta was occluded for about 3 cm and that the occlusion had caused hypertrophy of the vessels in the collateral arcade between the superior mesenteric artery (SMA) and the inferior mesenteric artery, including the middle colic arteries. The right and left middle colic arteries ran independently. The aneurysm arose from the left branch of the middle colic artery (LBMCA; Fig 1). The right renal artery (RA) arose above the occlusion and the left RAs arose, one above the occlusion and the other below. The main pancreatic duct was dilated on the distal side of the aneurysm. There were no other aneurysms or stenoses. She was receiving oral medications for diabetes, hypertension, and dyslipidemia. She had smoked until the age of 60 years, but had never consumed alcohol. There was no family history of cardiovascular disease.

On physical examination, she was otherwise healthy. She was 154 cm tall and weighed 85 kg (body mass index of 35.8). Her abdomen was soft and nondistended. No pulsatile mass was palpable. All distal pulses in the limbs were easily palpable. The ankle-brachial pressure index was 0.77 on the left and 0.75 on the right. The following diagnostic studies were performed to exclude inflammatory processes: positron emission tomography, magnetic resonance imaging, echocardiography, erythrocyte sedimentation rate, C-reactive protein, antinuclear antibodies, rheumatic factor, cyclic citrullinated peptide antibodies, anti-SS-A antibodies, complement, antineutrophil cytoplasmic antibodies, and immunoglobulin G4. The results were all negative. Her history was negative for rheumatologic or systemic disease, recurrent fever, arthralgia, pancreatitis, infection, and trauma. Routine blood tests, including renal function, were unremarkable.

We then suspected that the aneurysm resulted from hyperdynamic flow in the collateral vessels between the SMA and inferior mesenteric artery because of chronic aortic occlusion; surgical treatment was indicated because of the shape, size, expansion, and compression of the aneurysm. We decided on a hybrid procedure in preference to pancreaticoduodenectomy

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From the Division of Vascular Surgery, Department of Surgery, Graduate School of Medicine, The University of Tokyo.

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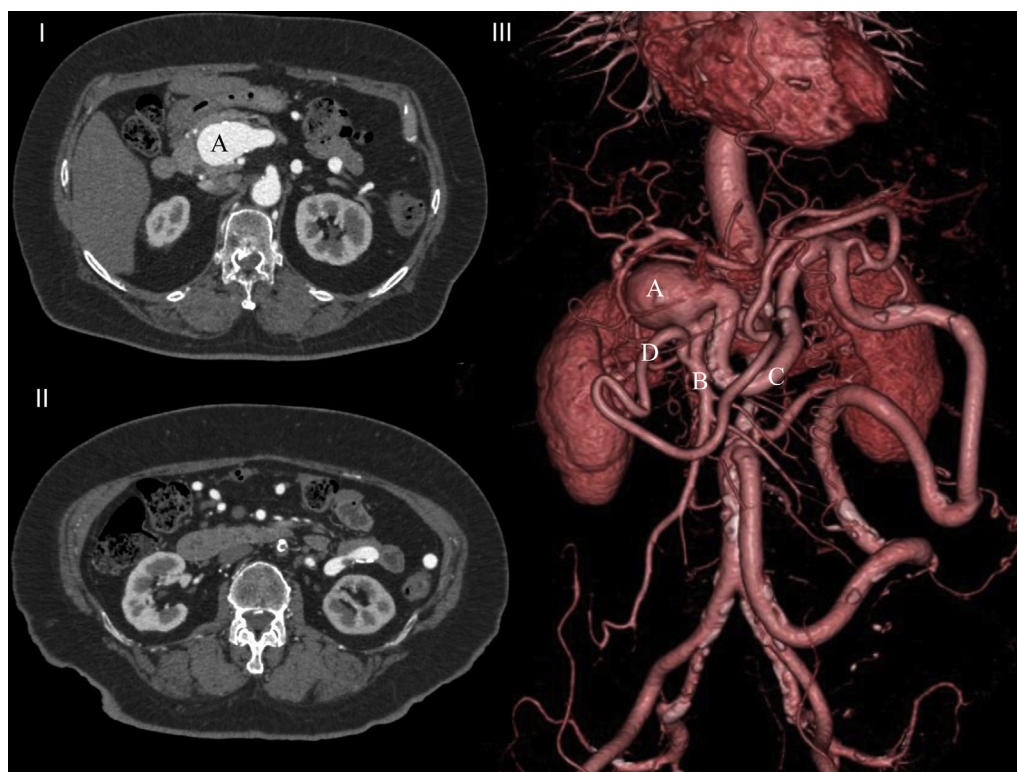
Correspondence: Toshio Takayama, MD, PhD, Division of Vascular Surgery, Department of Surgery, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8655, Japan (e-mail: [takayamato-sur@h.u-tokyo.ac.jp](mailto:takayamato-sur@h.u-tokyo.ac.jp)).

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**Fig 1.** Axial computed tomography (CT) scans showing (I) a 30-mm saccular middle colic artery aneurysm (MCAA) and (II) a juxtarenal aortic occlusion. III, A preoperative three-dimensional reconstruction of the MCAA. **A**, The MCAA behind the pancreas. **B**, The superior mesenteric artery (SMA). **C**, The left branch of the middle colic artery (LBMCA) distal to the aneurysm. **D**, The right branch of the middle colic artery.

because it would be less invasive. This procedure consisted of excluding and bypassing the aneurysm followed by endovascular embolization of the arteries flowing into the aneurysm. A physical model was created from the preoperative CT angiogram with three-dimensional printing technology, which was useful for understanding the complicated relationship between the vessels (Fig 2).

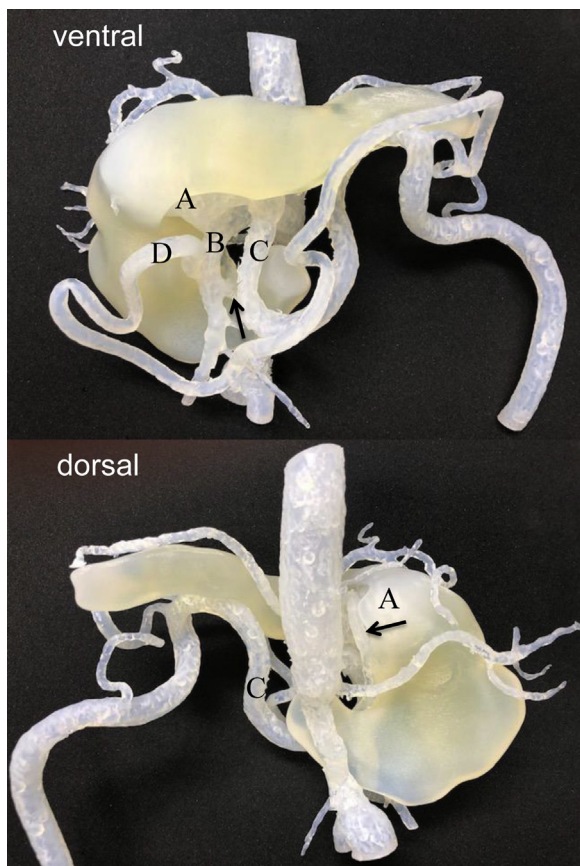
Angiography was performed from the left brachial artery under general anesthesia. The posterior inferior pancreaticoduodenal artery (PIPDA) was found to flow into the aneurysm. Initially, we attempted to embolize the PIPDA via the SMA but had to abandon the attempt because of torsion and hyperdynamic flow in the colic artery. A midline laparotomy was then performed, and intra-abdominal adhesions were separated. Proximal and distal control of the SMA and distal control of the LBMCA were obtained. The root of the LBMCA was ligated (Fig 3) and a side-to-end primary anastomosis of the SMA to the LBMCA distal to the PIPDA was performed. After that, embolization of the aneurysm and PIPDA was also performed

with 0.018 microcoils, resulting in complete isolation of the aneurysm (Fig 4). The catheterization was performed from the same access with a microcatheter via the celiac trunk, common hepatic artery, and its branches. As before, the pedal pulses were easily palpable. The blood loss was 2750 mL, and 1410 mL was transfused back to the patient. The operating time was 611 minutes.

The patient's postoperative recovery was unremarkable. Contrast-enhanced CT angiography on postoperative day 4 confirmed isolation of the aneurysm and preservation of the collateral vessels (Fig 5). She was discharged on postoperative day 11.

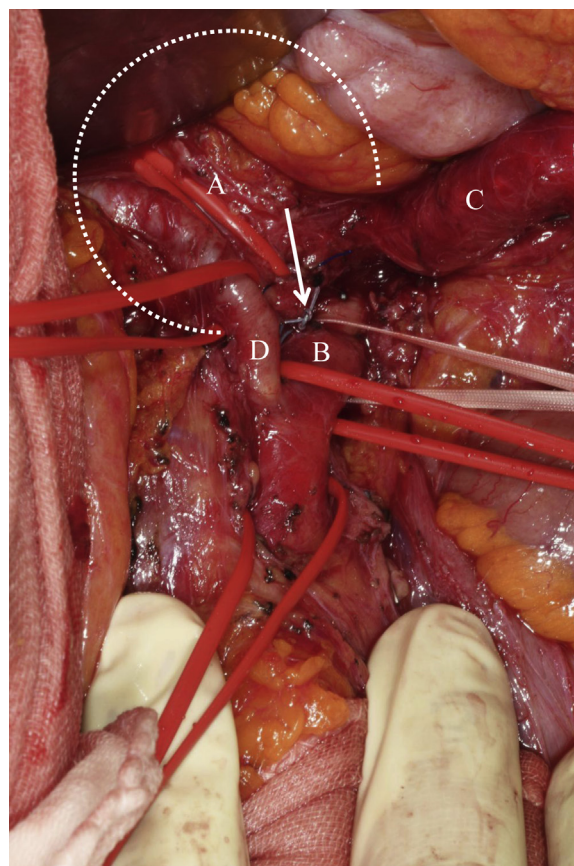
## DISCUSSION

The common sites of VAAs are the splenic artery (60%), followed by the hepatic artery (20%), SMA (6%), celiac artery (4%), gastric artery (4%), and jejunal, ileal, and colic arteries (4%).<sup>5-7</sup> MCAAs are extremely rare and often ruptured at the time of presentation.<sup>8</sup> The etiology of



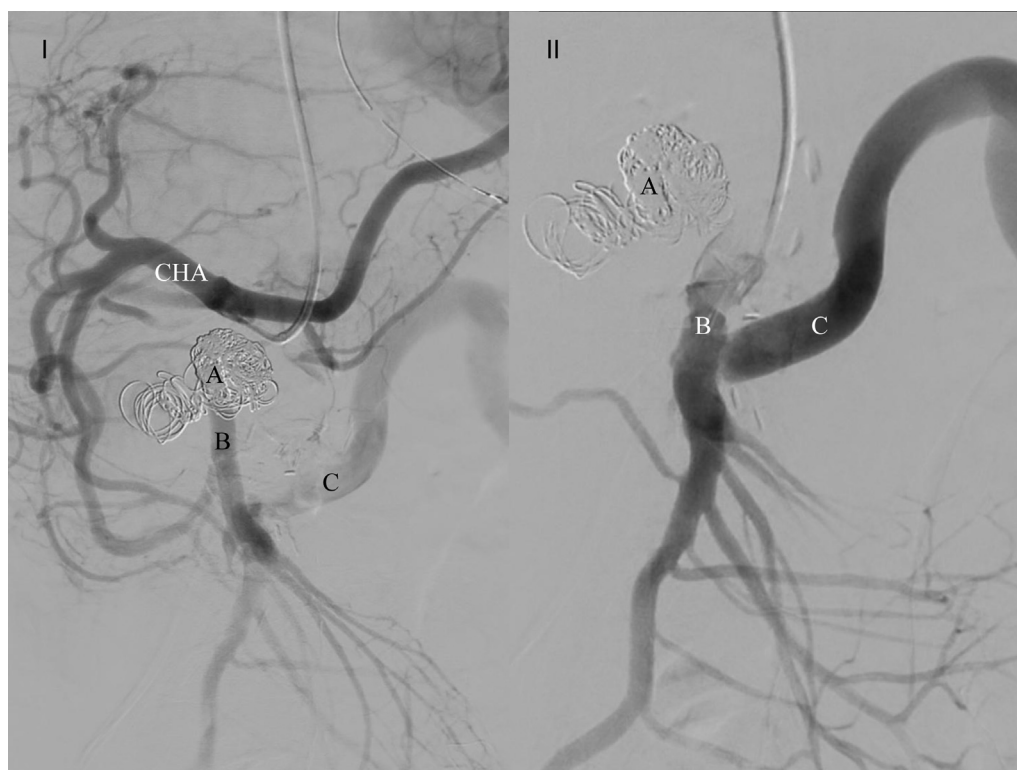
**Fig 2.** Physical model generated by three-dimensional printing. **A**, The middle colic artery aneurysm (MCAA) behind the pancreas. **B**, The superior mesenteric artery (SMA). **C**, The left branch of the middle colic artery (LBMCA) distal to the aneurysm. **D**, The right branch of the middle colic artery. The posterior inferior pancreaticoduodenal artery (PIPDA) flowing into the aneurysm is indicated by the arrow.

most VAAs is unknown, but possible causes include arteriosclerosis, segmental arterial mediolysis, trauma, infection, inflammation such as pancreatitis, and collagen vascular disease.<sup>9</sup> Aneurysms in the pancreaticoduodenal arcade sometimes accompany stenosis or obstruction of the celiac trunk.<sup>10</sup> The treatment options for VAA include open surgery, EVT, or a combination thereof (as in the present case) according to the size, site, and etiology of the aneurysm.<sup>11</sup> Open surgery includes aneurysmectomy, ligation, and resection of the ischemic bowel if necessary. EVT includes embolization and endografting; bowel ischemia can usually be avoided when EVT is performed because of the rich collateral network.<sup>12</sup>



**Fig 3.** **A**, The middle colic artery aneurysm (MCAA) behind the pancreas. **B**, The superior mesenteric artery (SMA). **C**, The left branch of the middle colic artery (LBMCA) distal to the aneurysm. **D**, The right branch of the middle colic artery. The root of the MCAA was ligated and dissected (as indicated by the arrow).

Abdominal aortic coarctation or occlusion in an adult is uncommon. The possible etiologies include, but are not limited to, a congenital anomaly, arteriosclerosis, inflammatory aortitis such as Takayasu's arteritis, neurofibromatosis, Williams syndrome, or fibromuscular dysplasia.<sup>13</sup> The renal and visceral arteries are sometimes involved in aortic coarctation or occlusion. The symptoms are secondary hypertension (owing to increased systemic resistance or RA stenosis) and claudication of the lower extremities (because of arterial insufficiency).<sup>14</sup> Whether the patient is symptomatic depends on the degree of collateralization bypassing the occlusion, which can induce hypertrophy of the collateral vessels and excessive blood flow to the vessels, leading to a damaged vessel wall in which an aneurysm subsequently develops.<sup>4</sup>



**Fig 4.** An intraoperative angiogram (I, celiac trunk; II, superior mesenteric artery [SMA]) shows final control demonstrating complete exclusion and bypass of the aneurysm and coil embolization of the aneurysm and posterior inferior pancreaticoduodenal artery (PIPDA), **(A)** the coil-embolized aneurysm, **(B)** the SMA, and **(C)** the left branch of the middle colic artery (LBMCA) distal to the aneurysm. *CHA*, Common hepatic artery.

In our case, the site of the MCAA and aortic occlusion complicated the management. Aneurysmectomy might have resulted in postoperative pancreatic fistula or a need for pancreaticoduodenectomy if there was strong adhesion between the pancreas and MCAA. Transcatheter embolization might have induced renal or limb ischemia or enlarged the aneurysm. We could not perform endografting because there was no adequate sealing length. Therefore, we opted for a hybrid therapy that combined open exclusion of the aneurysm with a bypass procedure and transcatheter coil embolization. This procedure successfully excluded the MCAA and preserved the important vessels. We did

not consider revascularization or endovascular stenting of the aortic occlusion because the patient was asymptomatic.

## CONCLUSIONS

It should be borne in mind that aortic occlusion can cause formation and expansion of VAAs in collateral vessels and complicate management. EVT for VAAs is a routine procedure nowadays. However, when aortic occlusion accompanies a VAA, we can consider a hybrid procedure depending on the preoperative estimation of the courses of the vessels.



**Fig 5.** A postoperative three-dimensional reconstruction showing (A) the coil-embolized aneurysm, (B) the superior mesenteric artery (SMA), (C) the left branch of the middle colic artery (LBMCA) anastomosed to the SMA, and (D) the right branch of the middle colic artery. The primary anastomosis is indicated by the arrow.

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