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Superior mesenteric artery stenting using embolic protection device for treatment of acute or chronic mesenteric ischemia

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ABSTRACT

Objective: The objective of the study was to report the feasibility and results of superior mesenteric artery (SMA) stenting using embolic protection devices (EPDs) to treat acute mesenteric ischemia (AMI) and chronic mesenteric ischemia (CMI).

Methods: A retrospective review was conducted of consecutive patients who underwent SMA stenting with EPDs from 2007 to 2016. EPDs were used selectively in patients with occlusions, severe calcification, or acute thrombus. A two-wire technique with SpiderFX 0.014-inch filter wire (Medtronic, Minneapolis, Minn) combined with a 0.018-inch wire was used to provide support and to facilitate stenting and EPD retrieval. Presence of macroscopic debris in the EPD was recorded and graded as minor (minimal debris) or major (large thrombus or plaque). End points were technical success, presence of EPD debris, embolization, early morbidity, and mortality.

Results: SMA stenting was performed in 179 patients, of whom 65 (36%) had EPDs. The mean age was 73 ± 11 years, and 49 were female (75%). Clinical presentation was CMI in 48 patients (74%) and AMI or acute-on-CMI in 17 (26%). Indications for EPD were severe calcification in 22 patients (34%), acute thrombus in 18 (28%), and total occlusion in 16 (25%). Bare-metal stents were used in 33 patients, covered stents in 26, and both types in 6. Adjunctive therapy included thrombolysis in seven patients, thrombectomy in four, and atherectomy in three. Technical success was 100%. There were no instances of filter retention or arterial trauma due to filter manipulation. Distal embolization was noted in four patients (6%), of whom two had AMI. All large emboli were retrieved using catheter aspiration devices, but one small distal embolus was left untreated with no clinical consequences. Two patients had vessel spasm treated by nitroglycerin. Macroscopic debris was noted in 43 patients (66%) and was major in 21 (49%) or minor in 22 (51%). Of the patients with AMI, five (29%) required exploratory laparotomy and four (23%) had bowel resection. Eight additional patients (12%) had early complications (five CMI, three AMI), including cardiac complications, brachial hematoma, acute cholecystitis, and acute respiratory distress syndrome in two patients each. There were no deaths among CMI patients and two early deaths (12%) among those who had AMI.

Conclusions: Use of EPDs during SMA stenting is safe and feasible with a two-wire technique. Large macroscopic debris was noted in one-third of the patients when the filter was applied selectively in patients with acute symptoms, occlusions, or severely calcified lesions. Despite the use of EPD, distal embolization occurred in 6% of patients and was successfully treated using catheter aspiration devices. (J Vasc Surg 2018;■:1-8.)

Keywords: Chronic mesenteric ischemia; Endovascular treatment; Embolic protection

Endovascular therapy has become the main modality for treatment of atherosclerotic mesenteric arterial disease. Several large series have shown high rates of technical success, symptom improvement, and low morbidity and mortality in patients treated for chronic mesenteric ischemia (CMI). Patients with acute mesenteric ischemia (AMI) and acute-on-CMI have higher mortality rates and lower technical success, which is related to duration of ischemia, presence of advanced bowel gangrene, and significant thrombus burden within the mesenteric arteries.[1-3] In these patients, the superior mesenteric artery (SMA) is generally affected by complex, heavily calcified plaque or associated thrombus, which often requires recanalization of chronic total occlusion or in situ acute-on-chronic thrombotic occlusions. These lesions have higher risk of thromboembolic complications and acute vessel or stent reocclusion, which can lead to bowel gangrene, multisystem organ failure, and death.[4]

Embolic protection devices (EPDs) have been designed for coronary grafts and carotid arteries but have been successfully used off-label in other vascular beds.[5,6] There

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is little if any controversy that EPDs should be indicated when the consequences of embolization cause irreversible end-organ damage, such as during carotid stenting, which has a known risk of embolic stroke.[7] Mesenteric stenting can also cause embolization from catheter manipulations or dislodgment of plaque or thrombus, which may result in occlusion of distal branches, leading to vessel thrombosis and bowel gangrene.[4] This is particularly important if the vessel occlusion is not immediately recognized and treated. Despite the relative lack of literature, we have used EPDs selectively in patients with heavily calcified stenosis, occlusions, and acute or subacute presentations. The objective of our study was to analyze the indications, techniques, and outcomes of patients who underwent primary stenting of the SMA using EPDs to treat occlusive mesenteric artery disease.

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective, single-center cohort study
- **Take Home Message:** In 65 of 179 patients presenting with mesenteric ischemia, embolic protection devices were used selectively during superior mesenteric artery stenting in cases of occlusion, severe calcification, or acute thrombus with a technical success rate of 100% and macroscopic debris identified in 66% of cases.
- **Recommendation:** This study suggests that embolic protection devices should be used during superior mesenteric artery stenting in cases of occlusions, severe calcification, and acute thrombus.

METHODS

This study was approved by the Mayo Clinic Institutional Review Board. All patients consented with research participation. We performed a retrospective review of consecutive patients who underwent SMA stenting with EPDs from 2007 to 2016. The indication for use of an EPD was left to the discretion of the practitioner and was recorded when available on medical records. In general, indications were chronic occlusions, lesions longer than 3 cm with >66% circumferential or luminal calcification, and acute or subacute symptom presentation. EPDs were also used in patients without these anatomic criteria at the discretion of the treating physician. We excluded from the study patients who had mesenteric stenting without embolic protection.

Demographics, cardiovascular risk factors, and clinical presentation were recorded. The primary symptom presentation was classified as chronic (>4 weeks), subacute (2-4 weeks), or acute (<2 weeks) on the basis of duration of symptoms. Lesion characteristics were analyzed using preoperative computed tomography angiography whenever possible. Calcified lesions were further analyzed as encompassing <33%, 33% to 66%, or >66% of the vessel circumference in the proximal 1 to 4 cm of the vessel. The length of circumferential calcified plaque, occlusion, and thrombus was also noted. Thrombus was recorded as present when irregular, hypodense filling defects were identified on computed tomography angiography, both occlusive and nonocclusive. Procedural details were noted, including approach (brachial or femoral), stent type, diameter and length, use of dilation before or after the intervention, EPD type and diameter, and presence of intraoperative complications. EPD-related complications were defined as side branch embolization, difficult filter retrieval, improper deployment, and target vessel spasm. Debris in the EPD basket was recorded and usually photographed. This was classified as absent, minor (diminutive or <20% of the filter basket), or major (large debris, plaque, or >20% of filter basket). Early outcomes were recorded, including morbidity, mortality, length of intensive care unit and hospital stay, and early reinterventions.

Technique. The technique of mesenteric artery stenting has been previously described by our group.[8] The left brachial artery approach using surgical exposure with a small incision was used preferentially, but the femoral approach was indicated in patients with a heavily diseased aortic arch and favorable angle of origin in the SMA. A catheter support system was built using a combination of a 6F or 7F 90-cm hydrophilic sheath combined coaxially with a 7F guide catheter and a 5F multipurpose A (MPA) catheter. For complex lesions, such as chronic total occlusions or heavy calcified lesions, the 7F sheath, 7F MPA guide catheter, and 5F MPA catheter were used to engage the stump of the occluded vessel, allowing enough support for passage of a guidewire to the distal SMA (Fig 1). The target lesion was initially crossed using a 0.035-inch soft straight or angled Glidewire (Terumo Interventional Systems, Somerset, NJ), which was exchanged for the interventional wire of choice after confirmation of true lumen access. Our preference was to use a small-profile (0.014- or 0.018-inch) stiff guidewire, such as the V-14 or V-18 wires (Boston Scientific, Marlborough, Mass), for most interventions. A covered stent was selected in most patients with proximal SMA lesions that did not involve side branches. Predilation is typically performed for very high grade stenosis and occlusions or in cases in which crossing of the lesion is otherwise difficult. A 320-cm SpiderFX 0.014-inch filter wire (Medtronic, Minneapolis, Minn) was used in all except one patient, who had the Accunet Embolic Protection System (Abbott Vascular, Santa Clara, Calif). If a 0.035-inch stent is selected, a two-wire technique is used by combining the 0.014-inch filter wire with a 0.018-inch "buddy wire"; the stent is introduced over both wires for better support and to facilitate subsequent retrieval of the EPD.