Set Yourself Up for Success: Approaches to a Short/Hostile Neck in a Must-EVAR Situation

A discussion of what constitutes a hostile neck, the importance of patient selection and preoperative planning, device limitations and deployment tips, and key principles in intraoperative techniques.

By Jeanwan Kang, MD

Endovascular aneurysm repair (EVAR) has become the primary treatment modality for managing patients with abdominal aortic aneurysms (AAAs), with multiple studies demonstrating lower perioperative morbidity and mortality compared to open repair.[1] However, 40% to 60% of patients with AAAs do not have anatomy that fits the instructions for use (IFU) of available devices, complicating treatment options and potentially compromising outcomes.[2] Patients with hostile necks constitute a large proportion of these patients who fall outside of the IFU, and determining the best treatment plan for such patients remains a challenge. Hostile necks have been associated with increased risk of type I endoleak, graft migration, aneurysm sac enlargement, reintervention, and aneurysm-related mortality when treated with conventional EVAR devices.[3-7] To achieve optimal results after EVAR in patients with hostile necks, several factors should be taken into consideration, including judicious patient selection, careful preoperative planning with a keen understanding of and familiarity with the various stent grafts and adjunctive devices available, and utilization of key principles in intraoperative techniques.

WHAT IS A HOSTILE NECK?

Although there is no clear consensus on the definition of what constitutes a hostile neck for standard EVAR, most studies looking at the effect of such "hostile neck" include aortic neck length < 10 to 15 mm, infrarenal aortic neck angulation > 60°, infrarenal aortic neck diameter > 28 mm, conical or reverse taper neck, and presence of > 50% circumferential thrombus and/or calcium.[2] The majority of patients with hostile necks will have more than one, if not several, of these features, making endovascular treatment even more challenging. Interestingly, many of the stent grafts and adjunctive devices that have been developed to offer improved fixation and seal in treating patients with hostile necks may only address one of these features, and their effectiveness in treating patients with multiple, high-risk neck anatomy features remains largely unstudied.[8,9]

WHAT IS A "MUST-EVAR" SITUATION?

There is no single set of criteria that determines a "must-EVAR" situation. The decision to proceed with endovascular rather than open repair should be based on several different factors, including the patient's life expectancy, comorbidities, anatomic features, and preference and ability to adhere to regular follow-up, as well as the urgency of treatment. When assessing a patient's operative risk, additional preoperative evaluations, such as echocardiography or pulmonary function testing, may be helpful in providing objective data beyond the simple listing of

medical history. Certainly, a patient with history of coronary artery disease who has undergone a successful revascularization with preserved heart function is at a very different operative risk than someone with ischemic cardiomyopathy with reduced ejection fraction, even though both patients have a "history of coronary artery disease." For patients presenting with ruptured aneurysms, endovascular treatment may be the better option, even with less-than-ideal anatomic features, if the operator is able to get the patient through the emergent situation and buy time to provide a more definitive and durable treatment in an elective manner.

FB-EVAR AS FIRST-LINE ENDOVASCULAR TREATMENT

Fenestrated-branched EVAR (FB-EVAR) provides durable treatment for patients with hostile aortic necks by raising the seal zone to an area with healthy tissue.[10,11] Increased technical difficulty, higher risk of target vessel injury, and risk of spinal cord ischemia have been some of the reasons to discourage FB-EVAR; however, recent reports of outcomes following FB-EVAR have been excellent and continue to improve over time as experience and technology evolve.[12,13] Although FB-EVAR can also be used as a bailout after failed EVARs, they are more difficult than when performed as the index procedure, especially in those with high neck angulation, tortuous iliac arteries, bare suprarenal stents, parallel renal/visceral stent grafts, or short main body endografts.[14] Therefore, serious consideration should be given to offering FB-EVAR as the first-line endovascular treatment option in patients with hostile aortic necks. Unfortunately, FB-EVAR may not always be available due to lack of expertise or resources, and patient transfer to a facility that offers FB-EVAR may not be feasible due to urgency of the case, patient preference, or financial/social circumstances.

PREOPERATIVE PLANNING

If the decision is to proceed with standard EVAR, maximizing the seal zone and utilizing every millimeter of the neck with orthogonal placement of the stent graft is essential. To help achieve this, careful evaluation of preoperative imaging studies is needed, including assessment of proper gantry angle for orthogonal visualization of the renal artery origins, measuring the effective neck length and diameter, and determining the optimal side of main body device delivery.

When measuring the aortic neck length in patients with highly angulated necks, there may be a significant difference between the centerline measurement and the effective neck length along the inner curve of the aortic neck. Higher neck angulation also results in greater degree of change in blood flow velocity, which subjects the stent graft to greater displacement force and a theoretically higher risk of graft migration. Therefore, in patients with highly angulated necks, longer neck length may be needed to achieve durable fixation and seal. The ability to achieve graft placement in orthogonal position to centerline may also be compromised in those with highly angulated necks. In such cases, the effective aortic diameter where the stent graft deploys may end up being larger than the diameter based on centerline measurement. Hence, a larger stent graft size may be necessary based on the predicted final position or lay of the stent graft within the angulated neck.

Tortuosity of the iliac vessels, especially the aortoiliac angle, influences the direction of the guidewire and therefore the stent graft placement along the aneurysm neck. Choosing the appropriate side for device delivery facilitates the wire and stent graft taking course along the outer curve of the angulated neck and optimizes stent graft deployment in orthogonal position.

UNDERSTANDING THE FINE POINTS OF DEVICE DEPLOYMENT AND LIMITATIONS

Advances in device technology have addressed issues in treating the different features of the hostile aortic necks, including reduction in minimal aortic neck length, conformability of the stent graft to adapt to angulated necks, and better control and precision in device deployment. Adjunctive devices have also been developed for improved fixation of aortic stent grafts to AAAs with short necks. Familiarity with specific stent grafts is essential, as each device has its own set of "tips and tricks" to achieve optimal deployment.[9]

Knowing when to use certain devices with a keen understanding of their limitations is important when deciding between the various treatment options. Although most patients with "hostile necks" have multiple high-risk features, it is important to note that the results of the studies looking at the effectiveness of treating aneurysms with hostile necks actually only address one such high-risk anatomy.

Recently, the Gore Excluder conformable endoprosthesis (Gore & Associates) received FDA approval for use in patients with aortic neck angulation > 60° and ≤ 90°. The 1-year outcomes of a pivotal trial substudy among these patients with highly angulated necks were favorable.[9] However, while the IFU of this device includes those with aortic neck length as short as 10 mm and neck angulation of up to 90°, the average neck length among those with high neck angulation in the pivotal trial was 21.3 ± 10.1 mm. More importantly, those who developed type I endoleaks after EVAR had

neck lengths ranging from 19 to 25 mm. The study reports a further subgroup analysis of patients with high-risk anatomy, defined as neck length < 15 mm and high neck angulation, but there were only 20 patients in this group, and it would be difficult to make conclusions on the effectiveness of the device in patients with a combination of short and angulated necks based on such a low number of patients.

The Heli-FX EndoAnchor system (Medtronic) was developed to replicate a hand-sewn anastomosis between a graft and native vessel to improve fixation of devices in patients with short aortic necks. The 5-year outcomes for treatment of patients with short-neck AAA (4-10 mm) using the Heli-FX EndoAnchor system showed favorable results.[8] But again, the study essentially looked at patients with isolated short necks and did not include those with additional high-risk features such as neck angles > 60°, reverse tapered neck, or extensive calcification or thrombus. Therefore, while the EndoAnchor may be useful in treating patients with isolated short necks, especially in emergency situations, one should be cautious with a more liberal use of this technique in treating patients with multiple, high-risk neck features.

INTRAOPERATIVE TRICKS

Although each stent graft has its own set of "tips and tricks" for accurate deployment, there are some general principles that may be useful. Obtaining optimal gantry angle for orthogonal visualization of the renal artery origins may be difficult when extreme angulation of the imaging system is needed. Precannulation of the lowest renal artery may be helpful in such situations and allows the operator to aggressively maximize seal zone without sacrificing access to the lowest renal artery. Partial deployment of the stent graft above the lowest renal artery, then slowly pulling down with repeat imaging as needed, may also help offset "slipping" of the stent graft once it starts to take the angle of the aortic neck. In addition, one may need to adjust the imaging angle depending on how the device lies, as the angulation may change once the stent graft is in position and the "stiffness" of the device interacts with the native aorta. The stiffness of the wire during deployment may also affect how the device will lie or take to the curvature of the aneurysm neck. Finally, the delivery system should be carefully removed once the graft is fully deployed, especially in cases with tortuous aorta to ensure that the delivery sheath does not catch the proximal end of the stent graft, resulting in inadvertent distal displacement.

CONCLUSION

Although endovascular management of AAAs offers improved perioperative outcomes, managing patients with hostile aortic neck remains the Achilles' heel of EVAR. Multiple factors should be taken into consideration when treating such patients to achieve the best outcome for each individual patient. Although there is no single solution that is right for every patient, every effort should be made to provide the best treatment for each patient. Judicious patient selection, careful preoperative planning with a keen understanding of available devices, knowing when and when not to use certain devices, and utilizing key principles in intraoperative techniques can help optimally manage these challenging patients. ■

1. Antoniou GA, Antoniou SA, Torella F. Editor's choice—endovascular vs open repair for abdominal aortic aneurysm: systematic review and meta-analysis of updated peri-operative and long-term data of randomized controlled trials. Eur J Vasc Endovasc Surg. 2020;59:385-397. doi: 10.1016/j.ejvs.2019.11.030
2. Marone EM, Freyrie A, Ruotolo C, et al. Expert opinion on hostile neck definition in endovascular treatment of abdominal aortic aneurysms (a Delphi consensus). Ann Vasc Surg. 2020;62:173-182. doi: 10.1016/j.avsg.2019.05.049
3. Schanzer A, Greenberg RK, Hevelone N, et al. Predictors of abdominal aortic aneurysm sac enlargement after endovascular repair. Circulation. 2011;123:2848-2855. doi: 10.1161/CIRCULATIONAHA.110.014902
4. Stather PW, Sayers RD, Cheah A, et al. Outcomes of endovascular aneurysm repair in patients with hostile neck anatomy. Eur J Vasc Endovasc Surg. 2012;44:556-561. doi: 10.1016/j.ejvs.2012.10.003
5. Stather PW, Wild JB, Sayers RD, et al. Endovascular aortic aneurysm repair in patients with hostile neck anatomy. J Endovasc Ther. 2013;20:623-637. doi: 10.1583/13-4320MR.1
6. Antoniou GA, Georgiadis GS, Antoniou SA, et al. A meta-analysis of outcomes of endovascular abdominal aortic aneurysm repair in patients with hostile and friendly neck anatomy. J Vasc Surg. 2013;57:527-538. doi: 10.1016/j.jvs.2012.09.050
7. McFarland G, Tran K, Virgin-Downey W, et al. Infrarenal endovascular aneurysm repair with large device (34- to 36-mm) diameters is associated with higher risk of proximal fixation failure. J Vasc Surg. 2019;69:385-393. doi: 10.1016/j.jvs.2018.02.054
8. Arko FR 3rd, Pearce BJ, Henretta JP, et al. Five-year outcomes of endosuture aneurysm repair in patients with short neck abdominal aortic aneurysm from the ANCHOR registry. J Vasc Surg. 2023;78:1418-1425. doi: 10.1016/j.jvs.2023.07.058
9. Rhee RY, Almadani MW, Yamanouchi D, et al. Early results from the pivotal trial substudy of the GORE EXCLUDER conformable endoprosthesis in angulated necks. J Vasc Surg. 2025;81:342-350. doi: 10.1016/j.jvs.2024.09.013
10. Verhoeven ELG, Katsargyris A, Oikonomou K, et al. Fenestrated endovascular aortic aneurysm repair as a first line treatment option to treat short necked, juxtarenal, and suprarenal aneurysms. Eur J Vasc Endovasc Surg. 2016;51:775-781. doi: 10.1016/j.ejvs.2015.12.014
11. Starnes BW, Zettervall S, Larimore A, Singh N. Long-term results of physician-modified endografts for the treatment of elective, symptomatic, and ruptured juxtarenal abdominal aortic aneurysms. Ann Surg. 2024;280:633-639. doi: 10.1097/SLA.0000000000006422
12. Oderich GS, Huang Y, Harmsen WS, et al. Early and late aortic-related mortality and rupture after fenestrated-branched endovascular aortic repair of thoracoabdominal aortic aneurysms: a prospective multicenter cohort study. Circulation. 2024;150:1343-1353. doi: 10.1161/CIRCULATIONAHA.123.068234
13. Finnesgard EJ, Jones DW, Beck AW, et al. Trends and outcomes over time with fenestrated and branched endovascular aortic repair in the United States Aortic Research Consortium. J Vasc Surg. Published online February 4, 2025. doi: 10.1016/j.jvs.2025.01.213
14. Schanzer A, Beck AW, Eagleton M, et al. Results of fenestrated and branched endovascular aortic aneurysm repair after failed infrarenal endovascular aortic aneurysm repair. J Vasc Surg. 2020;72:849-858. doi: 10.1016/j.jvs.2019.11.026

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Disclosures: None.