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OBSERVATIONAL STUDY

Management of isolated superior mesenteric artery dissection

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Abstract

AIM: To evaluate our experience of the clinical management of spontaneous isolated superior mesenteric artery dissection (ISMAD).

METHODS: From January 2008 to July 2013, 18 patients with ISMAD were retrospectively analyzed, including 7 patients who received conservative therapy, 9 patients who received reconstruction with bare stents, and 2 patients who underwent surgical treatment. The decision to intervene was based on anatomic suitability, patient comorbidities and symptoms.

RESULTS: Intestinal ischemia-related symptoms completely resolved in 7 patients who received conservative therapy. Stent placement was successful in 9 patients. Of the 9 patients who received endovascular stenting, abdominal pain was alleviated after the procedure and gradually disappeared within 3 d. Follow-up computed tomography and computed tomography angiography were available in all patients during the first month and the first year after the procedure, which revealed patent stent and patent involved superior mesenteric artery branches with complete obliteration of the dissection lesion. In the 2 patients who underwent surgical treatment, good clinical efficacy was also observed.

CONCLUSION: ISMAD may be managed successfully in a variety of ways based on the clinical symptoms. ISMAD should be treated by conservative management as the first-line option, however, in those with bowel necrosis or imminent arterial rupture during conservative therapy, endovascular or surgical therapy is indicated.

Key words: Intestine; Superior mesenteric artery; Dissection; Therapy; Endovascular reconstruction

Core tip: Therapeutic options for isolated superior mesenteric artery dissection include conservative management, endovascular treatments or open surgery. In this small series, conservative therapy was indicated for asymptomatic patients or those with short-term symptoms, while endovascular or surgical therapy was recommended for those with clinical or imaging evidence of bowel necrosis or imminent arterial rupture. Percutaneous endovascular reconstruction with bare stent implantation is a feasible treatment choice with a high success rate and good clinical outcome.

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INTRODUCTION

Since the first description by Bauersfeld[1] in 1947, occasional cases of spontaneous isolated superior mesenteric

artery dissection (ISMAD) have been reported. However, early identification in the acute stage is increasingly possible due to the development of advanced imaging technology, in particular, abdominal computed tomography (CT) scanning[2,3]. Therapeutic options include conservative management[4-7], endovascular treatments or open surgery such as bypass or direct surgical reconstruction of the lesion, although no consensus has been reached with regard to the best treatment modality[8-13]. From January 2008 to July 2013, 18 patients with ISMAD received treatment in our center. We adopted a treatment algorithm based on the current literature and report our results in these patients.

MATERIALS AND METHODS

Patients and general information

We retrospectively reviewed the medical history of 18 patients who were diagnosed with ISMAD from January 2008 to July 2013 in our institution. There were 14 males and 4 females with a mean age of 49.8 years (range, 36-66 years). All patients presented with sudden upper abdominal, low back pain, nausea, vomiting, bloody stools, and diarrhea. Of the 18 patients in this series, 6 had hypertension, 7 had dyslipidemia, 2 had diabetes and 9 had a history of smoking. Presenting symptoms and risk factors in these 18 patients are shown in Table 1.

ISMAD was detected *via* upper abdominal contrast-enhanced CT examination in all patients. The distance from the superior mesenteric artery (SMA) ostium to the origin of the dissection was measured using 3-dimensional (3D) reconstructions of CT scans. The percentage of true lumen compression by the false lumen was also calculated from CT scans. The diagnosis of ISMAD was made when one of the following signs was seen in the SMA on the initial CT: (1) intimal flap and contrast enhancement within the false lumen (Figure 1A); or (2) a crescent-shaped area along the wall of the SMA with higher attenuation than blood, showing no contrast enhancement after injection of contrast material.

Therapeutic options

Conservative therapy was performed in 7 patients focusing on antiplatelet therapy, blood pressure control, bowel rest, intravenous fluids, and nutritional support with or without antithrombotic therapy. Abdominal pain was gradually alleviated within 7 d in these 7 patients. Percutaneous endovascular reconstruction with bare stents was carried out in 9 patients with persistent abdominal pain despite conservative treatment or signs of bowel ischemia (bloody stools). Two patients underwent surgical treatment. One of these two patients, who failed conservative and endovascular therapy, underwent dissecting aneurysm resection plus vascular prosthesis grafting. The other patient underwent emergent surgery with thrombectomy plus partial intimectomy due to persistent acute abdominal pain and bloody stools. All patients received antithrombotic therapy (anticoagulant, $n = 6$, antiplatelet agents $n = 8$, both $n = 4$).

Stent placement for ISMAD

Under local anesthesia, a 7F short vascular sheath was inserted into the right femoral artery. Selective superior mesenteric arterial angiography was performed with a 4-5F RH catheter (TERUMO, Japan) and the patient was given a bolus of intravenous heparin (50 IU/kg) followed by an infusion to maintain full heparinization (500-1000 IU/h). A 6F or 7F guiding catheter (Envoy; Cordis) was used as an access channel into the proximal SMA. After successfully cannulating a branch of the SMA with a guide-wire (Cordis, United States), a balloon-expandable stent or a self-expanding stent was advanced over the guide-wire and was deployed covering the entire dissected segment. The stents used included various types of self-expanding stents (PRECISE, Cordis; WALLSTENT, Boston Scientific; RX Acculink, Abbott) and balloon-expandable renal stents (Medtronic, Inc). Patients who underwent endovascular bare stent placement were instructed to take aspirin (150 mg/d) and clopidogrel (75 mg/d) orally for 6 mo postoperatively.

Follow-up data

Follow-up data were obtained at outpatient examinations twice or three times per year. Imaging follow-up using CT was routinely performed once during the first month, and once within the following year.

RESULTS

As described by Yun *et al*[14], ISMAD was classified into three types based on the presence of dissection re-entry and SMA main trunk patency at initial diagnosis. Four patients were type I, five were type Ⅱa, six were type Ⅱb, and three were type Ⅲ. The entry sites were all located within a short distance of the ostium. The distance from the SMA ostium to the origin of the dissection ranged from 0.6 cm to 4.8 cm (mean, 2.1 cm). The medium percentage of true lumen compression by the false lumen was 27.1% (range: 0%-62%) (Table 1). Two patients had aneurysmal dilatation of the SMA at the time of presentation. The diameter of these SMA aneurysms was 1.0 and 1.3 cm, respectively.

Stent placement was successful in 9 patients. A single stent was used in six patients, the overlapping stent technique was used in two patients (Figure 1), and the triple overlapping technique in one patient (Table 2). The diameter of the dissection proximal normal artery, the length of the dissection and the SMA branches involved are shown in Table 2.

Intestinal ischemia-related symptoms completely resolved in the patients who received conservative therapy. Of the 9 patients receiving endovascular stenting, abdominal pain was alleviated after the procedure and gradually disappeared within 3 d. Follow-up CT and CTA were available in all patients during the first month and the first year after the procedure, which revealed patent

Table 1 Clinical characteristics and percentage of true lumen of isolated superior mesenteric artery dissection in eighteen patients

Patients age (yr/sex)	Symptoms	Risk factors	Percentage of true lumen (%)	Treatment outcome	Follow-up (mo)
46/M	Abdominal pain	Smoking	25	Pain resolution	32
56/M	Abdominal pain	Hypertension, diabetes	40	Pain resolution	28
66/M	Abdominal pain radiating to the back	Hypertension	60	Pain resolution	33
40/M	Abdominal pain, nausea, vomiting	Smoking, hypertension	0	Pain resolution	11
48/M	Abdominal pain	Smoking	45	Pain resolution	32
52/M	Abdominal pain, Diarrhea	Dyslipidemia	36	Pain resolution	32
61/F	Abdominal pain	Smoking	48	Pain resolution	14
43/M	Abdominal pain, bloody stools	Smoking, hypertension	30	Pain resolution	26
49/M	Abdominal pain	Smoking	0	Pain resolution	16
48/M	Abdominal pain	Smoking	10	Pain resolution	16
36/F	Abdominal pain, bloody stools	Dyslipidemia	62	Pain resolution	22
39/M	Abdominal pain	Hypertension	0	Pain resolution	18
44/M	Abdominal pain	Hypertension, diabetes	20	Pain resolution	22
45/M	Abdominal pain	Dyslipidemia	8	Pain resolution	28
58/F	Abdominal pain	Smoking, dyslipidemia	20	Pain resolution	17
52/M	Abdominal pain, nausea, vomiting	Dyslipidemia	52	Pain resolution	12
55/M	Abdominal pain	Dyslipidemia	12	Pain resolution	18
58/F	Abdominal pain	Smoking, dyslipidemia	20	Pain resolution	14

M: Male; F: Female.

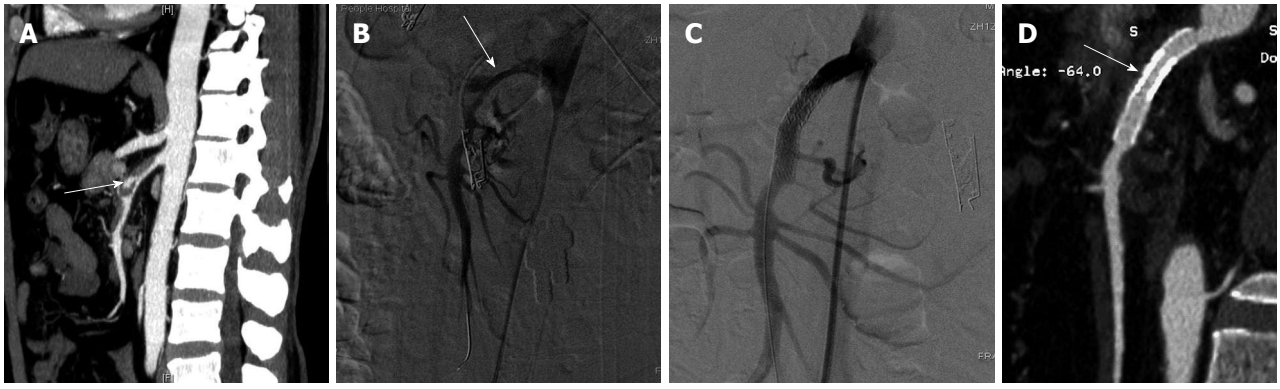

Figure 1 Two overlapping stent-in-stent technique. A: Computed tomography angiography (CTA) showing a thrombus generated inside the false lumen, an ulcer-like niche intruding into the false lumen (indicated by the arrow); B: DSA demonstrating isolated superior mesenteric artery dissection (ISMAD) and narrowing of native lumen (arrow); C: Post two bare stent (a balloon-expandable and a self-expandable bare) deployment, repeat angiograph showing complete exclusion of the true lumen preserving patency of the superior mesenteric artery; D: Follow-up CTA at 5 mo, demonstrating disappearance of the false lumen and patency of true lumen (arrow).

stent and patent involved SMA branches with complete obliteration of the dissection lesion. The patient with ISMAD who underwent resection plus vascular prosthesis grafting and another patient who underwent thrombectomy plus intimectomy recovered well, without intestinal ischemia-related symptoms.

DISCUSSION

Although an increasing number of ISMADs have been reported in recent years due to the development of advanced imaging technology[2,3], the natural history of ISMAD is not well understood due to the complexity and rarity of the condition. In the present study, six patients (6/18) presented with hypertension, however, there was no atherosclerotic change in the orifice and the proximal segment of SMA. It seems that different mechanisms are involved in ISMAD as compared with aortic dissection. With regard to the causes of ISMAD, hemodynamic abnormalities in the SMA at the transitional point may be a major cause of ISMAD[15-17].

Isolated SMA dissections are most commonly diagnosed by CT scanning, but may also be diagnosed by ultrasound imaging, MRI, or angiogram[10]. The clinical presentation in our ISMAD patients was acute abdominal pain. This pain is related to stenosis of the true lumen causing mesenteric ischemia[18], or to rupture of the dissection causing a mesenteric hematoma[3]. Yun *et al*[14] classified ISMADs into three types based on their imaging findings. In our eighteen ISMAD patients, four were type Ⅰ, five were type Ⅱa, six were type Ⅱb, and two were type Ⅲ. Endovascular procedures were performed in type Ⅰ (1), type Ⅱb (4), type Ⅱa (3) and type Ⅲ (1). Surgery was required in two patients (type Ⅲ). This indi-

Table 2 Anatomical features of isolated superior mesenteric artery dissection and choice of stents in nine patients

Patients	Proximal arterial diameter (mm)	Length of dissection (mm)	Number of branches involved	Stent size	Stent type
1	5	23	1	6 × 18	Balloon-expandable (Palmaz Blue)
				7 × 30	self-expanding (Precise)
4	5.6	30	2	6 × 40	Self-expanding (Precise)
8	6	15	0	7 × 30	Self-expanding (Precise)
10	7	35	2	7 × 18	Balloon-expandable (Palmaz Blue)
				8 × 40	self-expanding (Precise)
				8 × 40	Self-expanding (Precise)
13	5.5	10	0	6 × 18	Balloon-expandable (Palmaz Blue)
14	5.4	18	1	6 × 30	self-expanding (Precise)
15	6.4	28	1	7 × 15	Balloon-expandable (Palmaz Blue)
				8 × 30	self-expanding (Precise)
17	7	19	1	7 × 30	Self-expanding (Precise)
18	5.8	22	1	6 × 30	Self-expanding (Precise)

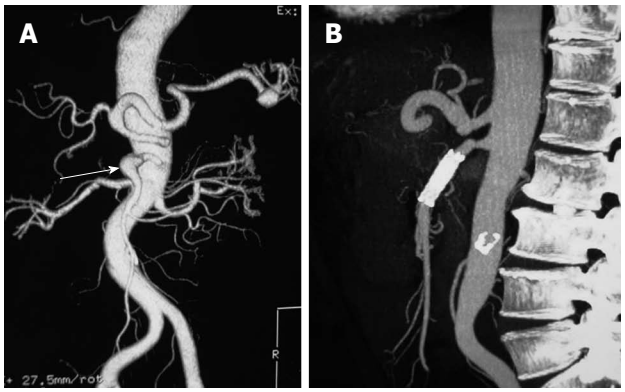

Figure 2 Single bare stent technique. A: An isolated superior mesenteric artery dissection detected by computed tomography angiography (indicated by the arrow); B: Patent true lumen and the disappearance of the false lumen at 3 mo after single bare stenting.

cated that ISMAD with SMA occlusion can be monitored carefully and the patient can undergo endovascular or surgical treatment if necessary. Therefore, the treatment of ISMAD should be partially based on imaging findings[19].

The treatment methods for ISMAD are not universally agreed[19-22]. In the present study, symptomatic patients were treated by conservative management as first-line treatment, including hypotensive and antiplatelet measures, bowel rest, intravenous fluids, and nutritional support, which showed favorable efficacy in 7 patients in whom abdominal pain was gradually alleviated within 5 d. However, if conditions such as aneurysmal false lumen dilation, rupture of artery, persistent abdominal pain, or ISMAD-induced severe intestinal ischemia during conservative therapy are observed, surgical or interventional therapy is indicated. Surgery was required when there was non-viable bowel or where endovascular techniques were considered inappropriate or failed. The surgical procedure for ISMAD included thrombectomy and intima resection.

Recently, interest has centered on endovascular treatment with the use of bare stents for ISMAD[10,16,19,22-25]. There are two aims of endovascular treatment: one is to prevent the extension of dissection and the other is to increase blood flow into the small intestine by obliterating the false lumen[9,16]. The choice of stent diameter was based on the proximal normal artery diameter. The types of bare stents were determined according to the operator's preference and availability of the stent. In our study, we chose the self-expandable carotid bare metal stent, due to its radial strength, multisegmental design, and good compliance. This stent is generally appropriate for the SMA, which is characterized by weakened vascular wall and curved original site[19]. A balloon-expandable stent (Palmaz Blue) is also useful if the dissection is short.

A bare stent is sometimes sufficient for compressing the septum of an ISMAD, opening the stenotic segment and increasing inflow to remedy the ischemia, and with gradual endothelialization of the stent, the thrombosis or the occlusion inside the false lumen can be observed. However, in some cases, such as ruptured, expanding, or large pseudo-aneurysms, and in cases of remodeling failure with single stent treatment, multiple stents are required. In our multiple stent series, 3 ISMADs were treated by a balloon-expandable stent plus a self-expandable stent, however, 1 ISMAD with a pseudoaneurysm was treated using one self-expandable stent (Figure 2). Our experience showed excellent immediate and long-term (11-32 mo) results[14]. The patency rates of the involved stented SMA and SMA branches were determined in all patients during the first month and the first year after the procedure.

In conclusion, symptomatic ISMADs should be treated by conservative management, however, in patients with persistent abdominal, ISMAD-induced severe intestinal ischemia, and chronic intestinal ischemia-related symptoms during conservative therapy, rupture of artery, and obvious aneurysmal false lumen dilation at high risk of rupture, endovascular or surgical therapy is indicated. Although a larger sample and expanded follow-up are needed, our series shows that percutaneous endovascular bare stent placement can be easily manipulated with a high success rate and can be achieved with excellent prognosis and no severe adverse effects.

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COMMENTS

Background

The natural history of isolated superior mesenteric artery dissection (ISMAD) is not well understood due to the rarity and complexity of the condition. Therapeutic options include conservative management, endovascular treatments or open surgery, although no consensus has been reached with regard to the best treatment modality.

Research frontiers

ISMAD may be managed successfully in a variety of ways based on the clinical symptoms.

Innovations and breakthroughs

Percutaneous endovascular reconstruction with bare stent implantation is a feasible treatment choice with a high success rate and good clinical outcome.

Applications

In this small series, conservative therapy was mainly indicated for asymptomatic patients or those with short-term symptoms, while endovascular or surgical therapy was recommended for those with persistent intestinal ischemia-related symptoms or rupture of the artery.

Terminology

The choice of stent diameter was based on the proximal normal artery diameter. The types of bare stents used were determined according to the operator's preference, availability of the stent, and the degree of difference in the vessel diameter.

Peer review

This is a good descriptive study in which the authors evaluated their experience of the clinical management of ISMAD. Eighteen patients with ISMAD were retrospectively analyzed. The manuscript is clear and well written. The authors found that ISMAD may be managed successfully in a variety of ways based on the clinical symptoms.

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