CE

2.5
ANCC CONTACT HOURS

Care of the endovascular repair patient with an endoleak

By Michelle R. Tinkham, RN, BSN, MS, PHN, CNOR, CLNC, RNFA

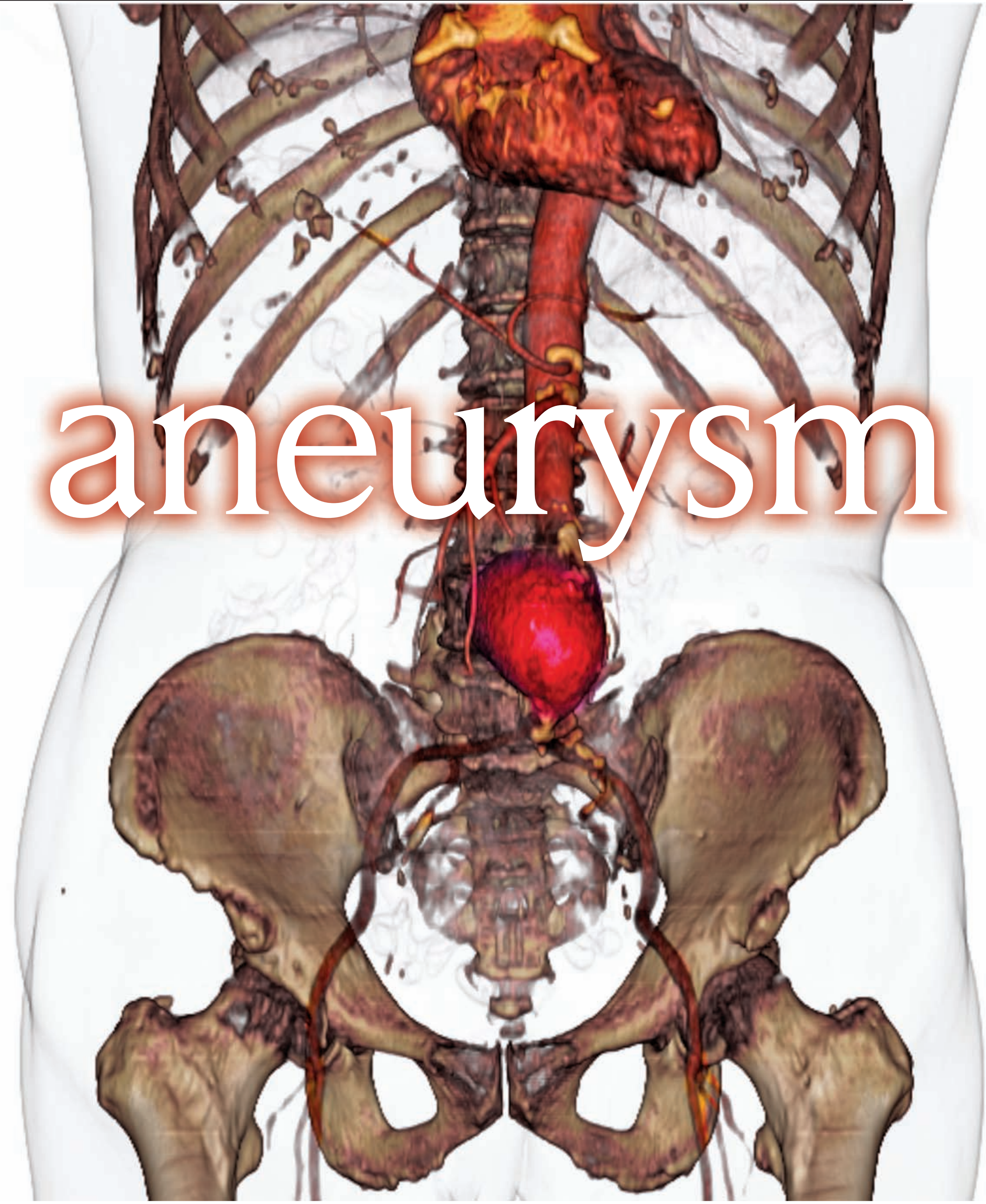
Aneurysmal disease is caused by a ballooning of the artery, often due to atherosclerosis or some other form of stress to the artery.[1] In many cases, these types of structural changes take years to form, and often don't cause warning signs for many years, if at all. Depending on the etiology and size of the aneurysm, medical management may be possible, but surgical treatment is often necessary. For instance, aortic aneurysms less than 5 cm (2 in) are only monitored unless they become symptomatic.[1] Before the advent of endovascular aneurysm techniques, the only repair option was an extensive, open surgical procedure. These were often long and risky to the patient due to the extent of the surgical wound, risk of infection, and possible large blood loss (see *Open surgical repair of AAA*).

In the 1990s, a new, less invasive technique employing interventional radiology evolved and allowed many aneurysms–especially those in the aorta–to be repaired through the use of stent grafts rather than open techniques.[2] Although less invasive than open repair, endovascular aneurysm repair isn't without its own set of risks and complications. These can be procedural issues, such as malposition of the stent pieces, device defects, or development of an endoleak, which allows blood to continue to flow into the aneurysmal sac despite the repair.[2]

Preoperative

Although stent graft repair can be employed in many different aneurysmal areas, perioperative nurses are most likely to encounter aortic aneurysms, which can be abdominal, known as endovascular aneurysm repair (EVAR) or thoracic endovascular aneurysm repair (TEVAR). Thoracic aneurysms are usually much larger than abdominal aneurysms and,

aneurysm



due to their location, require cardiac surgery standby should an open repair become necessary. Both of these procedures require special supplies, radiologic imaging equipment, and highly-trained staff in addition to the patient's proper preoperative workup. CT scan, magnetic resonance imaging, and intravascular ultrasound (IVUS) are all available diagnostic tests that can be used to measure the size of the aneurysm.[1] An arteriogram may also be performed to evaluate circulation around the aneurysm to the extremities and other surrounding organs.[1] The perioperative nurse should ensure the performed diagnostic test results are available intraoperatively and posted according to the surgeon's preference. The nurse should also verify all endovascular supplies, implants, and the company representative (if requested) are available prior to the start of the procedure (see *An example of a basic supply list for EVAR and TEVAR procedures*).

The preoperative patient interview is a vital function of the perioperative nurse. During this time, the completeness of any necessary paperwork, such as the history, physical, and surgical consent, should be reviewed. The patient's past medical and surgical history, as well as current medications and allergies, should also be carefully examined. Preexisting cardiac, respiratory, and renal problems should be identified during the preoperative interview. The perioperative nurse should alert other team members to any possible complications and ensure a cardiac clearance is available if requested. Any renal impairment can affect the patient's ability to excrete anesthetic medications and radiographic I.V. contrast media. A thorough review of all recent lab tests should also be performed, particularly coagulation studies and creatinine levels. Patients with vascular disease are usually on anticoagulant medications for thromboprophylaxis, which can adversely affect prothrombin time (PT) and partial thromboplastin time (PTT), leading to excessive intraoperative bleeding. Normal PT is 10 to 14 seconds, and PTT is 32 to 45 seconds.[2] Blood urea nitrogen (BUN) and creatinine levels also need to be reviewed preoperatively, since high lab levels paired with the intraoperative use of I.V. contrast media can cause inadvertent renal damage. Normal BUN is 6 to 23 mg/dL, and normal creatinine levels are 0.6 to 1.5 mg/dL.[2] Past abdominal surgeries that can cause scar tissue as well as the use of any closure devices from past interventional procedures should be assessed, since both of these can hinder vascular access to repair the aneurysm and endovascular stent device deployment. It's also helpful to review any prior orthopedic surgeries that may affect positioning and patient comfort, especially if the procedure will be done under monitored anesthesia care. The perioperative nurse should also confirm if a preoperative bowel preparation was performed, if prescribed, and if the patient has been N.P.O. The nurse should also verify which medications the patient took prior to surgery. The patient should have been instructed to continue any cardiac and respiratory medications as prescribed with the exception of anticoagulants and medications for diabetes, which are usually held for a specific amount of time determined by the surgeon. The perioperative nurse must alert the surgeon and anesthesia care provider if this hasn't occurred as planned.

In addition to the necessary preparation for the team, the preoperative interview is also a time to assess the patient's understanding of the procedure and educate and support the patient as needed. Be sure the patient is aware of the possibility of having to convert to an open procedure and that the patient is properly consented for that risk. In addition, remind the patient and family that the patient may be transferred to the ICU after surgery and may have several tubes in place, including an endotracheal tube and urinary drainage catheter. During this time, the ICU nurses will be frequently monitoring BP and pulses in the feet and groin. Letting the patient and

Open surgical repair of AAA

Photo courtesy of the author.

An example of a basic supply list for EVAR and TEVAR procedures

Basic supplies*:
- Endovascular or laparoscopic pack
- Basins for irrigation and contrast medium
- Sterile drape (usually a laparotomy or split sheet drape in case of conversion to an open procedure)
- Sterile reinforced gowns and gloves
- Sterile medication labels
- Electrosurgical device
- Radiolucent 4 × 4 sponges
- Suction tubing and tip
- Sterile light handles
- Sharps holder
- Vessel loops, if performing groin dissection
- Suture boots
- Polypropylene suture and/or closure device
- Closing sutures/staples
- Dressings

Endovascular supplies:
- Percutaneous needle (18-gauge)
- 7- and 8-Fr introducers and dilators (EVAR) 12-Fr (TEVAR)—groin
- 4-Fr introducer and dilator (brachial)
- 16- and 22-Fr introducers and dilators (EVAR) [20-Fr (TEVAR)]
- Soft and stiff guidewires (0.35 × 180 cm, 260 cm, TEVAR—460 cm)
- Angiogram catheters with markers (4 and 5-Fr)
- High-pressure tubing for I.V. contrast medium injector
- Stent grafts of choice
- Snare kit
- Balloons and embolization coils of various sizes
- IVUS catheter
- Torque device
- Instrumentation
- Minor vascular instrument set if performing groin dissection
- Conversion instruments on standby to include major abdominal instrument set
- Arterial tray if abdominal approach is planned

Equipment:
- High-pressure I.V. contrast medium injector
- Radiolucent OR bed
- Imaging equipment (C-arm and additional monitor)
- Lead aprons with thyroid shields
- Doppler (internal, external)
- IVUS
- Medications
- Heparinized normal saline
- I.V. contrast medium
- Irrigation (antibiotic)
- Hemostatic agents (thrombin, glue)

Please note supplies may vary per institution and situation

Sources: Tinkham MR. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.
Cardiothoracic Surgery Network. Thoracic Endovascular Aortic Repair (TEVAR). http://www.ctsnet.org/portals/endovascular/procedures101/exp_tech1.html#PREFERENCECARD.

family know what to expect will help alleviate any fear should these additional safety measures occur postoperatively.

Intraoperative

Endovascular aneurysm procedures may occur in an OR, within an interventional radiology, or a catheterization lab suite. No matter where the procedure is scheduled, a radiolucent operating table—allowing vision from the patient's nipples to knees—is required for the surgeon to see the devices being deployed intraoperatively. Proper radiologic equipment, such as a C-arm, and ideally, an additional monitor, is also needed along with a high-pressure I.V. contrast medium injection system and possibly an IVUS. The basic room setup and procedure steps are similar among all endovascular procedures (see *Endovascular procedure room setup*). The perioperative nurse needs to keep proper totals of any I.V. contrast media injected, urine output, and estimated blood loss. The perioperative nurse will also need to keep accurate records of which stent graft devices are implanted into the patient, and properly complete the implant recording method used within the facility. Proper radiation safety and use of protective devices are also important concepts in any endovascular procedure and will be discussed in greater detail later.

The surgeon will palpate or employ the use of an external Doppler to locate the femoral artery on each side of the patient's groin. This artery is then accessed either through a mini groin dissection (see *Groin dissection–open technique*) or percutaneous technique using a needle stick. Once the vessel is visualized, a percutaneous needle is inserted into it, and a flexible guidewire is passed through the hollow bore of the needle into the vessel. This guidewire will be used to allow the surgeon to insert a sheath into the vessel once the percutaneous needle is removed. The size of the sheath chosen depends upon the size of the vessel and the size of the endovascular stent graft to be placed into the aneurysm. The initial sheaths are often smaller in diameter and used to introduce the stiffer guidewires that'll guide the stent graft devices into the vessel. Once the stiff wires have been placed, the flexible guidewires are removed, and the smaller sheaths are replaced with one that has a larger diameter and length. On occasion, based on surgeon preference, the device may be deployed bare (without the use of the larger sheaths). In this case, the stent devices are loaded onto the stiffer wires into the vessel itself. Once it's decided which side the main body of the graft will be deployed, an angiographic catheter will be inserted on the opposite side, so I.V. contrast media and IVUS can be used. Angiographic catheters come in many shapes and lengths to enhance the ease of insertion. Many also have radiolucent markings, so their exact position can be determined under the C-arm.

The stent graft is packaged into several pieces, each inside its own deployment device. The main body of the stent graft is deployed first under radiography followed by the iliac limb on the opposite side. Additional iliac extension pieces and an aortic cuff can be placed, so the device covers the length of the aneurysm (see *Parts of a stent graft* and *Steps of stent graft deployment*). Once all pieces have been placed and before the incisions are closed, an angiographic balloon catheter may be placed into the devices to ensure a proper fit. Another angiogram is taken to evaluate placement and look for one of the most common complications of endovascular repair: an endoleak.

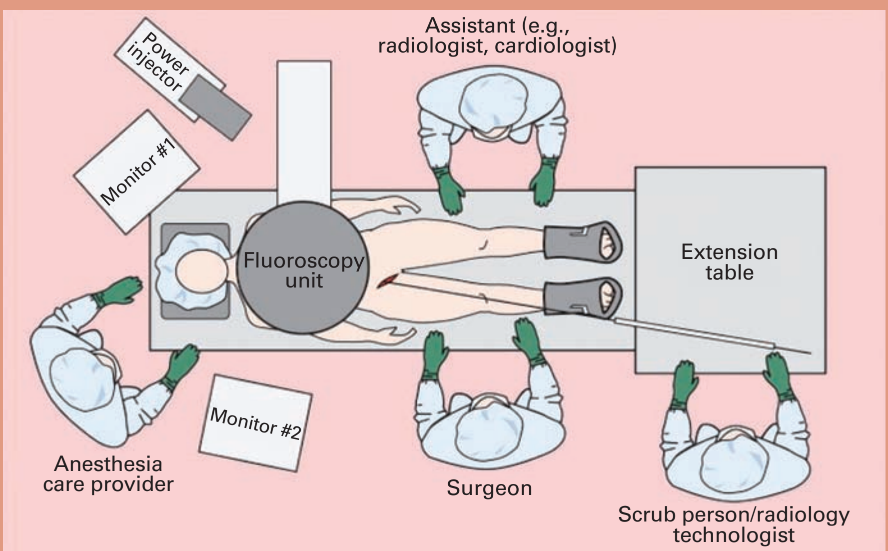
Endoleaks

An endoleak is a complication that allows blood to still flow into the aneurysmal sac.[2] There are four types of endoleaks that are based upon where the leak is occurring. (See *Classification of endoleaks.*) Type V endoleaks are not actually leaks. They are different because the aneurysmal sac continues to enlarge even though there is no apparent leak (often referred to as endotension).[3]

Type I endoleaks are significant and account for approximately 10% of EVAR endoleaks.[3] These leaks are usually treated as soon as they are discovered, often during initial implantation, since they don't usually resolve on their own. Angioplasty is often used as the first attempt to treat type I endoleaks.[4] Treatment options can range from deployment of additional stent pieces (aortic cuffs and iliac limbs), embolization, or conversion to an open procedure if the endoleak isn't resolved, especially in a proximal type I leak with a large aneurysm.[3] The use of bare metal balloon expandable stents over the affected area is also a treatment option.[4] it's suggested by some authors that proper patient selection and endovascular stent device choices can help to avoid these types of endoleaks.[3]

Type II endoleaks are caused by "retrograde flow through collateral vessels into the perigraft space."[3] These types

Endovascular procedure room setup



Reprinted with permission from Tinkham MR. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2): 289-302. Copyright (2009).

of endoleaks may appear at implantation or may have a delayed appearance during one of the follow-up scans; they may also account for 10% to 25% of incidences.[4] Treatment is required if the aneurysmal sac continues to enlarge or if the enlargement has persisted for longer than 6 months.[3] Many of these endoleaks that do not cause sac expansion will resolve on their own.[4] When intervention is chosen, employment of devices, such as embolization coils, synthetic fiber formed into a coil, occlusion plugs, and mesh/gel devices to the offending vessels to clot off the bleeding vessels, are the most common treatments. These coils can be placed as a single-vessel embolization or through a translumbar approach, where the patient is positioned prone, and the coils are placed into the aneurysmal sac and feeding vessels.[4] These coils may be stainless steel or platinum, and each have associated risks and benefits. Stainless steel coils are beneficial, especially in later radiographic follow-up because they produce less artifact, but they are stiffer, whereas platinum coils form a tighter plug for the endoleak.[4] Laparoscopic clipping and robotic ligation of the inferior mesenteric artery (IMA) are also options.[4]

Type III endoleaks, also known as device failure, are similar to type I endoleaks, and as a result, require immediate treatment. These types of leaks are usually treated by adding additional stent graft pieces to compensate for the defect followed by additional angioplasty.[4] Type IV isn't really a device failure but simply due to the nature of the device material itself. As endovascular stent grafts have continued to advance, these leaks are no longer common. When they occur, it's usually immediately after placement when the patient is anticoagulated for the procedure. As a result, when the anticoagulant medications have resolved and the patient's blood levels have returned to normal, these types of endoleaks usually resolve on their own.[4] Type V (endotension) appears to be related to the graft's design, the transfer of vibrations from the pulsatile wall of the graft to the aneurysmal sac, and may be relieved by releasing pressure through the use of a spinal needle.[3] In other situations, the stent grafts may need to be replaced, additional stent pieces may need to be placed for reinforcement, or the procedure may need to be converted to an open repair.[4] Stent pieces are placed endoscopically under radiograph, usually C-arm. Each piece is packaged separately in a long, dilator-type device and threaded up a guidewire placed by the surgeon. The items are then uncoiled from the packaged device inside the patient. This is continued for each piece to be used. After positioning, an endoscopic balloon is usually used to expand the device in the patient and help it seal.

Groin dissection–open technique

Reprinted with permission from Tinkham M. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.

Radiology safety

The advancing uses for fluoroscopy have greatly improved the treatment of patients. This is especially true in endovascular procedures. Unfortunately, it has risks and benefits. Anyone using radiation must understand its use and effects on the body, and ways to use it safely to prevent injury. These potential hazards can be acute (dermatitis) or more chronic (skin cancer or genetic damage that may lead to congenital effects to future offspring).

Radiation safety consists of three basic principles: time, distance, and shielding.[2] The key concept of time is to limit exposure to the radiation. This is true for both the patient and staff. In reference to distance, OR staff need to stay as far away as possible from where the radiation is being emitted. Finally, the concept of shielding is twofold. In reference to patients, expose the necessary areas of the body that are needed on the radiographic equipment. Protective shields (lead aprons) must be used for both the patient and the OR staff. If the OR staff are within 24 inches, they should also wear a thyroid shield and lead eyewear.[5,7] Leaded gloves are also available for the surgeon, since the surgeon's hands often need to be kept under the imaging device to control the angiographic supplies.

There are two main guidelines put forth by Occupational Safety and Health Administration (OSHA) regarding radiation exposure. One relates to the general industry, and the other is specific to healthcare: OSHA Technical Manual Hospital Investigation Health Hazards (Section IV Chapter 1).[5] Their main recommendations include: wearing radiation badges that track exposure; use of barrier lead walls and lead plated glass in X-ray rooms; use of shielding devices (lead aprons and eyeglasses); designation of a specific person's responsibility for monitoring; and maintenance of radiographic equipment.[5]

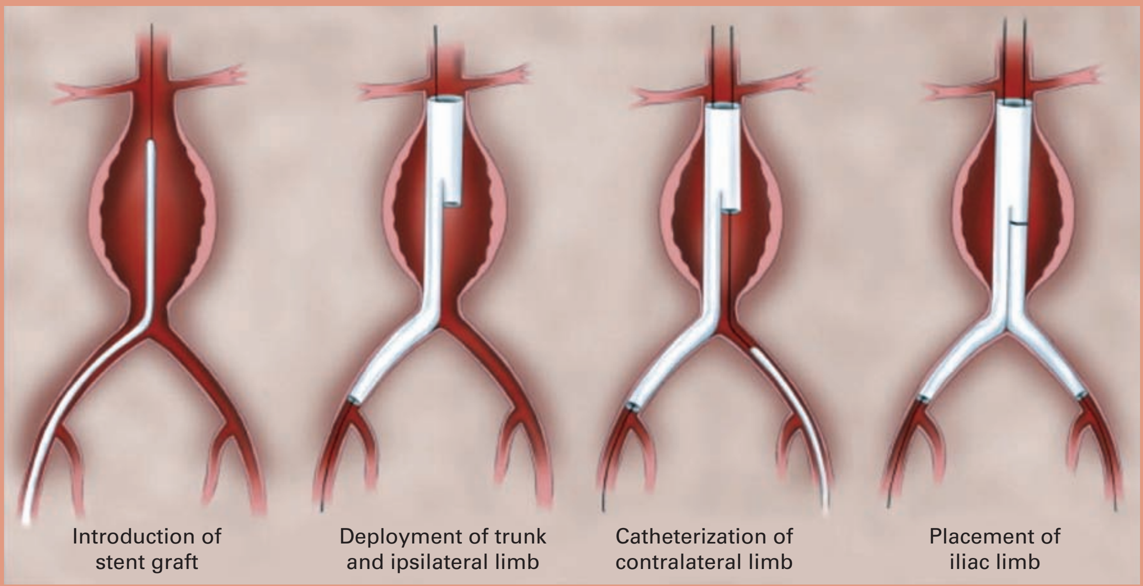
Postoperative

Immediately after the surgery, the patient is usually transported to the postanesthesia care unit or directly to the surgical intensive care unit based on the surgeon and anesthesia care provider's preferences. In addition to standard postoperative monitoring, such as vital signs and pain measurement, the nurse recovering an endovascular patient needs to be observant for any bleeding or swelling from the operative sites. Distal pulses and temperature should also be monitored, since circulation to the areas below the intervention may be impeded by the implanted devices. Urine output should also be monitored closely due to the possible injury to renal vessels or reaction to the I.V. contrast media given intraoperatively. If the procedure was performed percutaneously, the patient will usually need to lie flat for 4 to 6 hours and may need a pressure device to help the puncture sites stabilize.[2] Although it depends on the condition of each patient and surgeon preference, these patients are usually discharged within 1 to 2 days after the procedure. Patients should be instructed to call their physician immediately if they experience pain, swelling, or bleeding at the incision sites, cold or numbness of the lower extremities, unusual dizziness, chest pain, or back pain.[6]

Follow-up

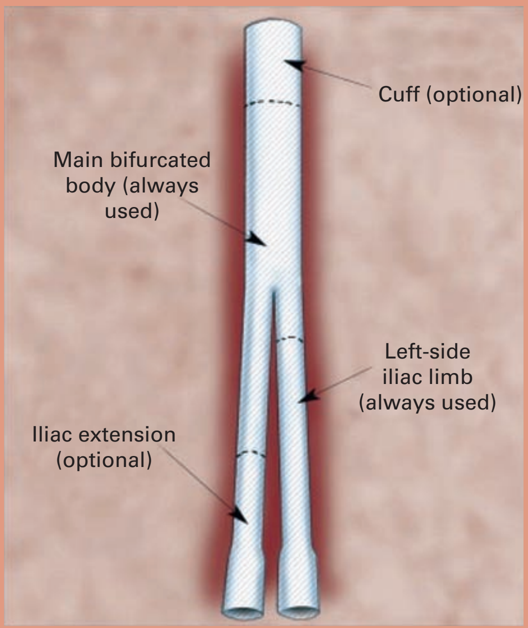
After having EVAR or TEVAR, patients need lifelong radiographic surveillance to monitor graft placement, development of endoleaks, and enlargement of the

Steps of stent graft deployment



Reprinted with permission from Tinkham M. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.

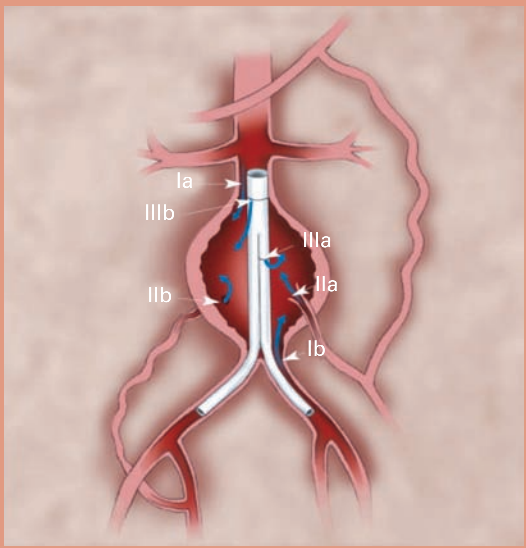
Parts of a stent graft



Reprinted with permission from Tinkham M. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.

Classification of endoleaks

There are four types of endoleaks that are based upon where the leak is occurring. An endoleak can be from attachment problems (Ia) at the proximal fixation site of the graft, the distal fixation site (Ib), or any of the limbs. The incoming blood can also occur from branch leaks (II), from the IMA, hypogastric artery, or the lumbar arteries. Finally, the last two classifications refer to material of the stent graft itself. Dislocation of the components (IIIa), tears in the fabric (IIIb), or the porous nature (IV) of the material can also cause endoleaks.



Reprinted with permission from Tinkham M. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.

aneurysm.[4] Due to the possibility of delayed endoleaks weighted against the risk of prolonged radiation exposure, follow-up protocol is often adjusted to each individual patient and their adherence to continued lifelong scans. With that said, a CT scan, often triphasic computed tomography angiography (CTA),[4] is usually performed within 24 hours after the procedure. Subsequent follow ups are every 3 months for the first year and may employ ultrasounds instead of CT scans. For instance, an ultrasound at 1 month post-op, CT scan at 3 months, ultrasound at 6 months, CT scan at 1 year, and then annually thereafter.[6] Additional methods that can be used include magnetic resonance and duplex ultrasounds.[4] Once an endoleak has been discovered (usually on CTA), the patient may be referred for digital subtraction angiography (DSA) for classification and then scheduled for the repair procedure.[4]

Nursing implications

Recommended practices (RPs) and care plans are part of the perioperative nurse's daily practice. The Association of periOperative Registered Nurses (AORN) has developed several RPs relevant to endovascular surgery, such as reducing radiologic exposure.[7]

Other important concepts include the AORN guidance statement: "Safe medication practices in perioperative settings across the life span" and "Recommended practices for maintaining a sterile field" are also important in all procedures, especially in endovascular surgery.[7] This is due to the usage of medications, such as I.V. contrast media and heparin, which can have life-threatening consequences due to dosing errors, medication allergies, and contraindications based on the patient's medical history. Maintaining a proper sterile field is important in any procedure and especially during endovascular procedures, which utilize groin incisions with a large number of natural flora. The placement of permanent implants also increases the risks associated with surgical site infections, since these foreign bodies are difficult to remove if they become infected. A review of AORN's current *Perioperative Standards and Recommended Practices* is recommended to evaluate all the applicable documents relevant to these procedures.[7]

The related nursing diagnosis "risk of injury" and "risk of infection" are key diagnoses related to the RPs.[2] The obvious desired outcome is to keep the patient free from injury, such as electrosurgical, radiological, positional causes, and infection related to the surgical procedure.[2] Appropriate preoperative interview, intraoperative planning and surveillance, and surgical sterile technique can prevent many of these potential problems.[2]

Moving forward

The endovascular technique has been shown to be a beneficial medical advancement, especially in the treatment of aneurysms. Increases in education and technology are helping to make these procedures safer and more effective for patients. Many of the potential complications can be avoided with proper patient and device selection. The only major drawback for patients seems to be the continued need for lifelong follow-up and the risks involved with excessive radiologic exposure. As advances in treatments help to decrease the risks of endoleaks and other complications, hopefully, a time will come when they will no longer be an issue, and such stringent follow ups will not be required. Until then, multidisciplinary teamwork and patient adherence to the postoperative follow-up schedule are keys to a successful outcome in these complex cases. **OR**

REFERENCES

1. Society for Vascular Nursing. Abdominal aortic disease. http://svnnet.org/uploads/File/PatientEd/AbdominalArterialDiseaseBk.pdf.

2. Tinkham MR. The endovascular approach to abdominal aortic aneurysm repair. *AORN J.* 2009;89(2):289-302.

3. Rosen R, Thompson J. Endoleaks a persistent problem. *OR Nurse. 2009*;3(5):24-35.

4. White SB, Stavropoulos SW. Management of endoleaks following endovascular aneurysm repair. *Semin Intervent Radiol.* 2009;26(1):33-38.

5. United States Department of Labor. Occupational Safety & Health Administration. *OSHA technical manual (OTM)*—Section VI: Chapter 1. http://www.osha.gov/dts/osta/otm/otm_vi/otm_vi_1.html.

6. Thompson J, Bertling G. Endovascular leaks: perioperative nursing implications. *AORN J.* 2009;89(5):839-846.

7. Conner, R. Perioperative Standards and Recommended Practices 2013. AORN,Inc.: Denver. 2013.

Michelle R. Tinkham is a Clinical Educator Eisenhower Medical Center Rancho Mirage, Calif.

The author and planners have disclosed that they have no financial relationships related to this article.

DOI-10.1097/01.ORN.0000429402.25469.83

CE CONNECTION

Earn CE credit online:
Go to http://www.nursingcenter.com/CE/ORnurse and receive a certificate *within minutes.*

INSTRUCTIONS

Care of the endovascular aneurysm repair patient with an endoleak

TEST INSTRUCTIONS

- To take the test online, go to our secure Web site at http://www.nursingcenter.com/ORnurse.
- On the print form, record your answers in the test answer section of the CE enrollment form on page 41. Each question has only one correct answer. You may make copies of these forms.
- Complete the registration information and course evaluation. Mail the completed form and registration fee of $24.95 to: Lippincott Williams & Wilkins, CE Group, 74 Brick Blvd., Bldg. 4 Suite 206, Brick, NJ 08723. We will mail your certificate in 4 to 6 weeks. For faster service, include a fax number and we will fax your certificate within 2 business days of receiving your enrollment form.
- You will receive your CE certificate of earned contact hours and an answer key to review your results.There is no minimum passing grade.
- Registration deadline is June 30, 2015.

DISCOUNTS and CUSTOMER SERVICE

- Send two or more tests in any nursing journal published by Lippincott Williams & Wilkins together and deduct $0.95 from the price of each test.
- We also offer CE accounts for hospitals and other health care facilities on nursingcenter.com. Call 1-800-787-8985 for details.

PROVIDER ACCREDITATION

Lippincott Williams & Wilkins, publisher of *ORNurse2012* journal, will award 2.5 contact hours for this continuing nursing education activity. Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia and Florida #50-1223. This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.5 contact hours.

Your certificate is valid in all states.

The ANCC's accreditation status of Lippincott Williams & Wilkins Department of Continuing Education refers only to its continuing nursing educational activities and does not imply Commission on Accreditation approval or endorsement of any commercial product.