



Review

The emergency medicine approach to abdominal vascular graft complications☆☆☆



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ABSTRACT

Introduction: Abdominal aortic aneurysm (AAA) is a deadly condition, particularly with rupture. Emergency physicians provide vital frontline care to the diagnosis and treatment of this disease. Endovascular aortic repair (EVAR) has become the gold standard for treatment of AAA, but the management of EVAR complications is not well discussed in the emergency medicine literature.

Objective of this review: The purpose of this article is to provide an emergency medicine–focused review of the complications of EVAR.

Discussion: Although many complications may arise after AAA repair, the most common include aortoenteric fistula, endoleak, limb ischemia, and graft infection. All potential complications should receive vascular surgery consultation and hemodynamic resuscitation. Aortoenteric fistula often presents nonspecifically with gastrointestinal (GI) bleeding, abdominal pain, and vomiting. Computed tomography with intravenous contrast is required for diagnosis. An *endoleak* is defined by vascular flow outside of the graft. The optimal diagnostic modality includes triple phase computed tomographic scan (noncontrast, arterial, delayed phase). Limb ischemia may occur before 2 months, or in a later period, with symptoms ranging from claudication to complete neurovascular compromise. Graft infection is most commonly due to *Staphylococcus aureus*, and imaging can suggest the diagnosis. Definitive diagnosis requires tissue or fluid sampling. Through an understanding of these complications, emergency physicians may improve patient outcomes.

Conclusions: With the growing use of EVAR, emergency physician exposure to complications of this procedure is increasing. Knowledge of the complication presentations, diagnoses, and management can play an integral role patient care.

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1. Introduction

Endovascular aortic repair (EVAR) has largely replaced open aortic repair as the gold standard since its introduction in the 1990s [1]. This has been especially important with the increasing rate of surgery on elderly patients, as it decreases operative times, blood loss, intensive care needs, length of stay, and major postoperative morbidity when compared with open abdominal aortic aneurysm (AAA) repair [2]. As endovascular surgery becomes more prominent, an increased number

of patients with abdominal vascular grafts will be evaluated and managed by emergency physicians.

The diagnosis and management of AAA is a concept well embedded in emergency medicine (EM) literature. Little literature exists that addresses the potential complications after EVAR. Patients undergoing EVAR can have postoperative complication rates approximating 30% [3]. Even nonspecific presentations such as abdominal pain, hematuria, flank pain, or syncope may be a warning sign of graft complication. Although multiple studies are present in vascular surgery and interventional radiology literature, few studies exist in EM literature. The goal of this review is to perform a succinct, EM-focused review of the presentations and diagnoses of common complications of EVAR in the emergency department (ED).

2. Discussion: complications of EVAR

2.1. Aortoenteric fistula

Aortoenteric fistula is arguably the deadliest complication with a mortality rate as high as 50%, even with operative intervention [4].

☆ Conflicts of Interest: None.

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Although much more common after open AAA repair (0.4%–1.6%), aortoenteric fistula may occur after EVAR [4]. Fistulas are more common after open repair because of the difficulty of obtaining complete tissue coverage of the graft. These fistulas may occur anywhere along the GI tract (esophagus, duodenum, small bowel) [5].

Most patients present with nausea, vomiting, back pain, hematochezia, and nonspecific abdominal pain. However, a smaller subset of patients suffers from an underlying graft infection with secondary fistulization. These patients present with less obvious symptoms such as fever, weight loss, sepsis, and lack of obvious GI hemorrhage [4]. Although patients with EVAR and GI bleeding more commonly have gastritis or ulcer as the cause of bleeding, it is vital that emergency physicians understand and evaluate for this potentially dangerous complication, despite the often nonspecific examination and history.

Computed tomography angiography (CTA) is the most sensitive, fastest, and least invasive diagnostic modality for this condition. Unfortunately, the sensitivity for aortoenteric fistula diagnosis ranges from 30% to 80% [5]. Fig. 1 demonstrates computed tomography (CT) findings. Other diagnostic modalities such as esophagogastroduodenoscopy and aortography are more invasive and have not proven to have better sensitivity than CT. With new generation scanners, this sensitivity has moved closer to 94%, though the test currently cannot reach 100% sensitivity for definitive rule-out [6].

As many of these are associated with infection and or graft failure/migration, there is a need for vascular surgery consultation. Hemodynamic support and broad-spectrum antimicrobials are required in initial management.

2.2. Endoleaks

An endoleak is vascular flow outside of the endograft, but still contained in the aortic aneurysm sac [7]. There are 5 different types of endoleaks, which can be summarized by location.

1. Type 1 - at the attachment site/seal failure - 10%
2. Type 2 - through a collateral vessel - 40%
3. Type 3 - graft failure/tear - 4%
4. Type 4 - porosity of the graft
5. Type 5 - endotension/unidentifiable source



Fig. 1. Aortoenteric fistula involving duodenum with contrast extravasation on arterial phase. Case courtesy of Dr Lawrence Chia Wei Oh, Radiopaedia.org, rID: 25 668.

Types 1 to 3 are the most common types of endoleaks diagnosed in the ED. This can be difficult, as many endoleak presentations are asymptomatic or nonspecific, unless the AAA has ruptured [8]. Fortunately, most patients with endografts undergo routine imaging at 30 days, 6 months, and annually after placement of the graft. The type of imaging varies between institutions but is most commonly CT with intravenous contrast [9].

Although this surveillance screening can detect complications, a graft may migrate, fracture, or partially occlude at any time. The optimal imaging modality for diagnosis is a triple phase CT scan (noncon, arterial, delayed phase), which will likely require discussion with the radiologist. The CT with intravenous contrast does not have sensitivity equivalent to triple phase scanning [7]. Figs. 2 and 3 demonstrate contrast extravasation found on CT.

Type 1 endoleaks are arguably the most worrisome, as the leak results in full pressurization of the AAA. These are most commonly treated endovascularly with graft extension or further stenting [10]. Graft migration is a predictor for type 1 endoleak. Type 2 endoleaks can also be of worry in the ED setting, which result from collateral vessel flow. Although 40% of these will end up sealing spontaneously, there is a subset of patients that will require more expedited intervention. Expansion of aneurysm sac by 5 to 10 mm from baseline is a predictor for need of intervention [11].

Rapid vascular surgery consultation is required when an endoleak is suspected. Aside from supportive care, including potential blood product transfusion, vascular surgery intervention is essential. The majority of these can be managed with endovascular techniques, and some are placed under more routine surveillance [12]. Aneurysm sac expansion from endoleak can lead to rupture if not detected, warranting consideration of this complication.

2.3. Limb ischemia and graft thrombosis

Limb ischemia is one of the more serious complications that can occur with vascular grafts. In the past, before there was supporting material built into stents, the rate of this complication reached 40% [13]. Newer generation grafts have complication rates approaching 5%. Graft thrombosis occurs at a rate of approximately 0.5% to 11% [14].

In general, 2 types of limb ischemia may occur with EVAR. Early limb ischemia occurs within the first 2 months after surgery and is most often associated with kinking of the graft. Late limb ischemia occurs after the first 2 months and is almost exclusively due to graft migration into the external iliac artery [15]. One recent study demonstrated that the most important risk factor for limb occlusion was extension of the



Fig. 2. Type 1 endoleak with contrast extravasation at the origin of the aortoiliac endograft. Case courtesy of Dr Laughlin Dawes, Radiopaedia.org, rID: 7821.

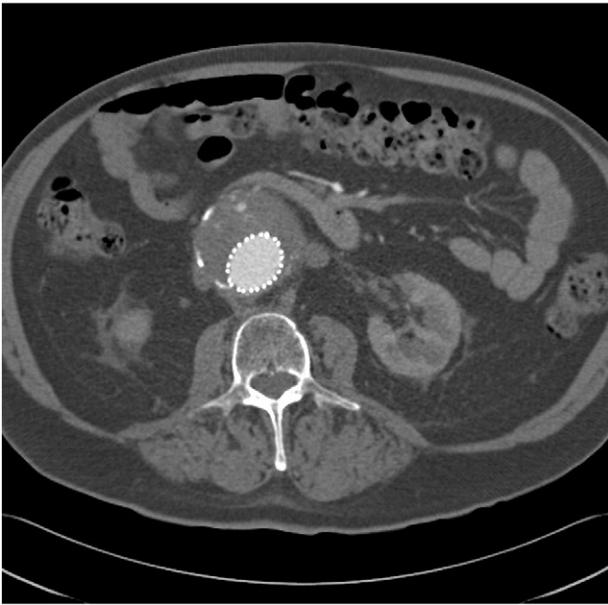


Fig. 3. Type 2 endoleak with contrast extravasation anterior to graft. Case courtesy of RMH Core Conditions, Radiopaedia.org, rID: 34 237.

graft into the external iliac artery [1]. Graft thrombosis occurs most commonly in the first 6 months after implantation with differing degrees of limb claudication. The treatment of this condition depends highly on the location and extent of thrombus, but may include anticoagulation, thrombectomy, or bypass [16].

The symptoms of acute kinking or thrombosis can range anywhere from mild claudication to loss of neurologic and motor function [16]. Obtaining history is an integral part of the evaluation in the ED. As many of these patients will already have symptoms of claudication at baseline, it is vital to discern whether or not the symptoms they are experiencing are new or different from prior symptoms.

Diagnosis of this particular condition has traditionally been performed with CTA, but there are studies to suggest duplex ultrasonography alone or in combination with CTA may be useful [17]. As these are time-sensitive diagnoses, immediate consultation with a vascular surgeon or use of an institutional protocol is highly recommended. Treatment of these conditions is dependent on patient situation and may include stent relining, anticoagulation, and even further bypass [18]. Management is highly dependent on the individual graft and patient, and treatment should not be initiated without vascular surgery consult.

2.4. Graft infection

Endovascular graft infection is a rare complication reported between 0.5% and 3%; however, the mortality rate is between 20% and 40% [19]. A graft infection is often the inciting factor for endoleaks, fistulas, and graft migration. The diagnosis of this condition can be difficult because of nonspecific symptoms including malaise, back pain, fever, GI bleeding, or ischemia from a clotted graft [20]. What is most relevant to the emergency physician is that these may also present asymptotically or atypically, thus emergency physicians must consider this condition with a patient presenting with graft and the symptoms listed. Although early graft infection may occur from contamination during device implantation, the most common cause of infection is heterogeneous spread from another site [15].

Management of these patients in the ED should ideally be performed in collaboration with a vascular surgeon. However, for those suspecting the diagnosis, CTA of the involved anatomic location of the graft is considered the radiographic gold standard for diagnosis, with a reported sensitivity of approximately 60%, whereas the specificity approaches

100% [21]. The CT findings include air around the graft or perigraft inflammation [20]. This modality is not sensitive enough to definitively rule out the condition. Fig. 4 shows findings consistent with graft infection. Although positron emission tomography has been noted to have a sensitivity of greater than 90%, this test is not often available in the ED [22]. Laboratory tests are usually nonspecific. Unfortunately, definitive diagnosis requires fluid or tissue sampling from the graft or from perigraft fluid collection [20].

The most commonly isolated bacterium from graft infections is *S. aureus*[23]. If this condition is diagnosed in the ED, broad-spectrum antimicrobial coverage is required and then subsequently narrowed based on cultures/sensitivities. For definitive treatment, most patients require graft replacement, though some may improve with antimicrobial therapy alone [19].

2.5. Other complications

Less common complications of EVAR include the following: [15]

- Renal artery occlusion - <5% of cases
- Colonic ischemia - up to 3%
- Spinal cord ischemia - 0.21%

Although the above complications are rare possibilities, outcomes are potentially fatal. Patients with endovascular graphs are a highly specialized population that are prone to numerous complications. A careful history, physical examination, low threshold for diagnostic testing, and consultation with vascular surgery are required when the signs and symptoms suggest possible graft complication.

3. Conclusions

With increased AAA repair using EVAR, emergency physicians must be aware of the complications of this operation. Numerous complications may occur from EVAR including aortoenteric fistula, endoleak, limb ischemia, and many others. As with many conditions in the ED, the correct diagnosis requires knowledge of these complications, proper imaging use, and vascular surgery consultation. Patients may present with hemodynamic instability or with few symptoms until catastrophic complications occur. Emergency

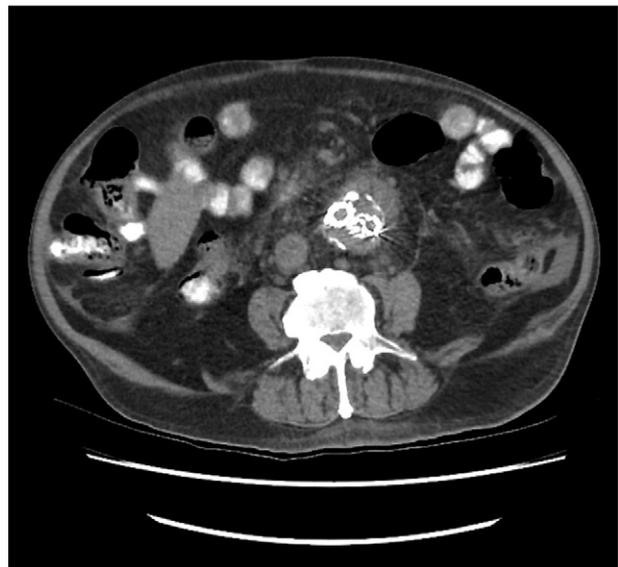


Fig. 4. Aortic graft infection: aortobifemoral stent with eccentric soft tissue density on anterior portion of aorta and stranding of retroperitoneal fat planes. Small amounts of free fluid on lateral aspect of soft tissue density. Multiple enlarged lymph nodes, with small amounts of free fluid within the peritoneum. Case courtesy of Dr Amit Chakraborty, Radiopaedia.org, rID: 44 979.

physicians must maintain vigilance and take extra caution in patients with indwelling vascular grafts.

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