Preprocedural Planning for Endovascular Stent-Graft Placement

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ABSTRACT

Endovascular stent grafts have become a viable treatment for aortic thoracic and abdominal aneurysms in both elective and emergent situations. Computed tomographic (CT) angiography is the primary tool for determining eligibility for this procedure. This article discusses the preprocedural evaluation of an endovascular stent candidate. Evaluation begins with identification of the aneurysm pathology and its relationship to treatment efficacy. The radiologist must evaluate the aneurysm geometry for compatibility with stent hardware. Aneurysm features that suggest a contraindication must be recognized. Procedures that involve a combination of endovascular stenting and surgical revascularization are discussed so that the reader understands the limits of stent eligibility. Vascular access for stent placement must also be evaluated for the ability to accommodate stent delivery. The radiologist also must be familiar with CT imaging protocols and alternative methods of imaging that can evaluate stent feasibility. The utility of three-dimensional processing is discussed.

KEYWORDS: Aortic aneurysm, vascular surgical procedures, X-ray computed tomography, preoperative care, patient selection

Objectives: Upon completion of this article, the reader should be able to identify the aneurysmal features most important to consideration of treatment with endovascular stent graft.

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In recent years, endovascular repair of aortic aneurysms has become an accepted alternative to open aneurysm repair in both elective and emergent situations. Preprocedural imaging is used to determine eligibility for stent placement, select the appropriate hardware, and plan the procedural technique. This review will focus on information clinicians desire to determine eligibility, select hardware, and predict technical success.

CLINICAL

Thoracic aortic aneurysms (TAAs) occur with a yearly incidence of 6 per 100,000 people and are present in > 0.4% of autopsies.^{1,2} Abdominal aortic aneurysms (AAAs) are present in 5 to 10% of men age 65 to 79 years.³ Thoracoabdominal extension is present in 5% of asymptomatic thoracic aneurysms. Most aneurysms are discovered incidentally or through imaging prompted by symptoms related to mass effect.

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Risk of aneurysm rupture is most closely correlated with size. Repair of AAAs is recommended when the sac diameter exceeds 5.5 cm or has expanded by greater than 1 cm per year, suggesting a yearly > 9% rate of rupture if left untreated.^{4,5} TAA repair is recommended when diameter reaches 5 to 6 cm.

When the decision is made to repair an aneurysm, both open surgical repair and endovascular stenting are considered. In the past, endovascular stenting was reserved for patients who were poor surgical candidates. More recently, stenting is being considered as a primary treatment choice.⁶⁻⁹

Mortality is decreased in elective thoracic endovascular stenting compared with open repair (0 to 20% versus 10 to 20%, respectively).¹⁰ Morbidity is decreased and mortality is equivalent in elective abdominal aortic endovascular stenting compared with open repair.¹¹ In the acute setting, the benefits of AAA and TAA endovascular repair are even greater.^{12,13}

HARDWARE

From a hardware perspective, the ability to stent is based on (1) the ability to deliver a stent through available vascular access and (2) compatibility between aneurysm geometry and available stent hardware. Originally, stent grafts were custom fit to each patient; however, at this time, premanufactured stents are used with sizes that are constantly changing.¹⁴ Table 1 lists the four currently U.S. Food and Drug Administration–approved stents, which each come in a variety of sizes and configurations. Stents vary based on length, deployed luminal diameter, and collapsed diameter. A patient may be “stentable” under one manufacturer but not another. This issue is further complicated by new stent designs with fenestrated portions that cover major branch vessels or incorporate branch vessels altogether.^{15,16} Therefore, criteria to ensure compatibility will always partly depend on what stents are commercially available and physician preference.¹⁷ After discussing the best way to image aneurysms, we will discuss the rules that govern compatibility between stents and aneurysms.

PREPROCEDURAL IMAGING TECHNIQUE

Computed Tomography Technique

Computed tomographic (CT) angiography is preferred for procedural planning of endovascular stent repair.¹⁸ For both thoracic and abdominal aneurysms, the CT examination includes a noncontrast portion followed by an enhanced arterial phase examination. The field of view must include the aneurysm, major branch vessels, and pathways for vascular delivery of stent hardware.

For a TAA, imaging begins at the thoracic inlet and ends in the proximal thigh, including the aneurysm

Table 1 FDA-Approved Stents

Device Name	Company	Introduced
AneuRx	Medtronic	September 1999
Excluder	W.L. Gore & Associates	November 2002
Zenith	Cook	May 2003
Powerlink	Endologix	October 2004

FDA, U.S. Food and Drug Administration.

as well as common femoral arteries, the most likely vascular access route. For an AAA, the field of view begins above the celiac artery and also ends in the proximal thigh. Specific institutional imaging protocols may vary based upon available CT equipment; however, imaging for stent-graft planning is most easily performed using a 16- or greater slice multidetector CT scanner, which allows thin-section imaging of the chest, abdomen, and pelvis within a reasonable breath-hold time. Table 2 includes a generic protocol for thoracic and abdominal stent-graft evaluation studies on a 16- or greater slice scanner. Noncontrast images are used to evaluate arterial wall calcification of both the access pathways and the aneurysm. Unenhanced images also allow visualization of intramural hematoma, the detection of which is enhanced by review in a narrow window setting as needed. In the acute setting, aneurysm rupture can also be seen on unenhanced acquisitions. New dual-energy acquisition techniques, which acquire simultaneous high and low kilovolt potential (kVp) images, allow creation of “virtual” noncontrast images from postcontrast acquisitions and may eliminate the need for a separate unenhanced acquisition in stent planning and follow-up studies.¹⁹

High iodine content (320 to 370 mg/dL) non-ionic iodinated contrast material is administered rapidly through a peripheral intravenous catheter. This is followed by a saline bolus, which can reduce both the total amount of contrast needed and the presence of streak artifact in the superior vena cava. The amount of contrast used is proportional to the duration of the scan, which depends upon the generation of equipment used and scanning volume, as well as patient-specific factors including aneurysm size and cardiac output. In those patients with larger aneurysms and/or poor cardiac output, increasing both contrast dose and the delay between the beginning of the contrast injection and initiation of scanning will result in improved vascular enhancement. If involvement of the ascending aorta and/or aortic arch is suspected, an electrocardiogram-gated CT may be used to minimize aortic pulsation artifact; however, this will result in a longer scan, increased radiation dose, and possibly additional contrast, although newer acquisition techniques may not suffer from these limitations.²⁰

Radiation dose reduction techniques, including in-plane and z-axis dose modulation, should be used

Table 2 CT Protocol for Evaluation of Aortic Aneurysm Using 16-Slice or Greater MDCT

	Pre-IV Contrast	Angiographic Phase	Delayed Phase
Beam energy (kVp)	120	100 or 120 (larger patients)	120
Tube current-time product (mAs)	90	150	180
Slice collimation (mm)	≤ 1.5	≤ 0.75	≤ 0.75
Slice width (mm)	3	2	3
Feed/rot (mm)	30	15	15
Rot. time (s)	0.5	0.5	0.5
Reconstruction kernel	B31f	B31f	B31f
Increment (mm)	2	1.2	2
Direction	Cranial to caudal	Cranial to caudal	Cranial to caudal
Coverage	Chest, abdomen, pelvis	Above arch to femoral bifurcation	Chest, abdomen, pelvis
Oral contrast	No	No	No
IV contrast	No	Yes	Yes
IV contrast injection rate	No	3–4 mL/s for total of 80–100 mL contrast + 40 mL saline	No
Scanning delay	N/A	Peak + 8 s	60 s

CT, computed tomography; MDCT, multidetector computed tomography; IV, intravenous.

whenever possible. Precontrast imaging can be performed with a relatively low radiation dose, and low kVp technique can be used for arterial phase postcontrast imaging in many nonobese patients to further reduce radiation dose and improve vascular enhancement.

Although images can be reconstructed at sub-millimeter thickness, such thin slices are generally not needed either for clinical interpretation or automated planning software, and 1.5- to 3-mm slices with 30 to 50% overlap is sufficient.

Alternative Imaging Modalities

Digital angiography may supplement a CT examination. Injection is performed in anteroposterior and lateral views through a 5-French pigtail catheter containing 1-cm markers in the region of interest. An angiogram of the pelvis is also performed to assess for vascular access. In cases of extreme tortuosity, angiography may more accurately measure aneurysm neck diameter, a critical metric in predicting stenting success.^{18,21} Disadvantages of angiography compared with CT include evaluation of vascular calcifications and mural thrombus, findings critical for determining eligibility. Preprocedural angiography and actual stent placement cannot be performed on the same day due to iodinated contrast load and the time required to evaluate the images. Thus the patient is subjected to two procedures.

Magnetic resonance angiography may be performed in cases where patients cannot receive iodinated contrast.²² Gadolinium-enhanced T1-weighted three-dimensional (3-D) angiography sequences are the most useful sequences for simulating CT measurements. If renal function is impaired, gadolinium may be contraindicated due to the risk of nephrogenic systemic fibrosis. In these cases, noncontrast magnetic resonance

imaging may be performed using balanced steady-state free precession sequences. Glomerular filtration rate cutoffs for gadolinium administration vary by institution; at our institution, it is 30 mL/min/1.73 m². Disadvantages of magnetic resonance imaging include inferior spatial resolution, inability to directly visualize calcium, and susceptibility to motion artifacts. Advantages include the ability to use multiple pulse sequences, which enables a comprehensive evaluation of the aneurysm. Soft tissue visualization is superior to CT. If history of severe contrast reaction prevents a patient from receiving iodinated contrast, CT imaging can be performed using gadolinium-based contrast agents. Although the relative X-ray attenuation of these agents is much less than an equivalent volume of iodinated contrast, the use of 0.4 mmol/kg (50 to 60 mL) of gadolinium-diethylene triamine pentaacetic acid (DTPA) for CT angiography can produce diagnostic images in patients with normal renal function.²³

WORKSTATION REVIEW

Aneurysm measurements are more accurate when performed using a 3-D workstation,^{24,25} an example of which is seen in Fig. 1. Traditional two-dimensional workstations will overestimate neck diameter by 2 to 4 mm compared with a 3-D workstation. Larger error was present as the neck demonstrated greater tortuosity.²¹ If minimal tortuosity is present, results from a two-dimensional workstation are similar to a 3-D workstation.²⁶ Software that uses automated or semiautomated vessel segmentation and centerline determination in combination with automated or manual identification of vascular landmarks can be very useful for obtaining the measurements needed for stent-graft planning, significantly reducing the time needed for postprocessing.

Figure 1 Centerline measurements have been shown to be more accurate than simple two-dimensional workstation measurements. In this example, the axial images (A) suggested a luminal diameter large enough to accommodate a traditional aorto-bi-iliac stent. However, an axial oblique plane determined by the centerline (B) showed that the aortic lumen was less than 1.8 cm, requiring placement of an aorto-uni-iliac stent graft.

GENERAL ANEURYSM FEATURES

Description of the general aneurysm features is useful for treatment planning. True aneurysms are less likely to be successfully treated with an endovascular stent compared with a false aneurysm.²⁷ Traumatic pseudoaneurysms, in the acute setting, are amenable to stenting due to patient stability and primary outcome.²⁸ However, stable chronic pseudoaneurysms may be followed without intervention (Fig. 2). Mycotic aneurysms may suggest an open repair due to infection rates associated with stent placement^{29,30} (Fig. 3). Iatrogenic aneurysms, most commonly due to extracorporeal circulatory cannulation, respond favorably to stenting. Inflammatory aneurysms, identified by perianeurysmal fibrosis, have a higher complication rate³¹ and stenting is controversial (Fig. 4). Ruptured AAAs and TAAs, historically treated with open repair, are now known to have significantly decreased mortality when treated with stenting.^{9,12,32} Aortic aneurysms are also present in poststenotic dilation distal to an aortic coarctation.

SPECIFIC EVALUATION OF THE THORACIC ANEURYSM

Stenting success depends on thoracic aneurysm morphology and acceptable vascular access.

Proximal Aneurysm

The proximal neck morphology is the most important aneurysm feature. Proximal to the aneurysm, 1.5 cm of disease-free aorta must be present distal to the left subclavian artery takeoff. This distance ensures an

adequate seal, which minimizes risk of a type I endoleak. It should be noted that this 1.5-cm limit is not universally acknowledged, and some studies have reported that 1 cm may be acceptable.¹⁰ However, generally, if the aneurysm is within 1 to 1.5 cm of the left subclavian artery takeoff, a stent that intentionally covers this vessel may be placed. In this situation, bilateral vertebral artery patency is of specific interest. If the vertebral arteries are patent, the subclavian artery can be safely occluded without

Figure 2 Sagittal oblique view through the chest at the level of the aortic arch, in a patient with a history of severe trauma, shows the classic appearance of a traumatic pseudoaneurysm. The aneurysm was stable following the accident, and therefore the patient was not stented.

Figure 3 A 79-year-old man underwent preprocedural computed tomography evaluation for stent-graft placement. Findings compatible with a mycotic aneurysm were present, illustrated by the irregular, multilobed aneurysm with several small saccular out-pouchings. The remainder of the aorta was disease free. Axial (A); coronal oblique maximum-intensity projection (B); three-dimensional volume rendering (C). High infection rates are associated with stenting these lesions and open repair may be considered.

symptoms. However, if the patient complains of verte-brobasilar insufficiency or left arm pain, revascularization is performed by a carotid-subclavian bypass. If less than 1 cm of proximal clearance is present, a combination of endovascular and open repair is considered.^{33,34}

In addition to proximal clearance, the proximal neck should be free of mural thrombus or calcifications. These findings place the patient at risk for poststenting dilation. In one series, this was the most frequent reason for treatment failure.¹⁰

A proper proximal and distal stent-aortic seal is achieved by placing a stent that exceeds the aortic luminal diameter by 10 to 15%.^{7,35} Therefore, the maximum aortic diameter that can be stented depends on the maximum commercially available deployed stent size. Currently, this value is ~42 mm.

Aneurysm Sac

Length and tortuosity of TAAs provide technical challenges to stenting. Aneurysms that extend the entire length of the descending aorta will likely require multiple overlapping stents. Severe tortuosity will require multiple stents because a single stent does not have sufficient flexibility to be deployed in an area of severe angulation.

Distal Aneurysm

An adequate distal landing zone for the stent is required, ideally 1.5- to 2-cm long.³⁶ If the stent is too close to the celiac axis, a revascularization procedure may be considered. Angulation at the level of the hiatus is a common contraindication to stent placement.

Figure 4 Magnified axial view (A) and sagittal maximum-intensity projection (B) show an 8-mm ring of tissue that extends beyond the aneurysm contour marked by calcifications. This is characteristic of an inflammatory aneurysm. Although this patient was stented, the presence of an inflammatory aneurysm may indicate primary medical therapy.

Vascular Access for TAA

Vessels between the access point and the aneurysm location must accommodate the collapsed stent. The required diameter depends upon the stent being placed, but a common rule is that a diameter of >7 mm is sufficient.⁶ If the access vessels are too small, heavily calcified, or tortuous, an alternative approach is required. Calcification may be reported as the percent of the segment containing scattered calcifications. Tortuosity can be graded by quoting the tortuosity index.³⁷ This is defined as the length of the vessel along the center of the lumen (centerline) divided by the direct 3-D distance from the beginning to the end of the vessel. A tortuosity index of <1.25 is considered negligible and an index of >1.6 is considered severe (Fig. 5). For thoracic aneurysms, the common femoral artery is the most commonly used access point. If this site is unacceptable, the common iliac artery or distal aorta may be used via a retroperitoneal approach.³⁸ The proximal aortic arch may be used for access, requiring a sternotomy.

SPECIFIC EVALUATION OF AN ABDOMINAL AORTIC ANEURYSM

Stenting success depends on aneurysm morphology and acceptable vascular access.

Proximal Aneurysm

In AAA, unfavorable neck anatomy is the most common reason why patients are not candidates for endovascular repair.³⁹ Appropriate proximal length, diameter, and morphology is required for secure attachment.

A 1.5-cm landing zone of normal aorta is required proximal to the aneurysm. If a barbed stent is being used, 1.0 cm may be sufficient. If less than 1 cm of clearance is present but the proximal aneurysm is otherwise linear, successful suprarenal stenting has been reported.¹⁶

Angulation at the hiatus is a common finding. If proximal neck angulation exceeds 60 degrees, stent placement is contraindicated. Angulation that exceeds 30 degrees is considered an unfavorable feature.⁸

Stents are chosen to oversize the proximal and distal landing sites by 10 to 20% but not more than 30%.⁴⁰ Therefore, as in thoracic aneurysms, the proximal and distal aneurysm neck diameter may not exceed 90% of the deployed stent diameter. This value is dependent on the available stents but is generally 42 mm or less. In addition to an absolute allowable neck diameter, large neck diameter places the patient at risk for stent migration.⁴¹

Caliber change of the aneurysm neck may be either straight, tapered, or reverse tapered (Fig. 6). The reverse-tapered morphology, a >3 mm larger diameter proximally versus distally, is associated with increased complication.⁴² Irregular wall bulging at the proximal neck is also associated with increased complications, likely because it also prevents an adequate stent fixation.

Mural thrombus and calcifications at the proximal neck can also result in deployment fixation problems. Thrombus greater than 2 mm in radial depth that involves more than 90 degrees of the neck circumference is considered unfavorable.³⁷

Aneurysm Sac

Aneurysm repair is recommended when sac diameter exceeds 5.5 cm. However, an increased risk of type 1

Figure 5 Marked differences in the tortuosity of the iliac vessels are easily appreciated in this preprocedural examination for stent-graft placement. Three-dimensional (3-D) volume-rendered image (A). Quantification relies on determining the tortuosity index (centerline distance/3-D end-end distance). The 3-D end-to-end distance is illustrated in (B), where the distance between the vessel ends are measured through 3-D space in a coronal oblique plane maximum-intensity projection. The center of the slab must pass through the vessel lumen at both ends. The centerline distance is illustrated in (C), where the distance along the centerline of the vessel is measured with a 3-D software package. In this case, the tortuosity index = $23/14 = 1.65$, which indicates severe tortuosity.

endoleak is present when sac diameter exceeds 6.5 cm. Sac diameter > 7 cm is a relative contraindication to endovascular repair.

Conversely, an aorta that is too small in caliber is also a contraindication. A stent deployed in such a lumen would further decrease the vessel caliber and reduce blood flow.

Distal Aneurysm

Thrombus at the touchdown site is a relative contraindication. Although not as critical as in the neck, an endoleak may originate at the distal stent due to poor fixation.

If the distal portion of an AAA is too close to or involves the aortic bifurcation, an endovascular stent graft containing iliac components is placed. Coexisting iliac artery aneurysms occur in roughly 20% of patients with AAA.⁴³

If the patient has a distal aortic diameter of > 1.8 cm, an aorto-bi-iliac graft may be placed. However, the dual iliac stent components significantly restrict the distal aortic lumen. If the distal aortic lumen is less than 1.8 cm, insufficient flow enters the iliac arteries. To remedy this situation, an aorto-uni-iliac stent is placed (Fig. 7). This provides a large-caliber conduit into the ipsilateral iliac artery but simultaneously occludes the contralateral iliac artery. Revascularization to the

Figure 6 Infrarenal neck reverse tapering is a strong predictor of stent-graft failure. A “straight” neck morphology is most favorable.

Figure 7 During evaluation for stent placement, this patient was found to have distal aortic narrowing, which indicated the placement of a left-sided aorto-uni-iliac stent. At the time of stent placement, perfusion to the right side was restored via a femorofemoral bypass. (A) coronal oblique maximum-intensity projection pre-stent; (B) three-dimensional volume rendering with bone removal pre-stent; (C) three-dimensional volume rendering post-aorto-uni-iliac stent placement.


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***** General Aneurysm *****
An [infrarenal-abdominal, thoracoabdominal] aortic aneurysm is present.
The aneurysm extends from [] to [].
Greatest outer diameter/level: [..] mm/ [..] mm
Bordering branch vessels:
    Proximal      =
    Distal        =

Luminal diameter/level:
    Minimum      = [..] mm/ [..] mm from beginning
    Maximum      = [..] mm/ [..] mm from beginning

Neck Characteristics:
    Geometry      = [tapered, reverse tapered, straight]
    Diameter      = [..] mm
    Length        = [..] mm
    Angulation    = [< 30 deg, 30-60 deg, > 60 deg]
    Thrombus      = [< 2mm, > 2 mm], [< 90 deg, > 90 deg]
    Calcification = [none, mild, more than mild]

Aneurysm Characteristics:
    Geometry      = [fusiform, saccular, bilobed, ...]
    Tortuosity    = [index]
    Angulation    = up to [..] deg
    Thrombus      = [none, mild, moderate, severe]
    Calcification = [none, mild, moderate, severe]

Touch-down Characteristics:
    Geometry      = [tapered, reverse tapered, straight]
    Diameter      = [..] mm
    Length        = [index]
    Angulation    = [< 30 deg, 30-60 deg, > 60 deg]
    Thrombus      = [> 2 mm at < 90 deg, > 90 deg circumferential coverage]
    Calcification = [none, < 90 deg, > 90 deg circumferential coverage]
*****

***** Specific to Thoracic *****
Right vertebral artery: [patent]
Right subclavian artery: [patent]
Brachiocephalic artery: [patent]

Left vertebral artery: [patent]
Left subclavian artery: [patent]
*****

***** Specific to Abdominal *****
Distance between lowest renal and end of aneurysm: [..] cm
Distance between lowest renal and aortic bifurcation: [..] cm

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Figure 8 Example reporting structure of preprocedural computed tomography evaluation of thoracic or aortic aneurysms. Brackets identify text possibilities, based on the findings. For example, "[..] mm" indicates that a measurement in mm is required; "[tapered, reverse tapered, straight]" indicates that one of the text values is required.

Distance between lowest renal and RIGHT common iliac bifurcation: [..] cm

Distance between lowest renal and LEFT common iliac bifurcation: [..] cm

***** Branch vessels *****

Left renal artery: [Single], [patent]

Right renal artery: [Single], [patent]

The [right, left] renal artery is the more inferior.

Celiac trunk: [patent]

Superior mesenteric artery: [patent]

Inferior mesenteric artery: [patent]

Left renal vein course: [pre-aortic, retro-aortic, circum-aortic]

***** Vascular Access *****

RIGHT:

Right common iliac artery: [patent]

Right internal iliac artery: [patent]

Right external iliac artery: [patent]

Right common femoral: [patent]

Minimal luminal diameter of right common iliac: [..] mm

Minimal luminal diameter of right external iliac: [..] mm

Right iliac tortuosity: [..] index

Right iliac calcification: [..] %

LEFT:

Left common iliac artery: [patent]

Left internal iliac artery: [patent]

Left external iliac artery: [patent]

Left common femoral: [patent]

Minimal luminal diameter of left common iliac: [..] mm

Minimal luminal diameter of left external iliac: [..] mm

Left iliac tortuosity: [..] index

Left iliac calcification: [..] %

***** Additional Findings *****

Figure 8 (Continued)

contralateral side is then performed with a femorofemoral bypass.

Iliac portions of the stent are selected to exceed the iliac diameter by 2 mm.⁴⁴ The maximum iliac diameter that can be stented is hardware dependent but a commonly accepted diameter is 18 mm. Some groups have reported stenting iliaes up to 24 mm in diameter.⁴⁵

If common iliac aneurysms extend into the external iliac, then the internal iliac artery will be occluded by the bridging stent. In this situation, bilateral internal

iliac artery patency should be noted. If the contralateral internal iliac artery is already occluded, occlusion of the second internal iliac artery may result in buttock claudication (28%) or erectile dysfunction (17%).⁴⁶ If mesenteric artery occlusion is already present, iliac artery occlusion may place the patient at risk for bowel ischemia.

Branch Vessel

Evaluation of mesenteric vessel patency can be useful to predict the risk of mesenteric ischemia induced by

endovascular stenting. For example, a critical stenosis of the superior mesenteric artery may lead to mesenteric ischemia when the inferior mesenteric artery is occluded by the stent graft.

Accessory renal arteries should be identified because they may be occluded by stent placement. If an accessory renal artery will be occluded, therapeutic options include revascularization or occlusion of the vessel. Overall appearance of the kidneys should be noted, and the amount of renal tissue supplied by accessory artery should be estimated. If the patient has otherwise good renal function, the kidneys appear normal, and the accessory artery supplies a small portion of the kidney, it may be safely occluded.

Recently, studies with fenestrated grafts have been reported that would enable stenting without accessory artery occlusion.¹⁵

Vascular Access for AAA

AAA stents are most commonly deployed through the femoral arteries. Severe calcification, > 50% stenosis, or > 90 degrees of angulation between the access point and the deployed position are contraindications to stenting. The minimum acceptable luminal diameter is dependent on the stent hardware, but 7 mm is a common cutoff. If severe tortuosity of the iliac arteries is present without other contraindication, a brachial catheter may be placed to assist passage of the collapsed stent. Tortuosity may be reported as a the tortuosity index.³⁷ This index allows identification of the most favorable vessel for access. Therefore, consideration of the superior access should be evaluated if included in the field of view.

REPORTING

Because so many metrics exist for determining stent-graft eligibility, structuring a report can be daunting. Fig. 8 provides an example reporting structure that may be used for either thoracic or aortic aneurysms. The report is composed of sections encompassing different aspects of the evaluation: general aneurysm features, features specific to thoracic or abdominal aneurysms, branch vessel evaluation, vascular access, and other findings.

CONCLUSION

Endovascular repair of thoracic and aortic aneurysms has become the preferred method of treatment in both emergent and elective environments. Determination of endovascular repair eligibility depends on a multitude of factors including aneurysm-stent compatibility, ability to deliver the stent through available vascular access, and identification of branch vessels that may be affected by the procedure.

As hardware options are continually changing, a complete description of the aneurysm morphology and dimensions are recommended. Knowledge of the basic limitations of endovascular stent placement will enable more useful interpretations of planning studies.

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