Treatment of Ruptured Abdominal Aortic Aneurysm

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Chief Complaint: Mr. X is a 68-year-old Caucasian male who presents to your local Emergency Department with complaints of left mid back and flank pain that came on gradually over the past 12 hours. He states that it feels kind of like a kidney stone that he had about 10 years ago. He states he feels a bit fatigued today. He denies seeing any blood in his urine at this point. He denies any recent heavy activity or injuries. He denies any recent history of angina, palpitations, nausea/vomiting, abdominal pain, weight loss, fevers, chills, or diaphoresis.
History

• Past Medical History: Is positive for hypertension, hyperlipidemia, CAD, and kidney stones. He denies any known history of CHF, MI, Cancer, COPD, or spinal/disc problems.

• Past Surgical History: Is positive for lipoma resection from the left neck 18 years ago, bare metal stent to left circumflex 15 years ago, right knee surgery 14 years ago, and Right carotid endarterectomy (CEA) 10 years ago.
History

• Allergies: ciprofloxacin

• Social: Married x 41 years. Lives at home and is independent. He is able to perform all of ADLs without assistance. He has never had a fall. Retired architect, and spends a lot of time doing wood working at home. Likes to take walks with his wife, but has been having trouble with left leg fatigue during their walks. Does not smoke or drink any longer. He quit both when he had his CEA 10 years ago. He has a 52 pack year history. He has 2 children; one lives local, the other lives in Prague, Czech Republic.
History

- Physical Exam: V/S: 118/60, P90, R: 18, afebrile, he is 5’ 11” tall and 282 lbs
- General: Elderly male with constant left flank pain, well groomed, of average to large build.
- HEENT: Mild left carotid bruit, but otherwise normal
- Chest: Diminished breath sounds bilaterally, prolonged expiratory time, and mild expiratory wheezing.
- Heart: R,R,R, -rubs or murmurs
- Abdomen: Soft, mild-tenderness around the umbilicus, +Bowel Sounds x 4, notable pulsatile mass just superior to the umbilicus, - rebound/guarding/tympany/distension, + left iliac bruit
- Extremities: Warm well perfused feet, normal pulses right lower extremity, but weak pulses in left lower extremity.
- Neuro: No deficits noted.
History

- **CXR**: Hyperinflation of the lungs with an increased anteroposterior chest diameter, flattening of the domes of the diaphragm.
- **KUB**: No hydronephrosis, no renal calculi noted. Bladder and ureters are normal. Normal loops of bowel and bowel gas.
- **ECG**: NSR
- **Labs**: CBC: wbc: 10, HCT:29%, Platelet Count: 300,000
- **BMP**: Na:141, Potassium: 4.2, CL:114, CO2:24, BUN:28, Creatinine: 1.0
- **U/A**: Color: clear, very light pink, No casts, no squamous cells, No bacteria, Microscopic hematuria present.
Question 1

The most likely diagnosis is:

A. Herniated nucleus pulposis
B. Aortic dissection
C. Kidney stone
D. Ruptured abdominal aortic aneurysm (AAA)
Answer

D. Ruptured abdominal aortic aneurysm (AAA)
Discussion

Ruptured AAA can present quite similarly to symptomatic renal calculi and aortic dissection. In this case, the patient has had a history of kidney stones and should be very high on the differential diagnosis. Microscopic hematuria was also seen. However, no evidence of stones on KUB. However, this patient is a male, > 65, and a very long history of tobacco use. He has evidence of PAD and carotid stenosis. Abdominal aortic aneurysm and aortic dissection should be at the top of the differential as well. In light of the present symptoms, ruptured aneurysm and aortic dissection should be considered until proven otherwise. Symptoms came about more gradually and the patient denies an inciting event, such as heavy lifting or any other injury, so herniated disc is less likely. The patient denies acute abdominal pain, tearing back pain, or acute limb ischemia, so aortic dissection is less likely than aortic rupture, but still high on the differential. There are essentially two types of aortic rupture: contained rupture and free rupture. Free rupture typically results in near sudden death due to the aorta rupturing into the peritoneum and majority of the blood volume spilling into abdomen within seconds. A contained rupture can progress slowly as the blood is confined to the retroperitoneal space and has the potential to tamponade while the body compensates for hours.
Question 2

Which set of risk factors is most associated with both aortic aneurysm and aortic dissection?

A. Male, > 60, non-smoker, connective tissue disorder, bicuspid aortic valve
B. Male, > 60, tobacco smoking history, hypertension
C. Female, > 60, tobacco use, no connective tissue disorder
D. Female, < 60, no tobacco use, coarctation of the aorta
Answer

B. Male, > 60, tobacco smoking history, hypertension
Discussion

Male gender, connective tissue disorder (i.e. Marfan’s or Ehlers Danlos), and bicuspid aortic valve are strong risk factors for aortic dissection.\(^1\) A female > 60 with a smoking history, but no connective tissue disorder has very little risk for AAA or dissection.\(^2,3\) A female < 60 with no history of tobacco use, but has coarctation of the aorta has a greater risk for aortic dissection. Classically, a male > 60, with any history of tobacco use, and hypertension, has a similar risk for aortic dissection or aortic aneurysm.\(^4,5\)
The recommended first line test to confirm the diagnosis of ruptured AAA or aortic dissection is:

A. CT angiogram of abdomen
B. MR angiogram of abdomen
C. Aortic Ultrasound
D. Conventional aortogram
Answer

A. CT angiogram of abdomen
Discussion

Among asymptomatic patients, ultrasound imaging detects AAA accurately and reproducibly. Ultrasound is the cheapest and quickest modality for evaluation, but can be limited by bowel gas. Ultrasound has been known to miss the presence of rupture or dissection. Conventional angiography can be used for imaging, however, in the case of possible rupture, time, convenience, and logistics can be a rate limiting step. Additionally, angiography is less accurate in identifying true aneurysm size due to mural thrombus in the aneurysm sac. Magnetic resonance imaging is sufficient to evaluate AAA, but is time consuming and can be complicated by the presence of metal in the body or concurrent pacemaker or AICD. MR (with Feraheme) can be helpful to evaluate AAA or dissection in the case of decreased creatinine clearance (i.e. stage II, IV, V chronic kidney disease). CT angiogram of the abdomen is considered the gold standard for detection of AAA rupture or aortic dissection as well as for operative planning, given the capacity to determine the extent and morphology of the aneurysm, as well as the presence of accessory or anomalous renal arteries and coexistent occlusive disease.
Question 4

CT angiogram is performed which reveals the following:

. Normal thoracoabdominal aorta in the visceral segment
. Normal renal arteries with the right renal being 3mm lower than the left
. 6.2 x 5.9 cm fusiform AAA with a 12mm neck from the lowest renal artery
. The aneurysm extends into the right common iliac artery, measuring 3.5 x 3.8 cm
. There is notation of contained aneurysm rupture into the left retroperitoneal space with a 5.2 x 4.8 x 7.2 cm retroperitoneal hematoma present.
. 30 degree angulation of the infrarenal aorta.
. Proximal, normal infrarenal aorta measures 30mm in diameter
. Left iliac artery native diameter = 10mm, but has moderate length 70% stenosis
. Hypogastric (internal iliac) arteries are patent bilaterally, but with atherosclerosis present.
. Common femoral arteries are ~8mm in diameter with only mild, non flow limiting atherosclerosis
Question 4
Question 4

This is most consistent or confirms the diagnosis of:

A. Asymptomatic AAA
B. Symptomatic AAA with free rupture
C. Acute dissection of the infrarenal aorta
D. Symptomatic AAA with contained rupture
Answer

D. Symptomatic AAA with contained rupture
Discussion

An aneurysm associated with pain or rupture is considered symptomatic.\textsuperscript{11} The patient has presented with pain and the CT scan notes extravasation of blood from the aorta. There is no indication of free blood in the peritoneum, but there is blood accumulating in the retroperitoneal space. \textasciitilde80\% of contained ruptures take preference to the left retroperitoneal space. There is no notation of a dissection flap or true/false lumen on the CT, negating a diagnosis of dissection.
Question 5

The next recommended step would be:

A. Aggressive fluid management to prevent circulatory collapse and hypotension

B. Admission to Vascular Surgery for observation to evaluate for stability and improvement of symptoms.

C. Expeditious transfer to the OR for emergent vascular surgery

D. Stat pulmonary function tests to see how his function might impact a surgical intervention.
C. Expeditious transfer to the OR for emergent vascular surgery
Discussion

The situation or the patient can decompensate rapidly, and with the significant blood loss to date, seemingly normal blood pressure (but likely hypotensive, given his history of hypertension and elevated heart rate), and potential for continued blood loss, an initial reaction may be to fluid resuscitate so as to avoid getting behind. However, a principle of “hypotensive hemostasis” should be considered and implemented in this setting to avoid increasing systemic pressure, and thus promoting hemorrhage. This protocol should be followed as long as the patient remains conscious, and systolic pressure exceeds 50 mmHg. Observation of symptomatic, but unruptured AAA has been studied with uncertain results, but observation of ruptured aortic aneurysm is not considered safe or appropriate. Thorough pre-operative testing is usually customary prior to any surgery and particularly for elective cardiovascular operations; however, in the case of active aortic rupture surgery must be performed expeditiously. The patient’s medical history, including CAD and COPD should be taken into account by the surgery team and anesthesia, but typically there is not time for delay in order to obtain further pre-operative testing.
Question 6

Which operation should this patient have?

A. Open surgical aneurysm repair with bifurcated Dacron graft (OSR)
B. Endovascular aneurysm repair (EVAR)
C. Either operation is acceptable
C. Either operation is acceptable
Discussion

There is increasing data to support EVAR for the management of stable and unstable ruptured AAA. In experienced hands within a tertiary medical center, vascular control can be achieved quickly with clamp or balloon. Recent studies analyzing national trends in the United States have observed that EVAR is being used with increasing frequency in the emergency management of ruptured AAA, with decreasing mortality.\textsuperscript{14,15} Non-teaching and low volume centers report less promising data to support EVAR.\textsuperscript{16} In this case, the patient is stable at present time and his anatomy favorable for both EVAR and OSR.
You have decided to proceed with EVAR. Based on the CT scan, all will be technical considerations for EVAR planning, except which?

A. Aneurysm size  
B. Neck length  
C. Neck diameter  
D. Lowest renal to hypogastric length
A. Aneurysm size
Aneurysm size has no bearing on EVAR repair or planning. Neck diameter is critical in deciding on the main body size and neck length has significant implications on creating an adequate proximal seal zone. Neck length requirements have relaxed over the years with improved devices designed to seal into the renal arteries or create fenestrations over renal and visceral vessels. Neck length requirements used to be ~15mm, but can now be considered 0mm with new technology. However, these newer devices are more complicated to use and can be more challenging to come by in an emergent situation. It is critical to know the flow path length from the most caudal renal artery to the iliac bifurcation on either side in order to plan for main body length as well as docking extension limbs. It is also critical to determine whether a distal seal can be achieved by landing in the common iliac artery or if the seal can only occur in the external iliac artery (effectively “jailing” the internal iliac artery). The latter will require additional planning and procedures to ensure safety and efficacy of the operation. One must consider all anatomy from the access site and device delivery zone. Diseased common femoral arteries can make for challenging or impossible access to the arterial system and disease external or common iliac arteries may require adjunctive treatment prior to large sheath and device delivery.
Question 8

What type of anesthesia will you choose to perform this operation with planned EVAR?

A. Monitored anesthesia care (MAC) and Local anesthesia
B. Low epidural with General anesthesia for back up
C. High epidural with general anesthesia for back up
D. General anesthesia
Answer

C. High epidural with general anesthesia for back up
Discussion

EVAR has been performed with MAC/local anesthesia and is happening with greater frequency. There is more evidence to support the safety and efficacy of this technique in elective cases.\textsuperscript{18} Low epidural is also extremely effective in elective cases, but does not provide adequate anesthesia in the event of conversion to open surgery. High epidural anesthesia is gaining more interest and experience and can be sufficient anesthesia in the event to conversion to open surgery. Each of the aforementioned anesthesia techniques can promote hemodynamic stability at commencement of surgery and while vascular control is rendered, however, can be more risky to ensure anesthesia control if open conversion is necessary. General anesthesia can have heavy hemodynamic implications at time of induction, particularly in patients with ruptured AAA. Induction of general anesthesia can cause vasodilation and lead to sudden hypotension.\textsuperscript{19,20} General anesthesia can contribute to increased morbidity and mortality for patients with significant pulmonary or coronary history. As in the case of our patient, he does have a history of CAD with stent as well as COPD. He is currently stable and would benefit from placement of a high epidural to facilitate hemodynamic stability. The option for general anesthesia can be used for back up if needed.
Question 9

You have gained access via open right common femoral exposure and have performed your initial aortogram. You note active extravasation into the peritoneum and the patient becomes hemodynamically unstable with a blood pressure of 62/40 via intra-arterial pressure monitor and tachycardic to the 120s. You also note the right common iliac aneurysm and left common iliac stenosis of ~80%. At this point, the first most appropriate step would be to:

A. Convert to an open operation and clamp the suprarenal aorta
B. Continue your current plan and deliver the device
C. Treat the left iliac lesion prior to moving forward with device delivery
D. Place a large, occlusive Coda balloon in the suprarenal aorta
Answer

D. Place a large, occlusive Coda balloon in the suprarenal aorta
At this point, you have intravascular access to the patient. Intravascular balloon control can be achieved within 1-2 minutes to control hemorrhage while anesthesia catches up with medical, fluid, and blood resuscitation. With the added time, the device can be prepared and delivered in a controlled fashion.\textsuperscript{21,22} Conversion to an open operation at this point will take longer to expose the aorta and place a suprarenal clamp. Risk of injury is dramatically increased as well as the risk of exsanguination. If you continue with device delivery, you risk mal-deployment of the endograft leading to endoleaks, or renal coverage. You risk further hemorrhage with the added time to prepare and deliver the device as well as blood loss from any potential endoleaks. Treatment of the left iliac lesion at this time would not promote vascular control and therefore would be inappropriate. Rapid blood transfusion or fluid resuscitation would be an appropriate next step immediately following, or in parallel to intravascular balloon control of the rapid blood loss.
Question 10

You have successfully treated the ruptured AAA endovascularly with no evidence of endoleak on your completion runs and your patient has recovered without deficit. The acute pain is improving and he has been hemodynamically stable. Your patient is discharged on post operative day 2 with a small oblique incision in the right groin and percutaneous access on the left. What will your plan for follow up surveillance be?

A. CTA at 1 month and 12 months, and Ultrasound annually for life thereafter if no abnormalities

B. CTA at 1 month, 3 months, 6 months , 12 months, and annually for life thereafter

C. CTA at 1 month, 6 months, 12 months, and every other year for life

D. Ultrasound at 1 month and then annually thereafter for life.
Answer

A. CTA at 1 month and 12 months, and Ultrasound annually for life thereafter if no abnormalities
Discussion

As the current EVAR devices continue to evolve and improve, post operative surveillance recommendations continue to evolve. Early generation devices were subject to migrate distally or kink due to poor proximal fixation ability. The instance of this has decreased significantly due to improved engineering and materials. Based on the most recent data, it is recommended to have CTA at 1 months post op, and if no abnormalities, CTA at 12 months. If this study is again normal, the recommendation is to continue annual follow up surveillance with ultrasound imaging.
You see your patient back at his 1 month follow up and he is doing extremely well. No major complaints or concerns other than some mild, ongoing left flank soreness and bruising. You view his CTA and notice excellent device placement and runoff to the lower extremities bilaterally. He has no evidence of type I or type III endoleak, but you do notice a Type II endoleak on the delayed phases of the CTA. His sac size unchanged from the pre-operative size of 6.2 and there is no extravasation into the retroperitoneum. How do you manage this?

A. Immediately send the patient for conventional arteriogram for treatment of the endoleak

B. Recommend re-operation and attempt to stop the leak with additional stent-graft placement or cuff

C. Continue to observe and see the patient back in 6 months with another CTA to evaluate for resolution of the leak or change in sac size

D. Continue to observe and see the patient back in 12 months with another CTA to evaluate for resolution of the leak or change in sac size
C. Continue to observe and see the patient back in 6 months with another CTA to evaluate for resolution of the leak or change in sac size
Discussion

Type II endoleaks are the most common type of endoleaks and typically is perpetuated by at least 2 patent vessels (one for inflow and the other for outflow). In most cases Type II endoleaks arise from a patent inferior mesenteric artery and patent lumbar artery. Delayed rupture from persistent Type II endoleak has been reported, however, most cases can be observed safely until resolution of the endoleak, or an increase in sac size is noted. If the endoleak resolves, you can continue with the original follow up surveillance pattern of ultrasound imaging annually after a normal 12 month CT scan. However, treatment of the endoleak is imperative if an increase in sac size is observed. Type II endoleaks can be treated endovascularly by coil, particle, or glue embolization. This is often achieved by trans-arterial, retrograde catheterization and required advanced endovascular skills and equipment.¹¹
References


References


References


References


