REVIEW ARTICLE

Abdominal Aortic Aneurysm: A Case Report and Literature Review

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ABSTRACT

Introduction: Abdominal aortic aneurysms (AAA) more commonly affect men than women and are estimated to affect 4% to 8% of men older than age 60 years. Mortality because of a ruptured AAA is high, but elective repair is an effective and relatively safe intervention.

Case Presentation: A 79-year-old man came to the Emergency Department because of worsening back pain. Workup revealed a previously unknown, 10-cm aneurysm that had ruptured. Unfortunately, the patient died during emergency surgery.

Discussion: A literature review of proper screening, referral timeframe, the most common surgical techniques, potential complications, and postoperative surveillance was conducted. Early detection, referral to vascular surgery, and possible open or endovascular repair are key to limiting the morbidity and mortality associated with AAA.

INTRODUCTION

Ruptured abdominal aortic aneurysms (AAA) represent the 13th leading cause of mortality in the US.1 An arterial aneurysm is a weakening of the arterial wall with subsequent dilation to 150% or greater of its normal diameter.2 The most common type of arterial aneurysms, AAA, becomes clinically significant at diameters greater than 3 cm. Most commonly, AAA are located inferior to the renal arteries. However, they can extend proximally above the celiac trunk and distally beyond the aortic bifurcation. We report the case of an elderly man who was found to have a previously unknown, 10-cm AAA that had ruptured. Informed consent could not be obtained. An effort has been made to anonymize patient information so as to not cause harm to the patient or his family.

CASE PRESENTATION

Presenting Concerns
A 79-year-old man presented to the Emergency Department reporting the acute onset of low back pain radiating to the left side of his chest. The pain started earlier the same day, had become progressively worse, and was not relieved by changes in position. The patient denied hematuria, dysuria, constipation, diarrhea, or any recent trauma.

His medical history was remarkable for known cardiovascular disease, including coronary artery disease with previous myocardial infarction and 4-vessel coronary artery bypass graft; a 31-pack-year history of tobacco use; paroxysmal atrial fibrillation treated with warfarin anticoagulation; and hypertension. Other comorbidities included stage 3 chronic renal insufficiency and hyperlipidemia. He had no known history of aortic aneurysm. On presentation, the patient’s vital signs were stable; however, he appeared in obvious discomfort. His blood pressure was 104/66 mmHg, pulse was 64/min, respiratory rate was 16/min, oxygen saturation was 97% on room air, temperature was 36.5 °C, and body mass index was 28.62 kg/m². Results of his physical examination included clear lungs; a regular heart rate and rhythm; and an obese abdomen that was soft and had mild distention. No AAA or hepatosplenomegaly were palpated. The patient had considerable discomfort on light palpation of the abdomen, with pain radiating to his flank and back bilaterally.

Laboratory results were overall unremarkable and included a normal troponin I level of 0.01 ng/mL (normal value = 0.00-0.09 ng/mL), white blood cell count of 13.9 × 10⁹/L, and hematocrit of 41%. Of note, the patient’s anticoagulation was subtherapeutic with an international normalized ratio of 1.7 (goal range = 2.0-3.0). The results of an electrocardiogram demonstrated normal sinus rhythm without acute ST changes. The results of an emergent computed tomography angiography (CTA) scan of his abdomen and pelvis demonstrated a 10-cm AAA with a large retroperitoneal hematoma consistent with a contained aortic rupture (Figure 1).

Figure 1. Axial computed tomography angiography scan shows ruptured abdominal aortic aneurysm (AAA). Triangle = center of a 10-cm AAA; star = the building retroperitoneal hematoma.

Keywords: AAA, abdominal aortic aneurysm, arterial aneurysm, endovascular aneurysm repair, open aortic repair, ruptured AAA
Therapeutic Intervention and Treatment

Establishment of appropriate intravenous access with judicious intravenous fluid administration and narcotic pain control was initiated. Blood typing and crossmatching were initiated while the patient received fresh frozen plasma and vitamin K for reversal of warfarin therapy. An emergent vascular surgical consultation was obtained, and open surgical exploration was recommended to the patient. He subsequently underwent an attempted open aortic repair (OAR). Unfortunately, blood loss was extensive, and the patient suffered a myocardial infarction intraoperatively.

Follow-up and Outcomes

Despite extensive resuscitation efforts, the patient died in the operating room. Figure 2 shows the timeline of the case.

DISCUSSION

Reported mortality rates for patients with a ruptured AAA are as high as 90%.1 In contrast, mortality rates for patients undergoing elective AAA repair are typically less than 10%.4 Accordingly, it is imperative to diagnose AAA before rupture. The risk factors for AAA include male sex, age greater than 65 years, a history of tobacco use, and a family history of AAA in first-degree relatives.3 It is estimated that 4% to 8% of men and 0.5% to 2% of women older than age 60 years have AAA.1 If left untreated, the natural progression of AAA is to continue to enlarge. Larger aneurysms have an associated higher risk of rupture. In addition, larger aneurysms expand at a faster rate than smaller aneurysms.3 A 5-cm aneurysm has an estimated 20% annual risk of rupture, whereas a 6-cm aneurysm has an estimated 40% annual risk of rupture.3 Aneurysm repair is a relatively safe and effective way to minimize the risk of death associated with rupture.4,5-7 Along with ordering appropriate AAA screening, primary care physicians should be knowledgeable about when to refer a patient to a vascular surgeon, how to optimize a patient’s comorbid conditions before surgery, the potential complications, and the necessary postrepair surveillance.

Screening

Dedicated ultrasonography is the gold standard for AAA screening. However, AAA can also be detected by physical examination. According to the Society for Vascular Surgery, all men and women older than age 65 years who have smoked more than 100 cigarettes in their lifetime, as well as those with a family history of AAA in a first-degree relative should undergo 1-time abdominal aortic ultrasonography.3 An aortic width of greater than 3 cm is considered clinically significant, and details of when to refer to a vascular surgeon will be addressed later in this article.

Cursory evaluation for AAA can also be done during the annual physical examination. To appropriately evaluate for AAA, the patient should lie supine with knees bent, allowing relaxation of the abdominal wall. The physician should palpate the epigastric region for an abdominal pulse. Then the physician can determine the width of the aorta by placing his or her index fingers on either side of the pulsating aorta.6 AAA will demonstrate an expansile pulsation that is appreciable anterolaterally. An experienced practitioner will recognize the characteristic feel of an expanded aorta. Patients with less abdominal girth, as well as those with larger aneurysms, are more likely to have an aneurysm discernable on physical examination.6

Many practitioners are not aware of the effectiveness of the physical examination at identifying AAA. In a study by Fink et al,4 blinded physicians were asked to examine patients with or without known AAA. The physical examination was 82% specific for aneurysms larger than 5 cm, 69% for aneurysms 4 to 4.9 cm, and 61% for aneurysms from 3 to 3.9 cm.4 Their study demonstrates that the physical examination can be very useful for detecting moderate-sized to larger aneurysms. This may be of particular use in patients who would not otherwise qualify for screening according to the current guidelines.

Patients suspected of having AAA on the basis of the physical examination findings, and all patients meeting the screening criteria, should undergo an abdominal aortic ultrasonogram evaluation to confirm the presence of AAA.

For any stable patient suspected of having a symptomatic or ruptured AAA, CTA of the abdomen and pelvis should be ordered.3 Classic symptoms of a ruptured AAA are hypotension, acute severe back or flank pain, and a pulsatile abdominal mass.

When to Refer

An abdominal aorta with a width larger than 3 cm is considered aneurysmal, but the risk of rupture at 3 cm is minimal.3

Any patient found to have an AAA greater than 4 cm should be

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**Table 1. Recommended aneurysm surveillance**

<table>
<thead>
<tr>
<th>Aneurysm diameter, cm</th>
<th>Ultrasonography frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0-3.9</td>
<td>Every 3 y</td>
</tr>
<tr>
<td>4.0-4.9</td>
<td>Annually</td>
</tr>
<tr>
<td>5.0-5.4</td>
<td>Every 6 mo</td>
</tr>
</tbody>
</table>

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**Figure 2. Timeline of the case (in hours).**

CTA = computed tomography angiography; ED = Emergency Department.
referred to a vascular surgeon for further evaluation and possible intervention. Typically, women are considered for intervention at an aneurysm size of 5 cm or larger, and men are recommended to undergo repair at 5.5 cm or larger. Serial ultrasonogram evaluations are recommended for patients who have AAA smaller than the threshold for treatment. The frequency of imaging depends on the size of the aneurysm (Table 1). Because larger aneurysms tend to expand at a faster rate, they require a more frequent monitoring schedule. 2,3

**Optimization for Surgery**

Once a patient is found to be a candidate for elective AAA repair, s/he should undergo a comprehensive cardiac evaluation and be thoroughly counseled about the importance of tobacco cessation. This should include appropriate nicotine replacement therapy in addition to group or individual counseling. Cardiovascular disease, often perpetuated by tobacco use, is one of the leading causes of mortality following aortic aneurysm repair.4

Optimization preoperatively should also include consideration of statin therapy. Multiple studies of aneurysm repair have reported that fewer than 50% of participants were taking a statin medication at the time of the procedure. 4,5,7,10,11 Among Medicare patients older than the age of 50 years undergoing repair, Galiñanes et al13 reported preoperative statin use to be associated with a 26% reduction in 1-year mortality in addition to a decreased overall complication risk. In another study, Pini et al10 found that patients receiving statins were more likely to have a reduction in type 2 endoleaks at follow-up compared with their counterparts not receiving statins.

Many studies have attempted to identify medications effective at inhibiting the enlargement of AAA, therefore decreasing the need for surgical intervention. Primarily, research efforts have focused on antibiotics and propranolol. Doxycycline has demonstrated a reduction in aneurysm growth in animal models. Many studies have attempted to identify medications effective at inhibiting the enlargement of AAA, therefore decreasing the need for surgical intervention. Primarily, research efforts have focused on antibiotics and propranolol. Doxycycline has demonstrated a reduction in aneurysm growth in animal models. However, these results have not translated to humans.13 Studies of the effects of propranolol have not demonstrated statistically significant results and have been further complicated by poor tolerance in patients.13

**Methods of Repair**

There are 2 methods of AAA repair: OAR and endovascular aneurysm repair (EVAR). The first OAR was reported in 1951. Since this first-reported OAR, improved surgical technique as well as robust perioperative management have led to excellent morbidity and mortality rates. However, OAR remains a major surgical procedure, particularly in patients with associated comorbidities. As such, EVAR was developed in the early 1990s.

For an OAR, the surgeon will typically approach the aorta through a midline abdominal incision. The AAA is exposed in the retroperitoneum. The aneurysm is then excluded by suturing a prosthetic graft to the proximal and distal end of the diseased aorta. Patients who receive OAR spend, on average, 3.7 days longer in the Intensive Care Unit and 6.5 days longer in the hospital than their counterparts who receive EVAR (p < 0.001 and p < 0.001, respectively).2 Most patients will feel fully recovered 4 to 6 weeks after surgery. The perioperative risk of mortality from OAR is 4% compared with 1.4% in EVAR.12 Open repairs are higher risk procedures with greater blood loss and typically longer operative duration. Despite these perioperative disadvantages, OAR has lower rates of repeated intervention and lower long-term mortality than EVAR has.3

The EVAR technique is performed in an operating room with radiologic capability. Access is typically obtained via the femoral arteries either percutaneously or via a small incision in the groin. Guidewires and catheters are then manipulated under fluoroscopic guidance through the iliac arteries into the aorta. A modular stent graft device is assembled in vivo to exclude the aneurysm. The EVAR devices require patients to meet strict anatomic criteria. In fact, incompatible anatomy accounts for 93% of the patients who are rejected for EVAR.14 Most patients treated with EVAR are discharged on postoperative day 1 and feel fully recovered 1 to 2 weeks after surgery. In the first 6 months postoperatively, EVAR is associated with lower rates of morbidity and mortality.5,6 Disadvantages of EVAR include the need for lifelong surveillance with radiologic imaging, a higher rate of re-intervention, and a higher rate of aneurysm-related death after 6 months.5

**Women and Abdominal Aortic Aneurysm**

Men are more likely to have AAA. However, women have worse outcomes in AAA management than men do, including aneurysm rupture at smaller diameters.15 Women also have higher rates of perioperative mortality, longer hospital stays, and are more prone to serious intraoperative complications.16 Although EVAR has become the more frequently performed procedure for AAA repair, many women do not meet the strict anatomical criteria.

**Perioperative Complications**

Perioperative complications are similar between EVAR and OAR, including colonic ischemia, wound complications, renal failure, myocardial infarction, pneumonia, and death. However, the rates at which these complications occur are, overall, higher in patients who receive OAR vs EVAR.2 Additionally, EVAR is associated with complications not encountered with OAR, including contrast medium reaction, contrast medium-induced renal insufficiency, and radiation injury in the event of a prolonged procedure.

**Colonic Ischemia**

Colonic ischemia occurs because of occlusion of the inferior mesenteric artery during repair of the AAA. This complication is 2.7 times more likely after OAR than EVAR.17 Colonic ischemia commonly presents within the first 24 hours postoperatively with symptoms of left-sided abdominal pain, cramping, and rectal bleeding.17

**Wound Complications**

Groin pain or fever after EVAR is associated with infections at the access site. If a wound infection is not identified early, it can lead to the feared complication of graft infection. After an OAR, it is important to identify wound infections to avoid skin breakdown and abdominal wall dehiscence.
Long-Term Complications

Endoleaks

Endoleaks are the most commonly encountered complication of EVAR. An endoleak is a leakage of blood between the graft and the aneurysm sac. Some types can cause the aneurysm sac to enlarge and, if untreated, to eventually rupture. There are 5 types of endoleaks, and all are asymptomatic until rupture of the aneurysm sac. They may be noted at the end of a procedure or may develop years later. Table 2 details the classification, the timing of presentation relative to the primary intervention, and the next steps in the management of endoleaks.

Graft Infection

Graft infections are a rare complication of both EVAR and OAR. Infection of the graft should be suspected in anyone with history of EVAR or OAR who has sepsis of an unknown etiology or a new pseudoaneurysm juxtaposed to an indwelling aortic graft. As mentioned earlier, infection at the groin access site of an EVAR should also raise suspicion. Treatment of a known graft infection is surgical removal.

Aortoenteric Fistula

Aortoenteric fistula (AEF) is a complication that can occur in isolation or accompany a graft infection. As the name implies, an AEF is a connection between the aorta and the small intestine, most commonly the duodenum, which overlies the proximal AAA repair site. An AEF typically presents with a herald gastrointestinal bleed followed by frank exsanguination. Emergent CTA or endoscopy can confirm the presence of an AEF.

Buttock Claudication and Limb Occlusion

Endograft exclusion of the internal iliac artery can result in the development of buttock claudication. Most of these cases are self-limiting. A much more serious complication is limb occlusion, which is a medical emergency. Patients will typically present with acute symptoms of claudication.

Sexual Dysfunction

Sexual dysfunction is common in patients with arterial disease. Symptoms may worsen postoperatively after OAR. Often this is self-limited. A subset of patients will require a urology referral for further management.

Surveillance and Follow-up

After undergoing EVAR, patients require a surveillance CTA scan at 1 month, 6 months, and 12 months. If the results of the 1-month scan are normal, patients do not require the 6-month scan. Surveillance of the aneurysm does not end there. Yearly abdominal CTA is recommended for the rest of the patient’s life. Long-term follow-up is challenging, and noncompliance with imaging reaches close to 60% approximately 3 to 4 years after EVAR. Lifetime surveillance of these patients is important given the potential for late complications, which may not present until they become life threatening.

Patients who receive EVAR are subjected to a greater lifetime burden of ionizing radiation than their counterparts who underwent OAR; however, studies have failed to demonstrate a statistically significant increase in malignancy rates among EVAR populations.

The recommended follow-up after OAR is much less intensive compared with EVAR. Patients should receive a dedicated abdominal aortic ultrasonogram with color Doppler of their aneurysm sac every few years to monitor for endoleaks and para-anastomotic aneurysms. They do not require annual CTA.

CONCLUSION

Our case highlights the importance of appropriate screening for AAA, referral to vascular surgery, and possible lifesaving interventions. Unfortunately, in the case reported here, the patient’s AAA remained undiagnosed until he presented to the Emergency Department with a rupture of his AAA. A screening ultrasonogram would likely have identified his AAA before rupture and allowed him to be evaluated for EVAR or OAR. This case emphasizes the potential role for screening programs, such as registries or notifications in the electronic medical record. Barriers to screening are many, including limited time in each clinic visit and patient ambivalence to screening. We suggest dedicated clinic visits to address preventive care recommendations, which would allow adequate discussion surrounding the patient’s goals and preferences.

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

Table 2. Classification of endoleaks, timing of presentation relative to primary intervention, and next steps in management

<table>
<thead>
<tr>
<th>Type of endoleak</th>
<th>Cause</th>
<th>Timing</th>
<th>Increased risk of rupture</th>
<th>Next steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A/1B</td>
<td>Poor aorta-graft seal</td>
<td>Perioperative or late complication</td>
<td>Yes</td>
<td>Immediate intervention</td>
</tr>
<tr>
<td>2</td>
<td>Patent lumbar arteries or IMA</td>
<td>Late complication</td>
<td>Maybe</td>
<td>Monitor with serial imaging (CTA/ultrasonography)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intervention if aneurysm expansion</td>
</tr>
<tr>
<td>3</td>
<td>Poor seal or separation between graft parts</td>
<td>Late complication</td>
<td>Yes</td>
<td>Immediate intervention</td>
</tr>
<tr>
<td>4</td>
<td>Porous graft</td>
<td>Perioperative complication</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Late complication</td>
<td>Yes</td>
<td>Intervention needed</td>
</tr>
<tr>
<td>5 (endotension)</td>
<td>Expansion of the aneurysm sac for unknown reason</td>
<td>Late complication</td>
<td>Maybe</td>
<td>Intervention needed</td>
</tr>
</tbody>
</table>

CTA = computed tomography angiography; IMA = inferior mesenteric artery.
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How to Cite this Article

References