Endovascular treatment of spontaneous dissections of the superior mesenteric artery

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Background: Spontaneous dissection of the superior mesenteric artery (SMA) is exceedingly rare. Treatment options range from observation to anticoagulation to open surgery or endovascular repair. We present our experience to date in the management of isolated SMA dissections.

Methods: A retrospective review of the vascular surgery and radiology databases from 1998 to 2008 was performed. In general, incidental radiologic findings of a dissection were managed expectantly. The decision to intervene was based on anatomic suitability, patient comorbidities and symptoms, and physician preference. Endovascular stents were placed using a brachial approach, with the choice of stent determined by physician preference. Patients who underwent endovascular stent placement (ESP) were maintained on antiplatelet therapy for 6 months postoperatively. Follow-up consisted of yearly office visits and adjunctive computerized tomography (CT) or magnetic resonance imaging (MRI) when clinically indicated.

Results: CT or MRI imaging identified nine patients (7 men, 2 women) with an isolated SMA dissection. One patient also had a concomitant celiac artery dissection. Median age was 70 years (range, 46-73 years). Median follow-up time was 32 months (range, 13.8-62.5 months). Presentations included an incidental radiologic finding in three patients and acute onset abdominal pain in six. Treatment included expectant management in four patients, anticoagulation in two, and ESP in three. ESP was performed primarily in two patients and in a third patient after initial management with anticoagulation failed. The reduction in the diameter of the true lumen was significantly greater in patients treated with ESP vs patients who were successfully managed expectantly or with anticoagulation (F = 15.59, P < .005). No procedural complications were associated with ESP.

Conclusions: An isolated SMA dissection is a rare entity that may be managed successfully in a variety of ways based on clinical presentation. Endovascular stenting can be performed with good results and may be the preferred treatment in patients with symptomatic isolated SMA dissections. (J Vasc Surg 2009;50:1326-32.)

Spontaneous dissection of the SMA occurs very infrequently. Treatment options previously described for an isolated SMA dissection include expectant management, anticoagulation, open surgical repair, and endovascular repair. Although several treatment options are available, there are currently no consensus guidelines on the proper management of an isolated SMA dissection. We report nine cases of an isolated SMA dissection and provide a treatment algorithm we have adopted based on the current literature and our results.

METHODS

A retrospective review of the vascular surgery and radiology databases from 1998 to 2008 was performed after obtaining Institutional Review Board approval. Demographics, medical comorbidities, location of dissection, presence of an aneurysm, percentage of true lumen reduc-
Endovascular treatment of isolated SMA dissections were associated with ESP.

14.1% vs 30.0% P < .005). The error bars show the standard deviation.

RESULTS

CT or MRI imaging identified nine patients (7 men, 2 women) with an isolated SMA dissection. One patient also had a concomitant celiac artery dissection. The median age was 70 years (range, 46-73 years), and median follow-up time was 32 months (range, 13.8-62.5 months). Presentations included an incidental radiologic finding in three patients and acute onset abdominal pain in six. Treatment was by expectant management in four patients, anticoagulation in two, and ESP in three. ESP was performed as the initial treatment in two patients and in a third patient after initial management with anticoagulation failed.

The median distance from the SMA ostium to the beginning of the SMA dissection was 3.0 cm (range, 0.7-3.3 cm). Three patients had aneurysmal dilatation of the SMA at the time of presentation. The median diameter of SMA aneurysms was 1.3 cm (range, 1.1-1.3 cm). Aneurysmal dilatation of the SMA did not affect the management of the SMA dissection in any case. Patients who underwent ESP had a significantly greater reduction in the diameter of the true lumen compared with patients who were successfully managed expectantly (91.7% ± 5.8% vs 30.0% ± 18.3%, P < .005) or with anticoagulation (91.7% ± 5.8% vs 50.0% ± 14.1%, P < .005; Fig 1). No significant difference was noted in true lumen reduction in patients successfully managed expectantly or with anticoagulation (50.0% ± 14.1% vs 30.0% ± 18.3%, P > .05). No procedural complications were associated with ESP.

Endovascular treatment of isolated SMA dissections

Patient 1. A 43-year-old man with Behcet’s disease presented with postprandial abdominal pain for 3 weeks. A CT scan of the abdomen and pelvis demonstrated dissections of the SMA and celiac artery. The origin of the SMA was nearly occluded. The patient was treated with anticoagulation for 3 days without an improvement in pain. He then underwent placement of a 6- × 15-mm Herculink (Abbott Laboratories, Abbott Park, Ill) stent in the SMA. The completion angiogram demonstrated brisk flow and no residual SMA stenosis. The celiac stenosis was not flow-limiting and was not treated. Postoperatively, the abdominal pain completely resolved. A repeat CT angiogram at the 19-month follow-up demonstrated patency of the SMA stent.

Case 2. A 48-year-old man presented to the emergency department with acute abdominal pain. A CT scan of the abdomen and pelvis demonstrated a nearly occlusive thrombus of the proximal SMA with reconstitution distally (Fig 2, A and B). A selective SMA angiogram confirmed the presence of a focal dissection of the SMA 3 cm from the ostium, with severe compression of the true lumen by the partially thrombosed false lumen. A 7- × 20-mm Xceed (Abbott Laboratories) stent was placed in the SMA. A completion SMA angiogram demonstrated excellent blood flow distally, with obliteration of the false lumen proximally. His abdominal pain completely resolved and he was discharged home on postoperative day 3. A repeat CT angiogram performed at the 12-month follow-up demonstrated patency of the SMA stent (Fig 2, C).

Case 3. A 78-year-old woman with no prior medical problems presented with periumbilical abdominal pain and distension for 2 weeks. A MR angiogram of the abdomen and pelvis demonstrated a severe proximal SMA stenosis secondary to a partially thrombosed focal dissection (Fig 3, A). An intraoperative angiogram confirmed the presence of a focal dissection of the SMA 1.5 cm from the ostium, with severe compression of the true lumen by the thrombosed false lumen. A 6- × 18-mm Herculink stent was placed in the SMA, resulting in complete obliteration of the false lumen proximally and excellent blood flow distally. The patient’s abdominal pain completely resolved, and she was discharged home on postoperative day 2. A repeat CT angiogram performed at the 11-month follow-up demonstrated patency of the SMA stent (Fig 3, B).

Literature review of SMA dissection. A review of the PubMed database (www.pubmed.gov) for articles in English with the keywords “isolated,” “superior mesenteric artery,” and “dissection” revealed 106 documented cases of an isolated SMA dissection (Table 1). The average age of patients at the time of presentation was 54 years, and the disease was four times more prevalent in men than in women. Aneurysmal dilatation of the SMA occurred in 51 of the 106 documented cases.

Expectant management was successful in 31 of 56. In the 31 patients where expectant management was successful, 10 patients were asymptomatic at the time of presentation and 21 were symptomatic. Expectant management failed in 25 patients; surgical intervention was successful in 12 of these patients and 13 died (the diagnosis of an SMA dissection was made at autopsy in 12 of these patients).
Anticoagulation was successful in 15 of 23 patients. Seven patients in whom anticoagulation therapy failed were successfully treated with surgery, and one patient died. Open surgical repair was successful in all 22 patients in whom it was attempted. ESP was successful in four of five patients in whom it was attempted as a primary treatment. The lone failure was due to recurrence of an aneurysmal dilated false lumen that was successfully treated with a second SMA stent at a later date. ESP was also successful in two cases of failed expectant management and five cases of failed anticoagulation. Overall, ESP was successful in 11 of 12 patients where it was attempted.

DISCUSSION

Isolated spontaneous dissection of the SMA is rare. Reported risk factors include cystic medial degeneration, atherosclerosis, fibromuscular dysplasia, pregnancy, connective tissue disorders, and trauma; however, in almost all instances, a definitive pathologic cause for the dissection cannot be identified. Although an isolated SMA dissection most commonly presents as acute onset abdominal pain, patients may also present with intestinal angina and weight loss from a chronic dissection resulting in a compromised true lumen. With the increased sensitivity of CT scans, it is becoming apparent that a significant subset of patients may be asymptomatic, and the SMA dissection may only be detected as an incidental finding on imaging studies for other complaints. Isolated SMA dissections are most commonly diagnosed by CT scan but may also be diagnosed by ultrasound imaging, MRI, or angiogram.

The SMA dissection typically begins 1.5 to 3.0 cm from the ostium. Some have postulated the SMA is more susceptible to shearing stress at this point due its relationship to the pancreas, analogous to what is seen at the ligamentum arteriosum during rapid deceleration injuries such as aortic dissection. In our study, the median distance from the SMA ostium to the beginning of the SMA dissection was 3.0 cm, consistent with this hypothesis.

Before the first surgical repair of an isolated SMA dissection in 1975, the disease had only been diagnosed on postmortem examination. Since then numerous open and endovascular surgical techniques have been used to treat isolated SMA dissections. Nonoperative treatment for an isolated SMA dissection originally consisted of bowel rest and observation, without the use of anticoagulation. Our review of the literature found that this treatment approach was successful in only 31 of 56 patients. The SMA dissection was an incidental finding in almost a third (10 of 31) of these patients. Of the 25
patients in whom expectant management failed, surgical repair was successful in 12 and 13 died. Nearly all of the fatalities occurred before the first successful surgical repair.

Anticoagulation therapy has since become the mainstay for the conservative treatment of SMA dissections and has been associated with improved results. Ambo et al.\(^3\) were the first to successfully treat a patient conservatively with bowel rest and intravenous heparin therapy. Since this initial report, 22 similar cases have been described in the literature, with a successful outcome in 14 patients. In seven of the eight patients where conservative treatment with anticoagulation failed, surgery was successful in treating the SMA dissection.\(^4,24,32,34,35\) The eighth patient had a concomitant vertebral artery dissection that proved fatal.\(^36\)

Experience with treatment of cervical artery dissections suggests that treatment with antiplatelet therapy may be as effective as anticoagulation in preventing thrombosis of the true lumen, ultimately preventing transient ischemic attacks, stroke, or death.\(^37\) The Cervical Artery Dissection in Stroke Study was a prospective, multicenter randomized-controlled trial that was conducted to answer whether antiplatelet therapy is superior to anticoagulation in the treatment of cervical artery dissections.\(^38\) Unfortunately, given the paucity of SMA dissections compared with cervical artery dissections, results from this study may be of limited use for guiding management in SMA dissections. Moreover, the mainstay for the treatment of cervical artery dissections is clearly anticoagulation, whereas there is no consensus statement for management of SMA dissections.

The four patients in our study treated expectantly had a favorable outcome; however, only two of the patients were symptomatic at the time of presentation. Treatment with anticoagulation was successful in two of three patients. The lone failure occurred in a 43-year-old man with Behçet’s

**Table I.** Review of the literature for 106 isolated superior mesenteric artery dissections\(^a\)

<table>
<thead>
<tr>
<th>Primary management</th>
<th>No. Success, no.</th>
<th>Failure, no.</th>
<th>Procedure No.</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectant</td>
<td>56</td>
<td>31</td>
<td>25</td>
<td>Surgery 10</td>
</tr>
<tr>
<td>Anticoagulation</td>
<td>23</td>
<td>15</td>
<td>8</td>
<td>Surgery 2</td>
</tr>
<tr>
<td>Open surgery</td>
<td>22</td>
<td>22</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ESP</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>ESP 1</td>
</tr>
</tbody>
</table>

\(^a\)Of the 56 patients managed expectantly, 10 were asymptomatic and 46 were asymptomatic. All other patients managed with either anticoagulation, open surgery, or ESP were symptomatic.

\(^b\)12 of 13 patients who died with expectant management were diagnosed on autopsy.

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Fig 3. A, A magnetic resonance angiogram demonstrates a severe focal dissection of the proximal superior mesenteric artery (arrow). B, A computed tomography angiogram shows patency of the Herculink stent (arrow) 11 months postoperatively.
disease and simultaneous SMA and celiac artery dissections who was successfully treated with an SMA stent.

Yoon et al24 was the first to describe endovascular treatment of an isolated SMA dissection in a 52-year-old man after treatment with Coumadin (Bristol-Myers Squibb, Princeton, NJ)24; whereas Froment et al26 was the first to describe ESP as a primary treatment for an isolated SMA dissection. Overall, 15 patients with an isolated SMA dissection have been treated with ESP, including the three patients in our study (Table II). 4,23-30,32 The average follow-up for these patients is 11.4 months (range, 2-38 months). The result of all patients managed initially with endovascular intervention was pain dissipation. However, Kim et al25 reported a 54-year-old man who had a recurrence of the aneurysmal dilated false lumen 4 months after ESP placement.25 The patient was successfully treated by placement of a second stent and was asymptomatic at the 2-month follow-up visit.

In our study, the two patients initially managed with ESP had complete resolution of their abdominal pain postoperatively and were pain-free after 11 and 12 months of follow-up. In addition, a 43-year-old man in whom initial treatment with anticoagulation failed was successfully treated with ESP and was also pain-free after 19 months of follow-up. In all three patients, the patency of the SMA stent was documented by a CT angiogram.

On the basis on our experience and review of the literature, our group has adopted the following algorithm for treating an isolated SMA dissection (Fig 4). Patients with an incidentally detected SMA dissection should undergo regular surveillance imaging with an annual CT scan. If repeat imaging shows progression of the dissection or aneurysmal dilatation, ESP should be performed without delay. Patients presenting with acute abdominal pain should undergo emergency ESP to restore blood flow to the small bowel. Anticoagulation or open surgical repair may be attempted when ESP is technically unsuccessful or unavailable. However, open surgical repair should not

### Table II. Review of isolated superior mesenteric artery (SMA) dissections treated with endovascular stent placement (ESP)

<table>
<thead>
<tr>
<th>First author</th>
<th>Age</th>
<th>Sex</th>
<th>Abdominal pain Location</th>
<th>Treatment</th>
<th>Outcome</th>
<th>Follow-up, mon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leung (2000)</td>
<td>67</td>
<td>M</td>
<td>Acute SMA</td>
<td>8 × 68-mm Wallstent*</td>
<td>Pain resolution</td>
<td>6</td>
</tr>
<tr>
<td>Yoon (2003)</td>
<td>52</td>
<td>M</td>
<td>Acute SMA</td>
<td>6 × 15-mm Corinthian stent, ×2b</td>
<td>Pain resolution</td>
<td>12</td>
</tr>
<tr>
<td>Froment (2004)</td>
<td>58</td>
<td>M</td>
<td>Acute SMA</td>
<td>8 × 20-mm Wallstent, ×2; 7 × 28-mm Jo-Wave Max stent</td>
<td>Pain resolution</td>
<td>18</td>
</tr>
<tr>
<td>Kim (2004)</td>
<td>48</td>
<td>F</td>
<td>Acute SMA</td>
<td>8 × 7-mm Wallstentb</td>
<td>Pain resolution</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>M</td>
<td>Acute SMA</td>
<td>8 × 60-mm Wallstent; 10 × 50-mm S.M.A.R.T. stent</td>
<td>Pain resolution</td>
<td>2</td>
</tr>
<tr>
<td>Miyamoto (2005)</td>
<td>59</td>
<td>M</td>
<td>Acute SMA</td>
<td>10 × 60-mm LumineX stent; 10 × 40-mm LumineX stent</td>
<td>Pain resolution</td>
<td>2</td>
</tr>
<tr>
<td>Tsai (2005)</td>
<td>53</td>
<td>M</td>
<td>Acute SMA</td>
<td>5 × 18-mm Jostent stent; 4 × 38-mm Jostent stent</td>
<td>Pain resolution</td>
<td>22</td>
</tr>
<tr>
<td>Sakamoto (2007)</td>
<td>51</td>
<td>M</td>
<td>Acute SMA</td>
<td>Palmaz stent</td>
<td>Pain resolution</td>
<td>38</td>
</tr>
<tr>
<td>Casella (2008)</td>
<td>51</td>
<td>M</td>
<td>Acute SMA</td>
<td>8 × 36-mm Wallstent*</td>
<td>Pain resolution</td>
<td>3</td>
</tr>
<tr>
<td>Wu (2009)</td>
<td>56</td>
<td>M</td>
<td>Acute SMA</td>
<td>6 × 40-mm Fluency covered stentb</td>
<td>Pain resolution</td>
<td>9</td>
</tr>
<tr>
<td>Wu (2009)</td>
<td>53</td>
<td>M</td>
<td>Acute SMA</td>
<td>10 × 60-mm Aurora stent; 10 × 40-mm Aurora stentb</td>
<td>Pain resolution</td>
<td>6</td>
</tr>
<tr>
<td>Gobble (2009)</td>
<td>66</td>
<td>M</td>
<td>Acute SMA</td>
<td>9 × 60-mm Aurora stentb</td>
<td>Pain resolution</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>M</td>
<td>Acute SMA, CA</td>
<td>6 × 15-mm Herculink SMA stentb</td>
<td>Pain resolution</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>M</td>
<td>Acute SMA</td>
<td>7 × 20-mm Xceed stent</td>
<td>Pain resolution</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>78</td>
<td>F</td>
<td>Acute SMA</td>
<td>6 × 18-mm Herculink stent</td>
<td>Pain resolution</td>
<td>19</td>
</tr>
</tbody>
</table>

CA, Celiac artery.  
Wallstent (Boston Scientific, Natick, Mass); Corinthian, Palmaz, S.M.A.R.T. (Cordis, Miami Lakes, Fla); Jostent, Jo-Wave Max (Abbott Labs, Abbott Park, Ill); Fluency, LumineX (Bard, Murray Hill, NJ); Aurora (Medtronic, Minneapolis, Minn).  
*Treated expectantly before ESP.  
*bTreated with urokinase and anticoagulation before ESP.  
+cTreated with anticoagulation before ESP.

Fig 4. Treatment algorithm for isolated superior mesenteric artery (SMA) dissections. ESP, Endovascular stent placement.
be delayed if symptoms persist for >24 hours on anticoagulation. Our treatment algorithm is based on our experience treating isolated SMA dissections and a thorough review of the literature. An isolated SMA dissection is a rare entity; therefore, our recommendations should not be taken as a consensus guideline.

CONCLUSION

We report nine patients with an isolated SMA dissection, four of whom were treated with expectant management, two with anticoagulation, and three with ESP. On the basis of the results of this study and a thorough review of the literature, we report our algorithm for treating isolated SMA dissections and recommend primary stenting for patients who present with a symptomatic isolated SMA dissection.

AUTHOR CONTRIBUTIONS

Conception and design: RG, TM
Analysis and interpretation: RG, TM
Data collection: RG, EB, CR, EH, PL, GJ, TM
Writing the article: RG, EB, TM
Critical revision of the article: RG, EB, TM
Final approval of the article: RG, EB, TM
Statistical analysis: RG, EB, TM
Obtained funding: Not applicable
Overall responsibility: TM

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Submitted Apr 20, 2009; accepted Jul 7, 2009.