Intravascular stenting of traumatic abdominal aortic dissection

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Purpose: We describe the case of a 34-year-old man with blunt abdominal trauma. Initial abdominal computed tomography scan showed retroperitoneal hematoma, pancreatic contusion, multiple fractures of the transverse process in the thoraco-lumbar spine, and infrarenal aortic dissection.

Method: Angiography revealed that the aortic dissection originated proximal to the inferior mesenteric artery and extended down to the left common iliac artery without vascular obliteration. The pancreatic trauma was managed without operation, and the dissection was treated with aortic and left iliac endovascular self-expanding Schneider Wall Stents.

Result: Immediate angiographic and computed tomography scan examination showed the obliteration of the greater part of the dissection with persistence of a short dissected segment at the level of the aortic bifurcation. Examination a week later showed thrombosis of this false lumen and complete obliteration of the dissection.

Conclusion: Intravascular stenting allowed treatment of the dissection without open surgical procedures requiring laparotomy and aortic operation. (J VASC SURG 1996;23:156-61.)

Blunt injuries of the abdominal aorta with initial survival are infrequent and generally result from direct mechanical forces. They include simple contusion, intimal disruption with dissection, intramural hematoma, false aneurysm, and frank rupture. Conservative treatment leads to prohibitive mortality, prompt recognition, and proper surgical treatment of this condition, which are essential to improve the poor prognosis for these patients. This report deals with a case of blunt abdominal aortic injury resulting in intimal disruption with extensive dissection that was successfully managed without operation with intravascular stents. Percutaneous intravascular stenting may allow the aortic lesion to heal without use of open surgical procedures requiring laparotomy and aortic operation.

CASE REPORT

A 34-year-old man had blunt thoracoabdominal trauma after receiving a crushing injury by a fork-lift truck. On admission to the intensive care unit the patient had diffuse abdominal pain, dyspnea, sweating, and tachycardia but with stable vital signs without collapse. Physical examination revealed thoracic and epigastric cutaneous ecchymoses. The abdomen was soft but tender, and normal femoral pulses were found. An abdominal film showed fractures of the transverse processes from T12 to L4 and obliteration of the left psoas shadow. Chest x-ray examination and thoracic computed tomography (CT) scan did not show evidence of intrathoracic lesions. Abdominal CT scan revealed abdominal wall hematoma, minor pancreatic contusion, infrarenal aortic dissection, and retroperitoneal hematoma (Fig. 1). Angiography confirmed the aortic dissection starting above the origin of the inferior mesenteric artery, which was not obliterated, and extending distal to the left common iliac artery (Fig. 2). We did not observe spontaneous thrombosis of this dissection without anticoagulation 9 days after initial injury. The probability of further spontaneous thrombosis was low without obliteration of the superior intimal tear, which was certainly the main hemodynamic stimulus maintaining the patency of the false lumen. Because no evidence was found of continued internal bleeding from the pancreatic lesion or other intraperitoneal injuries, the aortic dissection was managed with intravascular stenting without operative therapy. By standard Seldinger technique two self-expanding intravascular stents (Schneider Wall Stent, Schneider Stent Division, Pfizer, Minneapolis, Minn.) were...
placed to compress the intimal flap. The stents were delivered on a 9F catheter over a 0.035-inch guide wire introduced in the left femoral artery. Aortic luminal diameter evaluated on the arteriography was 14 mm. The aortic stent was 2 to 4 cm in length with 16 mm in maximal diameter, and the iliac stent was 3.5 to 4.5 in length with 9 mm in maximal diameter. Immediate angiographic examination showed obliteration of most of the dissection without obliteration of the inferior mesenteric artery and with persistence of a short dissected area between the aortic and iliac stent at the level of the aortic bifurcation (Fig. 3). Anticoagulation therapy was not administered because of the retroperitoneal hematoma. The postprocedure course was uneventful. CT scans (Fig. 4) and angiograms (Fig. 5) obtained 10 days later showed the complete resolution of the dissection with thrombosis of the short segment of residual false lumen and mild stenosis of the left common iliac artery origin but without aortoiliac pressure gradient and with normal continuous-wave Doppler control. The patient was discharged from the hospital on day 12 after the radiologic procedure had been performed and day 21 after his initial trauma had occurred. Six months later he was in good condition without claudication and with normal abdominal CT scanning results (Fig. 6).

DISCUSSION
Because of its highly protected position injuries to the abdominal aorta in cases of blunt trauma are rare and generally result from severe trauma. The mechanism of injury to the aorta during nonpenetrating trauma is either direct from the blunt trauma with
Fig. 2. Digital subtraction angiography demonstrating aortic dissection beginning above origin of inferior mesenteric artery (arrow) and extending downward to left common iliac artery. Note persistent patency of inferior mesenteric artery.

compression of the aorta or indirect as a result of sudden deceleration. Blunt abdominal aortic injuries are usually fatal because of the severe blood loss and multiple associated lesions. Lesions of the abdominal aorta caused by blunt trauma with initial survival are infrequent, and only 32 cases have been reported in detail in the literature. The most common site of injury was at the inferior mesenteric artery (33%) (as in our case) followed by the level of the renal arteries (24%). Intimal disruption with dissection and secondary thrombosis or aortic occlusion is the common type of injury. Typical symptoms include acute symptoms in the form of hemorrhage or leg ischemia and delayed symptoms in the form of intermittent claudication, aneurysm, or false aneurysm. Overall the mortality rate was 27%, with 10% in the late period and 35% in the immediate and early period. Death in the late period was caused by a rupture of a false aneurysm. Operative therapy through a laparotomy includes aortotomy with intimal repair or resection of the aorta with primary reanastomosis or graft. In a review of 27 blunt injuries of the abdominal aorta, Lassonde and Laurendeau reported 25 surgical procedures including 17 bypass graft insertions, 4 thromboendarterectomies, and 3 flap sutures. Nonoperative therapy seems very hazardous, and in their review Lock et al. found a 75% mortality rate with nonsurgical treatment. Most authors recommend operative therapy because of the risk of thrombosis, rupture, or secondary false aneurysm and nonoperative management only for minimal intimal disruptions.

Endovascular catheter techniques have been used to ameliorate the immediate life-threatening ischemic complications of acute dissections in patients who are not good surgical candidates. Intravascular ultrasonography, balloon angioplasty, intravascular stents, and endovascular septal fenestration have been used successfully to manage ischemia of lower extremities and visceral and renal arteries. 

Fig. 3. Angiographic examination performed immediately after intravascular stenting showed quasicomplete obliteration of dissection with persistence of false lumen at level of aortic bifurcation.
Intravascular ultrasonography clearly demonstrated details of the pathologic anatomy associated with aortic dissection and has been used to guide and monitor stent deployment. Peterson et al. described successful percutaneous treatment of a traumatic aortic dissection by balloon fenestration and stent placement. This dissection was complicated by right renal infarction and infrarenal aortic occlusion with severe ischemia in the right lower extremity. In spite of improvement in flow in the abdominal aorta after fenestration, persistent aortoiliac pressure gradient and occlusion of the distal part of the common iliac artery required additional endovascular stenting of the distal aorta and common iliac arteries.

Recent reports suggested that intraluminal devices could be used to manage experimental acute aortic dissection with only less invasive procedures. It was proposed that placement of an endovascular stent at the site of an intimal tear may push back the inner dissected wall against the outer layer of the aorta, thus halting and subsequently curing the dissecting process. These studies reported successful endovascular treatment of experimental acute type B aortic dissection in the dog and demonstrated that it was possible to dilate the true lumen and completely obliterate the false lumen of this experimental aortic dissection with a balloon-expandable stent, if the entire dissected aorta was treated. With stenting of the entire dissection the aortic wall healed without residual false lumen, but stenting limited to the
proximal entry tear did not prevent formation of a chronic residual patent false lumen. In this experimental model the dissection results from surgical trauma to healthy aorta as in human traumatic dissection and in contrast to human spontaneous dissections involving an aorta with degenerative medical changes (medial necrosis). Consequently it is doubtful that this experimental model of aortic dissection is representative of the typical human dissection, and the question about the possibility of dilating the true lumen in Stanford type B dissection to a diameter large enough to obliterate the false lumen remains unanswered. The relevance of this endovascular technique to the treatment of the Stanford type B aortic dissection is an unproven hypothesis, but the results of these experimental studies should provide the stimulus for continuing research and exploration of this concept.

The interventional angiographic techniques provide an alternative of less invasive therapeutic procedure in the treatment of patients with traumatic or complicated aortic dissection in whom conventional treatment portends a high mortality rate. In our case invasive stress was reduced, and the catheter assembly was introduced percutaneously through a 9F sheath in the femoral artery. This technique caused minor stress to the patient, obviating the operative risk of invasive surgical procedures requiring laparotomy, aortic clamping, and graft repair with risk of sexual dysfunction. The persistence of a patent residual false lumen in spite of adequate obliteration of the proximal and distal dissected aorta (entry and reentry tears) suggests that several lumbar arteries had been sheared off the true lumen by the dissection, with the former true lumen lumbar origins acting as small reentry tears maintaining communication between the true and false lumen, even though no large reentry tear persisted. The spontaneous thrombosis of the unstented aorto-iliac transition was the result of the obliteration of the intimal entry tear and a large part of the dissection. The stenting has left a small residual false lumen without important hemodynamic stimulus for maintaining the patency of this false lumen. It is improbable that this intermediate false lumen, which underwent secondary thrombosis, is detrimental, and given the site of false aneurysm formation over the long term, the clinical experience indicates that aortic dissection with spontaneous thrombosis of the false lumen should be considered healed.

REFERENCES

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