Techniques to Facilitate Thoracic Stenting

Tips and tricks to ensure accurate device placement, patient safety, and durable outcomes.

BY TAKAO OHKI, MD, PhD

Stenting of thoracic aortic lesions has emerged as a viable alternative to standard surgical repair. These lesions include degenerative aneurysms, chronic and acute dissections, intramural hematomas, penetrating aortic ulcers, and traumatic lesions. Because traditional surgical repair involves thoracotomy and aortic cross-clamping, it is associated with a high morbidity rate. Endovascular graft (EVG) repair, therefore, provides a tremendous advantage in terms of safety and preservation of quality of life. EVG repair involves insertion of a large-caliber delivery system from a remote access site and anchoring of the EVG in aneurysm-free proximal and distal arterial segments. However, both steps may be hampered by the presence of extensive atherosclerotic disease in the access vessel as well as vessels adjacent to the target lesion.1 This article describes several adjunctive techniques to overcome various problems encountered during EVG repair of thoracic aortic lesions.

TECHNIQUES FOR SMALL OR TORTUOUS ILIACS

Patients undergoing EVG repair of thoracic lesions often have peripheral vascular disease involving the iliac arteries. Because the currently available EVGs have a large delivery system, insertion of these EVGs through a diseased iliac system may be difficult and is a commonly encountered problem. Several techniques have been described to facilitate safe introduction of the EVG.

Balloon Angioplasty and Stenting

The simplest technique is to perform PTA of the stenotic segment. One must be careful when dilating a densely calcified artery because the risk of arterial rupture is high. Stenting should be performed after the insertion of the EVG because the stent may damage the delivery system, and there is a potential risk of stent dislodgment during EVG insertion.

Dissection of the External Iliac Artery

When severe tortuousity of the external iliac artery is present, blind, digital dissection and mobilization of the external iliac artery can be performed through a groin incision to remove the redundancy and straighten the access vessel. The excess arterial segment can be excised and an end-end anastomosis performed at the completion of the procedure.

Direct Common Iliac Artery Access

When extensive disease is present in the iliac system, accessing the common iliac artery will greatly increase the safety of the procedure. The common iliac artery can be exposed readily through a right or left lower-quadrant oblique incision. This can be performed under epidural anesthesia, and the exposure is generally adequate, even in obese patients. One can insert the EVG directly through a common iliac arteriotomy. Alternatively, anastomosing a vascular graft to the common iliac artery can create a temporary conduit. Obviously one must make sure that the conduit (prosthetic graft) is large enough to accommodate the endograft.

Common Carotid Artery Access

Under desperate conditions, one may decide to use the common carotid artery as an access vessel. When utilizing the carotid artery, the right carotid artery will generally give a better angle for the delivery of the EVG. It may be advisable to perform an intracranial angiogram and to confirm the presence of adequate collateral filling via the anterior or posterior communicating arteries to avoid cerebral ischemia.

Direct Insertion Through Surgical Exposure of the Thoracic or Abdominal Aorta

The most definitive approach is through direct insertion via the abdominal aorta. Although some interventionists have used this approach solely for the purpose of EVG insertion, it has been performed in the presence of concomitant abdominal aortic pathology requiring surgical exposure.

Trial Sheath Insertion

Because the EVGs are quite expensive, it is unfortunate to attempt insertion of an EVG only to find out that it was not possible. If there is any question regarding the delivery of the EVG, a trial insertion of a standard sheath of a similar crossing profile will allow the interventionist to predict the possibility of inserting the EVG. It also functions as a vessel dilator in small iliacs.

DEALING WITH THE UNFAVORABLE ARCH

When the aneurysm is adjacent to the arch vessels or when the angle of the arch is unfavorable due to an elongated aorta, insertion of the EVG to the target site becomes a challenge. Although this problem becomes less of an issue with the availability of more flexible delivery systems such as the Gore TAG device (Gore & Associates, Flagstaff, AZ), it is still a significant technical issue.

Transseptal Guidewire

Dorros et al have described the use of a transseptal guidewire to facilitate safe insertion of the EVG when difficulty in EVG insertion was encountered.

Brachial Guidewire

Use of a brachial guidewire has gained more popularity due to its simplicity. A percutaneous access is made in either the right or the left brachial artery. It is important to use a guidewire that is longer than 260 cm because additional length is needed to load the EVG system. By applying tension to both ends of the brachial wire, unfavorable arch anatomy can be corrected more effectively than by simply using a super-stiff wire.

CREATING A BETTER ANCHORING SEGMENT

Unlike surgical anastomoses, all currently available EVGs employ a friction fixation proximally and distally. Therefore, absence of an adequate nonaneurysmal segment adjacent to the lesion is another significant problem encountered during EVG repair. Until branched endografts become more widely available, one of the following techniques may enable EVG repair.

Covering of the Branch Vessel Using the EVG With and Without Coil Embolization

In the vast majority of cases, it is safe to cover the left subclavian artery with the EVG. This technique cannot be applied to those patients who have a patent left internal mammary artery bypass graft or whose left vertebral artery is the dominant vertebral artery. Similarly, coverage of the celiac artery can be performed safely in many instances. However, one needs to perform careful angiography to check the presence of collateral vessels connecting the celiac and the superior mesenteric artery..

Bypass or Transposition of Branch Vessels

When perfusion of the end organ is a concern, bypass or transposition of the branch vessel may be performed. Debranching of the aortic arch by performing an ascending aorta-carotid/innonimate artery bypass allows one to deploy the stent across the aortic arch. Performing a visceral artery bypass graft (usually originating from the iliac artery) can facilitate EVG repair of type IV thoracoabdominal aneurysms.

"Elephant Trunk" and Hybrid Procedures

In patients who have ascending and/or descending aortic lesions, the former may be repaired surgically utilizing an "elephant trunk" technique. This will create an ideal proximal neck and facilitate the subsequent EVG repair of the descending aortic aneurysm. Also, some have advocated a hybrid procedure in which the proximal anastomosis is performed surgically via a thoracotomy while the distal end of the graft is secured with a stent.

TECHNIQUES TO IMPROVE THE ACCURACY OF EVG DEPLOYMENT

Due to the propulsive downstream force exerted by the aortic blood flow on the EVG as it is deployed, the EVG may be displaced distally more than planned. Two different techniques have been described to overcome this problem. In addition, setting the C-arm gantry at the correct angle (LAO), such that one can accurately visualize the orifice of the arch vessels, is a basic technique.

Pharmacologically Induced Temporary Cardiac Arrest

The most commonly used technique to achieve precise deployment is the use of adenosine to induce cardiac arrest. This technique is simple and reliable. A test injection starting at a low dose is performed to determine the appropriate dose to achieve cardiac arrest of a desired period. Alternatively, electrically induced ventricular fibrillation or nitroglycerin-induced hypotension have been used.

Use of Transesophageal Echocardiogram

In order to better visualize the target lesion and to facilitate accurate EVG deployment, the use of intraoperative transesophageal echo may be useful.

TECHNIQUES TO IMPROVE SAFETY

Obtaining an Iliac Angiogram After Removing the Delivery Sheath and Prior to Removing the Guidewire

Iliac artery rupture is not an unusual complication during thoracic stenting. Because the sheath may be sealing the rupture site, diagnosis of arterial rupture may not become apparent until this sheath is removed. If the guidewire has been removed at this point, the treatment of arterial rupture becomes a significant challenge, and urgent laparotomy may be needed. However, if the guidewire is still in place, immediate hemostasis can be readily obtained by inflating a balloon at the site of the rupture. Once hemostasis is achieved, the arterial perforation can be repaired by deploying a covered stent or by direct surgical repair through a limited exposure. The same can be said for arterial dissection.

Preventing Spinal Cord Ischemia

Use of cerebrospinal fluid drainage has been favored by many. This technique may be especially useful for a patient who requires coverage of the entire descending aorta, or those who have undergone previous AAA repair.

COMMENTS

Because EVGs used for thoracic lesions have larger crossing profiles and stiffer delivery systems than those used for AAAs, the insertion of the delivery system through challenging access vessel anatomy is a frequently encountered technical issue. Also, the lack of proximal or distal landing zones prohibits EVG repair in many patients. Although the adjunctive techniques described in this article may be helpful, it is also important to recognize when to quit. These adjunctive techniques may be of paramount value in nonsurgical patients who have life-threatening conditions; they may also be harmful, if one pushes the envelope too much in a patient who can be treated surgically. One should always keep in mind that the decision to convert to surgical repair or to simply quit may be equally important to these adjunctive techniques. ■

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