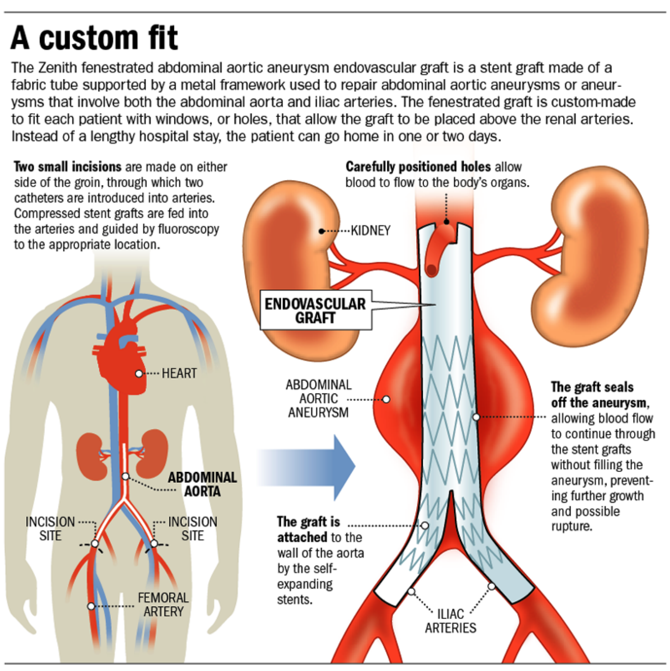
An endovascular stent graft is a tube composed of fabric supported by a metal mesh called a stent. A patient may be eligible for endovascular stent grafting if the aortic aneurysm measures least 5 cms diameter with a long enough area of normal artery above and below the aneurysm for the stent graft to attach securely.

The procedure involves placing a covered stent (stent-graft) in the aorta to serve as a blood flow conduit through the aneurysm sac. The stent-graft is anchored to the proximal and distal ends of the nonaneurysmal portions of the artery. The stent-graft prevents continued aneurysm growth and rupture by excluding the aneurysm and shielding the aneurysm wall from systemic blood pressure.

The most important complication to detect is aneurysm expansion and endoleak that can occur even after successful EVAR (endovascular aneurysm repair) and represents one of the limitations of this procedure. Endoleaks represent blood flow outside the stent-graft lumen but within the aneurysm sac. It occurs in approximately one-fourth of patients. The most common is reversal of flow through aortic branch vessels which then empty into the aneurysm sac.

The ultrasound exam consists of measurement of aneurysm size with identification of substantial changes in aneurysm dimensions, detection and, if possible, characterization of an endoleak, and detection of mechanical changes in the stent-graft, including migration, kinking, and fracture.



Look for ultrasound images of normal endograft & images of endoleak at end

Endoleak type:

Type 1: attachment site leak, proximal or distal

Type 2: collateral vessel leak (most common)

Type 3: graft failure-mid graft hole, junctional leak or disconnect

Type 4: graft wall porosity

Type 5: endotension

Type 1- With type 1a-proximal or type 1b-distal attachment leak, separation occurs between the stent-graft and the native arterial wall, creating direct communication between the aneurysm sac and the systemic arterial circulation. Type Ic endoleaks occur in patients with abdominal aortic aneurysms in whom aortouniiliac stent-grafts were placed in conjunction with a femoral-femoral bypass. To prevent retrograde perfusion of the aneurysm, the contralateral common iliac artery is occluded either with coils or with a specially designed occluder device. Type Ic endoleaks occur when the common iliac artery occlusion is not complete and back-filling of the aneurysm occurs. Type I (attachment site) endoleaks are repaired immediately after diagnosis because this represents a direct communication between the aneurysm sac and the arterial blood under systemic pressures. These leaks are usually corrected by securing the attachment sites with angioplasty balloons, stents, or stent-graft extensions.

Type II endoleaks represent retrograde blood flow through aortic branch vessels into the aneurysm sac. Type II endoleaks occur when blood travels through the branches from the portion of the aorta that has not received a stent or iliac arteries that anastomose with vessels in direct communication with the aneurysm sac. Typical sources include the inferior mesenteric and lumbar arteries. Type II endoleaks should be followed up indefinitely as long as the aneurysm does not increase in size. Indeed, up to 40% of type II endoleaks will spontaneously thrombose. Others believe that type II endoleaks should be repaired because these collateral vessels can transmit arterial pressure to the aneurysm sac, which places the patient at risk for aneurysm rupture

Type III endoleaks occur when there is a structural failure of the stent-graft. This includes stent-graft fractures, holes that develop in the fabric of the device, or junctional separations seen with modular devices. Repetitive stresses that are placed on the grafts from arterial pulsations can cause these types of leaks. Endoleaks due to a defect in or failure of the graft material (type III) provide direct communication between systemic arterial blood and the aneurysm sac and are therefore fixed immediately at diagnosis. These leaks are believed to be the most dangerous because of rapid repressurization of the aneurysm sac.

Type IV endoleaks are caused by stent-graft porosity. These leaks are identified at the time of implantation as a “blush” seen on the immediate post implantation angiogram, when patients are fully anticoagulated. These endoleaks require no specific intervention other than normalization of the coagulation profile.

Type V- Expansion of the aneurysm without the presence of an endoleak is commonly referred to as endotension or a type V endoleak. Although the exact cause of endotension is unknown, causes may include an existing type I, II, or III endoleak that is occult to traditional imaging techniques, ultrafiltration of blood across the stent-graft, or a thrombus in the sac providing an ineffective barrier to pressure transmission. If the aneurysm is expanding but no endoleak is seen at CT angiography, US and/or MR angiography should be performed as part of an exhaustive search for an endoleak. If an endoleak is found, it can be treated. If endotension is confirmed, these patients typically require conversion to open aneurysm repair, although nonsurgical management of endotension after EVAR has been described

Migration, Kinking, and Fracture

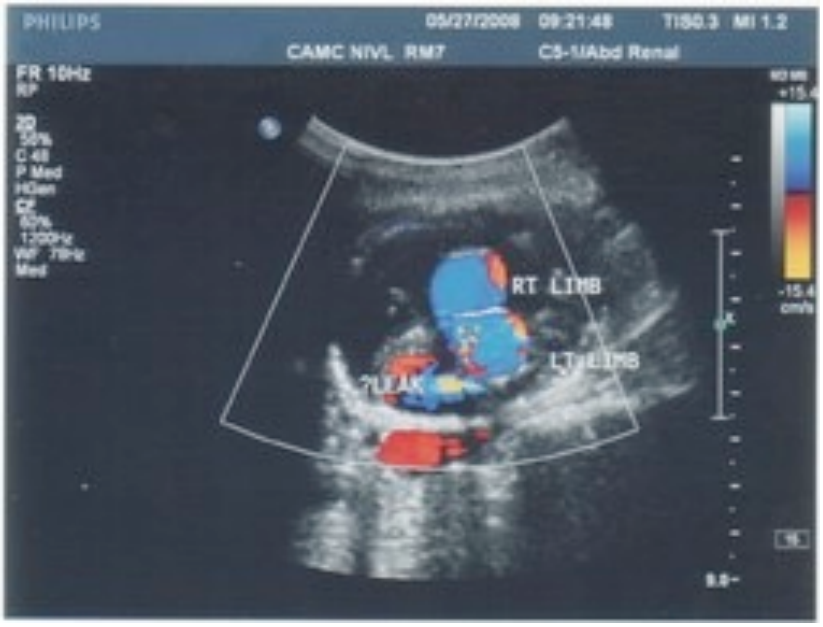
The combination of chronic exposure to hemodynamic forces and changes in aneurysm dimensions can lead to stent-graft migration. The aneurysm neck can progressively enlarge after endovascular repair, and this can lead to failure of proximal fixation and migration. Alternatively, migration can be associated with inadequate overlap of the aneurysm neck with the device at the time of deployment, stent-graft migration of 5 mm or more to be substantial, and stent-graft position with respect to some consistent anatomic landmark should be noted during surveillance imaging. With CT angiography, useful landmarks of stent-graft position include nearby aortic branches, for example, the left subclavian artery, the superior mesenteric artery, or the renal arteries.

Decreased aneurysm diameter after EVAR is associated with decreased aneurysm length, which can lead to stent-graft kinking. Kinking is in turn associated with stent-graft migration, stent-graft thrombosis, and endoleak

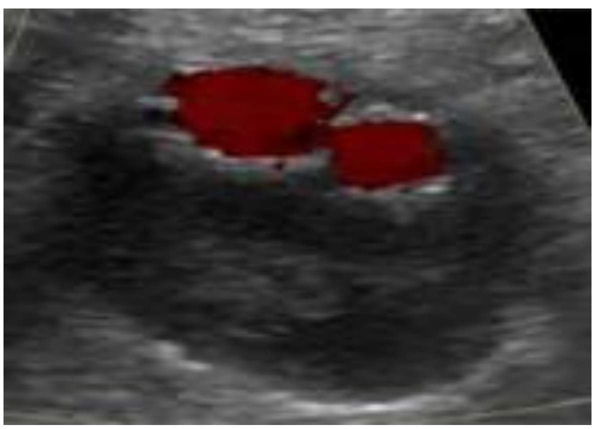
Stent-grafts can fail mechanically in a variety of ways. The metal framework of the stent may fracture due to either fatigue or corrosion. The sutures holding the metal framework together can break. The graft fabric may tear. These changes can cause endoleaks, but it has also been suggested that turbulent flow in the aneurysm sac caused by a preexisting endoleak could lead to early device fatigue.

References:

1. Imaging Surveillance following Endovascular Aneurysm Repair. Anand Shah, et al.
2. Imaging Techniques for Detection and Management of Endoleaks after Endovascular Aortic Aneurysm Repair. S. William Stavropoulos, MD/ Sridhar R. Charagundla, MD, PhD



Endograft leak



Patent right & left limbs of endograft without leak

Ellipse measurement of aneurysm sac