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Case Report

Revision Surgery for Venous Graft Stenosis of SMA Bypass

Takao Nonaka, MD,[1] Tetsuyoshi Takayama, MD,[2] Masaomi Suzuki, MD,[2] Hiroshi Asano, MD, PhD,[2] and Harunobu Matsumoto, MD, PhD[1]

A 67-year-old male with postprandial abdominal pain for 4 months obtained medical attention for severe pain. He was diagnosed with small intestinal necrosis, secondary to chronic mesenteric ischemia by CT scan. We performed the surgery including a partial resection of the small intestine and left external iliac artery to the superior mesenteric artery bypass using saphenous vein graft. His symptoms improved after surgery. However, 5 months later, abdominal pain appeared after eating. A CT scan identified graft stenosis, leading to a revascularization. A synthetic vessel was used to perform the re-bypass surgery. Postoperatively, the patient's abdominal pain improved.

Keywords: chronic mesenteric ischemia, saphenous vein graft, vein graft stenosis

Introduction

Chronic mesenteric ischemia (CMI) typically presents with postprandial abdominal pain and weight loss but may also lead to intestinal necrosis, requiring revascularization. Approaches to revascularization include endovascular therapy and surgical procedures. Bypass surgery is a common surgical approach, but it is necessary to choose the anastomosis site and graft type. In this report, we describe a case of retrograde bypass surgery using a great saphenous vein graft for small intestine necrosis due to CMI, which required re-bypass surgery using a synthetic graft due to abdominal pain caused by graft stenosis.

Case Report

A 67-year-old male presented with epigastric pain lasting 4 months. He felt severe abdominal pain during sleep, and he came to our hospital. He had a medical history of atrial fibrillation and dyslipidemia. He had not taken anticoagulant therapy. He had been smoking 20 cigarettes every day. On admission, his height was 172 cm, his body weight was 51 kg (there is no recent weight loss), and his abdomen was flat and soft. He had tenderness in his lower abdomen but no rebound tenderness. The hematological findings on admission were as follows: white blood cell count, 18700/μL; hemoglobin, 12.5 g/dL; creatine kinase, 26 U/L; lactate dehydrogenase, 164 U/L; C-reactive protein, 20.4 mg/dL; prothrombin time-international normalized ratio, 1.40; and activated partial thromboplastin time, 70.1 s, with no other findings requiring special mention. The abdominal CT scan image showed a poorly enhanced area with intramural emphysema in the distal ileum. The superior mesenteric artery (SMA) was calcified and occluded at its origin, and there was celiac artery (CA) stenosis, and the inferior mesenteric artery (IMA) was occluded at its origins (**Figs. 1A–1D**). Based on the findings of contrast-enhanced CT, the patient was diagnosed with small intestinal necrosis due to CMI. It was considered necessary to perform a partial resection of the small bowel; due to the risk of postoperative necrosis expansion caused by residual ischemia, we decided to perform revascularization. We considered that endovascular treatment would be difficult because the SMA was a highly calcified lesion, so we opted for bypass surgery. Considering the presence of small bowel necrosis and the need for infection control, the graft was the great saphenous vein. The infrarenal abdominal aorta was highly calcified, so we performed a retrograde bypass surgery from the left external iliac artery.

Surgical findings: A midline abdominal incision was made. The small intestine appeared generally pale with poor peristalsis. A segment of approximately 5 cm with black necrosis was identified in the terminal ileum,

[1]*Department of Vascular Surgery, Saitama Medical University, Iruma, Saitama, Japan*
[2]*Department of General Surgery, Saitama Medical University, Iruma, Saitama, Japan*

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Corresponding author: Takao Nonaka. MD. Department of Vascular Surgery, Saitama Medical University, 38 Morohongou, Moroyama, Iruma, Saitama 350-0495, Japan
Tel: +81-49-276-1330
E-mail: takaononaka0909@gmail.com

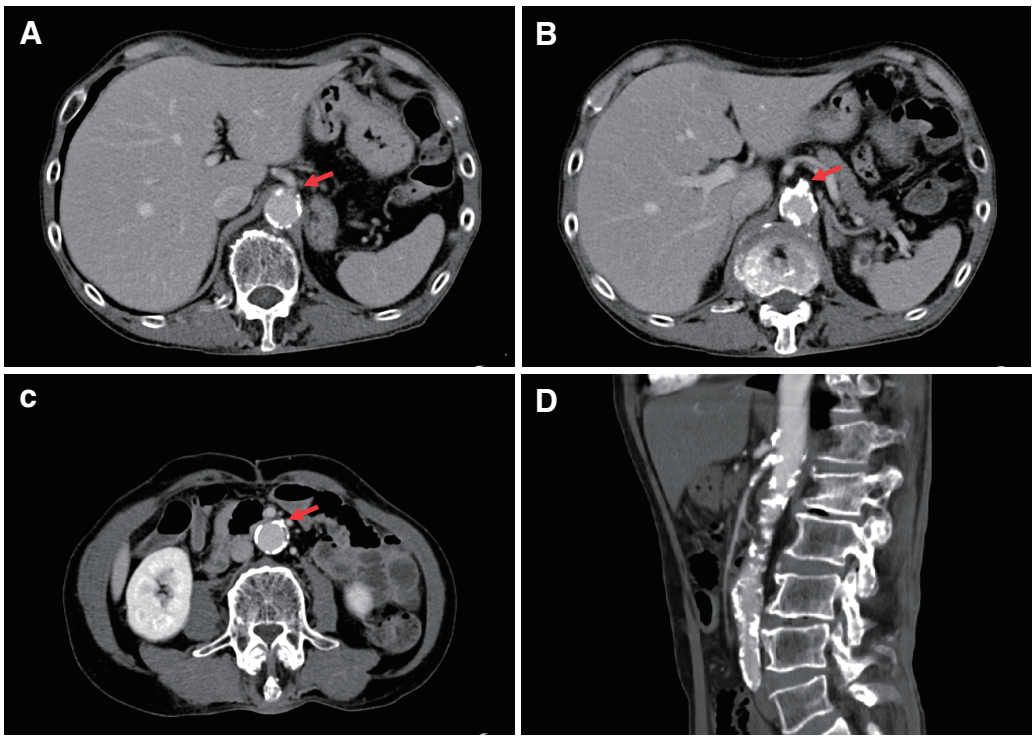

Fig. 1 Preoperative CT. (**A**) The CA showed stenosis at its origin. (**B**) The SMA was calcified and occluded at its origin. (**C**) The inferior mesenteric artery was occluded at its origin. (**D**) Lesions in the CA and SMA (sagittal view). CA: celiac artery; SMA: superior mesenteric artery

extending 30 cm from its distal end. There was no ascites retention. The pulsation of the SMA was not palpable, and arterial pulsations within the mesentery were weak. The necrotic small intestine with a length of 8 cm was resected. The great saphenous vein was harvested from the left thigh. A venous graft was passed through the retroperitoneal and the front of the pancreas route to the SMA, and a bypass from the left external iliac artery to the SMA was performed. After revascularization, intestinal peristalsis gradually improved. The operation time was 215 minutes, and the blood loss was 20 mL.

Oral meal intake was resumed on postoperative day 6 (POD6), and postprandial abdominal pain improved. On POD7, a contrast-enhanced CT was performed to confirm good bypass blood flow (**Fig. 2A**), and the patient was discharged on POD10. After discharge, there was no recurrence of the abdominal symptoms, but around 5 months after the surgery, postprandial abdominal pain reappeared. A contrast-enhanced CT revealed significant stenosis near the proximal and distal anastomoses of the graft (**Fig. 2B**). This symptomatic CMI was determined to require revascularization. Due to calcification at the origin of the SMA, bypass surgery was chosen again. The vein graft had been stenotic, and a synthetic vessel was selected for grafting. An echocardiogram to evaluate operability revealed a decreased left ventricular anterior wall motion and a reduced left ventricular ejection fraction of 44%, indicating reduced cardiac function. Considering the invasiveness of the procedure for a patient with reduced cardiac function, we decided to perform a retrograde bypass surgery again from the left external iliac artery.

Surgical findings: A midline abdominal incision was made. After dissection of the adhesions, the SMA was exposed on the central side of the previous anastomosis. During this process, the venous graft was identified, but no pulsation was palpable. The left external iliac artery was exposed peripherally from the previous anastomotic site. A 6-mm not-ringed Dacron graft was selected, and a bypass was performed from the left external iliac artery to the SMA through the retroperitoneal route. After revascularization, intestinal peristalsis gradually improved. The operation time was 202 minutes, and the blood loss was 30 mL.

The patient was admitted to the ICU after surgery and was discharged the next day. Oral meal intake resumed on POD3 and the postprandial abdominal pain that had been present before the surgery improved. On POD7, a contrast-enhanced CT was performed to confirm good bypass blood flow (**Fig. 3**), and the patient was discharged on POD9. The patency of the graft was confirmed 7 months after the surgery.

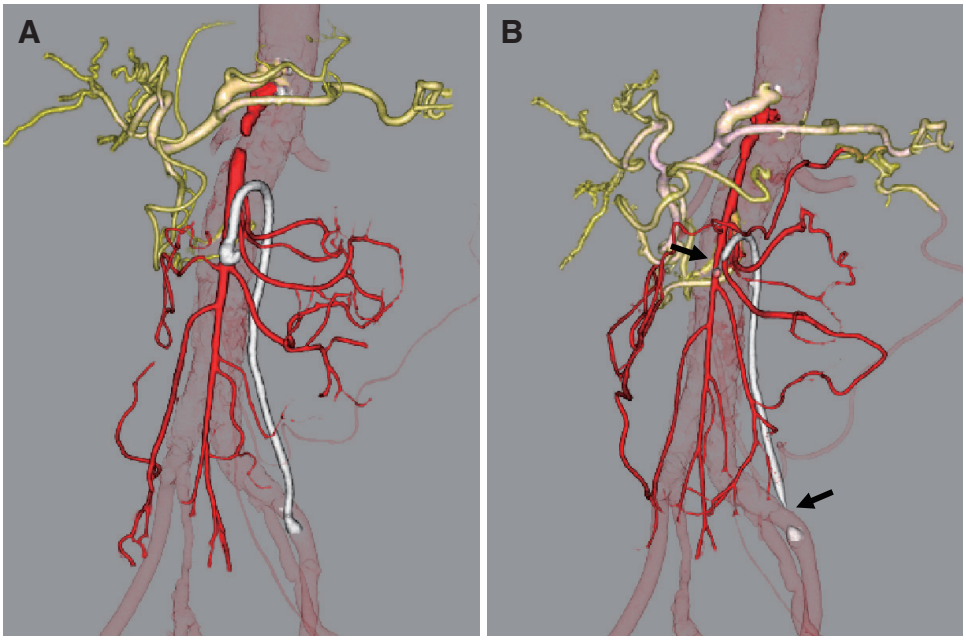

Fig. 2 CT after initial bypass surgery and graft stenosis. (**A**) Contrast-enhanced CT after the initial surgery. The patency of the venous graft can be observed. (**B**) Contrast-enhanced CT before the second surgery. Severe stenosis of the venous graft is seen near the central and peripheral anastomotic sites (arrows).

Fig. 3 CT after the second bypass surgery.

Discussion

CMI is a condition mainly caused by atherosclerosis, resulting in chronic stenosis or occlusion of the CA, SMA, and IMA, leading to impaired blood supply to the gastrointestinal tract.[1] Although it is a relatively rare condition, its incidence is increasing with the aging of the population, and it is more common in women >40 years old, with a male-to-female ratio of 1:3 to 1:4.[1] Typical symptoms of CMI include postprandial abdominal pain and associated weight loss due to reduced food intake. After meals, intestinal mesenteric blood flow normally increases to meet the increased oxygen demand during digestion and absorption[2]; however, in CMI patients, a relatively inadequate blood supply leads to abdominal pain. CA, SMA, and IMA are interconnected by rich collateral circulation, and as long as only one of these arteries is involved, intestinal blood flow is usually maintained,[3] often without symptoms. On the other hand, when two or more of these arteries are involved, patients are more likely to experience symptoms. In the present case, all three arteries were involved, resulting in severe circulatory impairment. Although the patient presented with typical symptoms of postprandial abdominal pain and weight loss, no treatment intervention was performed at that time, and intestinal necrosis eventually ensued.

In symptomatic cases of CMI, such as in this case, there is a risk of progression to intestinal necrosis, which is why early revascularization is necessary. Previously, surgical treatments like endarterectomy or bypass surgery were the mainstay, but with advancements in techniques and devices, endovascular therapy has expanded in indication and has become the primary choice of approach. While endovascular therapy is considered less invasive with fewer complications, surgical treatments are known for

their long-term patency and lower rates of re-intervention, so it is selected when its advantages surpass the early postoperative advantages of endovascular therapy.[4] Surgical treatment is recommended in cases where endovascular therapy is not successful or when dealing with complex or calcified lesions for which endovascular therapy is considered challenging, or in young patients with complex non-atherosclerotic lesions caused by vasculitis.[4] In our patient, the SMA, which was the target vessel for the treatment, had a calcified occlusive lesion from its origin, so endovascular therapy was thought unsuitable. Hence, bypass surgery was chosen. In bypass surgery, it is necessary to choose the inflow vessel, the target vessel, and the graft. Possible approaches to bypass surgery include antegrade bypass using the aorta above CA as the inflow vessel and retrograde bypass using the infrarenal abdominal aorta or the iliac artery. The former approach offers the advantage of a shorter graft, creating a more natural blood flow with less risk of kinking than the latter approach; however, it has some limitations, such as difficulties in ensuring operative field and the need for aortic clamping, which can be invasive.[5] The latter approach, especially when choosing the iliac artery, allows for the avoidance of aortic clamping and results in a less invasive procedure; however, it comes with the potential issue of a higher risk of long-term atherosclerosis around the anastomotic site and a risk of graft kinking or occlusion. Past studies have reported that there is no significant difference in long-term prognosis between the two approaches.[6] The choice of graft thus remains controversial. There is a report recommending the use of synthetic vessels over autologous vein grafts to prevent graft kinking.[7] However, in cases where concerns about contamination, such as intestinal necrosis, are present, autologous vein grafts are preferred. The use of the great saphenous vein is common, but there are also reports of using the femoral vein.[8] Therefore, there are many options for bypass surgery, and the optimal treatment should be considered based on specific cases. In this case, the patient presented with intestinal necrosis at the time of the initial surgery, and considering the patient's general condition, a retrograde bypass using the great saphenous vein was performed. The inflow vessel was the left common iliac artery with relatively mild calcification. When the patient's symptoms recurred 5 months after the surgery due to the stenosis of the autologous vein graft, we considered endovascular therapy for CA or stenosed vein graft. However, the main target vessel of revascularization was SMA,[4] and there was a concern about restenosis of vein graft after balloon angioplasty, so we decided to perform the re-bypass surgery. Considering the patient's low cardiac function and surgical tolerance, a second retrograde bypass from the left iliac artery was chosen. The choice of graft was 6 mm Dacron, because of its good operability, and it fit favorably to the loop to reach the SMA.

Regarding the patency of the great saphenous vein graft, Modrall et al.[8] reported an 82% patency at 6 months and 61% at 12 months. The mechanism of vein graft stenosis has been discussed by Scott et al., who noted that progressive intimal hyperplasia may lead to stenosis or occlusion within 1 month to 2 years (peak incidence at 4–12 months) after vein graft transplantation and that there is no clear preventive method for this condition.[9] This phenomenon has been suggested to occur in great saphenous vein grafts used for revascularization in CMI as well. Therefore, it is essential to perform appropriate follow-up care, including imaging examinations like ultrasound and CT, to monitor these grafts at the right time. While European guidelines recommend ultrasound examinations every 6–12 months for follow-up after revascularization for CMI, there is no clear evidence supporting this frequency.[10] In this case, vein graft stenosis was diagnosed 5 months after surgery, suggesting a need for shorter intervals between follow-up examinations.

Conclusion

The revascularization approaches for CMI are diverse, and the appropriate surgical approach should be chosen based on each case. In addition, in cases where bypass surgery is performed, it is essential to closely monitor the postoperative graft for the potential occurrence of stenosis.

Statement of Patient Consent

This paper was submitted with the consent of the patient.

Author Contributions

Study conception: TN and HM
Data collection: TN
Writing: TN
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors.

Disclosure Statement

The authors have no conflicts of interest to declare.

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