A New Angle on Precise Endograft Placement

The potential benefits of orthogonal device placement in angulated aortic necks.

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Abdominal aortic aneurysms (AAAs) are treated using endografts now more than ever. The ability to successfully perform endovascular abdominal aortic aneurysm repair (EVAR) depends on several key factors. The nature of the proximal aortic infrarenal neck is an essential component in predicting how successful EVAR will be. Conquering the proximal neck is likely the most important consideration in predicting an immediate, as well as long-term, successful outcome after EVAR.

Traditionally, the proximal infrarenal neck should be ≥ 15 mm in length, < 32 mm in diameter, and uniform in diameter throughout its length. The neck should be morphologically free of thrombus and calcification. Additionally, the neck should be straight to allow maximal coverage by the proximal graft. The endovascular treatment of AAAs in patients with angulated necks, both moderate and severe, remains one of the great challenges of EVAR. In our own practice, around 20% to 40% of all patients have significant angulation of the neck (> 60°).

CHALLENGES OF ANGULATED NECKS

When patients with angulated infrarenal aortic necks have other unfavorable characteristics such as reduced neck lengths, enlarged neck diameter, or circumferential thrombus, successful treatment becomes even more challenging. These infrarenal neck characteristics further increase the degree of difficulty of the EVAR procedure. The proximal portion of the covered stent serves as the seal of the graft to the proximal aorta. Failure to achieve optimal and complete apposition of the endograft to the vessel wall is likely to have poor results with a higher probability of developing a Type 1A endoleak in both the short- and long-term.

The endovascular treatment of AAAs in patients with angulated necks is difficult because the placement of the proximal graft along the true center of the aorta is mechanically difficult. Typically, the effective length of the infrarenal neck is minimized because the graft deploys horizontally to the angled aorta as opposed to horizontal to the center line or true lumen of the aorta. When the graft deploys straight across the aorta with effectively little compensation for the angle of the aortic lumen, the length of the infrarenal neck sealing is minimized. The graft is usually seated asymmetrically in respect to the aortic neck with a shortened portion of the neck length serving as part of the endograft's proximal seal.

In the scenario of a patient with an angulated proximal infrarenal neck needing EVAR with a challenged proximal aortic seal, operators may need to use additional devices such as proximal cuffs, balloon-expandable stents, and endoanchors in order to improve the resulting poor proximal aortic neck apposition and sealing. Clearly, one of the unmet clinical needs in EVAR technology is the ability to predictably achieve maximal primary fixation and sealing in an angulated neck without the need for immediate or secondary interventional procedures.

Currently at our institution, the presence of an angulated neck is not an exclusion criterion for endovascular therapy in isolation; however, it is a predictor of a challenging procedure with a higher risk of needing other therapies for endoleaks. In a recent study evaluating the M2S database, patients treated outside of the instructions for use with angulated, short, or dilated proximal aortic necks had a higher rate of secondary procedures and unsuccessful repairs (defined as aortic sac enlargement).[1]

TECHNIQUES FOR TREATING ANGULATED NECKS

Several procedural tricks have been attempted to maximize aortic sealing in patients with angulated necks. The removal of the stiff guidewire or exchange for a soft guidewire from the graft delivery device immediately before deployment of the graft can allow

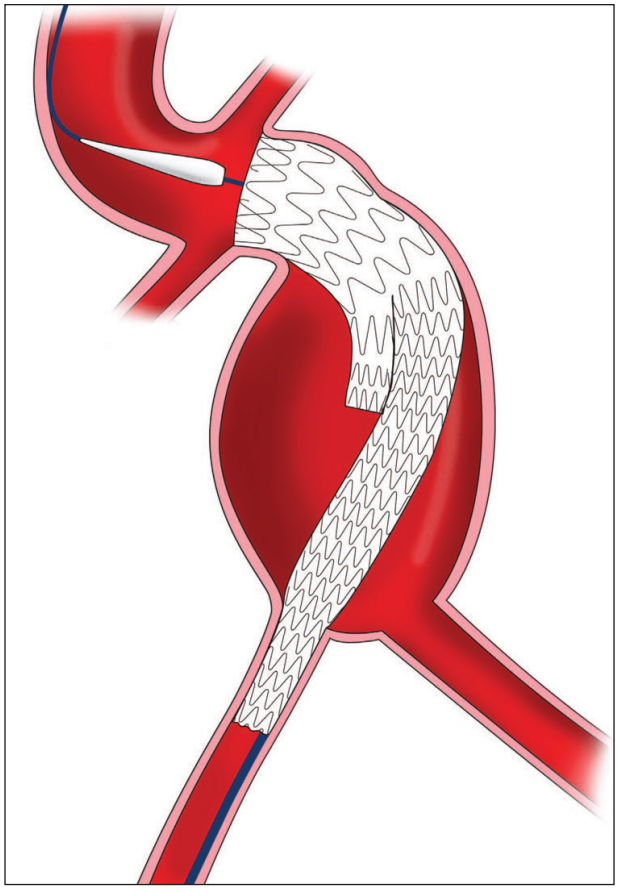

Figure 1. The ability to angulate the proximal portion of the endograft can allow sealing perpendicular to the aortic lumen, allowing maximal proximal neck appositon.

the proximal graft to better conform to the true center of the vessel. Also, a more aggressive technique to maximize the seal within the neck of an angulated aortic neck has included the use of a renal artery balloon from an upper extremity approach to buttress or serve as an "endowedge" on which the operator delivers the forward force of the delivery sheath and graft during deployment. Unfortunately, these techniques are usually not very helpful in angulated necks because of the inherent stiffness of the device delivery shaft, which only significantly aids the amount of sealing in a few patients.

Ideally, in an angulated infrarenal neck, the operator would have the ability to position an endograft along the centerline of blood flow (the angle of the angulation) in order to optimize the apposition of covered stent fabric throughout the length and circumference of the infrarenal neck. Currently, the endograft's deployment in an angulated neck generally results in the endograft's plane not matching the plane of the neck's angulation, resulting in placement of the superior aspect of the covered stent asymmetrically below the start of the infrarenal neck and the subsequent loss of 2 to 5 mm of possible apposition.

Orthogonal placement (perpendicular to the flow lumen) of an infrarenal endograft would maximize the amount of infrarenal graft apposition to the aortic wall, producing both excellent fixation and sealing (Figure 1).

What are the ideal characteristics of an endograft to maximize orthogonal placement in an angulated neck? In order to properly accommodate orthogonal placement in an angled aortic neck, the ideal endograft would not require a suprarenal component. Stent-graft fixation itself can be accomplished either with a suprarenal or infrarenal graft with similar acute and long-term results. The infrarenal device would maximize its seal by being able to conform along the flow direction of the vessel at the level of the neck. The endograft should be flexible in order to conform. The lack of a suprarenal component should improve its flexibility. Once in position, the endograft should be durable and stable in that position, due to active infrarenal fixation.

GORE® EXCLUDER® CONFORMABLE AAA ENDOPROSTHESIS*

The delivery system of the GORE EXCLUDER Conformable Device is intended to provide a unique solution to neck angulation through a number of unique benefits:

1. When the device is constrained on the delivery catheter, it can be angulated at the proximal end. This feature is intended to achieve proximal endograft positioning along the centerline of blood flow or orthogonal to the flow lumen.
2. The GORE EXCLUDER Conformable Device can also be angulated while it is partially deployed, providing another opportunity to align the endograft to be orthogonal to blood flow.
3. Similar to the GORE® EXCLUDER® Device featuring the C3® Delivery system, the GORE EXCLUDER Conformable Device can be constrained and reopened at the proximal end, which is intended to allow precise positioning in the proximal and distal portions of the neck. Another significant advantage of this feature is that it allows for optimal device positioning when cannulating the contralateral gate.

All of these delivery system characteristics, combined with a conformable endograft, are intended to provide marked improvement and operator control in the treatment of AAAs with angulated necks.

*Caution: Investigational Device. Limited by United States Law to Investigational Use.

CONCLUSION

As we attempt to better treat our patients with angled necks, a device that is designed to be conformable, reconstrainable, and accurately positioned to maximize the aortic neck coverage will provide more opportunity to achieve optimal seal and fixation for a successful, long-term AAA repair. ■

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1. Schanzer A, Greenberg RK, Hevelone N, et al. Predictors of abdominal aortic aneurysm sac enlargement after endovascular repair. Circulation. 2011;123:2848-2855.