On-table modification of self-expanding covered stents for hybrid aortobifemoral revascularization

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ABSTRACT

Femoral endarterectomy with iliac stenting is a safe and effective minimally invasive alternative to aortobifemoral bypass. However, TransAtlantic Inter-Society Consensus D lesions with contiguous iliofemoral occlusion are challenging cases for hybrid repair. Herein, we present a unique approach for iliofemoral revascularization by on-table modification of self-expanding covered stents. (J Vasc Surg Cases and Innovative Techniques 2019;5:179-82.)

Keywords: Aortoiliac occlusive disease; Endarterectomy; Covered stent; Hybrid vascular surgery

In patients with aortoiliac and femoral occlusive disease, hybrid repair combining endovascular iliac stenting and femoral endarterectomy offers a less invasive alternative to aortobifemoral bypass, with shorter length of hospitalization and less resource use.1-3 It yields acceptable long-term results with higher primary patency rates with the use of covered stents compared with bare-metal stents.3,4 Whereas this technique is ideal for stenotic iliac arteries, complete iliac occlusion extending into the proximal femoral arteries presents a more challenging scenario that can complicate the endarterectomy plane, proximal control, stent graft delivery, and apposition. Herein, we describe a new hybrid approach to aortobifemoral revascularization by on-table modification of self-expanding covered stents for treatment of TransAtlantic Inter-Society Consensus (TASC) D aortoiliac and femoral occlusive disease. The patient consented to publication of this report.

CASE REPORT

Presentation. A 72-year-old man with hypertension, hyperlipidemia, chronic obstructive pulmonary disease, 116 pack-year history of tobacco use, and alcohol abuse presented with disabling claudication of the thigh and legs bilaterally, absent lower extremity pulses, and ankle-brachial indices of 0.49 (right) and 0.38 (left). The patient failed to respond to supervised exercise therapy and several attempts at smoking cessation. He was medically optimized otherwise.

Computed tomography angiography showed the following: diffuse atherosclerosis of the abdominal aorta to the level of iliac bifurcation; radiologically stable ~3-cm infrarenal abdominal aortic aneurysm; occlusion of external iliac artery (EIA) and nearly occluded, calcified common femoral artery (CFA) on the left; diffusely diseased EIA and nearly occluded, calcified CFA on the right; and patent profunda femoris arteries (PFAs) and diseased superficial femoral arteries (SFAs) bilaterally (Fig 1, A) with three-vessel runoff. Given the patient’s comorbidities, bilateral common femoral endarterectomy with concomitant iliac angioplasty and stenting was offered, with plans for a novel approach to left EIA revascularization.

Surgical technique. Through left brachial access, flush aortography verified the computed tomography angiography findings (Fig 1, B). Bilateral CFAs were then exposed, and circumferential control of bilateral distal EIsAs was achieved by mobilization of the inguinal ligaments bilaterally.

After circumferential control of the bilateral SFAs and PFAs, the transbrachial system was exchanged over a stiff 0.035-inch platform for a 7F, 90-cm Raabe sheath (Cook Medical, Bloomington, Ind) and advanced into the distal aorta. With use of an angled Glidewire (Terumo Interventional Systems, Somerset, NJ) and a 0.035-inch Quick-Cross catheter (Spectranetics, Colorado Springs, Colo), a subintimal dissection plane was developed extending into the exposed left CFA. Next, balloon angioplasty of the subintimal plane was performed over an Amplatz Superstiff wire (Boston Scientific, Natick, Mass) to facilitate delivery of a stent graft system. The wire was then exchanged for a stiff 0.018-inch platform over which two Viabahn (W. L. Gore & Associates, Flagstaff, Ariz) self-expanding covered stents (7 × 50 mm) were deployed extending from the proximal left CFA into the mid-EIA with minimal overlap. Next, a more rigid VBX balloon-expandable covered stent (8L × 39 mm; W. L. Gore & Associates) was deployed into the left proximal EIA just distal to the takeoff of the internal iliac artery. A balloon-expandable stent was chosen in this particular location to provide maximal radial force and high accuracy of

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deployment. All stents were balloon angioplastied, and the balloon was left insufflated in the mid-EIA for proximal control.

The left outflow vessels were clamped in preparation for the novel approach. With the Viabahn stent and wire in place, extensive femoral endarterectomy was performed from the distal EIA to the proximal PFA (Fig 2, A and B), and the plaque was removed en bloc (Fig 2, C). Proximal endarterectomy was performed approximately 2.5 cm proximal to the distal tip of the Viabahn stent to allow maximum stent apposition and opening into the endarterectomy plane. The anterior surface of the Viabahn stent was cut longitudinally, and four interrupted 6-0 Prolene tacking sutures were placed along the posterior surface of the stent for optimal apposition to the arterial wall (Fig 2, D). Next, XenoSure (LeMaitre, Burlington, Mass) patch angioplasty was performed (Fig 2, E), incorporating the surgically modified stent and the overlying native arterial wall into each bite to allow maximal opening of the stent outflow and smoother incorporation of the stent into the endarterectomy plane. The remainder of the patch angioplasty was performed in the usual standard fashion. On completion of patch angioplasty, the proximal occlusion balloon was desufflated, and a bounding palpable pulse was noted.

Because the stenotic right iliac system was patent, traditional femoral endarterectomy and retrograde iliac stenting were performed with deployment of one Viabahn stent (7 × 10 mm) in the EIA and one VBX (8L × 39 mm) in the distal common iliac artery. A bounding palpable femoral pulse was appreciated along with biphasic Doppler signals in the CFA, SFA, and PFA. Completion transbrachial aortoiliac angiography revealed a widely patent aortoiliac system (Fig 3, A) with brisk runoff to a now widely patent bilateral femoral circulation without flow-limiting lesions, extravasation, or dissection (Fig 3, B and C). The patient tolerated the procedure well without complications and had biphasic pedal signals bilaterally. Claudication resolved on postoperative day 3. The patient was discharged on day 4; follow-up ankle-brachial indices were 1.1 (right) and 0.85 (left).

**DISCUSSION**

Iliofemoral endarterectomy with proximal iliac stenting is a safe and effective alternative to traditional open surgery in patients with iliofemoral occlusive disease. Studies have reported 5-year primary patency rate of 60% to 87%, primary assisted patency rate of 97%, and secondary patency rate of 98% for TASC C and D lesions treated with combined CFA endarterectomy and iliac stenting or stent grafting. The described case provides a modified alternative to the traditional technique of retrograde iliac stenting, eliminating the need to clamp heavily calcified, diseased iliac vessels, thus allowing a more extensive proximal endarterectomy plane (Fig 4, A and B) as well as a smoother transition and incorporation of the iliac stent grafts into the endarterectomized plane (Fig 4, C). This technique is best suited for TASC D aortoiliac lesions with total occlusion of the EIAs.

Conventionally, endovascular iliac graft stenting is performed after CFA patch angioplasty as placement of stents into the distal iliac arteries before endarterectomy precludes the ability to use a clamp for proximal control of the CFA because of the risk of crushing the stent. Although, in our unpublished experience, the Viabahn...
stents can be easily clamped with Fogarty Hydragrip clamps without stent fracture or compromise, the use of antegrade balloon occlusion before endarterectomy, as described before, foregoes this dilemma and makes for an atraumatic and simple method of proximal control. During the last decade, there have been several reports of successful stenting of the CFA. Notably in 2017, the Traitement des Lésions Athéromateuses de l’Artère Fémorale Commune par Technique Endovasculaire Versus Chirurgie Ouverte (TECCO [Endovascular Versus Open Repair of the Common Femoral Artery]) trial, a multicenter randomized controlled trial in France, showed that isolated stenting of the CFA had lower perioperative morbidity and mortality and not significantly different 2-year outcomes compared with open surgery. Traditional teaching in the use of stent grafts is to avoid

![Fig 2](image1)

**Fig 2.** A and B, Circumferential control of left superficial femoral artery (SFA) and profunda femoris artery (PFA) branches and common femoral artery (CFA) arteriotomy extending proximally into the distal end of the Viabahn stent as well as distally into the proximal PFA. C, The plaque removed en bloc. D, The longitudinally cut Viabahn stent and endarterectomy of the left distal external iliac artery (EIA), CFA, proximal SFA, and PFA. E, Patch angioplasty with incorporation of stent and the overlying native artery into each bite.

![Fig 3](image2)

**Fig 3.** Completion angiogram demonstrating widely patent (A) aortoiliac, (B) right iliofemoral, and (C) left iliofemoral segments.
crossing the inguinal ligament for fear of stent fracture or thrombosis, but many of the woven nitinol covered stents today demonstrate greater radial strength and flexibility. Moreover, iliac stent graft integration into the femoral endarterectomy plane in our technique further addresses this issue by providing a much smoother transition of the iliac stent across the inguinal ligament.

CONCLUSIONS
Surgical modification and incorporation of self-expanding covered stents into femoral endarterectomy planes can be a safe and effective hybrid technique for treatment of iliofemoral occlusive disease. This approach expands the reach of endovascular therapy to chronic total occlusions of distal iliac vessels and provides yet another alternative to aortobifemoral bypass in patients for whom a less invasive intervention is preferred.

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