Laser-Assisted Transgraft Embolization: A Technique for the Treatment of Type II Endoleaks

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ABSTRACT

A transgraft embolization (TGE) technique was performed in a patient to treat a type II endoleak. Using a transfemoral arterial approach, the endograft was punctured using a coronary laser catheter aimed toward the type II endoleak nidus, which was treated with Onyx (Medtronic, Minneapolis, Minnesota). TGE resulted in successful embolization, as demonstrated on 1-year follow-up CT angiography, which showed complete elimination of the type II endoleak and shrinkage of the aneurysmal sac. TGE is an alternative to transarterial embolization, translumbar embolization, and transcaval embolization.

ABBREVIATIONS

TAE = transarterial embolization, TCE = transcaval embolization, TGE = transgraft embolization, TLE = translumbar embolization

Type II endoleaks after endovascular abdominal aortic aneurysm repair are the result of retrograde flow from arterial aortic side branches refilling the aneurysm sac. They are complex vascular structures that contain an endoleak cavity, or nidus, with several feeding and draining vessels, similar to an arteriovenous malformation (1). Most are transient and either resolve spontaneously within a few months or remain benign (1–4). However, persistent type II endoleaks can be associated with sac expansion and therefore require secondary interventions to avoid rupture (2). Although open and laparoscopic techniques have been described to eliminate side branch perfusion, endovascular methods are usually preferred, given their minimally invasive nature. Endovascular methods include transarterial embolization (TAE), translumbar embolization (TLE), and, more recently, transcaval embolization (TCE) (5–8). TAE is the most commonly used method, and its technical success requires catheter and guide wire manipulations through small and tortuous arteries, which can be technically challenging. TLE is not always feasible owing to the location of the endoleak relative to the inferior vena cava, bowel loops, or kidney or its location in the pelvis, where safe needle access is impossible owing to surrounding bony structures. TCE has been reported to be effective, particularly in patients who have no transarterial access and are not a candidate for TLE. As an alternative to transarterial, translumbar, and transcaval approaches, transgraft embolization (TGE) technique is described. TGE uses laser energy to micropuncture the endograft via a transfemoral arterial approach to access the aneurysm sac at the precise site of the type II endoleak nidus, regardless of its anatomic location.

CASE REPORT

A 68-year-old man with stable coronary heart disease had undergone successful endovascular abdominal aortic aneurysm repair with a GORE EXCLUDER AAA Endoprosthesis (W. L. Gore & Associates, Inc, Flagstaff, Arizona) in 2013 at an outside hospital. He was referred for further evaluation of increasing abdominal aortic aneurysm size. Computed tomography (CT) angiography performed on January 20, 2016, revealed an aneurysm sac diameter of 6.2 cm and a type II endoleak (**Fig 1a**, **b**). CT images suggested that a translumbar approach might be complicated by the proximity of the inferior vena cava (**Fig 1a**).

Embolization of the type II endoleak was achieved using TGE. After detailed analysis (CT reconstruction) of CT angiography, it was determined that the left limb of the

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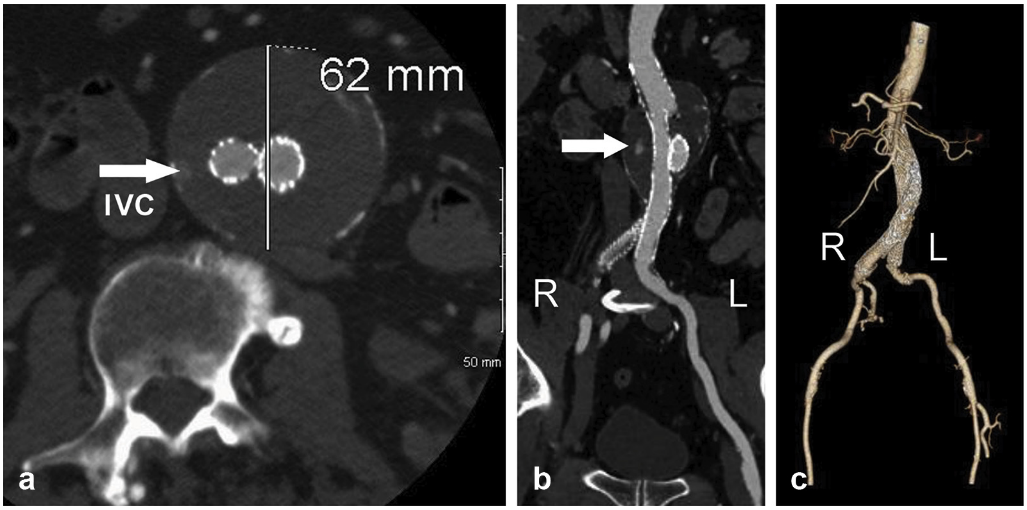

Figure 1. CT angiography views of the abdominal aorta of a 68-year-old man who had undergone endovascular aneurysm repair several years previously at an outside hospital. **(a)** CT angiography reveals a type II endoleak (arrow). An aneurysm sac with a diameter of 6.2 cm (bar) is also shown. **(b)** Coronal view of CT angiography shows type II endoleak (arrow) in close proximity to the crossed left limb of the endograft. **(c)** Three-dimensional reconstruction of CT angiography shows crossed limbs of the endoprosthesis.

endoprosthesis provided the most immediate access to the endoleak. Note the crossed limbs of the endograft shown in **Figure 1c**. Following percutaneous catheterization of the left common femoral artery, a 6-F 20-cm sheath (Cordis Corp, Miami Lakes, Florida) was advanced over a standard 0.038-inch guide wire of choice. Through the sheath, a 6-F VISTA BRITE TIP internal mammary artery coronary guide catheter (Cordis Corp) was advanced to the level of the proximal limb of the endograft (**Fig 2a**). The limb of the endograft was punctured using a 0.9-mm coronary laser probe (Turbo-Elite; Spectranetics Corp, Colorado Springs, Colorado) (**Fig 2b**) precisely pointed toward the site of the endoleak. The laser was activated at a frequency of 60 pulses/s and fluency of 60 mJ/mm^2. A 0.014-inch Hi-Torque Command ES guide wire (Abbott Vascular, Santa Clara, California) was advanced into the aneurysm sac (**Fig 2c**), and the probe was removed and exchanged for a 2.4-F microcatheter (Echelon; Medtronic, Minneapolis, Minnesota). Through the catheter, selective digital subtraction angiography showed the endoleak as well as unnamed vascular structures, most likely lumbar arteries (**Fig 2d**). Four vials of Onyx 18 (Medtronic) were administered through the catheter to obliterate the type II endoleak at the level of the nidus (**Fig 2e**). Follow-up CT angiography obtained 1 year later showed decreased (4.7 cm) aneurysm sac size (**Fig 3**) compared with the size before embolization.

DISCUSSION

Type II endoleak is the most common endoleak encountered after endovascular abdominal aortic aneurysm repair and is caused by retrograde blood flow from aortic side branches into the aneurysmal sac. Persistent type II endoleaks can lead to aneurysm sac expansion and possible rupture (9). Most clinicians consider reintervention for patients with type II endoleaks who have aneurysm sac growth of > 5 mm or persistent endoleaks (> 6 months) (2,10–12). The most commonly used treatment strategies in contemporary endovascular practice include TAE and TLE (11), with an average success rate of 63% (range, 15%–89%) and 81% (range, 67%–100%), respectively.

Successful type II endoleak embolization requires obliteration of the aneurysm sac as though it were the nidus of a vascular malformation. For instance, higher failure rates with femoral TAE compared with TLE (80% vs 8%) have been reported to be the result of incomplete embolization of the central nidus and the feeding vessels in the first attempt (5). Comparable success rates also have been reported when embolization of both the feeding arteries and the endoleak cavity is performed (2,11,12). More recently, it was concluded that embolization of the nidus alone versus the nidus and side branches yields similar outcomes and can be achieved with significantly reduced procedure time and radiation exposure (13).

Despite satisfactory results reported with TAE and TLE, some anatomic and technical limitations remain, the most important of which relate to incomplete or partial elimination of the endoleak nidus (2,8,11). For instance, with TAE alone, the nidus may not be reachable even with microcatheters and steerable guide wires. TLE is not always feasible because of the location of the endoleak relative to the inferior vena cava, bowel loops, or kidney or its location in the pelvis, where safe needle access is not possible owing to surrounding bony structures (8). These shortcomings result in incomplete embolization and repeat interventions, which have been reported in up to 20% (6,11,12) of cases regardless of whether TAE or TLE was used. These data underscore the importance of complete embolic obliteration of the endoleak nidus, regardless of the technique used.

To overcome the limitations of TAE and TLE, TCE has been shown to be safe and effective as a more direct approach to the type II endoleak nidus (7,8), and some authors have