임상의과학 석사 학위논문

Spontaneous Isolated Dissection of Superior Mesenteric Artery: Long-term Outcome of Endovascular Stent Placement

자발적 단독성 상장간막동맥 박리에서 혈관 내 스텐트 삽입술의 효과 및 장기적 결과

2017년 2월

서울대학교 대학원
임상의과학과 임상의과학 전공
김 정 훈

Spontaneous Isolated Dissection of Superior Mesenteric Artery: Long-term Outcome of Endovascular Stent Placement

자발적 단독성 상장간막동맥 박리에서 혈관 내 스텐트 삽입술의 효과 및 장기적 결과

지도교수 윤 창 진

이 논문을 임상의과학 학사 학위논문으로 제출함

2016년 10월

서울대학교 대학원

임상의과학과 임상의과학 전공

김 정 훈

김정훈 의 석사학위논문을 인준함

2017년 1월

위 원 장 김 영 훈 (인)

부위원장 김 규 석 (인)

위 원 윤 창 진 (인)

Abstract

Spontaneous Isolated Dissection of Superior Mesenteric Artery: Long-term Outcome of Endovascular Stent Placement

Kim Junghoon
Department of Clinical Medical Sciences
The Graduate School
Seoul National University

Purpose

To evaluate the efficacy and long-term outcome of endovascular stent placement (ESP) for the treatment of symptomatic spontaneous isolated dissection of superior mesenteric artery (SIDSMA).

Materials and Methods

This retrospective study was conducted on 22 patients (mean 52 years, ranged 43-68) with symptomatic SIDSMA between January 2004 and October 2012. Initial treatment was chosen based on clinical symptom and CT findings. Seven patients underwent ESP as the first-line treatment. Fifteen patients were treated conservatively. The technical results, complications, and clinical outcomes were analyzed.

Results

The first-line ESP was technically successful in all 7 patients. Conservative treatment was successful in 12 patients (80.0%). The remaining 3 patients with failed conservative treatment

required ESP as second-line treatment. There was no complication associated with the procedures. Abdominal pain completely resolved in all patients without relapse during follow-up (median 48 months, ranged 1-136). The fasting time and hospital stay were significantly shorter in patients treated with first-line ESP (median 1 day, ranged 1-4 and median 4 days, ranged 3-7) than in those treated conservatively (median 4 days, ranged 2-11 and median 7 days, ranged 5-15) (p=0.004 and p=0.002, respectively). Follow-up CT angiogram (median 53 months, ranged 11-99) revealed complete obliteration of false lumen and good stent patency in 9 out of 10 patients who underwent ESP. One patient treated with 2 stents experienced occlusion of distal stent at 99-month follow-up.

Conclusions

ESP is an effective treatment in patients with symptomatic SIDSMA. It can be employed as the first-line treatment in selected patients or as second-line treatment when conservative treatment fails. ESP provides rapid symptomatic relief with shorter fasting and hospital stay than conservative treatment as well as satisfactory long-term stent patency.

Keywords: superior mesenteric artery, dissection, endovascular procedure, stent, long-term outcome

Student number: *2015-22243*

Contents

Introduction

Spontaneous isolated dissection of superior mesenteric artery (SIDSMA) is a rare vascular disease, and most of the related reports were limited to case reports or small case series. However, recently, the increasing use of CT in the management of patients with acute abdominal pain has resulted in SIDSMA being more recognized [1-5]. SIDSMA is associated with a broad spectrum of clinical presentations. While many of these conditions are asymptomatic incidental finding, some patients present with severe abdominal pain and, more importantly, there is a potential risk of intestinal infarction or aneurysmal rupture.

Various treatment options have been used to treat SIDSMA, including conservative management with or without antithrombotic therapy, endovascular stent placement (ESP), and surgical bypass or repair [5, 6]. However, the optimal treatment strategy remains controversial because the etiology and natural course of the disease have not yet been fully clarified. Many authors have reported successful outcomes with conservative treatment [3-5]. However, surgical treatments were also required in patients with critical bowel ischemia or infarction [7]. Recently, ESP has emerged as a definitive treatment for SIDSMA [1, 8-11]. Some authors used ESP as the first-line therapy [8, 9], but mostly it has been used as a secondary treatment when conservative treatment failed [10, 11]. However, experience with this treatment is still limited and there is a concern about adverse sequelae of ESP such as stent thrombosis, intimal injury, and possible closure of branch vessels of the SMA [6, 12]. In addition, the long-term outcome of ESP remains unclear. In this study, we present our management experience of 23 consecutive

patients with symptomatic SIDSMA and the long-term outcomes of ESP.

Materials and methods

Patients

Our institutional review board approved this retrospective study, and informed consent was waived. The medical record system of our hospital was searched between January 2004 and October 2012, and 33 patients with SIDSMA were identified. Twenty-two patients presented with abdominal pain, whereas 11 patients were asymptomatic and had their SIDSMA discovered incidentally. We included the 22 patients with symptomatic SIDSMA in this study.

An abdominal CT angiography was performed to establish the diagnosis of SIDSMA. In all patients, CT angiography revealed characteristic CT findings including thrombosis of the false lumen, intramural hematoma, and/or intimal flap. One patient had concomitant celiac dissection. The distribution of bowel gas and content was normal, and no evidence of bowel distention was found.

Treatment options

The decision to manage conservatively or to place a stent was based on the severity of abdominal pain and the morphologic characteristics of SMA dissection on CT angiogram. ESP as the first-line treatment was performed in patients with i) severe abdominal pain which was persistent despite intravenous narcotic analgesics for 8 hours and ii) severe true lumen stenosis >75% on CT angiogram. Otherwise, conservative management was

chosen as the first-line treatment.

Conservative management consisted of i) fasting; iii) intravenous fluid therapy and analgesics; iii) anticoagulant therapy (low molecular heparin 4000U per 12hr) and/or antiplatelet treatment (100mg aspirin and 75mg clopidogrel per day). Diet was resumed after complete resolution of abdominal pain and confirmation of normal physical examination and laboratory data. When abdominal pain was persistent more than 5 days or aggravated during conservative treatment, ESP was performed as a second line treatment.

All ESP procedures were performed by one of two interventional radiologists (C.J.Y. and N. J. S.). The potential risks and benefits of the procedure were explained to patients and/or their family members, and informed consent was obtained. Angiography of SMA and inferior mesenteric artery was performed via the right femoral approach through 5-Fr catheters (Torcon NB Advantage; Cook, Bloomington, USA). The true and false lumen of SMA was identified in an optimal projection to profile the lesion. A 6-Fr guiding catheter (Vista brite; Cordis, Miami, USA) was placed into the SMA with its tip proximal to the lesion. A 5-Fr catheter and a 0.035-inch hydrophilic guidewire (Radiofocus;Terumo, Tokyo, Japan) were manipulated to pass through the true lumen under roadmap image guidance. After selection of distal part of ileocolic or ileal artery, the guidewire was exchanged with a long stiff 0.035-inch guidewire (Terumo). A self-expandable stent (SMART; Cordis or Zilver; Cook) was advanced along the guidewire and deployed to cover the dissection part of SMA. All stents were oversized by 5-10% compared with proximal non-dissected part of SMA. When the

dissection segment was too long to be covered by one stent, two stents were placed with 1-2cm overlapping. Completion SMA angiogram was obtained to confirm stent patency and improvement of blood flow through dilated true lumen (Fig 1). One patient with concomitant celiac dissection underwent celiac stent placement at same session. After the procedure, all patients were treated with antiplatelet therapy (100-mg aspirin per day for 12 months and 75-mg clopidogrel per day for 6 months).

Follow-up

After the procedure, CT angiography was additionally checked at any time with aggravation of symptoms during admission. After discharge, the patients were encouraged to visit the outpatient department every 1-3 months for recurrent symptoms. Abdominal CT angiography was performed at 3 months, 6 months, and yearly thereafter.

Analysis

The information collected included demographics of patients, clinical manifestations, CT findings, treatments, complications, duration of fasting and hospital stay, clinical outcomes during follow-up period. The CT findings of SMA dissection including type, location, and length of dissection, and true lumen stenosis were evaluated on multi-planar reconstruction image. The type and location of dissection was determined according to previous studies [13, 14]. The percent stenosis of the true lumen was measured using the diameter of the unaffected SMA orifice and the diameter of the true lumen at the site of maximal stenosis

[3]

Technical success of ESP was defined as placement of stent in the true lumen to cover the dissected part of SMA with good blood flow on completion angiogram. The clinical success of treatment was defined as complete resolution of abdominal pain during normal diet with no abnormal finding in physical examination and laboratory test. Complications that required an extended duration of hospitalization, increased the level of care, led to a specific therapy or resulted in permanent adverse sequelae or death were classified as major complications [15]. The remaining complications were considered minor.

The duration of fasting and hospitalization were compared between conservative treatment and ESP by Mann-Whitney U test. P values of $<.05$ were considered statistically significant.

Results

Patients and CT characteristics

The patients and CT characteristics of the 22 patients with symptomatic SIDSMA are presented in Table 1. There were 20 men and 2 women with a mean age of 51.0 years (range, 43-59 years). All patients presented with acute-onset abdominal pain in the epigastric or periumbilical area (mean, 1.6 days; range, 0-8 days). Accompanying clinical symptoms included vomiting (n=6), nausea (n=7), anorexia (n=2), and diarrhea (n=2). Most common comorbidities was hypertension (n=9). No patients had established risk factors such as Ehlers - Danlos syndrome, Marfan's syndrome, cystic medial necrosis, fibromuscular dysplasia, or

trauma.

The type of SIDSMA were type Ⅰ(n=3), type ⅡB (n=16), and type Ⅲ (n=3) according to Yun's classification. The median distance from the SMA ostium to the beginning of dissection is 20.3 mm (range, 6.2-28.3), which corresponds to zone 1 (n=5) and zone 2 (n=18). The median length of SMA dissection was 74.1 mm (range, 28.6-156.8). The extent of the dissection was type C (n=16) and type D (n=6) according to Luan's classification [14]. The true lumen stenosis was measured 41.7%-100% (median 77.0%). Three patients had focal dissecting aneurism at entry site measuring 4.8, 5.5, and 6.3 mm.

Clinical outcomes of treatments

Fifteen patients were initially treated with conservative treatment with anticoagulation (n=12) or antiplatelet therapy (n=3) (patients 1-15 in table 2). Among these, the abdominal pain was successfully relieved in 12 patients within 5 days. However, the abdominal pain persisted (n=1) or aggravated (n=2) in three patients. Therefore, the clinical success rate of conservative treatment was 80.0% (12 out of 15 patients). We performed ESP as second-line treatment in the 3 patients 4, 6, and 10 days after symptom onset (patients 13-15 in table 2, Figure 1). The ESP was also performed as the first-line treatment in 7 patients (patients 16-22 in table 2, Figure 2). Therefore, a total 10 patients underwent ESP. We used one self-expandable stent in 6 patients and two stents in 4 patients (6-8mm in diameter and 40-80mm in length, table 2). In one patient with concomitant celiac dissection with aneurysm, a self-expandable stent (10mm in diameter and 4cm in length) was placed in celiac artery in the

same session. All ESP was technically successful. Completion angiogram demonstrated good patency of stent placed in the true lumen. The 10 patients experienced rapid symptomatic improvement after the procedure, and discharged within 7 days after the procedure. Therefore, clinical success rate of ESP was 100%. In 7 patients with the first-line ESP, the median duration of fasting and hospitalization were 1 day (ranged 1-4) and 4 days (ranged 3-7), respectively, and in those treated with conservative treatment, 4 days (ranged 2-11) and 7 days (range 5-15), respectively. There was significant difference in the fasting time (p=0.004) and hospital stay (p=0.002) between the two treatment groups. There was no procedure-related complication.

Follow-up

Overall follow-up period were 1-136 months (median 48 months). Three patients treated conservatively and one patient treated with second-line ESP placement lost to follow-up within 12 months. There was no symptomatic relapse in all patients during the follow-up period. In 10 patients with first- or second-line ESP, CT angiogram revealed complete obliteration of the false lumen and good stent patency in 9 patients during follow-up period (median 53 months, ranged 11-99). In 2 out of the 9 patients, focal mild intimal hyperplasia was found at the proximal end of the stent on 3-month follow-up, but did not progressed and stent patency was confirmed up to 48- and 63-month follow-up CT, respectively. In remaining 1 patient treated with two stents, diffuse intimal hyperplasia in the distal stent gradually progressed and caused stent occlusion on 99-month follow-up (Figure 3). In 15 patients treated

conservatively, the false lumen was obliterated (n=12) or stationary (n=3). There was no delayed complication during follow-up period.

Discussion

SIDSMA is defined as a SMA dissection without the presence of the aortic dissection. Due to the rarity of this disease, the etiology of SIDSMA has yet to be determined, but hypertension and smoking have been reported as possible causes [2]. Other risk factors including atherosclerosis, connective tissue disorders, cystic medial degeneration, fibromuscular dysplasia, and pregnancy have been considered [3]. Yun et al. [13] reported that SIDSMA dissection occurs mainly in male patients in their fifth decade. In our study, SIDSMA occurs mostly in male patients (20 of 23 patients, 86.9%) in their middle age (43-68, median 51 years). None of our patients had any specific risk factor except hypertension (10 of 23 patients, 43.4%). Regarding the possible mechanism of SIDSMA, Solis et al. [16] indicated that dissection of the SMA typically begins at 1.5-3cm from the ostium, which corresponds with zone 2 in Li's study [17]. At this point, the SMA is assumed to be highly susceptible to shearing force due to its relationship with the pancreas, which is analogous to what is observed at the ligamentum arteriosum during rapid deceleration injuries such as aortic dissection [18]. In the present study, 18 patients (78.2%) had entry sites involving zone 2, which support the proposed mechanism of SMA dissection [13].

Sakamoto et al. [19] categorized SMA dissection into 4 types based on CT appearances. However, the type of total thrombotic

occlusion was not considered in this classification. Zerbib et al. [20] modified Sakamoto's classification and categorized SIDSMA into 6 types but did not consider propagation of the false lumen to the SMA ostium. In addition, this classification is too complicated to apply in clinical practice. Yun's classification [13] consists of 3 types according to the presence of false luminal flow and true lumen patency, which is simplest and most commonly used. However, these classifications do not consider extent of the dissection, which is critical factor in symptom and prognosis of SIDSMA. Luan et al. [14] categorized SMA dissection based on their location and extent, and demonstrated that their classification correlates with pain severity. Therefore, in our study, the dissections were classified by Yun's classification combined with Luan's classification as listed in table 1. Based on Yun's classification, type IIb (69.5%) was the most common (73.9%), followed by type III (13.0%). These two types of dissection are associated with stenosis or obstruction of true lumen, therefore, the abdominal pain was assumedly caused by bowel ischemia. The three patients with type I dissection in which the SMA blood flow is patent, the abdominal pain assumed to be caused by nonischemic factors, such as vessel wall swelling, high pressure in the false lumen, and perivascular inflammatory reaction [21]. As Yun et al. [13] reported that dissection length is positively associated with more severe clinical symptoms, all patients of this study had long segmental dissection (type C or type D). In addition, our results suggested that ileocolic involvement of dissection (type D) is associated with symptomatic severity. Five out of six patients with type D dissection experienced severe abdominal pain not controlled by

analgesics or unresponsive to conservative management, and eventually required ESP. Therefore, the combination of the two classifications provides valuable information to predict symptomatic prognosis and to determine treatment strategy.

Optimal treatment of SIDSMA is still controversial. However, recently, some authors have proposed treatment algorithms for SIDSMA based on literature reviews and the analysis of other reports [5, 6]. Although there is a slight difference, they share main treatment strategies in common as follows; asymptomatic patients require only routine surveillance. If the patient is symptomatic, conservative treatment with or without anticoagulation therapy should be given as the first-line therapy. The cases complicated with persistent pain, bowel ischemia, or aneurysm formation requires ESP or surgical revascularization. ESP predominates over surgical option for the treatment of SIDSMA for its minimal invasiveness. Our study supports this strategy as most patients initially treated with conservative treatment uneventfully recovered (82.3%, 13 of 16 patients). Follow-up CT revealed complete remodeling in 8 patients (50%) or stationary in 5 patients (31.3%) without any symptomatic relapse. However, in our study, 3 of 16 patients (18.7%) were unresponsive to conservative treatment, and underwent ESP. Recently, several studies reported similar experiences; Jia et al. [10] reported that among 14 patients treated conservatively, 2 patients (14.3%) required ESP for persisted or aggravated abdominal pain. In a study by Li et al. [17] including 24 patients received conservative treatment, there was clinical progression in 3 and imaging progression in 7 patients, of which 2 patients received successful ESP, but one patient died of bowel infarction.

Therefore, although the reported incidences are variable ranging 1.8-40% [7-10, 17, 22], it is clear that there is a subset of patients in whom the conservative treatment is not effective, and ESP appears excellent second-line treatment in those patients.

In present study, we performed ESP as the first-line therapy in 7 selected patients. However, the first-line ESP for SIDSMA has been rarely evaluated. Pang et al. [8], successfully treated 7 patients with first-line ESP. Fasting time and hospital stay were shorter than those of conservatively treated patients. The decision to perform ESP was based on clinical symptoms. In a study by Luan et al. [9], decision for the first-line ESP was based on angiographic finding; SMA occlusion (n=3) and severe stenosis unresponsive to vasodilator infusion (n=7). However, considering that conservative treatment was successful in 3 patients with severe true lumen stenosis (>75%), it is not reasonable to determine the first-line ESP based on imaging study alone. Likewise, since abdominal pain might be caused by nonischemic factors, for which ESP would be less beneficial, the decision should not be based only on clinical symptoms. Therefore, in our study, we determined the first-line ESP considering clinical symptom combined with CT finding (severe abdominal pain not relived by narcotic analgesics and severe true lumen stenosis). The clinical outcomes of the first-line ESP seem to be promising. The abdominal pain improved rapidly, and all 7 patients were discharged without symptoms within 1 week after the procedure. We believe the first-line ESP has a potential to reduce fasting time and hospital stay in selected patients. However, as experiences on this treatment strategy are rather limited; less than 40 cases have been reported including this study [8-10], we

need more data to define the role of this treatment strategy.

The long-term outcome of ESP in SIDSMA has not been confirmed yet. Recently, several studies have shown good stent patency with follow-up of 1-2 years [1, 5, 10, 17]. Although a few sporadic cases were followed-up without symptomatic relapse for 3-5 years after ESP [8, 9], the stent patency and stent-related delayed complications need more investigation. To our best knowledge, this study is the first to provide the long-term imaging follow-up of SMA stent placement. Among 10 patients who underwent ESP, 7 patients were followed-up for more than 4 years using CT angiograms. All stents except one were patent with minimal intimal hyperplasia at proximal end of the stents. False lumens were completely obliterated without compromise of side branches. In one patient treated with two stents, the distal stent covering ileocolic artery dissection was occluded at 8-year follow-up. This patient had no symptomatic relapse, probably because the stent was gradually occluded due to intimal hyperplasia, which provided enough time to develop collateral flow from adjacent mesenteric arteries. The excessive intimal hyperplasia was assumed to be caused by relatively large diameter of the stent (6mm in this case) against small mesenteric artery. A stent with tapering configuration suitable for SMA and branch vessels would be desirable, which is not available at the present time. Therefore, stent placement in small mesenteric artery is not recommended unless it is critical to improve mesenteric arterial flow.

This study has several limitations. First, this is a retrospective study with all its inherent limitations. For instance, symptomatic relief after treatment was determined by unquantified patients'

response. This may have an influence on decision to perform ESP. Numeric pain scale such as visual analog scale should be used for more objective treatment allocation in the future studies. Second, relatively small population precludes from generalization of our results. Considering the rarity of this disease, meta-analysis and multicenter study should be arranged to determine the optimal treatment strategies and their outcomes.

In conclusion, ESP is a safe and effective treatment in patients with symptomatic SIDSMA. It can be employed as the first-line treatment in selected patients based on patients' symptom and CT features or as second-line treatment when conservative treatment fails. This study demonstrates satisfactory long-term stent patency without any delayed complication. A further study with large scale should be conducted to confirm the role of ESP in treatment of SIDSMA.

References

[1] Li N, Lu QS, Zhou J, Bao JM, Zhao ZQ, Jing ZP. Endovascular stent placement for treatment of spontaneous isolated dissection of the superior mesenteric artery. Annals of vascular surgery 2014; 28:445-51.

[2] Kim HK, Jung HK, Cho J, Lee JM, Huh S. Clinical and radiologic course of symptomatic spontaneous isolated dissection of the superior mesenteric artery treated with conservative management. Journal of vascular surgery 2014; 59:465-72.

[3] Tomita K, Obara H, Sekimoto Y, et al. Evolution of Computed Tomographic Characteristics of Spontaneous Isolated Superior Mesenteric Artery Dissection During Conservative Management. Circulation journal : official journal of the Japanese Circulation Society 2016; 80:1452-9.

[4] Han Y, Cho YP, Ko GY, et al. Clinical Outcomes of Anticoagulation Therapy in Patients With Symptomatic Spontaneous Isolated Dissection of the Superior Mesenteric Artery. Medicine 2016; 95:e3480.

[5] Roussel A, Pellenc Q, Corcos O, et al. Spontaneous and isolated dissection of the superior mesenteric artery: proposal of a management algorithm. Annals of vascular surgery 2015; 29:475-81.

[6] Ogino H. Current Treatment Strategy for Spontaneous Isolated Dissection of the Superior Mesenteric Artery. Circulation journal : official journal of the Japanese Circulation Society 2016; 80:1323-5.

[7] Garrett HE, Jr. Options for treatment of spontaneous mesenteric artery dissection. Journal of vascular surgery 2014; 59:1433-9 e1-2.

[8] Pang P, Jiang Z, Huang M, Zhou B, Zhu K, Shan H. Value of endovascular stent placement for symptomatic spontaneous isolated superior mesenteric artery dissection. European journal of radiology 2013; 82:490-6.
[9] Luan JY, Li X, Li TR, Zhai GJ, Han JT. Vasodilator and endovascular therapy for isolated superior mesenteric artery dissection. Journal of vascular surgery 2013; 57:1612-20.
[10] Jia ZZ, Zhao JW, Tian F, et al. Initial and middle-term results of treatment for symptomatic spontaneous isolated dissection of superior mesenteric artery. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 2013; 45:502-8.
[11] Li Z, Ding H, Shan Z, et al. Initial and Middle-Term Outcome of Treatment for Spontaneous Isolated Dissection of Superior Mesenteric Artery. Medicine 2015; 94:e2058.
[12] Chang CF, Lai HC, Yao HY, et al. True lumen stenting for a spontaneously dissected superior mesenteric artery may compromise major intestinal branches and aggravate bowel ischemia. Vascular and endovascular surgery 2014; 48:83-5.
[13] Yun WS, Kim YW, Park KB, et al. Clinical and angiographic follow-up of spontaneous isolated superior mesenteric artery dissection. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 2009; 37:572-7.
[14] Luan JY, Li X. Computed tomography imaging features and classification of isolated dissection of the superior mesenteric artery. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 2013; 46:232-5.

[15] Sacks D, McClenny TE, Cardella JF, Lewis CA. Society of Interventional Radiology clinical practice guidelines. Journal of vascular and interventional radiology : JVIR 2003; 14:S199-202.
[16] Solis MM, Ranval TJ, McFarland DR, Eidt JF. Surgical treatment of superior mesenteric artery dissecting aneurysm and simultaneous celiac artery compression. Annals of vascular surgery 1993; 7:457-62.
[17] Li DL, He YY, Alkalei AM, et al. Management strategy for spontaneous isolated dissection of the superior mesenteric artery based on morphologic classification. Journal of vascular surgery 2014; 59:165-72.
[18] Park YJ, Park CW, Park KB, Roh YN, Kim DI, Kim YW. Inference from clinical and fluid dynamic studies about underlying cause of spontaneous isolated superior mesenteric artery dissection. Journal of vascular surgery 2011; 53:80-6.
[19] 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. European journal of radiology 2007; 64:103-10.
[20] Zerbib P, Perot C, Lambert M, Seblini M, Pruvot FR, Chambon JP. Management of isolated spontaneous dissection of superior mesenteric artery. Langenbeck's archives of surgery / Deutsche Gesellschaft fur Chirurgie 2010; 395:437-43.
[21] Dong Z, Ning J, Fu W, et al. Failures and Lessons in the Endovascular Treatment of Symptomatic Isolated Dissection of the Superior Mesenteric Artery. Annals of vascular surgery 2016; 31:152-62.
[22] Luan JY, Li X. CT classification and endovascular management of isolated dissection of the superior mesenteric

artery with anatomical variations. European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery 2014; 47:209.

Table 1. Demographics and CT characteristic of 22 patients with SIDSMA

Patient No.	Age	Sex	Comorbidity	Distance from SMA os (mm)	Entry site*	True lumen stenosis (%)	Length (mm)	Type*	Extent **
1	M	43	Hypertension	23.0	Zone 2	56.6	140.3	2b	C
2	M	57	Gout	16.2	Zone 2	41.7	28.4	1	C
3	M	59	Retroperitoneal fibrosis	6.2	Zone 1	67.2	80.3	1	C
4	M	52		10.8	Zone 1	52.9	104.5	2b	C
5	M	50	Hypertension	14.6	Zone 2	48.8	40.1	2b	C
6	M	45	Hypertension	18.9	Zone 2	57.2	88.2	2b	C
7	M	44		23.2	Zone 2	76.0	132.3	2b	D
8	M	46		21.6	Zone 2	64.3	28.6	2b	C
9	M	54	Duodenal ulcer	11.0	Zone 1	77.2	64.7	2b	C
10	F	46	Hypertension	6.2	Zone 1	75.7	52.8	2b	C
11	M	46		25.1	Zone 2	63.0	144.6	1	C
12	M	51	Hypertension	25.3	Zone 2	45.0	64.1	2b	C
13	F	56	Renal embolic infarction	15.1	Zone 2	78.0	140.1	2b	D
14	M	53		13.4	Zone 2	83.2	145.2	2b	D
15	M	58	Hypertension	28.3	Zone 2	74.4	80.6	2b	C
16	M	53		20.0	Zone 2	76.6	156.8	2b	D
17	M	50	Hypertension Celiac dissection	27.3	Zone 2	100.0	72.9	3	C
18	M	55	Hypertension	20.1	Zone 2	100.0	74.1	3	C
19	M	51	Hypertension Hyperlipidemia	24.9	Zone 2	100.0	52.5	3	D
20	M	48		27.5	Zone 2	75.7	60.6	2b	C
21	M	49		25.1	Zone 2	76.1	156.6	2b	D
22	M	56		20.4	Zone 2	78.7	30.8	2b	C

* According to Yun's classification (reference 13)

**AccordingtoLuan'sclassification(reference14)

Table 2. Treatments and clinical outcomes

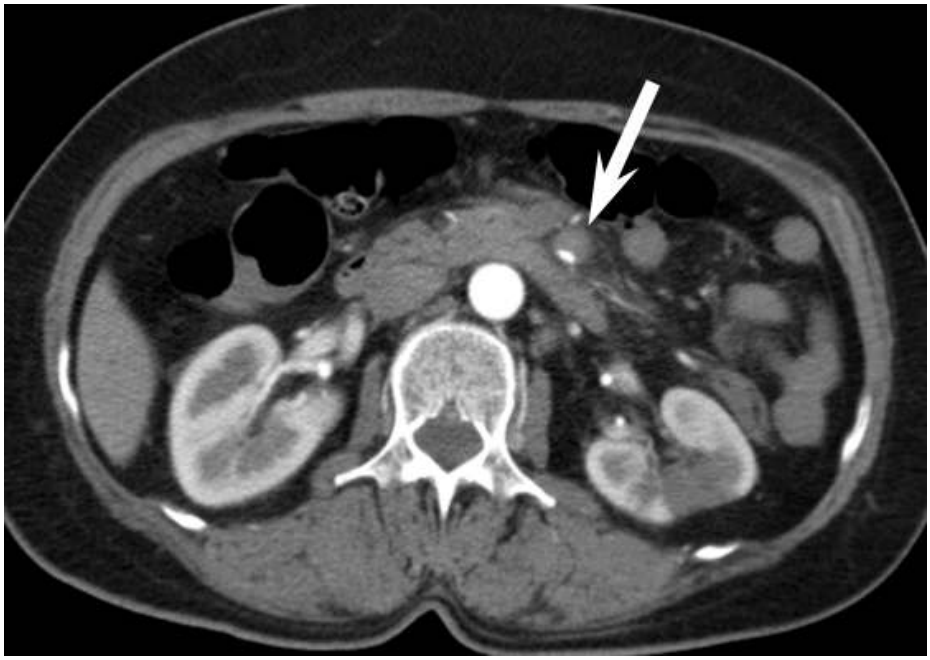
Patient No.	Treatment	Stent	Fasting time (days)	Hospital stay (days)	Follow-up (months)	Stent patency
1	Conservative	NA	3	9	15	NA
2	Conservative	NA	4	6	79	NA
3	Conservative	NA	6	9	111	NA
4	Conservative	NA	5	8	44	NA
5	Conservative	NA	2	8	103	NA
6	Conservative	NA	3	7	136	NA
7	Conservative	NA	2	5	112	NA
8	Conservative	NA	6	7	1	NA
9	Conservative	NA	2	5	10	NA
10	Conservative	NA	4	11	13	NA
11	Conservative	NA	3	7	13	NA
12	Conservative	NA	2	5	8	NA
13	Conservative -> Second-line ESP	1 stent: 7mm, 6cm	7	15	86	Patent
14	Conservative -> Second-line ESP	2 stents: 7mm, 4cm and 6mm, 8cm	11	15	46	Patent
15	Conservative -> Second-line ESP	1 stent: 8mm, 4cm	5	6	11	Patent
16	First-line ESP	2 stents: 7mm, 6cm and 6mm, 4cm	2	4	48	Patent
17	First-line ESP	1 stent: 7mm, 8cm	2	5	54	Patent
18	First-line ESP	2 stents: 7mm, 8cm and 6mm, 6cm	1	4	66	Patent, mild intimal hyperplasia
19	First-line ESP	1 stent: 7mm, 8cm	1	5	61	Patent
20	First-line ESP	1 stent: 8mm, 8cm	1	3	47	Patent, mild intimal hyperplasia
21	First-line ESP	2 stents: 8mm, 8cm and 6mm, 6cm	4	7	99	Occlusion of distal stent
22	First-line ESP	1 stent: 7mm, 6cm	1	4	52	Patent

NA, not applicable
ESP,endovascularstentplacement

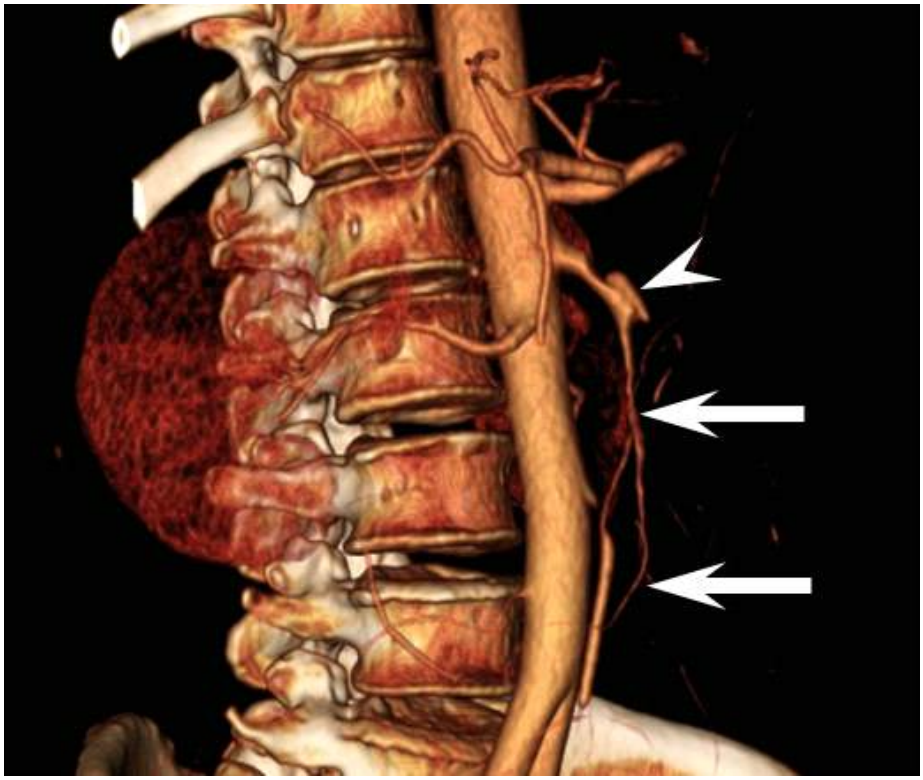
Figures

Figure 1. A 58-year-old woman (patient 13) who underwent second-line ESP for persisted abdominal pain in spite of conservative treatment for 5 days.

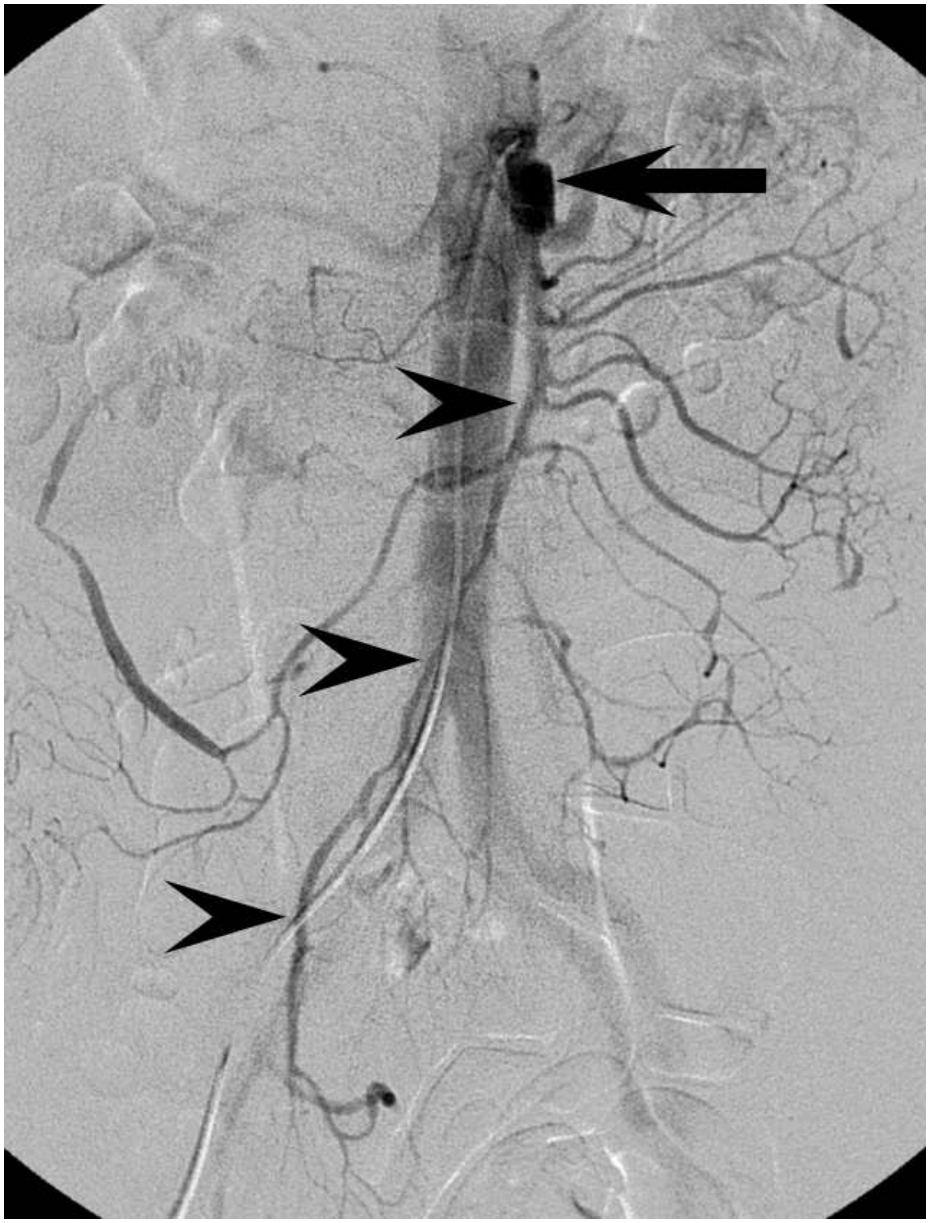
A. A CT angiogram transverse image shows SIDSMA with thrombosed false lumen (arrow).



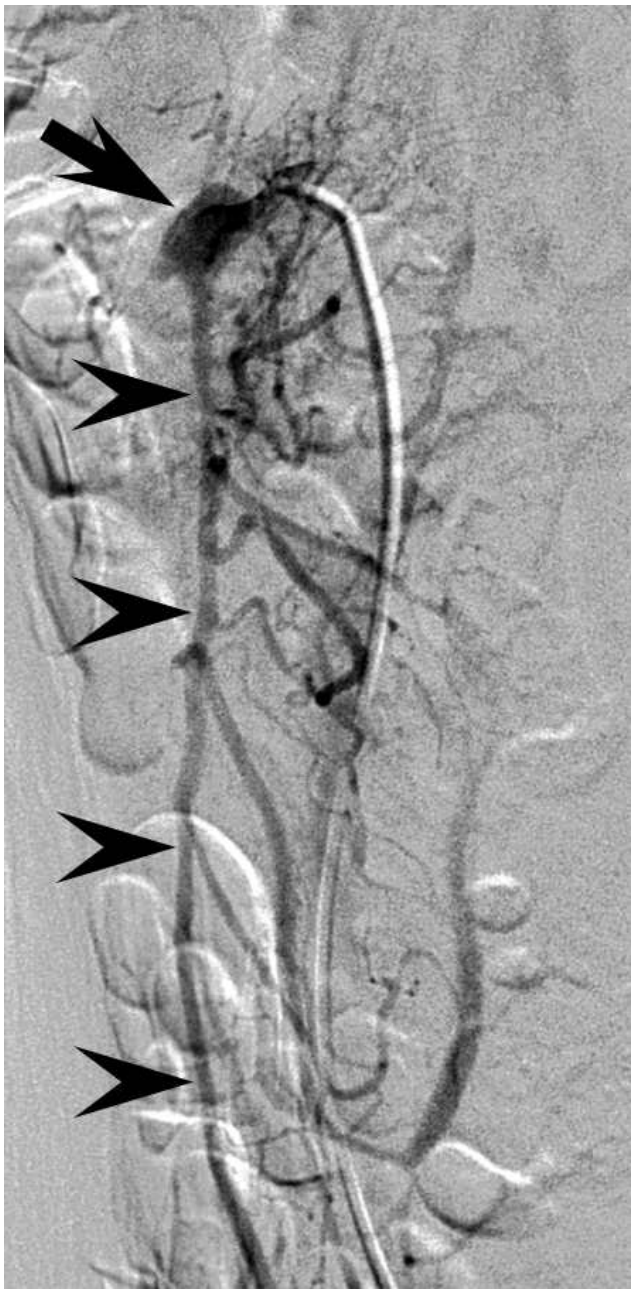
B. A CT angiogram volume rendering image shows SIDSMA with thrombosed false lumen. A dissecting aneurysm at entry site (arrowhead) with diffuse narrowing of the true lumen is noted (arrows).



C. An SMA arteriogram anteroposterior image shows the dissecting aneurysm (arrow) with diffuse true lumen stenosis involving whole SMA and ileocolic artery (arrowheads).

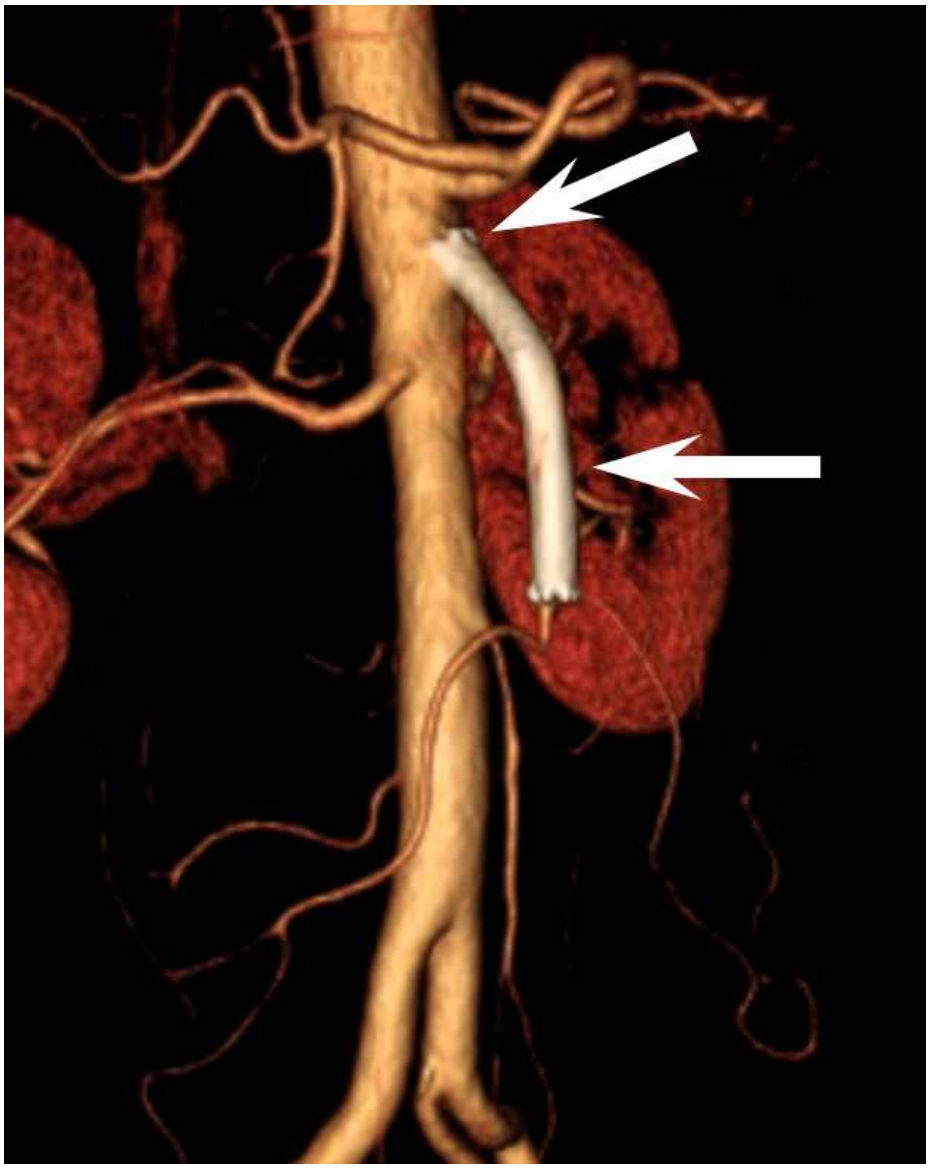


D. An SMA arteriogram left anterior oblique image shows the dissecting aneurysm (arrow) with diffuse true lumen stenosis involving whole SMA and ileocolic artery (arrowheads).



E. An angiogram of SMA obtained after ESP shows dilatation of stented proximal part of SMA (arrow) with decreased dissecting aneurysm (arrowhead).

F Follow-up CT volume rendering image obtained 30 months reveals patent stent (arrows). The dissecting aneurysm also disappeared.



G. Follow-up CT multiplanar MIP image obtained 86 months reveals widely patent stent with complete obliteration of the false lumen (arrows). The dissecting aneurysm also disappeared.

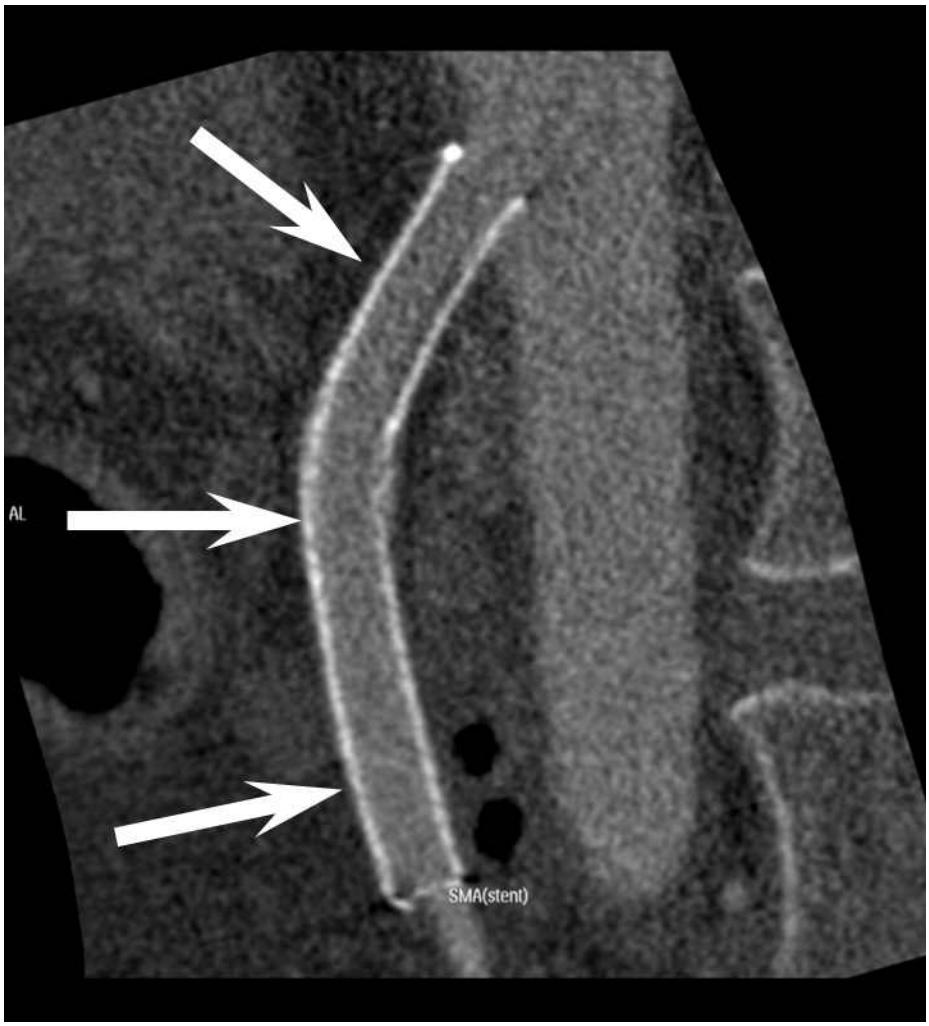
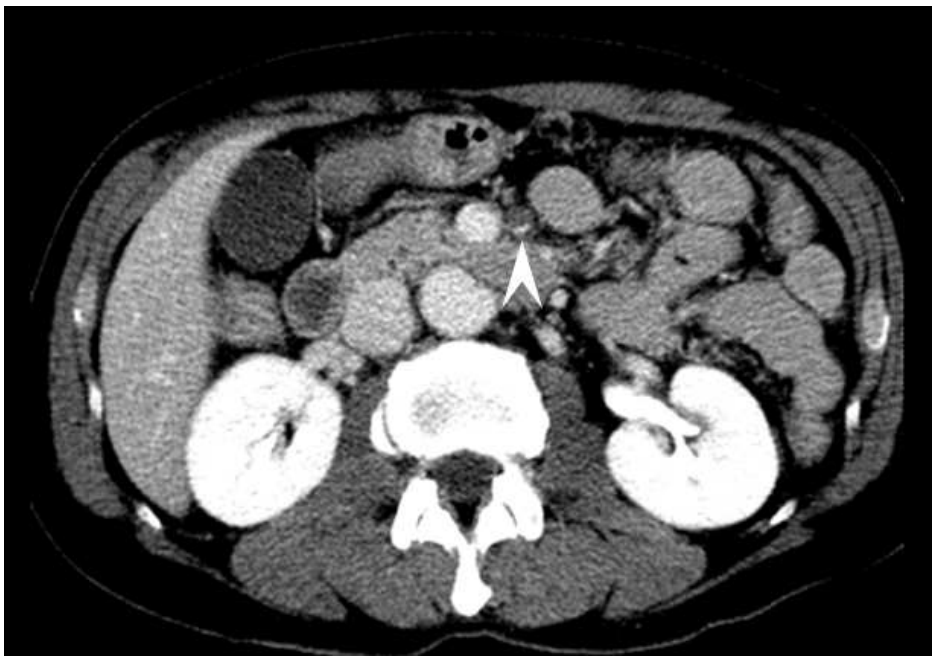
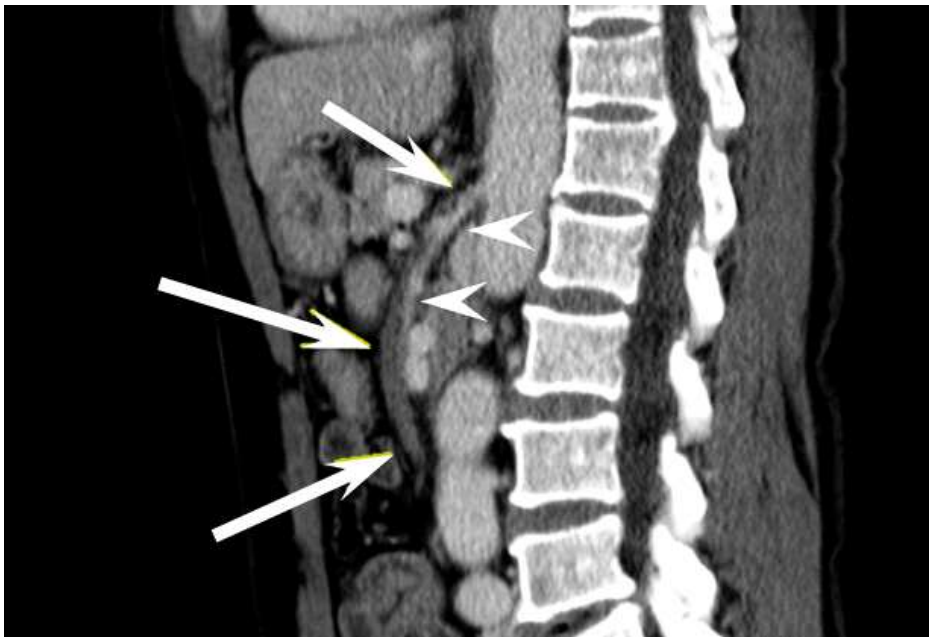


Figure 2. A 55-year-old man (patient 18) who underwent the first-line ESP for symptomatic SIDSMA.

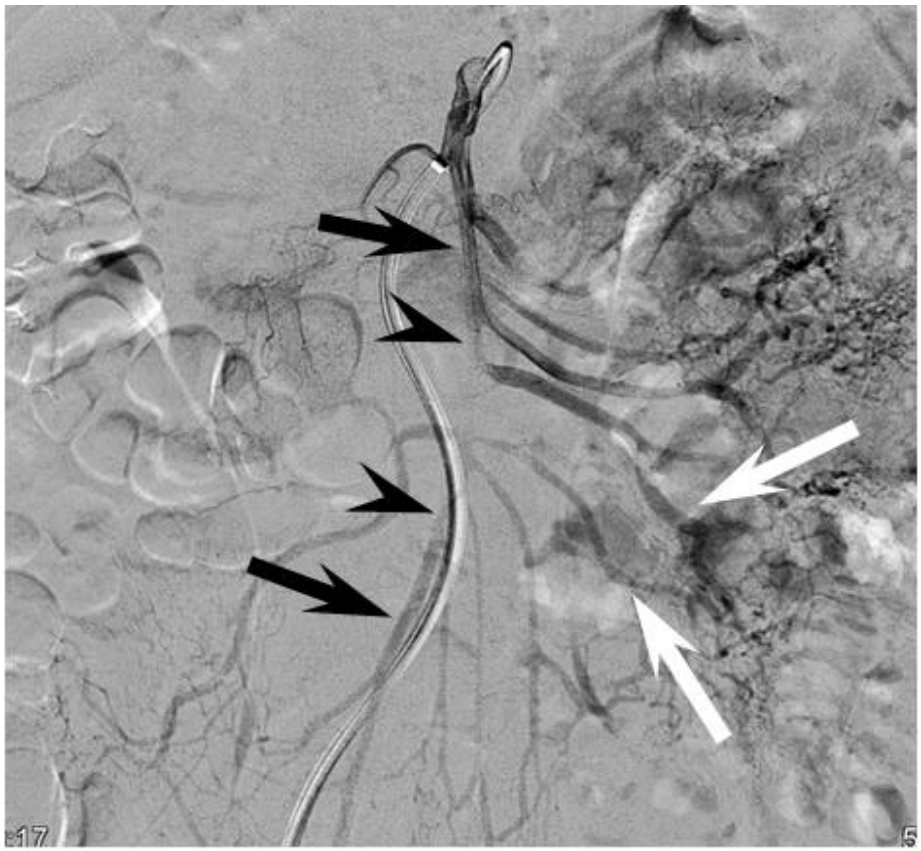
A. CT angiogram transverse image shows long segmental SMA dissection. The thrombosed false lumen causes diffuse true lumen stenosis (arrowheads).



B. CT angiogram sagittal image shows long segmental SMA dissection. The thrombosed false lumen (arrows) causes diffuse true lumen stenosis (arrowheads).

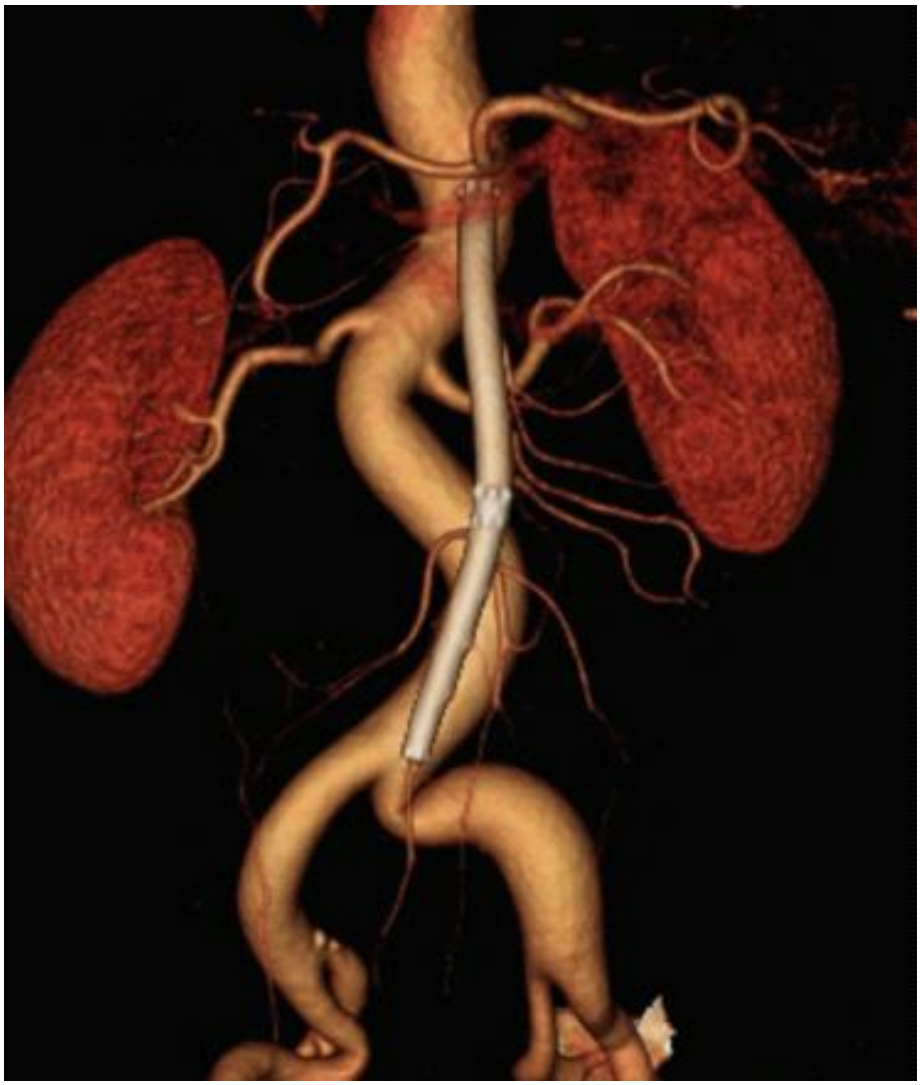


C. An angiogram of SMA revealed diffuse stenosis of true lumen (arrows) with segmental obstruction at the mid part of SMA (arrowheads). The distal part of SMA is faintly opacified by retrograde filling through jejuno-ileal anastomosis (white arrows).



D. An angiogram of SMA obtained after ESP shows two self-expandable stents covering whole SMA and proximal part of ileocolic artery (arrows) with improved antegrade flow.

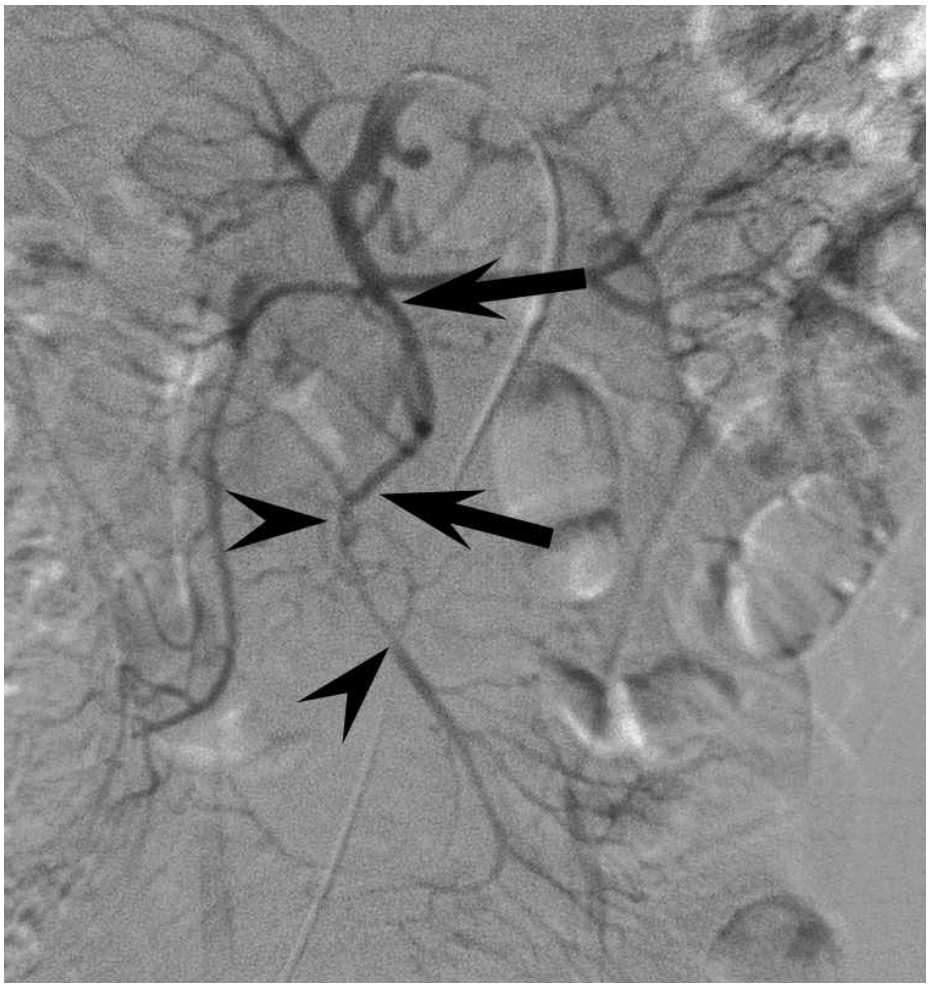
E. A follow-up CT volume rendering image taken 3 months after ESP shows patent SMA stents



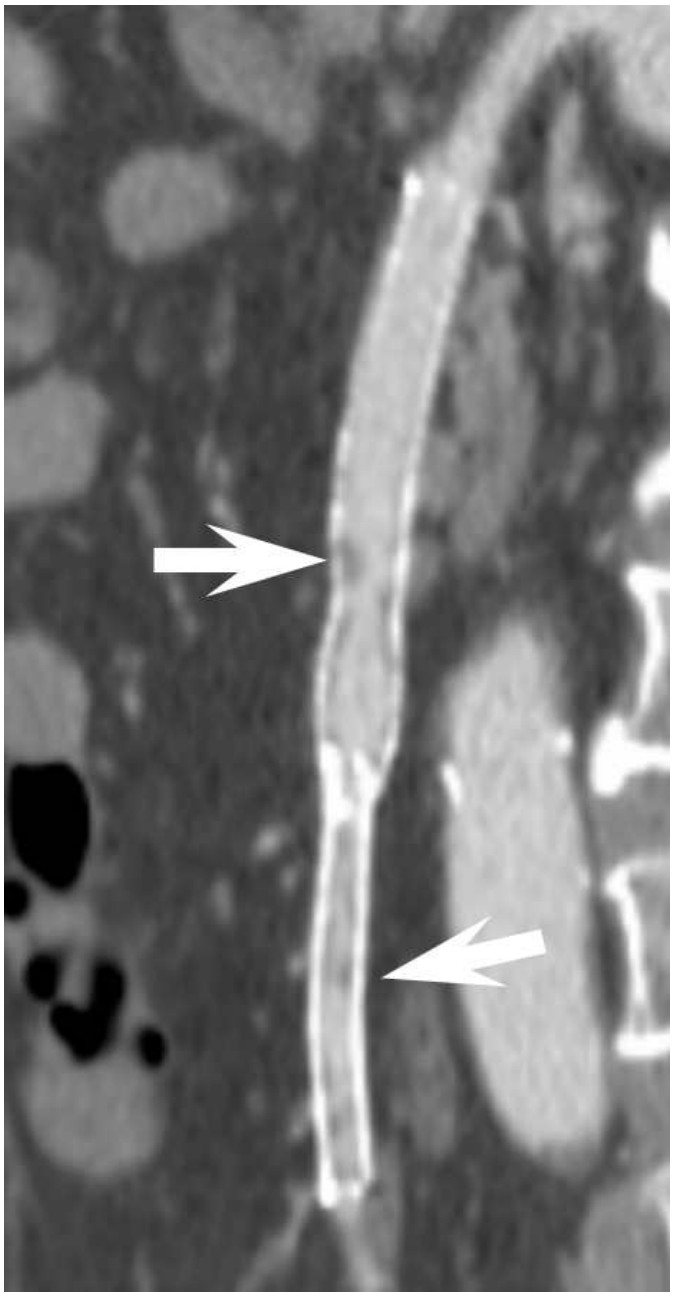
F. A follow-up CT MIP image taken 3 months after ESP shows patent SMA stents with obliteration of false lumen (arrows). Mild intimal hyperplasia is noted at the proximal end of the stent (arrowheads).

Figure 3. A 49-year-old man (patient 21) with stent occlusion.

A. An SMA angiogram shows diffuse true lumen stenosis involving mid to distal part of SMA (arrows). The maximum stenosis is noted at proximal part of ileocolic artery (arrowheads). Two self-expandable stents were placed to cover the dissected segment.



B. A 73-month follow-up CT angiogram multiplanar MIP image shows patent stents with diffuse intimal hyperplasia (arrows).



C. A 99-month follow up CT revealed stent occlusion at ileocolic segment (arrows). The proximal stent is still patent. The distal part of ileocolic artery is opacified through collateral vessels (arrowheads).

요약 (국문초록)

자발적 단독성 상장간막동맥 박리에서 혈관 내 스텐트 삽입술의 효과 및 장기적 결과

서울대학교 대학원
임상의과학과 임상의과학 전공
김 정 훈

목적

증상이 있는 자발적 단독성 상장간막동맥 박리의 치료를 위한 혈관 내 스텐트 삽입술의 효과와 장기적 결과를 평가하기 위함.

대상과 방법

이 후향적 연구는 2004년 1월부터 2012년 10월까지 증상이 있는 자발적 단독성 상장간막동맥 박리가 발생한 22명의 환자 (평균연령 52세, 43-68) 를 대상으로 하였고 초기 치료는 임상적 증상과 컴퓨터 단층촬영 소견에 따라 결정되었다. 7명의 환자가 초기 치료로 혈관 내 스텐트 삽입술을 시행받았고 15명은 보존적으로 치료되었다. 기술적인 결과, 합병증, 임상적 결과를 분석하였다.

결과

일차적 혈관 내 스텐트 삽입술은 7명의 환자에서 모두 기술적으로 성공적이었다. 보존적 치료는 12명의 환자에서 성공적이었다 (80.0%). 보존적 치료가 실패한 3명의 환자에서 혈관 내 스텐트 삽입술을 이차적 치료로 시행하였으며 시술에 관련된 합병증은 발생하지 않았다. 복부 통증은 완전히 회복되었으며 추적관찰 기간 동안 재발하지 않았다 (중간값 48개월, 1-136). 공복 시간과 입원 기간은 보존적으로 치료되었던 환자보다 (중간값 4일 (2-11), 중간값 7일

(5-15)) 일차적 혈관 내 스텐트 삽입술을 받았던 환자군에서 (중간값 1일 (1-4), 중간값 4일, (3-7)) 유의하게 짧았다 (p=0.004, p=0.002). 추적 관찰 혈관 조영 컴퓨터단층촬영에서 (중간값 53개월, 11-99) 혈관 내 스텐트 삽입술을 받은 10명 중 9명의 환자에서 거짓 내강의 완전 폐색과 스텐트의 충분한 개통성이 확인되었다. 두 개의 스텐트로 치료받았던 한 명의 환자에서는 99개월 추적관찰 검사에서 말단부 스텐트의 막힘이 관찰되었다.

결론

혈관 내 스텐트 삽입술은 증상이 있는 자발적 단독성 상장간막동맥 박리의 효과적인 치료법으로, 선택된 환자들에서 일차적 치료로 사용되거나 혹은 보존적 치료가 실패했을 때 이차적 치료로 활용될 수 있다. 혈관 내 스텐트 삽입술을 통해 보존적 치료보다 빠른 증상의 완화와 짧은 공복 및 입원 기간을 달성할 수 있으며 스텐트의 장기간 개통성 또한 충분한 것으로 확인되었다.

주요어: 상장간막동맥, 박리, 혈관 내 중재술, 스텐트, 장기적 효과
학 번: 2015-22243