Pitfalls in Patient Selection for Aortic Endografting

Staying out of trouble requires careful preprocedure planning and matching case difficulty to endovascular team skills.

BY HUGH G. BEEBE, MD

The appeal of a minimally invasive treatment that displaces a surgical procedure is intuitively obvious and especially compelling when increasingly informed patients ask for an endovascular alternative to major surgery. However, adverse features of an individual patient's vascular anatomy that predict a difficult endovascular procedure require thoughtful consideration about suitability for endografting. If the AAA patient has indications for treatment, usually determined by aneurysm size and consideration of rupture risk-enhancing factors, other criteria play a role in acceptance or rejection of a candidate for endovascular repair. Patient evaluation for endografting depends on the characteristics of available devices, team experience, and most importantly on critical assessment of aortoiliac morphology.

COMMON PROBLEMS FOR ENDOGRAFT CASE SELECTION

The Proximal Aortic Neck

Many candidates for endograft repair are appropriately rejected due to proximal neck problems. If the neck diameter is too large, it may be difficult to find an endograft large enough to accommodate the neck size. On a more sophisticated level, even if an endograft is capable of achieving an early seal in an aneurysm with a proximal neck diameter >28 mm, the neck may continue to enlarge, resulting in long-term complications. It is difficult at one point in time to determine whether a big aortic neck is stable or becoming aneurysmal, and attempts to base such evaluation on suprarenal aortic size have not been helpful.

Extreme proximal neck angulation is another reason for rejection. Angulation is difficult to arbitrarily evaluate because it must be considered in terms of neck length and characteristics of available prostheses. For example, an unusually long neck with angulation may be suitable for endografting, whereas the combination of severe angulation and a short neck length would be cause for rejecting endovascular treatment. It is safe to say that any angulation of the aortic neck beyond 70º would be too angulated for most current endografts. However, some endograft trials, notably the Medtronic (Santa Rosa, CA) Talent trials, have challenged these traditional limitations and accepted patients for endovascular treatment with aortic neck lengths as short as 5 mm and diameters as great as 34 mm, with early success in AAA exclusion.[1-3] But not all reports have agreed with this liberal approach to case selection criteria. A thoughtful evaluation of liberal selection criteria yielding increased endoleak risk even with a later-generation stent graft design, the Zenith endovascular graft (Cook Incorporated, Bloomington, IN), has been provided by Lawrence-Brown et al from Australia.[4] A short neck (<10 mm) is a reason to reject a

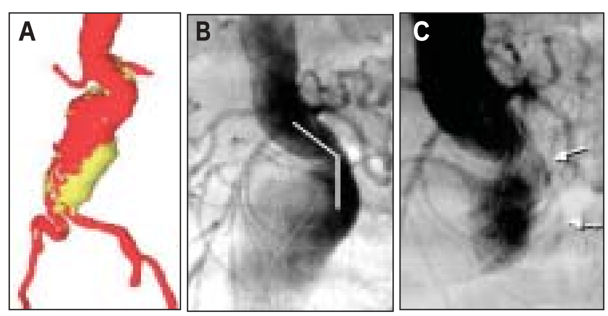

Figure 1. In a single view of a 3-D model (Medical Media Systems, West Lebanon, NH), the proximal neck is shown to be severely angled to 65° (A). The decision to attempt an endograft was based on the neck length seeming to be adequate despite the angle. An AP arteriogram just prior to insertion of the delivery system may appear less angled, but the 3-D model permits much more accurate measurement of both neck angle and length (B). An immediate type I endoleak can be seen (arrows), despite the stent graft inserted to the level of the left renal artery (C).

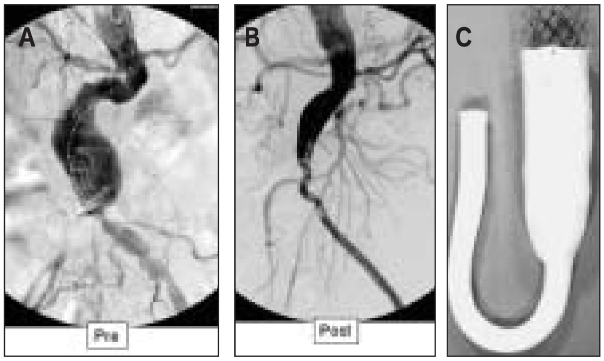

Figure 2. An aortogram shows a severely angled neck and right common iliac artery occlusion, two anatomical features that would rule out the use of any approved aortic stent graft available in the US (A). A completion aortogram after endovascular AAA repair (B) using the MEGS aortounifemoral graft (Vascular Innovation, New York, NY) (C). The balloon-expanded Palmaz stent was able to straighten and seal the neck. This patient had a ruptured AAA and survived. (Courtesy of Takao Ohki, MD, Montefiore Medical Center, New York.)

patient unless suprarenal fixation techniques are employed. Even then, there are very few data on the long-term results when the sealing zone offered by a short neck is accommodated by suprarenal fixation with an open stent graft design. The combination of short neck length and marked angulation is particularly adverse (Figure 1). As a general rule, when multiple adverse factors are present in a particular infrarenal aortic attachment zone, the whole of potential trouble is greater than the sum of the adverse parts. But the combination of appropriate technical skill with a stent graft type that is suited to the difficult neck may overcome the challenge (Figure 2). Neck angulation is poorly assessed using axial CT images and can only be qualitatively evaluated without image post processing. The all-too-common use of AP arteriography alone is usually misleading because neck angulation usually occurs in the same plane, as the infrarenal aorta is displaced anteriorly by a large aneurysm below it.

Necks that are cone-shaped must be rejected if much of the lower neck length has a diameter greater than the diameter limits of the available prosthesis, even if that limit is not exceeded at the most proximal aspect. The shape of diverging aortic walls limits contact with the endograft, which depends on friction to stay in position. An important neck characteristic that has traditionally limited eligibility for endografting is the presence of a significant luminal filling defect typical of thrombus (Figure 3). Such necks have unequivocally abnormal aortic walls and may result in short-term poor anchoring of the endograft, which depends on surface friction. However, experience suggests that there may be significant device differences in this condition and that balloon-expanded endografts can achieve successful results. Gitlitz et al reported favorable outcomes at a mean follow-up of 2 years after endograft placement based on use of the Palmaz stent in proximal necks with filling defects. No endoleak or migration occurred.[5] This example suggests that the traditional limitations of aortoiliac morphology on endograft eligibility may be relative to the characteristics of the endovascular prosthesis.

The Iliac Arteries

Difficult iliac arteries also may be the reason for patient rejection either because of being a poor access vessel through which the delivery system must be passed or because they present a poor opportunity to seal blood flow without incurring the risk of ischemic complications. Bilateral iliac artery aneurysms extending to the bifurcation or the presence of a large internal iliac artery aneurysm have commonly been used to exclude patients from endografting,[6] however, recent experience with the "bell-bottom" technique has allowed preservation of pelvic blood flow.[7] Several of the latest endograft designs have been produced with expanded distal diameters of the iliac limb that appear to be better suited to enlarged iliac vessels than the cylindrical shapes of earlier-generation stent grafts.

Other adverse factors in iliac arteries that are critically important include tortuosity, lumen size, and calcification, but these may be relative contraindications, and methods of combining endovascular with conventional open surgery for access have been successfully used. The degree of tortuosity that should rule out the use of

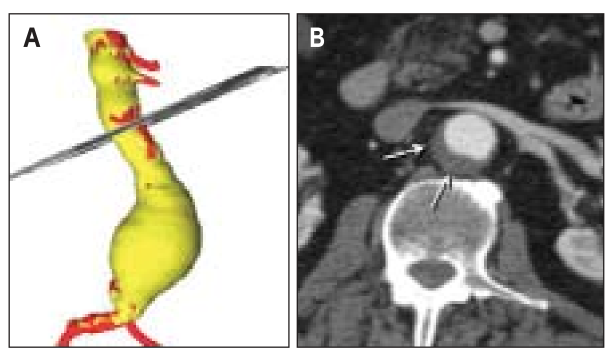

Figure 3. The CT slice location in the proximal neck is shown from a 3-D model (A) in which the CT slice is placed and reformatted to lie in an orthogonal plane. The CT slice shows a thick rim of what appears to be thrombus (arrows) (B). This patient was advised to have open surgical repair to avoid the risks of renal artery embolism and insecure proximal fixation and sealing.

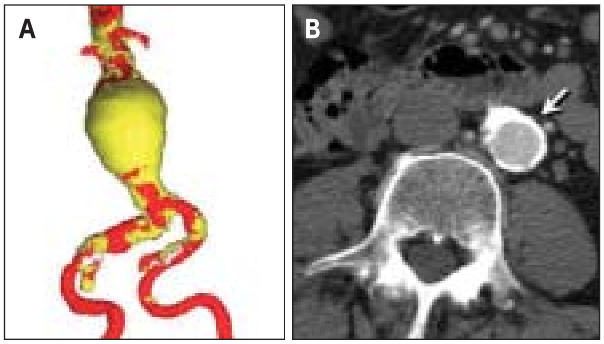

Figure 4. The combination of tortuosity (A) and dense circumferential calcification in the iliac arteries, as shown in the CT slice (arrow) (B), should be approached with caution even if there is no severe stenosis.

endovascular grafting is proportionate to the amount of calcification in the iliac artery and to the size of the endovascular delivery system—more or bigger is worse. When iliac artery angulation exceeds 90º, and often when associated with large aortic aneurysms it does so more than once, the use of an endograft will be much more difficult than in straighter vessels. When this is accompanied by stenosis and calcification, endovascular surgery is probably contraindicated, except in the most special circumstances (Figure 4). Even then, it will take a skilled and experienced team to successfully accomplish the endovascular procedure by employing extraordinary measures, such as through-and-through passage of stiff wires from brachial and femoral approaches.

A useful distinction can be made between intraluminal calcification in an atheroma and diffuse intramural calcification. The combination of dense calcification in the arterial wall with a high degree of tortuosity is dangerous. The degree of force required to pass the device may result in iliac artery rupture, usually from avulsion of the internal iliac artery at its origin and precipitous conversion to open repair (Figure 5). Cases with severe iliac stenosis have often been performed successfully using adjunctive iliac artery dilation with or without stenting. However, such added maneuvers add significantly to the risk and definitely make the procedure technically challenging. The amount of stenosis in a transit vessel that ought to rule out performing endovascular surgery cannot be described precisely. A good scale for grading calcification is lacking, thus experience must be used to identify acceptability limits. The selection of patients depends on being appropriately cautious and suiting the judgment of how much is too much for the operator's experience.

UNUSUAL PROBLEMS FOR ENDOGRAFT CASE SELECTION

A seldom-mentioned contraindication is the extremely small aortic flow lumen that may compress the endograft or result in procedural problems from inability to insert a contralateral limb when the "stump" portion of the endograft trunk is compressed (Figure 6). Other rejection criteria constituting at least relative contraindications include probable infected aneurysm, horseshoe kidney with thick isthmus, renal failure not requiring dialysis, and comorbidity with a current indication for laparotomy. When significant visceral vessels arise from the neck or AAA (ie, superior mesenteric artery occlusion with big meandering artery or low main or major accessory renal artery), alternatives should be considered. Each of these rejection criteria can be addressed differently depending on the patient's comorbidity and features of available prostheses. For example, if a major renal artery arises from the midportion of the aneurysm, it may be possible to transpose the aberrant and important renal artery to the external iliac artery by a relatively minor bypass procedure using a low-morbidity extraperitoneal approach. This then provides a new anatomical situation that allows straightforward endografting of the AAA.

A discussion of difficulties in patient selection for aortic endografting should include a brief mention of the importance of having excellent imaging by which to assess the vascular anatomy that will exert a controlling influence on the result. In an age of increasingly sophisticated imaging and readily available computerized post processing that can generate far more useful images to be used with accurate and informative measurement tools, it would seem that traditional limited 2-D imaging is no longer the standard of care. Demonstration of the practical benefits that derive from adopting a 3-D approach can be found in reports of obtaining

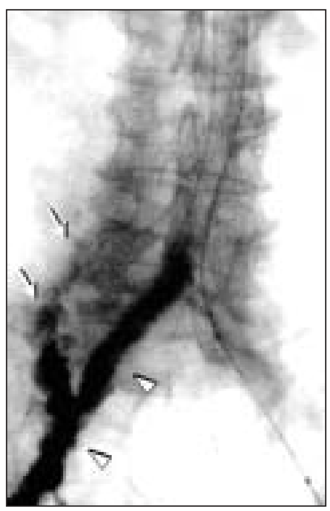

Figure 5. The stent skeleton of the endograft trunk can be seen within the aorta and was inserted through the left iliac artery. When the contralateral iliac limb delivery system was being passed through the right iliac artery, considerable force was required because of stenosis and calcification (arrowheads). The resultant perforation is shown by an arteriogram (arrows).

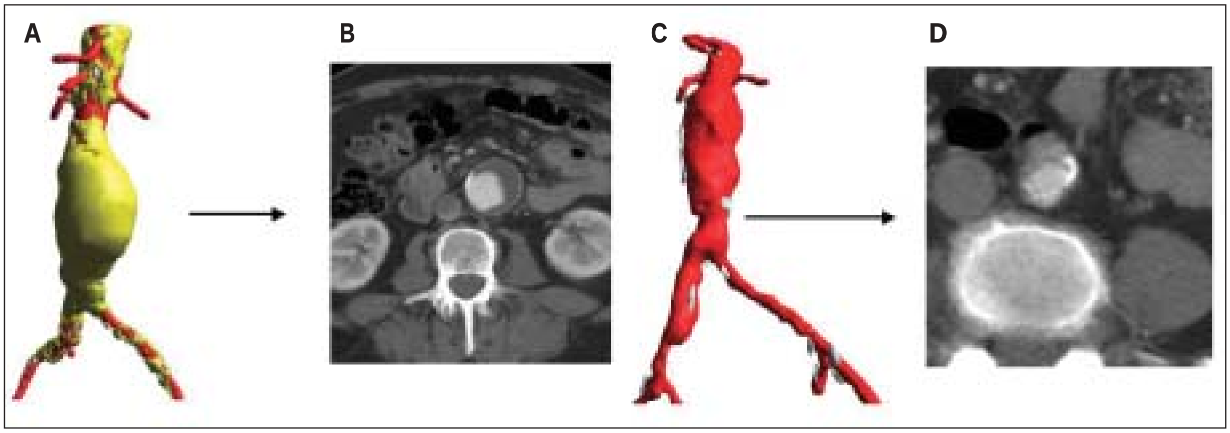

Figure 6. This patient's anatomy looks like a straightforward case without excessive angulation of the anchoring zones and adequate proximal neck length (A). In the midaorta, there is considerable thrombus, as shown in the CT slice (B). Technical difficulty arose during the stent graft procedure from a more severe stenosis located in the distal aorta. The 3-D model has been used to show the blood flow lumen by removing the aortic wall and thrombus (C). The degree of narrowing in the distal aorta was severe and only a 12-mm flow lumen remained. The proximal aortic trunk of the stent graft and ipsilateral limb were deployed easily, which resulted in blocking access to insert the contralateral limb. A series of complex maneuvers required a prolonged operation. The result, fortunately, was both a satisfactory outcome and a learning experience (D).

more and better endograft planning data from a single examination without the use of arteriography.[8,9]

Considering the prevalence of late adverse events in endograft trials through the first decade of experience, it may also be argued that younger and healthier patients would be better served with open repair than an endovascular approach. The larger the aneurysm and the sicker the patient, the more attractive is the option of endovascular repair. But when patients with a life expectancy of decades present with an aneurysm needing treatment and no important associated disease, it may be prudent to advise against endografting until late results have shown durable outcomes matching those of open surgery. In recent years, this option is less acceptable to patients who seek minimally invasive treatment, who know of its proven short-term benefits, and who wish to avoid surgery. However, thorough unbiased counseling about the choice sometimes produces a change in perspective and a confident, grateful patient. Recent reports of endograft structural failure and posttreatment aneurysm rupture make the need for close surveillance and secondary procedures to adjust the original endograft a real consideration for the younger patient who otherwise is in good health.[10]

SUMMARY

The fundamental cause of major technical problems during aortic endografting lies in poor patient selection. The root cause of poor patient selection is attempting a stent graft repair of the AAA in a patient whose adverse anatomy is not well suited to the experience of the clinician performing the procedure. Just as it is important for endovascular therapists to be thoroughly and quantitatively familiar with a patient's vascular anatomy, it is equally important that the strengths and limitations of available stent graft devices be completely understood. As more devices become approved for use in the US, it is likely that anatomical limitations may be modified when combined with thoughtfully analyzed endovascular experience. ■

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