Masters of Cardiothoracic Surgery

Laser fenestration in chronic type B aortic dissection: creating a distal landing zone to facilitate thoracic endovascular aortic repair

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Clinical vignette

The challenge of treating patients with chronic type B aortic dissections lies in creating an adequate distal landing zone. Herein, we describe an entirely endovascular approach to establish a distal landing zone to facilitate thoracic endovascular aortic repair (TEVAR) in the setting of a chronic dissection with aneurysm. This technique is demonstrated in a 65-year-old male with a history of proximal aortic reconstruction for an acute (Stanford) type A (DeBakey I) aortic dissection, and subsequent replacement of his aortic arch with elephant trunk for continued aneurysmal expansion of the arch and proximal descending thoracic aorta.

Surgical techniques

Patient selection

Computed tomography (CT) aortography with three-dimensional reconstruction is mandatory; the anatomy of the aorta itself, the origin and course of all major visceral vessels and their relation to true and false lumen perfusion are noted. History of previous abdominal aortic repair should be highlighted as this increases the risk of peri-TEVAR spinal ischemia.

Preparation

An adequate proximal landing zone is required for endovascular success (typically at least 1.5–2 cm), and, not infrequently, coverage of the left subclavian artery is necessary to facilitate this. In these patients, we prefer to undertake a subclavian transposition or a left common carotid-to-subclavian bypass prior to the planned TEVAR, and then proceed with the endovascular component either during the same procedure or within a few weeks thereafter.

Depending upon the degree of planned aortic coverage with the stent-graft(s), a preoperative spinal drain may be required to reduce the risk of perioperative cord ischemia.

Exposition

Bilateral, ultrasound-guided access to the common femoral arteries is obtained, and two Perclose Proglide sutures (Abbott Vascular, Chicago, IL, USA) are placed, obviating the need for formal surgical exposure of the vessels. Intraoperative intravascular ultrasound (IVUS) is mandatory to ensure that any wires and catheters advanced into the aorta are in the appropriate lumens at various stages of the procedure.

Operation

Following bilateral percutaneous femoral artery access, wire access of the true lumen is obtained with IVUS-guidance. In the case under discussion, aortography demonstrates free filling of the false lumen as well as marked compression of the true lumen (a "pseudo-coarctation" of the aorta).

The first endovascular stent-graft is advanced into the true-lumen and deployed (*Video 02:34*). Balloon dilatation of the proximal landing zone is undertaken to ensure appropriate graft expansion (*Video 03:07*). The “knickerbocker” technique is employed, whereby balloon rupture of the dissection flap is attempted, to allow apposition of the stent-graft to the aortic wall (*Video 03:18*). Not unexpectedly, there remains significant true-lumen compression with continued unimpeded filling of the false lumen (*Video 03:27*).

In order to facilitate further TEVAR, laser perforation of the chronic dissection flap to create a distal landing zone is performed. A 2 mm laser atherectomy catheter is utilized to create a hole in the intimal septum. We typically start using the laser at an energy output of 45 mJ/mm^2 at 80 pulses/second, gradually increasing to a maximum of 60 mJ/mm^2. A steerable introducer is useful to help guide the laser catheter into the appropriate position, and, as mentioned, IVUS is indispensable. Following initial intimal perforation, the laser catheter is advanced into the false lumen such that there is now wire access in both aortic channels (*Video 04:23–04:43*).

A 14-French laser sheath is loaded over both (true and false lumen) wires and advanced into the descending aorta until it meets the intimal septum. Controlled longitudinal laser fenestration of the intimal septum is undertaken under IVUS-guidance (*Video 05:05–05:45*).

We then proceed to position a second endovascular stent-graft, however, this proves somewhat more challenging than expected due to the tortuosity of the native aorta and interference of the new nosecone with the previously deployed stent-graft (*Video 05:46–05:58*). To provide a more rigid rail over which to advance the new stent-graft, a “body-flossing” technique is undertaken, attaining wire access via the right brachial artery and retrieving it from below (*Video 06:12–06:32*). The second stent-graft is now able to be advanced and deployed successfully (*Video 06:33*).

As expected, interval aortography still demonstrates filling of the false lumen (*Video 06:59*). Subsequently, a third stent-graft is deployed, now achieving the desired result, without further evidence of flow into the false lumen (*Video 07:10–7:32*).

Completion

The Perclose Proglide sutures are secured, hemostasis is obtained at the groin sites and the patient is typically extubated on the operating table.

For those patients who have a spinal drain, cerebrospinal fluid is drained for the subsequent 24–48 hours, guided by their neurological exam, capped 6 hours prior (to check for neurological sequalae) and the drain is then removed. The patient is typically discharged within 72 hours of the procedure.

A progress CT is usually obtained within the first month after discharge. In the case under discussion, a CT done two weeks post-operatively confirms a successful outcome, with a completely thrombosed false-lumen, a widely-patent true lumen with improved distal perfusion and no endoleak (*Video 07:47*).

Comments

Open surgical repair has been the traditional approach for patients with chronic dissection of the descending aorta with aneurysmal degeneration (1). This approach, however, is fraught with substantial morbidity including risks of stroke (4–16%), paraplegia (5–9%) and death (6–8%) (2). To mitigate these risks, TEVAR has continued to emerge as an alternative treatment strategy for these complex aortic pathologies (1-3).

Complete thrombosis of the false lumen is a prerequisite for achieving successful reverse remodeling of the aorta. In those patients in whom the dissection process is limited to the thoracic aorta (above the celiac artery), TEVAR has been reported to successfully achieve thrombosis of the false lumen in >80% of patients (4). However, when the dissection process extends into the abdomen, the absence of a suitable distal landing zone for the stent-graft reduces the likelihood of complete false lumen thrombosis to <20% (4), necessitating further reintervention down the track.

The fibrotic, immobile nature of a chronic dissection flap represents the major barrier to establishing a suitable distal landing zone for TEVAR in these cases. As we have demonstrated, controlled laser fenestration of the septum is one way to overcome this challenge and facilitate a successful endovascular strategy. We suggest that TEVAR be considered for all patients with aneurysmal chronic distal dissections who have favorable anatomy, although we regard a genetic aortopathy as a relative contraindication to this approach.

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Footnote

Conflicts of Interest: DRB (MD) is a consultant speaker for Terumo Aortic, Cook Medical, Cryolife, and W.L. Gore & Associates. The other authors have no conflicts of interest to declare.

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