# If a Complicated Type B Dissection Presents With Proximal Extension to the LCCA, How Should It Be Managed?

**Ali Azizzadeh, MD**
Professor and Chief
Division of Vascular and Endovascular Surgery
Program Director in Vascular Surgery
Department of Cardiothoracic and Vascular Surgery
McGovern Medical School at the University of Texas Health Science Center at Houston (UTHealth)
Houston, Texas
ali.azizzadeh@uth.tmc.edu
*Disclosures: Consultant for Gore & Associates and Medtronic.*

Management of patients with acute, complicated type B aortic dissection has undergone a significant paradigm shift over the past decade. The introduction of thoracic endovascular aortic repair (TEVAR) has provided a minimally invasive alternative to treat rupture, malperfusion, and refractory pain and hypertension by closing the proximal entry tear, repressurizing the true lumen, inducing false lumen thrombosis, and promoting aortic remodeling. One of the general requirements of TEVAR is to obtain a 2-cm proximal landing zone of uninvolved aorta. As a result, retrograde extension of the dissection into the arch presents a significant therapeutic challenge in this patient cohort.

Unfortunately, this is not a rare phenomenon. In our institutional series of more than 500 patients with acute type B aortic dissection, 33% had some arch involvement (eg, left subclavian, left common carotid, or innominate artery). Currently, there is no clear consensus on the ideal management of this subgroup. Generally, minimally invasive treatment of these patients (ie, TEVAR) provides a safer alternative to open repair. Obtaining an adequate proximal landing zone may require arch debranching, which may or may not be feasible in an emergency situation, such as in a patient who presents with aortic rupture. In addition, landing a device in a diseased or dissected aorta may increase the risk of retrograde type A dissection. Regardless of the treatment approach, it would be ideal to have cardiac surgery backup available if an open ascending or arch procedure becomes necessary.

I believe the therapy in this patient subgroup should be tailored to the patient's risk profile, presentation (rupture vs malperfusion vs refractory pain and hypertension), and anatomy, as well as local expertise and device availability. A patient who presents with rupture or malperfusion may be best served with an emergency TEVAR and left carotid revascularization using a branched thoracic device or a retrograde covered stent graft (chimney) placed from a left neck cutdown. Patients with refractory pain and hypertension may have the luxury of time to undergo a formal right-to-left carotid-carotid and left carotid-to-left subclavian bypass prior to standard TEVAR and zone 1 coverage. Alternatively, patients with complex arch dissection and/or aneurysm who are not candidates for TEVAR will require formal arch replacement and reconstruction using an elephant trunk technique. The TEVAR procedure can be performed in an antegrade fashion using a frozen elephant trunk device versus the traditional retrograde technique. In patients who present with malperfusion, extension of

the repair to the celiac artery may be necessary, which usually requires the traditional retrograde femoral access. A minority of patients with static obstruction of mesenteric or renal branch vessels will require additional percutaneous intervention to treat their malperfusion.

In summary, management of patients with acute, complicated type B dissection and retrograde extension into the aortic arch remains a significant challenge. Multiple treatment options are present. Therapy should be tailored to the specific patient considering their risk profile, anatomy, local expertise, and device availability. Fortunately, this technology is rapidly evolving, and newer arch-specific devices are on the horizon.

**Eric E. Roselli, MD**
Director of the Aorta Center
Heart and Vascular Institute
Cleveland Clinic
Cleveland, Ohio
roselle@ccf.org
*Disclosures: Speaker, consultant, and investigator for Bolton Medical, Cook Medical, Gore & Associates, Medtronic, and Vascutek Ltd.*

When a patient presents with complicated type B dissection extending to the left common carotid artery (LCCA), the first question to ask is, "What is the goal for this patient?" The answer to this question depends upon more specific details of the presentation. If *complicated* means that the patient has immediate life-threatening malperfusion (eg, visceral compromise), the initial goal is to reperfuse the compromised vascular bed. Reperfusion of the vascular bed is most expeditiously accomplished endovascularly with TEVAR of the descending aorta to address dynamic obstruction of the true lumen. Even if the proximal landing zone is not ideal, TEVAR extending through the descending aorta may stabilize the patient. If there is static obstruction of a branch vessel, it should also be stented. An antegrade approach from brachial or axillary access is often the quickest way to accomplish stenting of branched arteries. A more definitive operation can always be done at a later time, and true lumen TEVAR does not necessarily limit the possibility for any future interventions.

If *complicated* means contained rupture, the goal is not only to improve true lumen flow, but also to eliminate false lumen flow in the ruptured segment. Even with extension to the LCCA, this may be accomplished with TEVAR if the proximal entry tear is far enough beyond the arch. This will likely require coverage of the left subclavian artery (LSA), and longer aortic coverage should be used to eliminate retrograde false lumen perfusion from downstream reentry tears. If covering the LSA is dangerous (eg, critical patent internal thoracic-to-left anterior descending bypass), then laser fenestration of the graft with LSA stenting or carotid-subclavian bypass will need to be done simultaneously. Single branched stent grafts may be another good option when they become commercially available. If adequate coverage of the entry tear cannot be accomplished with a purely endovascular approach, a hybrid approach is another excellent option. This is best performed through a median sternotomy, with cardiopulmonary bypass, hypothermia with selective antegrade brain perfusion, and frozen elephant trunk arch reconstruction. The stent graft is delivered via a direct antegrade approach with suture fixation in the aortic arch. In acute situations, we perform the frozen elephant trunk as a branched single anastomosis procedure with direct stenting of the LSA. The left carotid artery can be stented also, if it is compromised. These procedures for patients with malperfusion are best performed in a hybrid operating room to allow for expeditious revascularization of branch vessels with static occlusion after the primary aortic operation addresses the dynamic obstruction.

For patients with less serious but complicated presentations (eg, persistent pain/hypertension), the urgency of repair is less critical. Balancing risks and benefits is more difficult than for the other presentations previously described. When the dissection extends to the LCCA, patients may be at higher risk for retrograde ascending dissection with a TEVAR-only approach. However, TEVAR may still be a reasonable option, especially for older patients or those with comorbidities. When planning, it is important that the device lies in a parallel position with minimal (< 10%) oversizing. I size the device based on the entire aortic diameter, not just the true lumen, at a segment between the LCCA and subclavian arteries. The LSA is revascularized selectively. If the proximal entry tear extends proximal to the LSA, there are other anatomic concerns about the safe deployment of the stent graft, or if the patient is young or has a connective tissue disorder, then the hybrid frozen elephant trunk as described previously is a better option than a purely endovascular repair. The hybrid approach also includes replacement of the ascending aorta, so concern for retrograde dissection is eliminated. The dissected LCCA can be treated directly.

Finally, for patients who present with less serious complications but demonstrate high-risk features on imaging, treatment is postponed until the subacute phase about

4 to 6 weeks after presentation and the same anatomic considerations about treatment choice apply.

In summary, patients presenting with complicated aortic dissection extending to the LCCA should be promptly managed by a multidisciplinary team with the full capabilities to deliver open, endovascular, and hybrid therapies. For most patients, a TEVAR approach is best, but the frozen elephant trunk technique provides an excellent alternative to a left thoracotomy if the proximal landing zone is hostile. Long-term survival requires consistent imaging follow-up with a proactive eye toward reintervention. As our understanding of this complex disease improves, so will our diagnosis and treatment.

**Matthew Thompson, MD, FRCS**
Professor of Vascular Surgery
St. Georges Vascular Institute
London, United Kingdom
profmattthompson@gmail.com
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The extension of retrograde hematoma toward the LCCA origin may be considered a risk factor for retrograde type A dissection (RTAD). RTAD is perhaps one of the most feared complications of thoracic endograft placement and may be fatal in > 30% of cases. For this reason, the treatment algorithm for patients with a retrograde extension of a dissection toward the LCCA may be slightly modified from a "standard" complicated dissection.

For me, the first decision would relate to the urgency of treatment. The term *complicated dissection* has been interpreted differently over the past few years, with authors noting radiologic appearances that may be considered complicated and nuanced academic arguments that all type B dissections are complicated. In my view, we should be talking about clinical complications, as these define clinical management. In the case of a complicated type B dissection, I would make a clinical decision as to whether the patient needed emergency surgery (absolute indications such as rupture, visceral, or lower limb ischemia) or could be treated over a longer period of time (relative indications such as pain, persistent hypertension, radiologic as opposed to clinical malperfusion).

Due to the risk of RTAD, in patients with a relative rather than an absolute indication for surgery, I would recommend an initial conservative approach with serial clinical and radiologic evaluation. Using this approach, some patients with a retrograde extension may demonstrate resolution of the hematoma over a short period of time and become theoretically safer to treat. The conservative approach relies upon close observation and frequent reevaluation. Any deterioration in clinical status would mandate intervention. We have observed that patients treated in this way may become better candidates for intervention as the retrograde hematoma resorbs. These patients can then undergo intervention a few weeks after the initial event.

In patients with absolute indications for intervention or those failing conservative therapy, assessing the site of the entry tear and sizing of the endograft is crucial. Obviously, the endograft needs to cover the primary entry tear, and thus bypass of the great vessels may occasionally be required. To reduce the incidence of RTAD, the endograft should be sized to match the true lumen of the aorta at the landing zone with no oversizing.

**Dittmar Böckler, MD, PhD, MHBA**
Professor of Vascular and Endovascular Surgery
Head and Chair of the Department of Vascular and Endovascular Surgery
University Hospital Heidelberg
Heidelberg, Germany
dittmar.boeckler@med.uni-heidelberg.de
*Disclosures: None.*

Guidelines and consensus statements recommend treatment for complicated type B dissections, and TEVAR is the most common first-choice treatment in these cases.[1,2] A proximal landing zone of at least 15 mm (and ideally 20 mm) is recommended and is within instructions for use for most commercially available stent grafts. An adequate proximal landing zone is defined as a healthy, nondissected aortic wall, and this is where the challenge to treating complicated type B dissection lies. Because of the typical distal localization of the main primary entry tear and origin of the LSA, zone 2 is the intended proximal landing zone in the majority of cases (Figure 1). In our experience with acute complicated type B dissections, 57% of stent grafts were deployed in zone 2, 26% in zone 3, and only 4.3% in zone 1 (proximal to the LCCA).[3]

In the early days of my practice, it was mandatory to land stent grafts in a healthy landing zone. Disease extension proximal to the LCCA (Figure 2) automatically led to semi-arch debranching with right carotid-left subclavian bypass with reinsertion of the LCCA. The one exemption was the bovine arch, in which no further proximal landing zone length could be achieved because of the risk of retrograde dissection, pericardial tamponade, and death. According to Canaud et al, this overall risk of retrograde dissection is 0.8% in TEVAR located in the arch.[4] A meta-analysis of hybrid

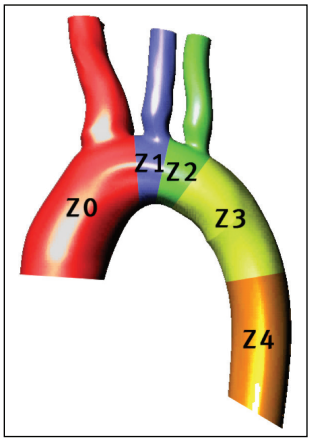


**Figure 1. Classification of landing zones in the aortic arch. Adapted from Mitchell RS, Ishimaru S, Ehrlich MP, et al. First international summit on thoracic aortic endografting: roundtable on thoracic aortic dissection as an indication for endografting. J Endovasc Ther. 2002;9:SII98–105.**

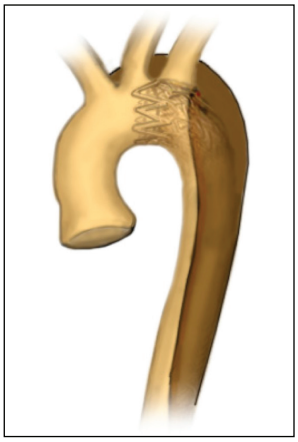

**Figure 2. The proximal landing zone for many type B dissections is proximal to the main entry tear in zone 2.**

arch procedures during TEVAR showed higher complication and mortality rates in patients with expanded debranching procedures, which were not only due to stroke.[5]

Today, when treating complicated type B dissections, I do not oversize at the proximal landing zone. I use stent grafts without bare stents and deploy the stent graft 15 mm proximal to the entry tear without postballooning. Left subclavian revascularization is performed selectively in emergent cases. At the end of the procedure, transesophageal echocardiography is performed to rule out retrograde dissection. Cardiac surgery backup is routinely organized. Considering the risk and benefits, I do not debranch the LCCA in cases of complicated type B dissection and cover the primary entry tear. Chimney solutions do not appear to work well, and fenestrated and branched stent grafting are not yet options under these circumstances.

In summary, patients with complicated type B dissection who present with proximal extension to the LCCA should receive TEVAR with primary entry closure, achieving a proximal landing zone of at least 15 mm, even if it shows aortic wall hematoma. ■

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