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A Case of Isolated Superior Mesenteric Artery Dissection Resulting in Recurrent Necrosis of the Small Intestine

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ABSTRACT

Isolated superior mesenteric artery dissection (ISMAD) is a rare cause of acute abdominal conditions. Most cases of ISMAD have a favorable prognosis, and only a few cases of ISMAD-associated intestinal necrosis have been reported. A 75-year-old male was referred to our department because of abdominal pain and portal venous gas detected on imaging. Computed tomography suggested ileal necrosis, necessitating emergency surgery. Indocyanine green was used for blood flow assessment; however, no fluorescence was observed in the ileum proximal to the Bauhin valve, leading to the decision for ileocecal resection. On postoperative day 6, abdominal pain recurred when meals were resumed. As a surgical intervention for ISMAD, a bypass was created using the left great saphenous vein as a graft between the superior mesenteric artery and the right external iliac artery. This case highlights a rare occurrence where intestinal necrosis recurred due to ISMAD. We propose that in cases of ISMAD with concomitant intestinal necrosis, a more aggressive revascularization strategy for the dissected segment of the superior mesenteric artery may be required.

Key words arterial dissection; necrosis; recurrence; superior mesenteric artery

Isolated superior mesenteric artery dissection (ISMAD) is a rare cause of acute abdominal conditions. A few cases that progress to intestinal necrosis have been reported, and most are managed successfully with conservative treatment.[1] In this report, we describe a case in which ileocecal resection was performed because of ileal necrosis secondary to ISMAD, followed by a recurrence of small intestinal necrosis. The recurrence required the implementation of a bypass, directing flow from the right external iliac artery to the superior mesenteric artery (SMA), along with an extra procedure involving resection of a portion of the small intestine.

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Abbreviations: EIA, external iliac artery; GSV, great saphenous vein; ICG, indocyanine green; ISMAD, isolated superior mesenteric artery dissection; SMA, superior mesenteric artery

PATIENT REPORT

A 75-year-old male patient experienced nocturnal abdominal pain and subsequent vomiting. These symptoms prompted the patient to seek medical care at his primary clinic. The patient presented with acute abdominal symptoms and was referred to our department approximately 12 h after the onset of symptoms. His medical history was notable for hypertension, dyslipidemia, type 2 diabetes mellitus, bilateral internal carotid artery stenosis, previous myocardial infarction, sick sinus syndrome (requiring a pacemaker), and lumbar spinal canal stenosis. The patient had no prior episodes of postprandial abdominal pain that suggested abdominal angina. His height was 160 cm, and his weight was 58 kg. His vital signs at admission were as follows: blood pressure, 114/50 mmHg; pulse, 91 beats per minute; respiration, 19 breaths per minute; and SpO2, 98% on room air. Physical examination revealed slight abdominal distention, lower abdominal tenderness, and muscular guarding. Laboratory results indicated leukocytosis (10,820/μL), elevated C-reactive protein (9.66 mg/dL), and normal levels of aspartate aminotransferase (15 IU/L) and lactate dehydrogenase (152 IU/L). Arterial blood gas showed mixed respiratory and metabolic alkalosis (pH, 7.515; $PaCO_2$, 33.7 mmHg; PaO_2, 122 mmHg; HCO3, 27.0 mmol/L; base excess, 4.7 mmol/L; lactate, 2.3 mmol/L). Abdominal computed tomography (CT) during admission demonstrated significant aortic and SMA root calcification, partial narrowing of the SMA root, well-contrasted peripheral SMA, and intramural and portal venous gas in the ileum with no wall contrast enhancement (Fig. 1).

Based on these findings, necrosis of the terminal ileum was diagnosed, prompting emergency surgery on the same day. Upon laparotomy, poor coloration of the intestine that extended proximally from the terminal ileum and turbid ascites were observed. No other

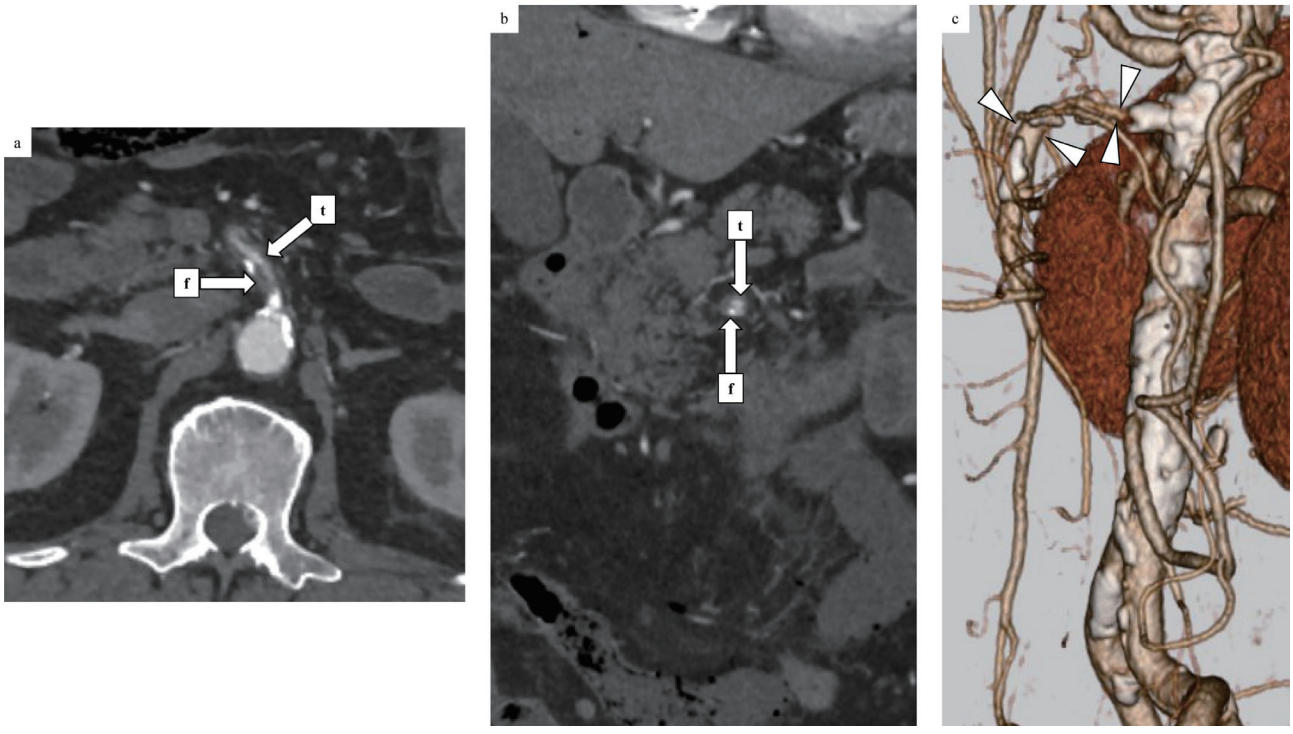

Fig. 1. Abdominal contrast-enhanced CT during admission showing significant calcification of the abdominal aorta and SMA root, with partial luminal narrowing observed at the SMA root. The main trunk of the peripheral SMA is well contrasted (t; true lumen, f; false lumen, white arrowhead; indicates the SMA) (**a**; axial section, **b**; coronal section, **c**; 3D).

potential causes of intestinal necrosis were found aside from ISMAD. Blood flow assessment using indocyanine green (ICG) revealed the absence of fluorescence in a 40-cm segment starting from the proximal Bauhin valve. However, blood flow was promptly confirmed in other areas. The affected section was resected, and functional end-to-end anastomosis of the ascending colon and ileum was performed.

After the surgical procedure, we sought the expertise of radiologists and vascular surgeons to assess the potential for endovascular therapy or further surgical revascularization. It was concluded that neither option was deemed appropriate. The patient's presurgical regimen of aspirin (100 mg/day) was supplemented with clopidogrel (75 mg/day). We anticipated that surgical revascularization would be indicated if the patient experienced postprandial abdominal pain postoperatively. Over time, the patient exhibited both clinical and laboratory improvements. On postoperative day 6, the patient started eating with lunch; however, severe abdominal pain recurred following the evening meal. Subsequent plain abdominal CT revealed extensive intramural gas throughout the small intestine and the presence of gas in both the portal and superior mesenteric veins.

Emergency reoperation involved an end-to-side anastomosis of the left great saphenous vein (GSV) to the right external iliac artery, with a GSV–SMA bypass established. Post-bypass Doppler revealed good flow; however, ICG revealed a nonperfused 120-cm small intestine segment, necessitating resection and functional end-to-end anastomosis. After surgery, the remaining small intestine was 160 cm in length.

After re-surgery, we noted enhancements in both the patient's clinical signs and laboratory results. Follow-up contrast-enhanced CT verified the patency and perfusion of the bypass graft and intestinal tract (Fig. 2). The patient recommenced oral feeding on the eighth day following the reoperation. Heparin anticoagulation was sustained until the resumption of oral intake, at which point, the pre-reoperation regimen comprising aspirin and clopidogrel was reintroduced. The patient experienced no further symptomatic episodes and was subsequently discharged to home care on postoperative day 47.

DISCUSSION

We encountered a rare case of recurrent small intestinal necrosis attributed to ISMAD. A literature search of the PubMed database and Ichushi-Web, using the terms "superior mesenteric artery dissection" and "necrosis"

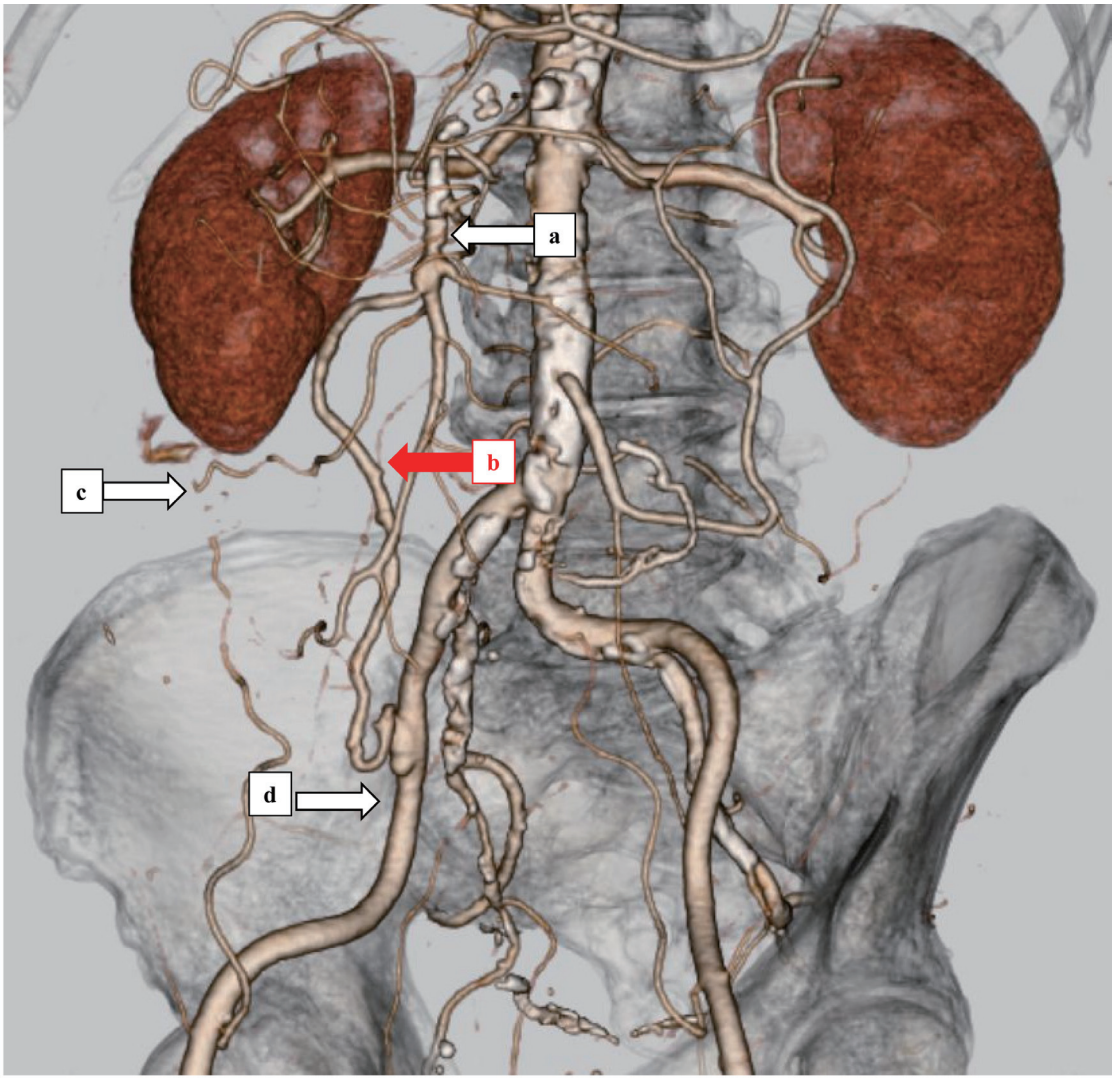

Fig. 2. Postoperative abdominal contrast-enhanced CT revealing the bypass between the SMA and external iliac artery (**a**; superior mesenteric artery, **b**; bypass graft, **c**; ileocolic artery, **d**; right external iliac artery).

while excluding conference proceedings from January 2003 to July 2023, yielded 16 cases of bowel resection related to ISMAD, including our report (Table 1).[2–16] Among these cases, 13 cases underwent bowel resection during the initial surgery, and did not undergo subsequent vascular reconstruction. However, our case was the only one in which a recurrence of intestinal necrosis was observed.

The optimal treatment for ISMAD remains undefined,[17] with conservative management, endovascular intervention, and surgical revascularization tailored to individual cases. It has been reported that most cases are managed conservatively,[1] and reports on surgical treatment and vascular reconstruction are limited. Surgical revascularization techniques include iliac artery–SMA bypass with a GSV graft, abdominal aorta–SMA bypass with a radial artery graft,[18] right gastroepiploic artery–SMA bypass,[19] SMA branch reconstruction employing the right gastroepiploic and middle colic arteries,[14] and SMA patch angioplasty.[20] Notably, the efficacy of retrograde stent placement in the SMA as a less invasive hybrid procedure has gained recognition for its minimal invasiveness, guaranteed guidewire passage through the true lumen, and capacity for concurrent intestinal and dissection treatment.[14, 17] In centers equipped for hybrid surgery, this approach is well-suited for short dissection cavities and was advantageous in our initial operation.

Sakamoto et al. developed a four-category classification system for SMA dissection based on false lumen patency.[6] Yun et al. later categorized ISMAD into three types based on the presence of false luminal flow and true lumen patency at the dissected segment (Fig. 3).[21]

Table 1. List of previously reported cases of intestinal resection associated with ISMAD

Author	Sex	Age	Initial surgery		Reoperation	Postoperative course
			Intestinal resection	Revascularization		
Javerliat	M	51	4 m of SI	None	On POD 1, a second-look confirmed the viability of the remaining intestinal loops	Survived for 2 yrs and 6 mos
Oda	F	71	From the jejunum 20 cm distal to the Treitz ligament to the right side of the transverse colon	None	None	Survived for 6 mos
Suzuki	M	78	2 cm of ischemic ileum	The mesenteric hematoma was resected (no other description)	None	Survived for 3 mos
Mizushima	M	66	The terminal ileum for 130 cm	None	None	Survived for 3 yrs and 4 mos
Sakamoro	M	45	The necrotic jejunum	None	None	Survived for 40 mos
Morris	F	39	Extensive SI resection and right hemicoloectomy	None	None	Survived for 2 yrs and 10 mos
Kobayashi	M	59	3 m of the SI and ascending colon	None	None	Survived for 6 mos
Shigemitsu	M	62	None	Endothelial thrombectomy and vascular reconstruction with a venous patch	On POD 1, massive bleeding from the patch formation site and necrosis of the ileum to the ascending colon	Death
Yunoki	F	71	210 cm of the SI, starting 30 cm from the Treitz ligament	None	None	Survived for 72 days
Tanaka	M	52	Extensive SI and ascending colon	None	None	Survived for 99 days
Kishibe	M	77	Right hemicolectomy	None	None	Survived for 23 days
Onishi	M	83	From the jejunum 120 cm from the Treitz ligament to the hepatic flexure of the transverse colon	None	None	Survived for 1 yr and 11 mos
Hashinokuchi	M	49	exploratory laparotomy only		On POD 1, right hemicolectomy, RGEA to 3rd JA bypass, and MCA right branch to ICA bypass. After the reoperation, necrosis of the jejunum in the 2nd JA region and intestinal perforation	Survived for 2 mos
Ueda	M	38	Approximately 30 cm of the ileum from the terminal ileum and the hepatic flexure of the ascending colon	Stent placement	On POD 56, additional resection of the SI. On POD 98, an ostomy closure procedure with an additional 25 cm of the SI resected	Discharged on POD 113
Shirakabe	M	46	25cm of the SI, starting 100cm from the Treitz ligament	None	On POD 2, a second-look was performed and anastomosis of the small bowel was performed	Survived
Our case	M	75	Approximately 40 cm of the terminal ileum and the cecum	None	On POD 7, a right EIA–SMA bypass and SI resection	Survived for 9 mos

F, female; ICA, ileocolic artery; JA, jejunal artery; M, male; MCA, middle colic artery; mos, months; POD, postoperative day; RGEA, right gastroepiploic artery; SI, small intestine; yr, year.

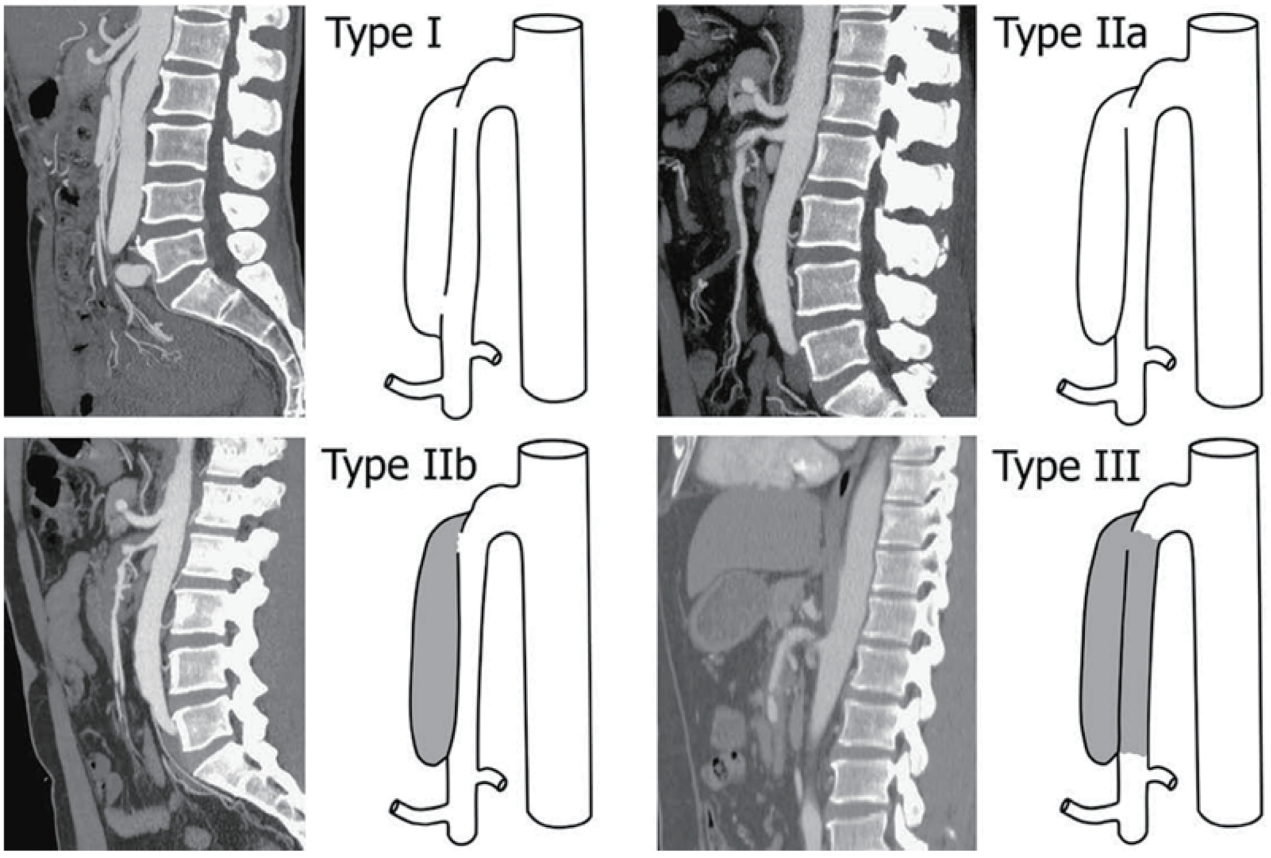

Fig. 3. The classification of ISMAD as proposed by Yun et al.

Yun's type IIb is the most common type of ISMAD and easily misdiagnosed.[22] This classification is often used in recent articles. In our case, significant calcification of the abdominal aorta and SMA root was noted, which was attributed to arteriosclerosis. Considering the satisfactory contrast of the main trunk of the SMA, we considered these findings to be chronic and suspected an alternative cause of intestinal necrosis. Our case aligned with Yun's type IIb classification. According to Yuan et al., out of 201 cases of ISMAD, only five cases (2.5%) required open surgery due to bowel infarction, necrosis, and peritonitis.[23] Surgery was more commonly performed in type III (18.2%) than in type IIa (2.7%) and type IIb (1.1%); therefore, our case followed a rather rare course.

We discussed the suitability of endovascular and surgical revascularization with the radiology and vascular surgery department. Considering the anatomical bends at the dissection site and associated risks of bleeding and dissection progression due to catheter manipulation and intimal injury,[24] we opted against this intervention because of potential complications. Recently, the use of intraoperative ICG fluorescence imaging to assess intestinal blood flow and determine the extent of bowel resection has become more common. Ishiyama et al. reported a case in which bowel preservation was achieved using ICG fluorescence imaging for ischemic enteritis accompanied by ISMAD.[25] In our case as well, ICG fluorescence imaging performed during the initial surgery revealed a localized absence of blood flow. Furthermore, several authors have reported that even in cases where the true lumen is occluded, as in Yun's type III, the prognosis is often good with conservative treatment and type IIb recovers spontaneously because of the absorption of false lumen thrombus, and conservative treatment should be considered.[21, 23, 26–28] In our case, the true lumen of the SMA dissection site was narrowed but not completely occluded, and the contrast effect of the SMA main trunk distal to the dissection site was maintained. If our cases had been type III, we would have performed revascularization during the initial surgery. In several previously reported cases, vascular reconstruction was not performed for the same reasons as ours: the poor blood flow was localized, and intraoperative findings indicated good blood flow in the remaining intestines. Ullah et al. presented a flow diagram in their

systematic review and meta-analysis that outlines the management approach for isolated SMA dissection.[20] In this flow diagram, revascularization for infarction cases was not a strong recommendation, but was only considered. Therefore, we considered that further intestinal necrosis could be avoided by establishing collateral circulation, remodeling the true lumen, and minimizing the demand for mesenteric blood supply. Additionally, because of the absence of a history of abdominal angina and a stable postoperative course, we opted for conservative management with antihypertensives and dual-antiplatelet therapy, without planning for a second-look surgery and vascular reconstruction.

Retrospectively, the initial presentation of intestinal necrosis and re-ischemia after the initiation of oral intake in our case was presumed to be due to vulnerability to ischemia caused by severe true lumen stenosis and underlying diseases. Furthermore, blood flow in the remaining intestine was confirmed intraoperatively; however, as intraoperative ICG fluorescence imaging is a qualitative assessment, it was insufficient to determine whether blood flow in the remaining intestine could meet the subsequent increase in intestinal blood flow demand. Reports vary on the timing of diet resumption after ISADM-induced intestinal ischemia, ranging from 1 to 14 days.[29] Our decision to start feeding on postoperative day 6 was consistent with prior cases. Considering the absence of intervention at the dissection site, a proactive reassessment of true lumen stenosis using contrast-enhanced CT may be prudent, possibly delaying diet resumption or treating the dissection site if significant stenosis is present. Reflecting on the absence of recurrence after surgical revascularization, we now consider that performing revascularization during the initial surgery or having a planned second-look surgery might have prevented the necrosis. As mentioned earlier, the existence of cases where intestinal necrosis did not progress even without vascular reconstruction suggests that vascular reconstruction can be excessively invasive in some cases. However, at present, there is no clear evidence to support this judgement. Considering the risk of short bowel syndrome due to extensive intestinal resection, we consider that assertive vascular reconstruction is appropriate for intestinal necrosis caused by ISMAD.

Despite the generally favorable prognosis of ISMAD, its rarity can complicate diagnosis and treatment selection. In our elderly patient with multiple comorbidities, the likelihood of organ ischemia was high, suggesting that a more aggressive approach to the dissection site is advisable before extensive small intestinal resection. Therefore, ISMAD cases initially presenting with intestinal necrosis may require assertive revascularization to mitigate the risk of recurrence.

The authors declare no conflicts of interest.

REFERENCES

1 Satokawa H, Takase S, Wakamatsu H, Seto Y, Kurosawa H, Yamamoto A, et al. Long-term outcomes of spontaneous isolated superior mesenteric artery dissection. Ann Vasc Dis. 2019;12:456-9. DOI: 10.3400/avd.oa.19-00082, PMID: 31942202

2 Javerliat I, Becquemin JP, d'Audiffret A. Spontaneous isolated dissection of the superior mesenteric artery. Eur J Vasc Endovasc Surg. 2003;25:180-4. DOI: 10.1053/ejvs.2002.1785, PMID: 12552483

3 Oda N, Furihata T, Nagata H, Mikami H, Sakuma A, Kubota K. A case of bowel necrosis due to dissection of the superior mesenteric artery with portal gas. Nihon Rinsho Geka Gakkai Zasshi. 2003;64:361-5. DOI: 10.3919/jjsa.64.361 J Jpn Surg Assoc

4 Suzuki S, Furui S, Kohtake H, Sakamoto T, Yamasaki M, Furukawa A, et al. Isolated dissection of the superior mesenteric artery. Abdom Imaging. 2004;29:153-7. DOI: 10.1007/s00261-003-0110-2, PMID: 15290937

5 Mizushima T, Owari M, Sando K, Ito T, Mizuno H, Mikata S, et al. A case of isolated dissection of the superior mesenteric artery complicating small intestinal ischemia. Nihon Shokaki Geka Gakkai Zasshi. 2005;38:231-6. DOI: 10.5833/jjgs.38.231

6 Sakamoto I, Ogawa Y, Sueyoshi E, Fukui K, Murakami T, Uetani M. Imaging appearances and management of isolated spontaneous dissection of the superior mesenteric artery. Eur J Radiol. 2007;64:103-10. DOI: 10.1016/j.ejrad.2007.05.027, PMID: 17628380

7 Morris JT, Guerriero J, Sage JG, Mansour MA. Three isolated superior mesenteric artery dissections: update of previous case reports, diagnostics, and treatment options. J Vasc Surg. 2008;47:649-653.e2. DOI: 10.1016/j.jvs.2007.08.052, PMID: 18295120

8 Kobayashi N, Saito J, Nakamura T, Sagae S, Iwata K, Kurihara E, et al. Dissection of the superior mesenteric artery which required resection of a large amount of the small intestine and the colon. (Kita Kanto igaku). Kita Kanto Igaku. 2009;59:357-60. DOI: 10.2974/kmj.59.357

9 Shigemitsu K, Niguma T, Nitta Y, Mimura T. Four cases of isolated spontaneous dissectin of the superior mesenteric artery. Nihon Shokaki Geka Gakkai Zasshi. 2010;43:863-9. DOI: 10.5833/jjgs.43.863

10 Yunoki T, Nishimoto M, Kittaka H, Kitamura Y, Sugie A, Kobata H, et al. A case of isolated dissection of the superior mesenteric artery due to blunt trauma. Nihon Kyukyu Igakkai Zasshi. 2014;25:723-8. DOI: 10.3893/jjaam.25.723 J Jpn Assoc Acute Med

11 Tanaka Y, Tada H, Takeda Y, Iino K, Hayashi K, Takemura H, et al. Spontaneous isolated superior mesenteric artery dissection requiring emergent surgery. Intern Med. 2018;57:2681-4. DOI: 10.2169/internalmedicine.0641-17, PMID: 30224605

12 Kishibe S, Miyaki A, Miyauchi T, Yamaguchi K, Naritaka Y. A case of colon perforation with superior mesenteric arterial dissection. Nihon Gekakei Rengo Gakkai Shi. 2018;43:659-64. DOI: 10.4030/jjcs.43.659 Japanese with English abstract.

13 Onishi E, Yoshida N, Aoyagi T, Tamehiro K, Ogata T, Taniguchi M. Diagnosis and treatment of superior mesenteric artery dissection—report of 20 cases—. Nihon Rinsho Geka Gakkai Zasshi. 2020;81:1041-8. DOI: 10.3919/jjsa.81.1041 Japanese with English abstract.
14 Hashinokuchi A, Uchiyama H, Motomura T, Honbo T, Yoshida R, Sadanaga N, et al. Reconstruction of the branch of superior mesenteric artery using right gastroepiploic artery and middle colic artery for isolated acute superior mesenteric artery dissection with mesenteric ischemia. Nihon Shokaki Geka Gakkai Zasshi. 2020;53:592-7. DOI: 10.5833/jjgs.2019.0111 Japanese with English abstract.
15 Ueda S, Hashimoto Y, Nishitani K, Tada S, Takayanagi T, Kawamorita K, et al. A case of isolated superior mesenteric artery dissection with prolonged ischemic enteritis requiring reoperation. Nihon Shokaki Geka Gakkai Zasshi. 2022;55:456-63. DOI: 10.5833/jjgs.2021.0086 Japanese with English abstract.
16 Shirakabe K, Kanzaki M. Isolated superior mesenteric artery dissection following blunt trauma: A case report. Surg J (NY). 2023;9:e89-91. DOI: 10.1055/s-0043-1770955, PMID: 37434872
17 Mizuno A, Iguchi H, Sawada Y, Nomura H, Komiyama N, Watanabe S, et al. Real clinical management of patients with isolated superior mesenteric artery dissection in Japan. J Cardiol. 2018;71:155-8. DOI: 10.1016/j.jjcc.2017.08.006, PMID: 28969970
18 Hirai S, Hamanaka Y, Mitsui N, Isaka M, Kobayashi T. Spontaneous and isolated dissection of the main trunk of the superior mesenteric artery. Ann Thorac Cardiovasc Surg. 2002;8:236-40. PMID: 12472390
19 Vignati PV, Welch JP, Ellison L, Cohen JL. Acute mesenteric ischemia caused by isolated superior mesenteric artery dissection. J Vasc Surg. 1992;16:109-12. DOI: 10.1016/0741-5214(92)90426-9, PMID: 1619710
20 Ullah W, Mukhtar M, Abdullah HM, Ur Rashid M, Ahmad A, Hurairah A, et al. Diagnosis and management of isolated superior mesenteric artery dissection: a systematic review and meta-analysis. Korean Circ J. 2019;49:400-18. DOI: 10.4070/kcj.2018.0429, PMID: 31074212
21 Yun WS, Kim YW, Park KB, Cho SK, Do YS, Lee KB, et al. Clinical and angiographic follow-up of spontaneous isolated superior mesenteric artery dissection. Eur J Vasc Endovasc Surg. 2009;37:572-7. DOI: 10.1016/j.ejvs.2008.12.010, PMID: 19208448
22 Lei Y, Liu J, Lin Y, Li H, Song W, Li Z, et al. Clinical characteristics and misdiagnosis of spontaneous isolated superior mesenteric artery dissection. BMC Cardiovasc Disord. 2022;22:239. DOI: 10.1186/s12872-022-02676-9, PMID: 35610570
23 Yuan Z, Hu G, Sheng S, You Y, Wang J. Management strategy and radiologic outcomes of symptomatic spontaneous isolated superior mesenteric artery dissection based on angiographic classification: the follow-up experience in a single center. J Endovasc Ther. 2022;15266028221133700. DOI: 10.1177/15266028221133700, PMID: 36346065
24 Lim EH, Jung SW, Lee SH, Kwon BS, Park JY, Koo JS, et al. Endovascular management for isolated spontaneous dissection of the superior mesenteric artery: report of two cases and literature review. J Vasc Interv Radiol. 2011;22:1206-11. DOI: 10.1016/j.jvir.2011.01.446, PMID: 21801996
25 Ishiyama Y, Mochizuki I, Kimura F, Narita K, Goto M, Hirano Y. A case of ischemic enteritis with isolated superior mesenteric artery dissection using ICG fluorescence to preserve the intestine. Rinsho Zasshi Geka. 2021;83:1341-6. DOI: 10.15106/j_geka83_1341
26 Fang G, Xu G, Fang Y, Yang J, Pan T, Jiang X, et al. Primary conservative treatment for peritonitis-absent symptomatic isolated dissection of the superior mesenteric artery with severely compressed true lumen. Vascular. 2020;28:132-41. DOI: 10.1177/1708538119892751, PMID: 31840566
27 Huang X, Li G, Zhang X, Chen Z, Xu M, Sun Y. Natural course and treatment of symptomatic spontaneous isolated superior mesenteric artery dissection with total true lumen occlusion. Vasc Endovascular Surg. 2023;57:41-7. DOI: 10.1177/15385744221130836, PMID: 36171181
28 Tomita K, Obara H, Sekimoto Y, Matsubara K, Watada S, Fujimura N, et al. Evolution of computed tomographic characteristics of spontaneous isolated superior mesenteric artery dissection during conservative management. Circ J. 2016;80:1452-9. DOI: 10.1253/circj.CJ-15-1369, PMID: 27118619
29 Suzuki T, Makuuchi H, Kobayashi T, Chikada M, Kitanaka Y, Murakami H, et al. Consideration and analysis of spontaneous isolated dissection of the splanchnic arteries: 7 case reports and review of 165 in the Japanese papers. J Vasc Surg. 2012;21:773-80. DOI: 10.11401/jsvs.21.773