

Intentional False Lumen Thrombosis After Aortic Dissection

The best strategies for thrombosing the false lumen, how to execute various techniques, and intervention timing.

BY KONSTANTINOS SPANOS, MD, MSc, PhD; FIONA ROHLFFS, MD; NIKOLAOS TSILIMPARIS, MD, PhD; AND TILO KÖLBEL, MD, PhD

In 1999, Nienaber et al published the first report on the nonsurgical insertion of an endovascular stent graft in selected patients with thoracic aortic dissection.¹ Since that time, thoracic endovascular aortic repair (TEVAR) has become the preferred treatment choice for type B aortic dissections (TBADs) over open surgical repair.²

Recently, endovascular treatment has expanded to aortic arch pathologies; thus, new stent grafts have been developed for the aortic arch with either fenestrations or branches to encompass the supra-aortic vessels in cases when a more proximal sealing zone is needed for the endovascular treatment of aortic dissections.³ The inner branched device by Cook Medical (a custom-made device designed with two inner side branches for the innominate trunk and the left common carotid) has been frequently used in cases of residual dissection after open repair of type A aortic dissection (TAAD).⁴ Additionally, a fenestrated custom-made device manufactured by Cook Medical constructed with fenestration and/or a scallop is another option for such cases.⁵ The arch branch device (Terumo Aortic) is constructed similarly to the Cook device, with two inner branches.⁶

Although TEVAR has been increasingly used for the treatment of aortic dissection, offering better outcomes in terms of mortality and morbidity compared to open surgical repair,^{2,7} complete false lumen (FL) thrombosis is only achieved in approximately 40% of patients by covering the proximal tear entry alone. New techniques have been developed during the last decade to treat patients with a patent FL after aortic dissection.

THE IMPORTANCE OF FALSE LUMEN THROMBOSIS IN AORTIC DISSECTION

Persistent perfusion from distal entry tears can maintain patency of the FL, leading to late FL expansion during follow-up in 30% of patients treated with TEVAR who require additional reinterventions.^{8,9} FL patency has been independently associated with poor long-term survival in patients with chronic TBAD (cTBAD),¹⁰ while thrombosis of the FL may be an independent predictor of no further growth.¹¹

The presence of distal entry tears may increase the occurrence of late aortic events and inhibit aortic remodeling, although it has not been proven to have a negative impact on late survival.¹² The use of fenestrated stent grafts covers an even longer segment of the aorta, occluding more entry points and reducing pressure and flow transmission into the FL.^{13,14} However, it was recently demonstrated that although combined proximal and distal stent grafting improves true lumen perfusion and diameter, it has failed to completely suppress FL patency¹⁵ and has increased the risk of spinal cord ischemia.¹⁶

Residual FL patency also remains a clinical problem after TAAD repair.^{17,18} Partial thrombosis of a residual FL after TAAD treatment may lead to a faster regional aortic sac growth rate and may predict an increase in the reintervention rate.¹⁸

After dissection with a perfused FL, the aorta has a significantly higher annual growth rate, most likely because of the higher pressurization of the FL.^{10-12,17,18} Patients with partial thrombosis may also require more intensive follow-up and may benefit from prophylactic intervention.¹⁹ Recently, the new imaging analysis of patients

in the ADSORB trial demonstrated that the number of vessels originating from the FL may predict FL growth in patients with TBAD.²⁰ Ge et al also showed that pre-operative dissected thoracic branches fed by an FL are correlated with distal thoracic aortic enlargement after TEVAR in patients with TBAD.²¹

Patients with TBADs who present with branch vessel involvement or a patent entry tear after TEVAR are less likely to develop FL thrombosis during follow-up.²² These patients may require a more extensive intervention and more intensive follow-up to prevent long-term complications.²²

FIRST INTERVENTIONAL ATTEMPTS TO ACHIEVE FALSE LUMEN THROMBOSIS

In 2003, Loubert et al induced FL thrombosis by placing two 15-F Greenfield vena cava filters (Boston Scientific Corporation) or a 24-mm Talent occluder device (Medtronic) into the FL, followed by detachable balloons and thrombin.²³ This acted like “a cork in the bottleneck” to block retrograde flow into the thoracic portion of the FL above the blockade.

Since then, a variety of devices and embolization materials (both solid and liquid) have been used to occlude the FL. However, these materials are limited by the diameter of the FL. The largest commercially available devices are 24 mm in diameter; thus, in many cases, occlusion cannot be easily achieved. Recently, a custom-made candy-plug device has been developed with a maximum diameter of 50 mm that may be used for thrombosis of a larger-diameter FL.

CURRENT STRATEGIES

Vascular and Iliac Plugs: Coils and Glue Embolization Technique

Many reports in the literature describe FL embolization using different materials (Figure 1). Roselli et al used iliac plug devices for FL embolization.²⁴ Because the delivery system for the iliac plug devices was too short to reach the intended target within the thoracic aorta, a 24-mm Zenith iliac plug occluder device (Cook Medical) was first delivered and deployed within the 18-F sheath. Next, the tip of the dilator of the 18-F sheath was removed on the backtable and was polished with a patch of sterile sandpaper to create a “pusher” for the occluder device. The occluder device was then delivered and deployed within the FL at the level of the distal end of the stent graft that was in the true lumen. An additional device was required because the area of the FL to be embolized was large. The access sheath was repositioned within the FL alongside the first occluder, and another device was deployed in the same

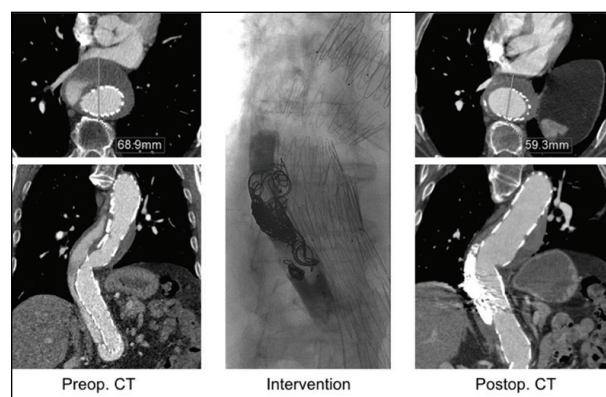


Figure 1. False lumen thrombosis with a combination of coils, plug, and glue.

manner as the first device. Idrees et al have recently reported the group’s expanded experience with the use of iliac plugs in patients with either cTBAD or residual dissection after open repair for TAAD, demonstrating good results.²⁵

Wojtaszek et al attempted to induce FL thrombosis by occluding single entry tears with the Amplatzer Vascular Plug (Abbott Vascular) in two patients with positive results.²⁶ Mendes et al filled the FL with several vascular plugs (18–22 mm).²⁷ However, use of a combination of materials appears to be the most common practice; in many cases, coils were initially deployed in the FL with an adjacent material to complete the embolization (eg, glue injection, Onyx liquid embolic [Medtronic], inflation of a detachable occlusion balloon). Similarly, in cases of TAAD, coils combined with vascular plugs were used for the induction of FL thrombosis.^{23,28–31}

On the other hand, Zhang et al attempted to induce thrombosis of the retrograde FL to enhance a proximal landing zone for the treatment of retrograde TAAD in a two-stage procedure.³² During the first stage, detachable coils (Interlock-35, Boston Scientific Corporation) were deployed into the retrograde FL most of the time, combined with the injection of Onyx glue. During the second stage, TEVAR with a single or double chimney was performed using a novel and more extensive proximal zone.

Of note, in almost all cases, FL thrombosis is achieved with intervention to the distal part of the dissection; however, in some cases, a proximal or mid aortic embolization may be needed. For example, Riga et al had to induce FL thrombosis in the mid thoracic segment because of anatomic restrictions of using coils proximally and distally and injection of Onyx in between, combined with the inflation of a detachable balloon at the narrowest point to slow down the flow.³³

niques require a high level of technical skill and a certain degree of practice for the interventionalist to achieve confidence for successful use. The development of referral centers may increase operator experience with these techniques, thus producing even better outcomes.

CONCLUSION

Intentional FL occlusion is an effective and less invasive approach to treat patients after TEVAR with patent FLs compared to open surgery or complex thoracoabdominal repair with fenestrated and branched endografts. Timing of the intervention depends on the diameter increase of the dissected aneurysm or the FL diameter during follow-up or if the patient is exhibiting symptoms. ■

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Konstantinos Spanos, MD, MSc, PhD

German Aortic Center Hamburg
Department of Vascular Medicine
University Heart Center
Hamburg, Germany
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Fiona Rohlfes, MD

German Aortic Center Hamburg
Department of Vascular Medicine
University Heart Center
Hamburg, Germany
Disclosures: None.

Nikolaos Tsilimparis, MD, PhD

German Aortic Center Hamburg
Department of Vascular Medicine
University Heart Center
Hamburg, Germany
Disclosures: Proctor, receives travel grants, and receives speaker's fees from Cook Medical.

Tilo Kölbel, MD, PhD

German Aortic Center Hamburg
Department of Vascular Medicine
University Heart Center
Hamburg, Germany
Disclosures: Proctor, receives travel and educational grants, and has intellectual property with Cook Medical.