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Preloaded contralateral gate techniques during endovascular aortic repair for aneurysms and occlusive disease

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ABSTRACT

We present two preloaded techniques to facilitate gate cannulation during endovascular aortic repair. In the first case, we relined the aorta using a Gore iliac branch endoprosthesis (WL Gore and Associates, Flagstaff, Ariz) for acute occlusion. This allowed for preloading the contralateral gate, which was compressed when deployed, and subsequently dilated open over the preloaded wire to allow for cannulation. The second patient had had an infrarenal aneurysm. A Gore Excluder was partially deployed extracorporeally to preload the gate from the ipsilateral side. The "snare ride" technique was used to rapidly cannulate the gate. Preloaded wire techniques during endovascular aortic repair can facilitate rapid gate cannulation, especially in patients with challenging anatomy. (J Vasc Surg Cases and Innovative Techniques 2021;7:84-8.)

Keywords: Aneurysm; Cannulation; Contralateral gate; Endovascular aortic repair; Infrarenal; Preloaded

Contralateral gate cannulation is often the rate-limiting step during endovascular aortic repair (EVAR).[1,2] This can be exacerbated by hostile anatomy and has led to strategies such as contralateral snaring[3] and upper extremity catheterization. However, these strategies have often been used as bailout options, can require significant time, and are more invasive in the case of upper extremity access. We report two techniques of preloading the contralateral gate to facilitate rapid gate cannulation. Both patients provided written informed consent for the report of their case and to the use of the preloaded techniques after an explanation of the risks and benefits, including modification of the deployment sequence for the Gore Excluder (W. L. Gore and Associates, Flagstaff, Ariz).

CASE REPORT

Patient 1. A 55-year-old man presented with acute bilateral lower extremity mottling, paralysis, and pulselessness. Computed tomography angiography (CTA) demonstrated aortic mural thrombus (AMT) in the ascending and descending thoracic aorta and arch, and an acute infrarenal aortoiliac occlusion with reconstitution at the external iliac arteries (Fig 1, *A*). The infrarenal aorta was nonaneurysmal and measured 19 mm, and the common iliac arteries measured 11 to 12 mm.

He was taken emergently to the hybrid operating room for bilateral femoral cutdowns. Aortoiliac thrombectomy with 7F Edwards Fogarty catheters (Edwards Lifesciences, Irvine, Calif) was performed, removing significant thromboembolus. This was followed by lower extremity thrombectomy and left common femoral artery (CFA) endarterectomy.

The right CFA was clamped to prevent distal embolism and accessed using a micropuncture needle, and an aortogram demonstrated significant residual aortic thrombus extending toward the aortic bifurcation but with patent renal and iliofemoral arteries. We, therefore, elected to reline the aortoiliac segment with a bifurcated device but anticipated contralateral gate compression. A Gore iliac branch endoprosthesis (IBE; WL Gore and Associates) was chosen to allow for preloading of the contralateral gate. This would address the concern of deploying a 23-mm main body with a 13-mm gate and 14.5-mm ipsilateral limb, within a 19-mm aorta.

A 16F Gore DrySeal sheath was placed on the right side over a Lunderquist wire (Cook Medical, Bloomington, Ind). Using a Kumpe catheter (Cook Medical), an Amplatz wire (Boston Scientific, Marlborough, Mass) was placed as a buddy wire alongside the Lunderquist wire. An angiogram was performed from the left side to locate the lowest renal artery. The IBE was advanced to the lowest renal artery, with the main body over the Lunderquist wire and the hypogastric branch over the Amplatz wire. The device was then deployed in anatomic configuration, with the gate compressed as anticipated (Fig 1, *B*). Therefore, a 10-mm angioplasty balloon was advanced over the Amplatz wire and used to dilate the gate, facilitating easy cannulation from

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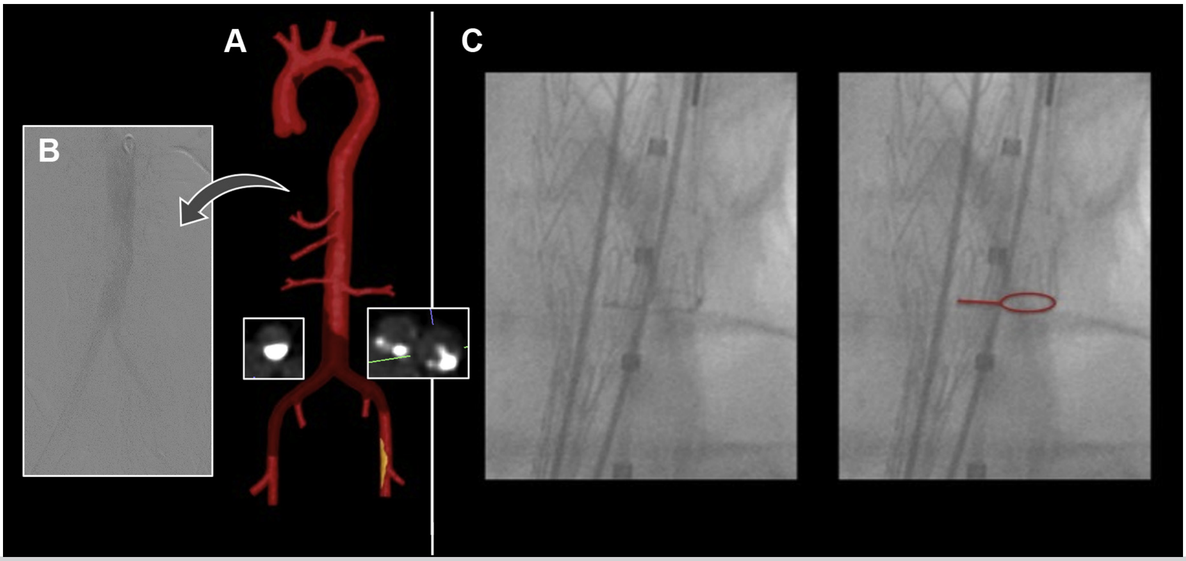

Fig 1. A, Illustration demonstrating mobile aortic mural thrombus in the ascending aorta, arch, and descending thoracic aorta, as well as an infrarenal aortoiliac occlusion. **Insets,** Axial computed tomography images demonstrating calcific stenoses in the bilateral common iliac arteries (CIAs). **B,** Angiogram performed after aortoiliac thromboembolectomy demonstrating residual thrombus. **C,** Fluoroscopic image demonstrating compression of the contralateral gate during endovascular aortic repair for occlusive disease, with the preloaded wire in place.

the left femoral approach. Iliac limbs were used to extend bilaterally, and the patient also underwent four-compartment fasciotomies. He was discharged on postoperative day 14 with oral anticoagulation for the AMT. However, he was readmitted within 2 weeks with a subtherapeutic international normalized ratio (INR) and moderate compression with occlusion of the left iliac limb. We presumed a multifactorial etiology of recurrent embolization due to the absence of some proximal AMT, a subtherapeutic INR, and limb compression. After embolectomy and iliac limb kissing-balloon angioplasty, his target INR range was increased to 2.5 to 3.5. He subsequently required another readmission for left limb thrombosis due to inadequate treatment of the compression, which was treated with kissing balloon-expandable stents. At 9-month follow-up, he denied claudication or rest pain, had no residual motor or sensory deficits, and had an ankle-brachial index of 1 bilaterally.

Patient 2. Although the IBE is a suitable option for a small-diameter aortic neck and occlusive disease, we sought to expand the preloaded approach to infrarenal abdominal aortic aneurysms (AAAs) using larger devices with infrarenal fixation. A 66-year-old man presented with a 55-mm infrarenal AAA. CTA demonstrated a long, 22-mm diameter infrarenal neck without significant angulation. The right and left common iliac arteries (CIA) measured 11 and 13 mm, respectively. We proceeded with elective endovascular repair, trialing the feasibility of the preloaded technique in an elective case without hostile anatomy.

Under general endotracheal anesthesia, we obtained surgical access of the right CFA and percutaneous access on the left. After angiography had confirmed the position of the lowest renal artery, a 22F Gore DrySeal sheath was placed above the lowest renal artery from the right CFA. A 26-mm × 14-mm × 16-cm Gore Excluder was advanced over the Lunderquist wire, such that the distal-most portion of the contralateral gate was just outside the sheath (Fig 2, *A*). The first trigger wire was released, deploying the main body to the level of the gate and maintaining the proximal device reconstraining function. This, however, opened the externalized portion of the gate (Fig 2, *B*), which allowed for insertion of a 5F × 10-cm sheath under direct vision. The sheath was given rigidity by placing the stylet from the Excluder through the dilator (Fig 2, *C*). A 0.018-in. wire was then inserted through the sheath and contralateral gate above the device as a preloaded wire (Fig 2, *D*). The 5F sheath was removed, and the device advanced with the preloaded wire as a single unit to the level of the lowest renal artery (Fig 3, *A*). The DrySeal sheath was withdrawn over the device into the ipsilateral CIA, deploying the stent-graft to the contralateral gate. The 0.018-in. wire was then exchanged for an Amplatz wire, and an over-the-wire Indy Snare (Cook Medical) was advanced over the Amplatz wire and opened directly opposite the contralateral CIA (Fig 3, *B*). The use of the Indy Snare as a buddy system was made possible by using a 22F DrySeal sheath rather than the typical 18F sheath required for a 26-mm device. A hydrophilic glide wire was then taken up the left side, immediately placed through the Indy Snare, and captured. The Indy Snare was then advanced over the Amplatz wire with the captured contralateral glide wire, through the gate, negating the need for traditional cannulation (Fig 3, *C*; Supplementary Video).

The glide wire was released and exchanged for a stiff wire, and the remainder of the procedure was completed in standard fashion. The patient was discharged uneventfully on postoperative day 1, with unremarkable CTA findings at 3 months.

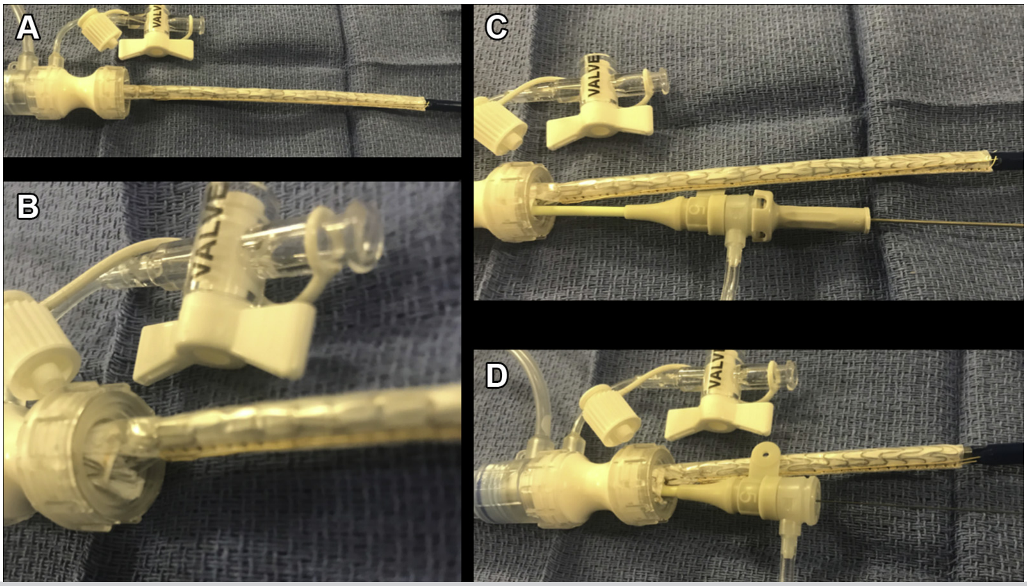

Fig 2. Intraoperative photographs demonstrating technique of preloading, with a sheath positioned at the lowest renal artery, the contralateral gate of the Gore Excluder. **A,** The device was partially advanced over a Lunderquist wire into a Gore DrySeal sheath, such that the distal end of the contralateral gate remained extracorporeal. **B,** The first trigger wire was released, deploying the main body to the level of the gate, which opened just outside the sheath. This allows for cannulation of the gate with a 5F sheath **(C)** to facilitate placement of a 0.018-in. wire through the gate as a preloaded wire **(D)**.

DISCUSSION

As technology and experience have improved over the past 25 years, EVAR has become the preferred approach for infrarenal AAA repair. With careful preoperative planning, using center-line flow of imaging for measurements, appropriate device selection and deployment, even the rate-limiting step of gate cannulation is typically quite efficient. Occasionally, patient anatomy can make cannulation more difficult, prolonging total procedure time. This has led to adjuncts such as up-and-over/contralateral snare techniques and upper extremity catheterization. A prospective randomized comparison of traditional cannulation to an immediate contralateral snare technique found that the median cannulation time was 2.7 minutes for the standard approach, with successful cannulation in 90% of cases.[3] In cases in which traditional cannulation attempts exceeded 5 minutes, the chance of eventual cannulation within 15 minutes using the same approach decreased to 67%. Therefore, the investigators suggested consideration of alternative methods for cannulation if the traditional approach has not been successful within the first 5 minutes.[3]

Although the contralateral snare technique is a useful adjunct, it is a reactive maneuver after a failed trial of the standard approach. The preoperative imaging findings can often be used to anticipate cases in which gate cannulation might be difficult and time consuming. The preloaded techniques could therefore, be used as a proactive adjunct rather than a response to technical challenges, if foresight is used. Although the preloaded Excluder technique was used in a case with benign anatomy, this was to test the feasibility. We propose consideration of preloading the contralateral gate in situations in which gate compression is highly likely, to allow for balloon dilation. This would include saccular aneurysms, penetrating aortic ulcers, aortoiliac occlusive disease, and unusually long infrarenal necks. Preloading with the "snare-ride" technique might be useful in situations in which wire and catheter manipulation/direction are challenging. These would include significant tortuosity or angulation at the infrarenal neck or aortic bifurcation, and large aneurysm sacs with minimal or no thrombus.

Preloading the Gore Excluder has few disadvantages, despite the requirement to release the first trigger wire with the device in the sheath. The proximal reconstraining function is maintained; thus, the device can be repositioned. Furthermore, in highly angulated infrarenal necks, slowly withdrawing the sheath to deploy the main body can facilitate more accurate placement.[4] Using a "snare-ride" over the preloaded wire also eliminates the time required for traditional cannulation, although it does add some time at the beginning of the procedure. We hypothesized that with hostile anatomy, this time will be less than that required for traditional cannulation, especially when adjuncts are needed such as contralateral snaring and upper extremity catheterization. Preemptive preloading might also be faster than contralateral snaring.

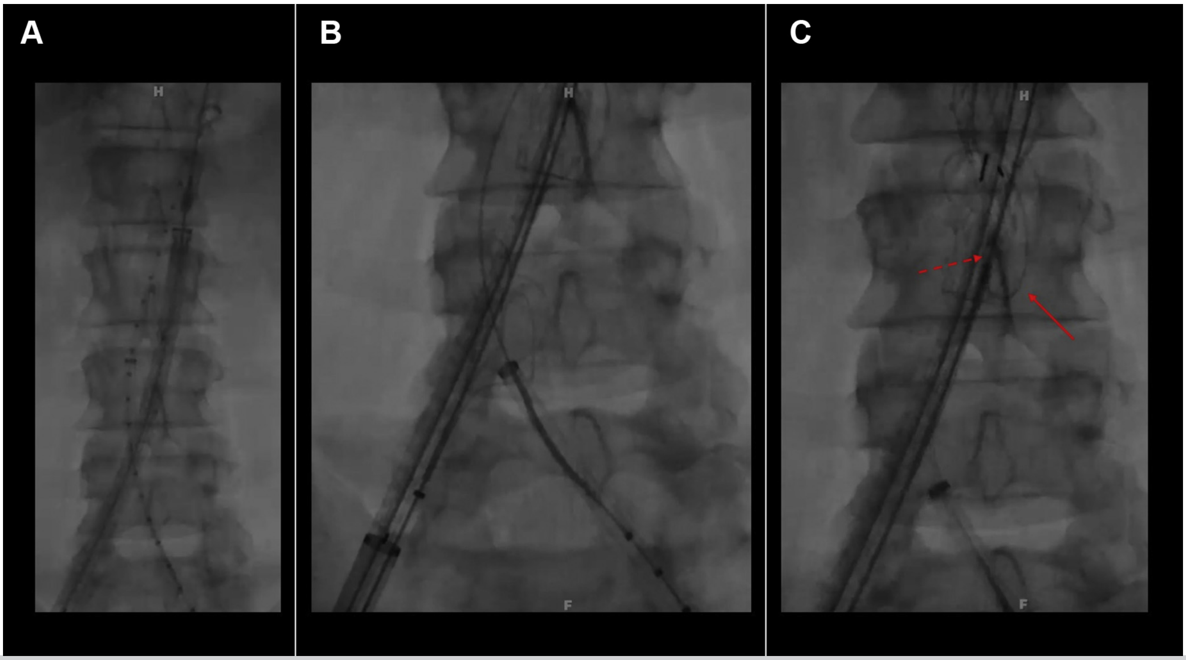

Fig 3. Fluoroscopic images of preloaded Gore Excluder with the "snare-ride" technique during endovascular repair of an abdominal aortic aneurysm (AAA). **A,** Main body and preloaded 0.018-in. wire were advanced as a single unit to the level of the lowest renal artery. **B,** Indy Snare was advanced over the preloaded wire and positioned immediately opposite the contralateral common iliac artery origin, such that the contralateral guidewire was advanced immediately through the snare and captured. **C,** The Indy Snare (*dashed red arrow*) was advanced with the captured contralateral guidewire (*solid red arrow*) over the preloaded wire through the contralateral gate.

The limitations of preloading the Excluder relate to access vessel size. The ipsilateral sheath must be upsized by 4F to allow room for the Indy Snare (8F outer diameter) to be advanced over the preloaded wire in a "buddy" fashion to the main body delivery system. Therefore, at least a 22F sheath will be required. Unfortunately, no over-the-wire snares with a lower profile are readily available.

Another theoretical technical concern relates to the partial deployment of the Excluder within the sheath. The first trigger wire releases a deployment string that secures the plastic constraining sleeve around the main body to the level of the gate. A separate deployment string secures the remainder of the constraining sleeve tightly around the ipsilateral limb. We have performed multiple ex vivo simulations and, with the required upsizing of the sheath by 4F, little to no friction/resistance occurs with device advancement. However, a possibility of inadvertent deployment of more of the ipsilateral limb as the device is advanced through the sheath might exist. We have not experienced this or any difficulties with device advancement but would suggest vigilance during all steps of the case.

The Anaconda AAA Stent Graft (Vascutek; Terumo, Inchinnan, Scotland) is a commercial device that has a preloaded gate from the ipsilateral side,[5] similar to the technique we have described, but uses a magnetic wire instead of a snare. The 5-year results of the French registry reported 98.3% technical and 94.9% clinical success rates; however, concerns have been reported regarding a high limb occlusion rate.[6,7] To the best of our knowledge, no large studies have compared gate cannulation using the Anaconda with traditional methods, and the device is not commercially available in the United States.

CONCLUSIONS

Preloading the contralateral gate during EVAR can facilitate rapid gate cannulation, especially in cases of challenging anatomy, in both aneurysmal and occlusive disease. Although it requires foresight with a preoperative assessment of the patient's anatomy, it can be used as a proactive measure, rather than as a reactive adjunct.

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