Initial and Middle-term Results of Treatment for Symptomatic Spontaneous Isolated Dissection of Superior Mesenteric Artery

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WHAT THIS PAPER ADDS

A variety of treatment options have been described for spontaneous isolated dissection of the superior mesenteric artery (SIDSMA), including conservative treatment, endovascular stenting (ES) and surgical repair. Although several treatment options are available, there are currently no consensus guidelines on the proper management of symptomatic SIDSMA. Herein, we report a contemporary series of 17 patients presenting with acute abdominal pain and describe the management strategy we adopted in cases of symptomatic SIDSMA and found that conservative treatment without anticoagulation can be applied successfully to the patients with symptomatic SIDSMA. ES is indicated if patients have compression of the true lumen or dissecting aneurysm likely to rupture. ES can also be provided to the patients in whom initial conservative treatment failed, as a rescue therapy.

Objective: Spontaneous isolated dissection of the superior mesenteric artery (SIDSMA) is extremely rare. Various treatment options are currently available, including conservative treatment, endovascular stenting (ES) and surgical repair. Herein, we present our experience in the treatment of symptomatic SIDSMA.

Methods: A retrospective study was conducted on 17 consecutive patients with symptomatic SIDSMA from May 2002 to May 2012. Conservative treatment consisted of strict blood-pressure control, bowel rest, nasogastric suction, intravenous fluid therapy and nutritional support as required; fasting was released on resolution of abdominal pain, and fluid food was given first; then, diet was resumed after complete resolution of abdominal pain. The decision to intervene was based on patient symptoms and signs, as well as the morphological characteristics of SMA dissection on computed tomography (CT) angiography. Self-expandable stents were placed via the common femoral artery approach. ES was indicated in patients with severe compression of the true lumen or dissecting aneurysm likely to rupture.

Results: All patients had acute-onset abdominal pain. Treatment included conservative treatment with the use of anticoagulation in five and without in nine patients, respectively. Three patients with severe compression of the true lumen or large dissecting aneurysm underwent ES as a primary treatment. ES was performed in two patients in whom initial conservative treatment failed. Patients who underwent ES were maintained on anti-platelet therapy for 3 months postoperatively. The median follow-up time was 24 months (range, 2—72 months). No complications were associated with the SIDSMA or ES. The patency of stents was demonstrated on follow-up CT scans up to 8.5 months (range, 4—38 months).

Conclusions: Conservative treatment without anticoagulation can be applied successfully to the patients with symptomatic SIDSMA. Our strategy of restricting ES for these patients who have compression of the true lumen or dissecting aneurysm likely to rupture (and for those with failed conservative treatment) was successful.

Keywords: Superior mesenteric artery, Spontaneous dissection, Endovascular stenting, Treatment

Spontaneous isolated dissection of superior mesenteric artery (SIDSMA) is defined as an SMA dissection without the presence of the aortic dissection. Although this condition is considered rare, the development of advanced imaging technology, in particular, abdominal computed tomography (CT) scan appears to have increased the detection of SMA in recent years. A variety of treatment options have also been described for SIDSMA, including conservative
treatment, endovascular stenting (ES) and surgical repair. Although several treatment options are available, there are currently no consensus guidelines on the proper management of symptomatic SIDSMA.

Herein, we report a contemporary series of 17 patients presenting with acute abdominal pain but no evidence of peritonitis and describe the management strategy we adopted in cases of symptomatic SIDSMA.

MATERIALS AND METHODS

Patients

A retrospective study was performed on 17 consecutive patients (12 male, five female, all Han) with symptomatic SIDSMA from May 2002 to May 2012 of the Second Hospital of Changzhou Affiliated to Nanjing Medical University. All patients were identified by CT angiography (CTA) in our study. Signs of bowel-wall necrosis and perforation (e.g., abdominal wall rebound tenderness, muscle rigidity or shock) were considered a contraindication for conservative treatment and ES. Patients who underwent the procedure provided written informed consent.

Diagnostic work-up and categorisation

Initial diagnosis of SIDSMA was made by a CT scan in all patients. CT was performed by using an eight-multidetector-row CT system (GE, Lightspeed, France) or a 64-multidetector-row CT system (Philips, Rotterdam, The Netherlands). CT technical parameters included: 512 × 512 matrix, 5-mm slice, 300 (GE) and 250 mA (Philips); 120 kV. In addition, the features of CT findings include thrombosis of the false lumen, intramural haematoma, dissecting aneurysm and intimal flap (Fig. 2).

Only the patients who needed to undergo ES did the digital subtraction angiography (DSA). Femoral access was gained by using a 5-French sheath and the SMA angiography was performed in posterior—anterior and lateral projection by using a 5-French catheter.

The initial CTA and DSA were assessed for entry and re-entry points of the dissection, dissection length, patency and degree of luminal stenosis at the dissected segment of the SMA.

Sakamoto et al. have categorised SIDSMA into four types based on contrast-enhanced CT scanning. Recently, Yun et al. added total thrombotic occlusion of the SMA trunk to Sakamoto’s classification, and devised a new classification of three types based on angiographic findings (Fig. 1) — type I: patent true and false lumina that show entry and re-entry sites; type II: patent true lumen but no re-entry flow from the false lumen; type III: no visible false lumen but no visible re-entry site (blind pouch of false lumen); type III: no visible false luminal flow (thrombosed false lumen), which usually causes true luminal narrowing; and type III: SMA dissection with occlusion of SMA.

Treatment

The decision to manage conservatively, to place a stent or to undergo surgery was based on patient symptoms and signs, as well as the morphologic characteristics of SMA dissection on CTA. The factors indicating ES included: (1) compression of the true lumen (degree of true lumen compression larger than 50%) and aneurysmal dilation of the SMA likely to rupture (Fig. 3, when the aneurysmal diameter equal to or larger than the SMA diameter was presumed, the false aneurysm was likely to rupture); (2) compression of the true lumen (degree of true lumen compression larger than 75%); and (3) aneurysmal dilation of the SMA likely to rupture. Aggravation of pain or increasing size of aneurysmal dilation of the SMA at follow-up CT was also considered indicative of ES in patients undergoing conservative treatment (patient nos. 4 and 5).

Conservative treatment consisted of strict blood pressure control, bowel rest, nasogastric suction, intravenous fluid therapy and nutritional support as required. During the earlier part of this study, we used anticoagulation therapy in five patients (patient nos. 6, 7, 8, 15 and 16), but all subsequent patients received neither anticoagulation nor anti platelet therapy. In patients with conservative treatment, fasting was released on resolution of abdominal pain and fluid food was given first; then, diet was resumed after complete resolution of abdominal pain and confirmation of normal physical examination in all the patients. CT scan was additionally checked at any time on aggravation of symptoms after the diagnosis.

ES was performed as a primary treatment in patients with severe compression of the true lumen and large dissecting aneurysm (patient nos. 1—3) and for those with failed conservative treatment (patient nos. 4 and 5). The hydrophilic Terumo wire was used as the guide wire. However, use of a hydrophilic wire in a friable dissected
artery should be very cautiously to avoid further dissection or perforation. Self-expandable stents were sized to the diameter of the normal proximal SMA and stents 10% greater in diameter were chosen. To ensure proper coverage of the entry site, it is important to position the proximal end of the stent around 1 cm proximal to the proximal end of the false lumen to avoid the influences of proximal shortening of the stent and inadvertent migration during deployment. Clopidogrel 225 mg was given before the procedure and heparinisation during the procedure. Anti-platelet therapy was achieved in combination with aspirin and clopidogrel post procedure. Clopidogrel 75 mg daily was administered during 3 months post procedure and continued with acetylsalicylic acid 100 mg daily.

Follow-up
Outpatient clinic visits were encouraged at 1, 6 months and annually thereafter, at which time the clinical features including the nature of abdominal pain (onset, duration, severity and relation to meals) and the provoking event (overeating, overdrinking and pancreatitis) were recorded and assessed.

Statistical analysis
The continuous variables were recorded as means ± standard deviation (SD). The t-test was used to compare the differences in two groups’ variables. All statistical analyses were performed using statistical software SPSS (version 11.5). A value of P <0.05 was considered to indicate a statistically significant difference.

RESULTS
The clinical characteristics of the 17 patients are summarised in Table 1. The median age is 57 (range 47–76) years. Relevant co-morbidities included hypertension (52.9%), diabetes mellitus (29.4%), hyperlipidaemia (17.6%), smoking (23.5%) and atherosclerosis (29.4%). No patients had identifiable risk factors such as Marfan’s syndrome, trauma, fibromuscular dysplasia or vasculitis. The time interval between onset of symptoms and performance of CTA was 7.5 ± 3.9 h (range 2–32 h). All patients reported abdominal pain (onset, duration, severity and relation to meals) and this was identified by CT scans. No patient exhibited signs of bowel wall infarction and perforation (e.g., abdominal wall muscle rigidity or shock). The median distance from the SMA ostium to the beginning of SMA dissection is 23 ± 12 mm (range, 9.6–50 mm). The median length of SMA dissection was 49 ± 26 mm (range, 22–120 mm). SISMAD lesions were categorised into the following groups according to their angiographic findings: 0% Type I, 29.4% Type IIa, 70.6% Type IIb and 0% Type III.

Conservative treatment was initially tried in 14 patients. Five patients (patient nos. 6, 7, 8, 15 and 16) underwent anticoagulation therapy and all subsequent patients received neither anticoagulation nor anti-platelet therapy. Among them, 12 patients were successfully treated with a median follow-up period of 30 months (range, 2–72 months), and serial CT scans demonstrated thrombosis and obliteration of the false lumen with time. The median fasting time was 8.5 days (range, 4–14 days), the abdominal pain was resolved and the patients were discharged without any significant complications. No complications associated with SMA dissection occurred during follow-up. ES was performed in two patients in whom initial conservative treatment failed. Patient no. 4 demonstrated a dissecting aneurysm at the 31-day follow-up CT scan after conservative treatment. Patient no. 5 evidenced an increasing diameter of SMA aneurysm from 2.6 to 5.8 mm at the 9-day follow-up CT scan. These two patients were treated successfully with ES.

Three patients (patient nos. 1–3) with severe compression of the true lumen or dissecting aneurysm likely to rupture underwent emergency ES after diagnosis. Self-expandable stents (ACCULINK carotid stent; nitinol, Abbot Laboratories, Abbott Park, IL, USA) with diameters of up to 8 mm and overall lengths of up to 50 mm were used. The
median fasting time was 3.5 days (range, 2–5 days), which was significantly shorter than in the conservative treatment group ($P < 0.05$). The dissecting aneurysm showed complete obliteration after stent placement in patient no. 2, and partial obliteration (i.e., the aneurysmal volume reduced, shape of aneurysm changed and the false lumen thrombosed) in patient nos. 1, 4 and 5, reduced (i.e., the aneurysmal volume reduced, but the shape of aneurysm did not change and there was no thrombus in the false lumen) in patient no. 3 and excellent distal blood flow was restored and abdominal pain was completely resolved postoperatively in all patients; the detailed information on the technical aspects of stented patients is given in Table 2. The median follow-up was 12 months (range, 6–38 months) and repeated CT scans demonstrated thrombosis and obliteration of the dissecting aneurysm with time and the patency of the SMA without any in-stent restenosis (Fig. 4). No ES-related complications were developed.

All patients attended follow-up, and the median follow-up time was 24 months (range, 2–72 months). Repeated CT scans demonstrated thrombosis and obliteration of the false lumen and dissecting aneurysm with time and the patency of the SMA without any in-stent restenosis. No patient received surgical repair. The treatments and outcomes of each patient are summarised in detail in Table 1.

**DISCUSSION**

SIDSMA is a very rare condition. The postmortem study revealed an incidence of 0.06% in a series of 6666 autopsies. Recently, however, SIDSMA has been reported more frequently. SIDSMA can be detected as an incidental finding but may also cause drastic complications such as bowel infarction and severe haemorrhage. Although approaches such as conservative treatment, ES and surgical repair have been previously reported, given the paucity of SIDSMA, the optimal treatment for SIDSMA remains a matter of some controversy.

Yun et al. reported that SIDSMA occurs mainly in male patients in their fifth decade. Furthermore, the underlying causes of SIDSMA did not appear to be related to atherosclerotic risk factors such as hypertension. In our series, SIDSMA occurs mainly in male patients (12 of 17 patients, 70.6%) in their fifth decade (median age is 57 years) and 52.9% (9 of 17 patients) of them have hypertension.

The natural course of SIDSMA would be as follows: (1) limited progression with thrombosis of the false lumen; (2) progressive dissection to distal branches of the SMA; (3) rupture through the adventitia; or (4) rapidly expanding false lumen resulting in the narrowing or obliteration of the true lumen. Thus, the primary objective of treatment in SIDSMA is to limit the extension of dissection, to preserve the blood flow distally through the true lumen and to prevent the rupture of the false lumen. Gobble et al. recently reviewed 106 SIDSMAs and reported that 12 (30.0%) among 43 patients with expectant therapy failed and eight (34.8%) out of 23 patients with anticoagulation failed. Moreover, anticoagulation required a prolonged fasting period of up to 33 days (27.2 days on average). Progression of disease and aneurysmal dilatation in some cases was reported despite the administration of chronic anticoagulation therapy. Considering the aforementioned treatment objectives of the SIDSMA and reports, however, there has been no firm evidence to support anticoagulation therapy in SIDSMA. In our series, 12 patients (70.6%) with symptomatic SIDSMA were treated successfully by conservative treatment, five patients

<table>
<thead>
<tr>
<th>No</th>
<th>Age/sex</th>
<th>Symptoms</th>
<th>Risk factors</th>
<th>Type</th>
<th>Treatment</th>
<th>Symptom change</th>
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<tbody>
<tr>
<td>1</td>
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<td>ES</td>
<td>Pain resolution</td>
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<td>—</td>
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<td>CT-ES</td>
<td>Pain resolution</td>
<td>38</td>
</tr>
<tr>
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<tr>
<td>9</td>
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<td>—</td>
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<td>CT</td>
<td>Pain resolution</td>
<td>2</td>
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<td>Iib</td>
<td>CT</td>
<td>Pain resolution</td>
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<td>Pain resolution</td>
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<tr>
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<td>Iib</td>
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<td>Pain resolution</td>
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<tr>
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<td>73/M</td>
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<tr>
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<td>Iib</td>
<td>CT</td>
<td>Pain resolution</td>
<td>38</td>
</tr>
<tr>
<td>16</td>
<td>57/M</td>
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<td>Iib</td>
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<td>Pain resolution</td>
<td>43</td>
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<tr>
<td>17</td>
<td>76/M</td>
<td>Abdominal pain</td>
<td>Hypertension, Hyperlipidaemia, DM, Atherosclerosis</td>
<td>Iib</td>
<td>CT</td>
<td>Pain resolution</td>
<td>10</td>
</tr>
</tbody>
</table>

*Age: years, conservative treatment: CT, diabetes mellitus: DM, CT-ES: started conservative treatment but converted to ES.*
underwent anticoagulation therapy and all subsequent patients received neither anticoagulation nor anti-platelet therapy. SMA ES is known to have a higher risk of stent thrombosis than other site artery stents in the long term.3 To prevent acute or subacute thrombosis after ES, a stent used for SMA needs to have minimal shortening, good flexibility and weaker radial force, and it must not change location as a result of the continuous movement of the mesentery;18 once did not want to submit the weakened artery wall to excessive tension, the self-expandable stent is usually recommended and used. ES to the entry tear site of SMA dissection can cover the intimal flap and occlude blood inflow to the false lumen. The false lumen then is obliterated by thrombosis. Radial force of the self-expandable stent can easily overcome the pressure of the false lumen, which is usually caused by fresh thrombus. Self-expandable stents also provide sufficient diameter of the true lumen. A covered stent graft can be successfully used to cover the dissecting broad-base pseudo-aneurysm of the SMA, of which intimal flap cannot be covered by an open stent.19 It may be more beneficial to implant a covered stent graft over the entry site of the dissection.20 As the covered stent graft can cause the obliteration of multiple side branches of the SMA, however, it is not usually recommended. In the currently described patients, and indeed in most cases of segmental dissection with side-branch involvement, which were treated successfully by open stents, we used an open stent and achieved good results. In our series, ES was offered as an initial treatment in three patients whose aneurysmal dilation or true lumen was severely compressed and secondary in two patients who failed in conservative treatment. ES provided immediate symptomatic improvement and prevented further progression of the false lumen with a shorter fasting time. With a median follow-up of 12 months, the patency of the stents was demonstrated by repeated CT scans. Therefore, our strategy of restricting ES for those patients who have compression of the true lumen or dissecting aneurysm likely to rupture (and for those with failed conservative treatment) was successful. Gobble et al.7 suggested that patients presenting with acute abdominal pain should undergo emergency ES to restore blood flow to the small bowel. In our series, all patients had acute-onset abdominal pain, and most of them (70.6%) underwent conservative treatment and got good result; therefore, conservative treatment is a promising alternative in patients without compression of the true lumen or dissecting aneurysm likely to rupture. Gobble et al.7 suggested that open surgical repair should not be delayed if symptoms persist for 24 h on anticoagulation also. In our series, symptoms persisted more than 26 and 32 in two patients (patient nos. 1 and 2) until diagnosed by CTA. From the CTA we could see the aneurysmal dilation and severe compression of the true lumen. The two patients underwent emergency ES, and got good results; therefore, ES for these patients having compression of the true lumen or dissecting aneurysm likely to rupture (and for those with failed conservative treatment) was successful even when the symptoms persisted for >24 h. The current evidence of treatment of symptomatic SIDSMA is summarised in Table 3.

Study limitations
The major limitation of this nonrandomised study is that its retrospective nature does not allow for direct comparison.

Table 2. The detail technical aspects information of stented patients.

<table>
<thead>
<tr>
<th>No</th>
<th>Severe compression of the true lumen</th>
<th>Aneurysm change</th>
<th>Dissection with side branch involvement</th>
<th>Self-expandable stent diameter/lengths</th>
<th>Fasting time (days)</th>
<th>Aneurysm change</th>
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<td>1</td>
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<td>Yes</td>
<td>No</td>
<td>7 mm/30 mm</td>
<td>5 d</td>
<td>Partly obliteration</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>7 mm/50 mm</td>
<td>4 d</td>
<td>Complete obliteration</td>
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<tr>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>8 mm/30 mm</td>
<td>2 d</td>
<td>Reduced</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>7 mm/40 mm</td>
<td>2 d</td>
<td>Partly obliteration</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>7 mm/30 mm</td>
<td>4.5 d</td>
<td>Partly obliteration</td>
</tr>
</tbody>
</table>

*Reduced means the aneurysmal volume reduced, but the shape of aneurysm didn’t change and no thrombus in the false lumen. Partly obliterated means the aneurysmal volume reduced, shape of aneurysm be changed, and thrombosed false lumen.

Figure 4. (Patient no. 3, type IIa): A computed tomography angiogram shows thrombosis and obliteration of the dissecting aneurysm and patency of the stent without any in-stent restenosis 6 months postoperatively.
with other treatment strategies. Patients were selected for the study based on CT findings. Therefore, a number of patients who presented with SMA occlusion, bowel infarction necessitating laparotomy, and died of bowel infarction related to an SIDSMA who never had a CT scan or a laparotomy wound not have been included in our study. In addition, the number of patients was few and the observation time was short.

**Recommendations**

We propose the following algorithm for the treatment of a symptomatic SIDSMA. If bowel perfusion is not compromised and the SMA aneurysm is not likely to rupture in patients with a symptomatic SIDSMA, they should initially undergo conservative treatment without anticoagulation and anti-platelet. ES is indicated if patients have compression of the true lumen of the SMA, or SMA aneurysm is likely to rupture on initial CT scan. Patients initially treated with conservative treatment should be monitored closely and should undergo a follow-up CT scan 15 days, 1 month, 6 months and yearly after diagnosis, and CT scan was additionally checked at any time with aggravation of symptoms after the diagnosis. Patients who underwent ES undergo follow-up CT scan 1 month, 6 months and yearly after the procedure. In cases involving aggravating symptoms, no major relief of pain within 7 days or progression of SMA dissection on follow-up CT scan, ES should be considered without delay. Imaging surveillance in successfully treated patients, by either conservative treatment or ES, should include CT scans or duplex sonography at 1 month, 6 months and yearly thereafter. A symptomatic SIDSMA is a rare entity; therefore, our recommendations should not be taken as a consensus guideline.

**CONCLUSIONS**

In conclusion, conservative treatment is a promising alternative in selected patients with symptomatic SIDSMA, and our strategy of restricting ES for these patients having compression of the true lumen or dissecting aneurysm likely to rupture (and for those with failed conservative treatment) was successful.

**ACKNOWLEDGEMENT**

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Ethical approval for the study was obtained from the Institutional Review Board at our hospital.

**CONFLICTS OF INTEREST**

The authors indicated no potential conflicts of interest.

**REFERENCES**


