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CASE REPORT

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Anastomotic stenosis of a reconstructed dissecting superior mesenteric artery aneurysm undetectable by intraoperative indocyanine green angiography: A case report

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Abstract

Intraoperative evaluation of blood flow using ICG angiography revealed no significant abnormality. However, the anastomotic stenosis was revealed by postoperative CT angiography; more precise intraoperative evaluation methods need to be developed.

KEYWORDS

dissecting superior mesenteric artery aneurysm, indocyanine green angiography, surgical repair

1 | INTRODUCTION

A 71-year-old man diagnosed with a dissecting superior mesenteric artery aneurysm underwent surgical repair. Intraoperative indocyanine green angiography was conducted, and it was confirmed that the small intestine was contrasted. However, postoperatively the patient developed paralytic ileus owing to distal anastomotic stenosis.

Indocyanine green (ICG) angiography has been used for intraoperative evaluation of blood flow during revascularization procedures in various fields.[1–3] However, although ICG angiography can confirm the presence or absence of blood flow, detailed evaluation of the anastomotic morphology is sometimes difficult.[4,5] In the present study, we report a case in which intraoperative ICG angiography failed to identify anastomotic stenosis during reconstruction in a patient with a dissecting superior mesenteric artery aneurysm (dSMAA).

2 | CASE HISTORY/ EXAMINATION

A 71-year-old man presented with a history of aortic stenosis, hypertension, and diabetes mellitus. Computed tomography (CT) scanning performed for the preoperative evaluation of aortic valve stenosis revealed a dSMAA with a diameter of 32 mm. The dissection originated 10 mm peripherally from the origin of the SMA and extended to the ileal artery bifurcation. There was a re-entry at the bifurcation of the right colic artery, the false lumen was partially thrombosed, and the true lumen was compressed and narrowed by the false lumen. The true lumen of the aneurysm gave rise to three jejunal arteries, and the middle colic artery was occluded (Figure 1).

3 | DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT

Although the patient was asymptomatic, the aneurysm was more than 30 mm in diameter and the true lumen was narrowed, indicating the need for therapeutic intervention owing to the risk of rupture and intestinal ischemia. Due to the patient's advanced age, endovascular treatment was considered as the first option. However, surgical intervention was preferred since stent-graft insertion could induce intestinal ischemia owing to the occlusion of important branches, and coil embolization of the false lumen could displace the thrombus to the distal SMA.

A midline abdominal incision was performed. After systemic heparin administration, the SMA and its branches were clamped. The false lumen was incised, and all thrombus were removed. Subsequently, the true lumen was opened through a longitudinal incision of the intimal flap from entry to re-entry. We attempted to resect the entire intimal flap; however, the distal intimal flap was remarkably thickened, resulting in inadequate resection. Therefore, the distal true lumen of the SMA was severely stenotic. The SMA was completely transected at its origin and anastomosed in an end-to-end fashion with a GSV using a 6-0 polypropylene running suture. The opened true lumen of the SMA was reconstructed using a long onlay patch from the GSV (Figure 2). Since the true lumen at the distal end of the SMA was severely narrowed by the residual thickened intimal flap, reconstruction was performed by inserting a 22-G cannula into the true lumen to avoid anastomotic stenosis.

4 | OUTCOME AND FOLLOW-UP

After completion of the procedure, the blood flow from the SMA to the intestines was investigated using ultrasound flowmetry and ICG angiography. The ultrasound flowmetry findings revealed good pulsatile sounds in the graft, important branches, and distal SMA. ICG angiography demonstrated good fluorescence from the proximal anastomosis site to the onlay patch and jejunal arteries; however, the ileal artery and distal SMA fluorescence were weak, and there seemed to be a slight time lag before

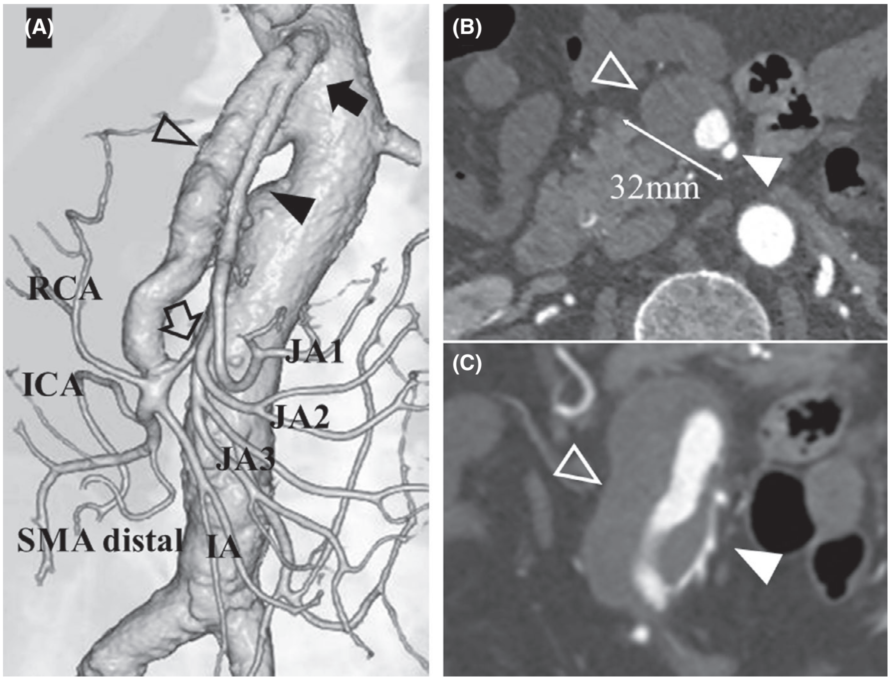

FIGURE 1 Preoperative computed tomography of the superior mesenteric artery (SMA) and aneurysm. (A) Volume-rendered image. (B) Axial view. (C) Coronal view. The SMA aneurysm has a diameter of 32 mm. The dissection extends 10 mm peripherally from the origin of the SMA to the bifurcation of the ileocolic artery. There is an entry (black arrow) 15 mm from the origin, and a re-entry (white arrow) involving the right colic artery (RCA), ileocolic artery (ICA), and ileal artery (IA). The false lumen (unfilled triangle) is partially thrombosed, and the true lumen (filled triangle) is narrowed due to compression by the false lumen. Three branches of the jejunal artery (JA) originate from the true lumen of the aneurysm

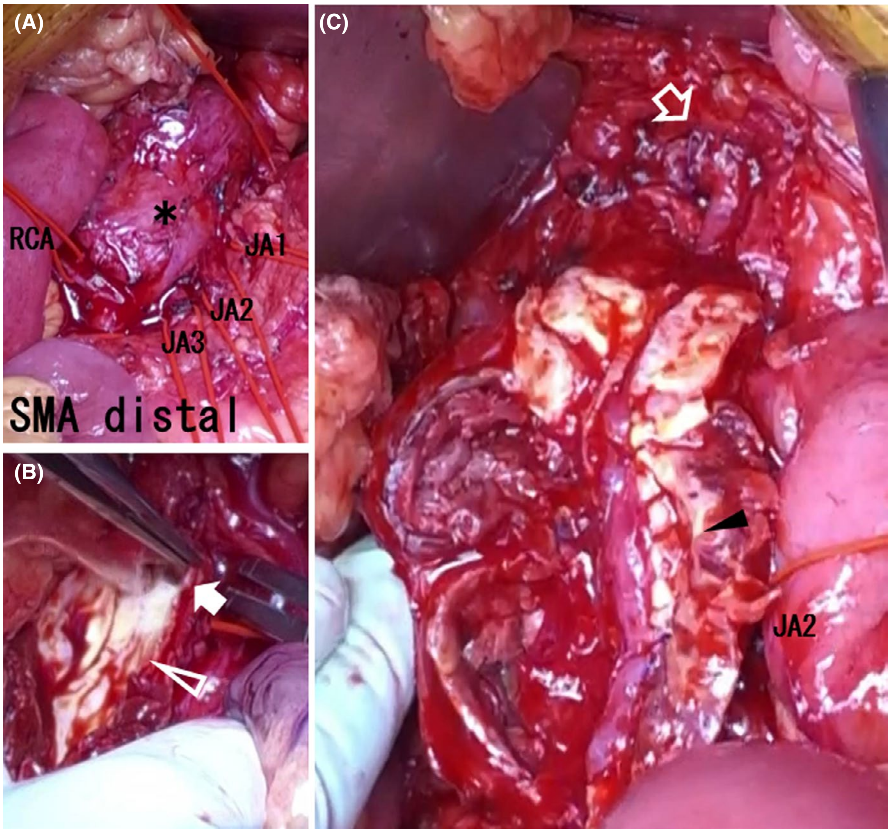

FIGURE 2 Intraoperative findings during the surgical reconstruction. (A) The superior mesenteric artery (SMA) aneurysm (white star) and its branches are peeled off and passed through the vessel loops. (B) The false lumen is opened (unfilled triangle), and the thrombus is removed. An entry (filled arrow) of approximately 3-mm diameter can be visualized. (C) The SMA is completely transected at its origin and anastomosed in an end-to-end fashion with the great saphenous vein (GSV) (unfilled arrow). In addition, the opened true lumen of the SMA is reconstructed with a long onlay patch using the GSV (filled triangle)

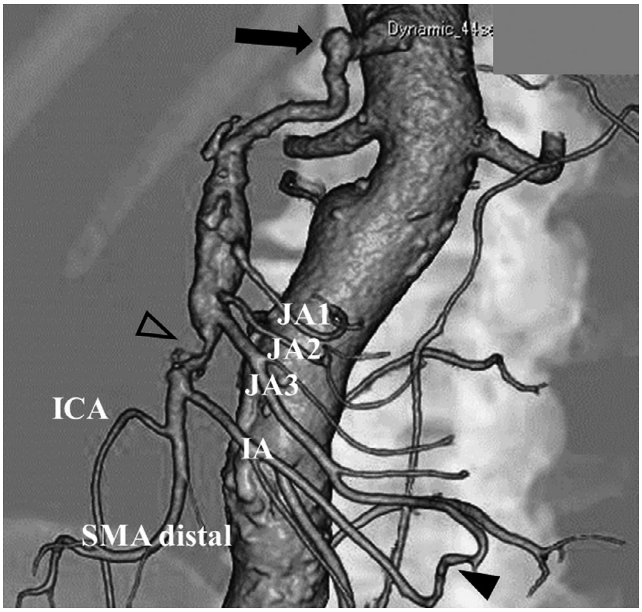

FIGURE 3 Postoperative volume-rendered computed tomography image of the superior mesenteric artery (SMA). There is no major abnormality at the proximal anastomosis (black arrow); however, the distal anastomosis site of the SMA was stenotic just before the ileal artery bifurcation (unfilled triangle). The jejunal arteries are all patent, and blood flow to the distal SMA is maintained via collateral blood flow (filled triangle) from the jejunal arteries

the fluorescence was seen. However, the fluorescence of the entire small and large intestine in the SMA region could be confirmed in about 30 s. The patient developed postoperative paralytic ileus that required fasting and gastric tube placement. The postoperative CT images revealed that the jejunal artery was patent; however, there was stenosis at the site of the distal SMA anastomosis just before the ileal artery bifurcation. Good collateral circulation was observed from the jejunal artery to the ileal artery (Figure 3). The patient recovered after 4 weeks of conservative treatment and was discharged on postoperative day 40.

5 | DISCUSSION

Recent reports have highlighted the safety and efficacy of endovascular treatment for dSMAA, including entry closure with a covered stent, coil embolization of the false lumen, and stenting of the narrowed true lumen.[6–8] However, problems, such as the risk of intestinal ischemia owing to blockage of some branches or coil migration, the possibility of aneurysm enlargement, and rupture owing to endoleak or stent migration, persist.

Surgical techniques for the treatment of dSMAA include simple aneurysm ligation, aneurysmorrhaphy, and aneurysm resection or ligation followed by reconstruction.[9] A simple ligation possesses the risk of intestinal ischemia; therefore, it is not recommended when the collateral flow from the celiac artery or inferior mesenteric artery is insufficient. Although aneurysmorrhaphy is a simple technique, safe and firm suturing is difficult to achieve in patients with fragile aneurysm walls or enlarged false lumen. The most reliable technique for the management of dSMAA is aneurysm resection or ligation followed by reconstruction. The grafts used for reconstruction include the GSV, superficial femoral artery, radial artery, and expanded polytetrafluoroethylene or Dacron graft.[10–13] In this case, aneurysmorrhaphy was technically difficult since the aneurysm was large and filled with thrombus in the false lumen. In order to exclude the aneurysm and preserve the important branches, the simplest method was to open the true lumen and reconstruct it using a graft by onlay-patch fashion. The great saphenous vein was chosen for the graft since it was easy to harvest and handle during anastomosis.

Endovascular treatment is minimally invasive and offers faster recovery compared with surgical treatment. The location of the entry of dissection, status of the arterial wall, and diameter of the artery determines whether treatment is possible.[6–8] For cases of ruptured aneurysms or intestinal necrosis, emergency surgery is given priority over endovascular treatment. In actual clinical practice, it is necessary to discuss in detail whether endovascular treatment is appropriate in each case. In the present case, surgical treatment was chosen because the entry of the dSMAA was close to the SMA origin, and the neck of the proximal aneurysm was extremely short.

If a technique capable of precise detection of problems at the anastomosis site during the revascularization procedure exists, prompt reanastomosis could be possible. Various methods have been used to evaluate intraoperative blood flow. Currently, ICG angiography, transit-time flowmetry (TTFM), and X-ray angiography are the methods of choice.[1–3,14,15] ICG angiography is easy and quick to perform, has few complications, and can be used for evaluating the presence of intestinal ischemia and for angiography; however, it is basically a qualitative evaluation and is difficult to evaluate anastomoses in detail. An additional problem is that the images are greatly affected by the circumstances of each case (peripheral arterial status, residual vascular bed, muscular mass, etc.), and ICG angiography alone may not provide sufficient intraoperative evaluation. Currently, studies on the quantification of ICG angiography are being reported.[4,16,17] Upon establishment of these measurements in clinical practice, ICG angiography is anticipated to become a very powerful intraoperative assessment tool. TTFM is widely used, especially for intraoperative graft flow evaluation in coronary artery bypass surgery.[14] It is easy and quick to use and can provide not only blood flow but also many other indices, enabling comprehensive evaluation of the revascularized area. However, morphological information cannot be obtained, and even if an abnormality in blood flow or other data exists, identifying the etiology may be challenging. In addition, many of the indices are derived from the coronary blood flow data, which requirs careful interpretation in areas such as the abdomen and lower limbs. X-ray angiography is still considered to be the most appropriate method for obtaining detailed information on the anastomosis site.[15] Problems with intraoperative angiography include the lack of feasible evaluation in the absence of an equipped hybrid operating room, the possibility of complications with the use of contrast media, and the exposure to radiation; however, it can be performed without hesitation if problems are suspected using other examination methods. In the present case, intraoperative ICG angiography showed a slight delay in the fluorescence of the distal SMA; however, there was no defect in the fluorescence of the intestinal wall, and thus, we ascertained that there was no intestinal ischemia. Therefore, intraoperative ICG angiography was unable to identify the stenosis of the distal side of the anastomosis. If a rapid and simple intraoperative evaluation method is established, reanastomosis or bypass creation would be possible.

In conclusion, we performed a surgical revascularization of a dSMAA. Intraoperative ICG angiography revealed no problem with the intestinal blood flow in the SMA dominant region. However, postoperatively, the patient developed paralytic ileus associated with intestinal ischemia, and contrast-enhanced CT scan revealed anastomotic stenosis. In some cases, intraoperative ICG angiography may not be helpful in evaluating the anastomotic morphology in detail; therefore, it is necessary to combine it with other examination methods to facilitate comprehensive evaluation.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

Shigeyuki Yamashita involved in study conception, data collection, analysis, investigation, writing, critical review and submission, final approval, and accountability. Kazuto Shibuya, Kanetsugu Nagao, Akio Yamashita, Kazuaki Fukahara, Tsutomu Fujii, and Naoki Yoshimura involved in data collection, analysis, critical review and revision, final approval, and accountability. Toshio Doi and Shigeki Yokoyama involved in data collection, analysis, investigation, critical review and revision, final approval, and accountability.

CONSENT

Informed consent was obtained from the patient for the publication of this case.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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