Abdominal Vascular Emergencies

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Abdominal Vascular Emergencies

- Abdominal Aortic Aneurysms
- Abdominal Aortic Dissection
- Mesenteric Ischemia
Objectives

• Review the clinical presentations
• List common misdiagnoses in patients with ruptured aortic aneurysms, dissections, and mesenteric ischemia
• Discuss imaging modalities
• Management strategy for treating these vascular emergencies
What Is an Aneurysm?

- Abdominal aneurysms are true aneurysms - intima, media, adventitia
- Primarily in the infrarenal area
- Usually regarded as aortic diameter of greater than 3 cm diameter
- AAA vs Aortic dissection
Abdominal Aortic Aneurysms

• Incidence
  – 1.5 million people have abdominal aortic aneurysm in the United States
  – 190,000 cases are diagnosed each year
  – 1-2% of all death in men over 65
  – Annual mortality rate from rupture is 15,000 patients—13th leading cause of death in the United States
Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>70.4 years</td>
</tr>
<tr>
<td>Sex</td>
<td>70% male</td>
</tr>
<tr>
<td>Smokers</td>
<td>68%</td>
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<tr>
<td>Hypertension</td>
<td>68%</td>
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<tr>
<td>Diabetes</td>
<td>2%</td>
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</tbody>
</table>

Diagnosed by exam 52%
Incidental findings on CT or US 48%

Smoking

- Smoking was identified as a risk factor for rupture in a study of British men, where the RR of rupture:
  - Increased 4.6x’s for cigarette smokers
  - 2.4x’s for cigar smokers
  - 14.6x’s for smokers of hand-rolled cigarettes

- Single non-invasive prevention of growth and rupture was to stop smoking.

Natural History/Prognosis

- Risk of rupture increases as diameter enlarges
- Estimated annual rupture risk:
  - < 4 cm = 0%
  - 4-5 cm = .5-5%
  - 5-6 cm = 3-15%
  - 6-7 cm = 10-20%
  - 7-8 cm = 20-40%
  - >8 = 30-50%
- Overall only 15% aneurysms ever rupture

Brewster, J Vasc Surg 2003, Guidelines for the tx of AAA
Clinical Anatomy

- Aorta is retroperitoneal, immediately anterior to the lumbar spine
- 5 main vascular branches before bifurcation
- 90% of AAA arise inferior to the renal arteries and extend to involve the iliac arteries.
Classic Presentation

- Triad - Abdominal pain or flank pain, shock and pulsatile abd mass *only* present in 24-42%.
- AAA rupture difficult to recognize
Classic Presentation

- Brief episode of hypotension common (>50-90%) but often attributed to vasovagal or unrecognized
- AAA is much less common than other diseases that can mimic it.
Common Misdiagnosis

- Back pain and hematuria (stone/DJD)
- Renal colic most frequent mis-diagnosis
- Compression by expanding aneurysm or hematoma
Common Misdiagnosis

- LLQ pain and guaiac positive stools (diverticulitis)
- Abdominal pain and a mass, esp in the LLQ (non-specific abdominal pain/constipation)
- Shock (presumed sepsis)
- AMI (primarily cardiac)
A review of 152 cases of ruptured AAAs found:

- 30% were initially mis-diagnosed or > 6 hour delay to dx
- Average time to diagnosis was 15 hours
- Patients with delays had a mortality of 45%
- The single most common mis-diagnosis was renal colic

Marston, J Vasc Surg 1992
## Signs & Symptoms

### Most Common Physical Findings

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<th>Condition</th>
<th>Percentage</th>
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</thead>
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<tr>
<td>Abdominal Pain</td>
<td>70%</td>
</tr>
<tr>
<td>Shock/hypotension</td>
<td>57%</td>
</tr>
<tr>
<td>Back pain</td>
<td>50%</td>
</tr>
</tbody>
</table>

Marston, J Vasc Surg 1992
Most Common Misdiagnosis

- Renal colic
- Diverticulitis
- “Low Back Pain”
- GI Bleed
- Bowel perforation
- Bowel obstruction
- Gastroenteritis
- Acute MI
- MVAs (hypotensive event while driving a car)
- Sepsis
Physical Exam

How good is the physical exam for AAA?

243 patients undergoing elective infrarenal AAA repair during a 10 yr periods were analyzed retrospectively.

- Only 38% dxed by PE, 62% found incidentally
- Pre-Op exam: only 77% AAA were palpable on preop PE, even when the diagnosis was known.
- Obese patients had only 15% of AAA detected on PE

Chervu, Surgery 1995
Imaging Findings

• Plain films
  – abnormal abdominal radiographs (~90%)
  – calcified aortic wall 55-68%
  – loss of renal shadow 78%
  – soft tissue mass 67%
  – renal displacement 25%
  – properitoneal flank stripe change 19%

• All non-specific for AAA except for aortic calcification. Not be used to exclude the presence of AAA.
Which test do I order first?

- Whichever test can be obtained fastest (CT or US)
- Stability of the patient
- Time delay in performing the test
- Disposition options available
  - Transfer if limited surgical back up
Ultrasound

- 100% sensitive
- Non-invasive, relatively inexpensive
- Excellent for the unstable patient to detect an aneurysm
- Limited by obesity, intestinal gas, adjacent lymph nodes
- Not helpful for assessment of renal artery involvement
CT

• Best study for stable AAA, can measure both size and extent of aneurysm
• Evaluates aortic lumen size, mural thrombus hematoma (from rupture), dissection, and retroperitoneal structures
• Newer spiral CT’s provide rapid 3-dimensional reconstruction of organs and vessels.
MRI

- Not practical for acute diagnosis
- Useful for elective evaluations, esp when you don’t want contrast
- MR angiography can quantify blood flow similar to angiograms
Angiography

- Should not be used by us
- Debated among surgeons on necessity
- Helical CTA’s can provide all the imaging for elective repair
Treatment

- **Surgery - Mortality**
  - 35-80% with rupture
  - 2-6% with elective repair

  Circulation 2003 O’Gara

- **Stent Grafting**
  - Less invasive
  - Good results
Long-Term Outcome of Open or Endovascular Repair of Abdominal Aortic Aneurysm

– Six years after randomization, 351 pts endovascular and open repair of AAA resulted in similar rates of survival (69.9 vs 68.9)

– Rate of secondary interventions was significantly higher for endovascular repair

Trivia

• Medical history: AAA caused the death of Albert Einstein, Charles de Gaulle, Lucille Ball, George C. Scott
• Survived: Joe DiMaggio, Bob Uecker, Former Senator Bob Dole
Trivia

• Medical history: AAA caused the death of Albert Einstein, Charles de Gaulle, Lucille Ball, George C. Scott

• Survived: Joe DiMaggio, Bob Uecker, Former Senator Bob Dole, Rodney Dangerfield
Indication for operation

- Rupture
- Symptomatic aneurysm
- Rapid expansion
- Asymptomatic > 6 cm - exact lower limit controversial (Women at higher risk of rupture)
DOES SIZE MATTER?

The UK Small Aneurysm Trial Participants study:
1090 pts aged 60-76 yrs with 4.0-5.5 cm elective Aneurysm repair. No improvement in long term survival.

US VA study (ADAM Trial):
Similar findings in 1136 patients, no improvement in survival by elective repair of AAA smaller than 5.5 cm, even when operative mortality is low.

Lancet 1998;352
Lederle in N Engl J Med 2002;349
• Sequel to their initial report, the UK Small Aneurysm Trial Participants, described their extended 10-year follow-up.

• Death of ruptured AAA - 5% in men and 14% in women. Risk of rupture was 4X’s higher.

• Concluded that threshold 5.5 cm diameter may be too high for women.

N Eng J Med 2002
Review of ruptured AAA from Finland, 24% of women with rupture had AAA < 5.5 cm. Results confirm previous observations and suggest that a 5 cm diameter in women is equivalent risk to 6 cm in a man.

Heikkinen, J Vasc Surg 2002
Screening

• Who should be screened?
• Patients over 65 years - especially hypertensive smokers
• Single US at 65 years reduces death from ruptured AAA by 70% in screened population
• Patients with small aneurysms should undergo regular surveillance
• Repeated ultrasound every 6 months
What’s New? Pharmacotherapy

- Aneurysm formation-loss of elastin
  - Inflammatory infiltrate
  - Excessive proteolysis
- Inflammation
  - NSAIDS
  - Antichlamydial macrolide
- MMPs (matrix metalloproteases)
  - Doxycycline is a broadspectrum MMP inhibitor; reduce MMP levels and reduced aneurysm expansion rates - small trials.
  - HMG-CoA reductase inhibitors (statins): reduce both cytokine and MMP’s
Pearls and Pitfalls

• Don’t count on PMH of AAA to suspect one
• Most patients present with rupture as the first sign of AAA
• Most ruptures are retroperitoneal
• US or CT are excellent tests
• When you dx back pain, renal colic, or diverticulitis…think AAA.
Aortic Dissections
Aortic Dissections

- 5-30 cases per million people/yr
- Most patients die before presentation
- 3:1 male to female
- Over the age of 40
• **DeBakey Type I**
  – Involves entire aorta

• **DeBakey Type II**
  – Least common
    • Ascending aorta only

• **DeBakey Type III**
  – Most common
    • Descending aorta only

• **Stanford Type A**
  – Ascending Aorta
    • Over half develop aortic regurgitation

• **Stanford Type B**
  – Descending Aorta
Predisposing factors

Hypertension
Atherosclerosis
Aortic Diseases
  Aortic stenosis
  Coarctation
  Bicuspid aortic valve
Connective Tissue Disorders
Trauma (indirect - sudden deceleration)
Cocaine
Pregnancy
Natural history

• Mortality rate for untreated proximal (Type A) aortic dissections
  – 1-3% per hour after presentation
  – 25% during the first 24 hr
  – 70% first week

1 Meszaros Chest 2000
2 Anagnostopoulos Am J Cardiol 1972
Clinical Type A

- Acute aortic insufficiency
- Acute MI
- Hemothorax
- SBP >20 mmHg in both arms
- Neurologic deficits
- Horner syndrome
- Vocal Cord paralysis and hoarseness
Clinical Type B

In a review of 384 type B dissections from the IRAD registry, the following clinical manifestations on presentation:

- Chest or back pain — 86%
- Abrupt onset of pain — 89%
- Migrating pain — 25%
- Hypertension — 69%
- Hypotension/shock — 3%
- Pulse deficit — 21%
- Spinal cord ischemia — 3%
- Ischemic peripheral neuropathy — 2%

Circulation 2003;108 Suppl 1
Diagnosis

• Clinical suspicion
• Differentiate between proximal and distal dissection (Stanford Type A or B)
• Imaging studies
Imaging Findings

Chest films (suggestive not dx)

- Mediastinal widening
- Left paraspinal stripe
- Displacement of intimal calcifications
- Apical pleural cap
- Left pleural effusion
- Displacement of endotracheal tube or nasogastric tube

PITFALLS:

“tortuous aorta”, “enlarged hilum” and “possible infiltrate right heart border”
CT

- Most common initial test in IRAAD
- Helical CT much better, least operator-dependent imaging modality
- Intimal flap
- Displacement of intimal calcification
- Differential contrast enhancement of true versus false lumen

CT of abdominal aorta show intimal flap (dark line) with true lumen anteriorly and false lumen posteriorly
MRI

- Extent of dissection
- Site of the entry tear
- Identify arch vessels involved
- Assess the renal artery involvement
- Intimal flap
- Slow flow or clot in false lumen
Diagnosis

- Contrast-enhanced CT can image arch and descending aorta - best study
- MRI if available, good if you don’t want contrast
- Transesophageal ultrasound, if available, especially for root and ascending aorta
Diagnosis
What’s New?

• Serum biochemical markers of aortic dissection
• Serum smooth muscle myosin heavy chain
  – Significantly elevated within the 1st 6 hours after onset of dissection
  – 30 mins to run assay
• D-dimers
  – Highly elevated in both acute PE and dissection
• sELAF (soluble elastin fragments)
  – 3 hrs to run assay
Treatment

• IV antihypertensive tx on all suspected acute dissections
• Reduce force of the left ventricular contractions
  – Reduce the systemic arterial pressure to as low a level possible without compromising perfusion to vital organs.
Treatment

- **Morphine**
- **β-blocker** and **nitroprusside** therapy
- **Propanolol, Labetalol, or esmolol**
  - $\alpha$-adrenergic and $\beta$-adrenergic antagonist
  - Short half-life and ability to titrate to effect
- Avoid direct vasodilators, such as **hydralazine**, increase aortic wall shear stress and irreversible control
Treatment

- Uncomplicated distal (Type B) aortic dissection has a survival rate 75% whether treated medically or surgically.
- Goals are to stabilize the dissection, prevent rupture, accelerate healing, and reduce the risk of complications.
Surgery

• Indications for performing surgery in distal (Type B) dissections are:
  – Rapid expansion of dissecting aneurysm
  – Blood leakage
  – Impending rupture
  – Persistent and uncontrollable pain
  – Impairment of blood flow to an organ or limb
Pearls and Pitfalls

• Aortic dissection does not always present with classical sx of CP radiating to the back.
• Aortic dissection can present primarily with neuro, abd, or back complaints.
• Genetic and hereditary disease, Marfan’s and familial aortic disease
  – dissect much earlier age
  – typically require surgical interventions
• CT is best test in the ED
CASE

64 year old man cc severe lower abdominal pain with abd distention, loss of appetite, and no bm x 3 days. Pain 10/10 day of ED visit. Denies F/C/N/V.

PMH: Chronic atrial fibrillation/anticoagulation.
CVA (no residual deficits)

PE: Mod distress, BP 144/109, HR 92, RR 28, 96% O2 sat
Abd exam: diffuse TTP, worse in lower abd, moderate distention. Heme + br stool

Labs: WBC 16.4, ABG 7.4/33/67, INR 5.8, lytes WNL
Case

Abdominal CT scan: “Mild distention of colon, large amount of stool in the rectosigmoid, consistent with pseudo-obstruction due to fecal impaction. No evidence of intraperitoneal inflammatory process.”
Next 5 hours, patient complained of worsening abd pain.

**Repeat ABG:** 7.15/28/96

**Repeat abd CT:** “Since study of 5 hrs prior, interval increase in colonic and distal small bowel distention with focal transition point at the level of distal sigmoid, concerning for high grade large bowel obstruction.”

**Pre Op Dx:** Sigmoid volvulus

**Post Op Dx:** Mesenteric Ischemia, prob secondary to embolus
Acute Mesenteric Ischemia

“Occlusion of the mesenteric vessels is apt to be regarded as one of those conditions of which the diagnosis is impossible, the prognosis hopeless, and the treatment almost useless” (Cokkinis, 1926)
Acute Mesenteric Ischemia

• **Acute** interruption of blood flow to small intestine
  – **Embolic**
    • Superior mesenteric artery embolus (SMAE)
  – **Thrombotic**
    • Superior mesenteric artery thrombosis (SMAT)
  – **Venous**
  – **Chronic** (thrombotic)
  – **Nonocclusive** mesenteric ischemia (NOMI)
Anatomy

- **SMA “Embolic”**
  - Takeoff at 45° with aorta and direct route for an embolus traveling down aorta
  - 1/3 of pts with SMA embolus have a hx of previous embolic event
  - Underlying cardiac disease
    - A. fib, other arrhythmias, valvular disease or MI with ventricular thrombus
Anatomy

- **SMA “Thrombotic”**
  - 80% chronic MI
  - Rupture of an unstable plaque, usu at origin of SMA - acute event

- **Venous thrombosis**
  - Uncommon
  - Predominantly underlying hypercoagulable state
  - 1/2 family hx of DVT or PE
  - Other: malignancy, pregnancy, sepsis, and liver disease with portal hypertension
Chronic Mesenteric Ischemia

- "Intestinal angina"
  - Abd pain 1 hour post eating
  - "food fear" and "small meal syndrome" to avoid pain
  - Severe weight loss

- Predispositions
  - Tobacco (70-96%), atherosclerosis, diabetes, and HTN
Nonocclusive mesenteric ischemia (NOMI)

- Low flow states
  - CHF, sepsis
  - Volume depletion (hemodialysis pts)
- Medications
  - Digitalis, ergot derivatives, vasopressors, cocaine
- 1/4 no abdominal pain
  - Unexplained Abd distention or GIB
- Mortality NOMI - extremely high
  - Reflects underlying poor health
Clinical signs and symptoms

- Severe abdominal pain out of proportion to physical exam
- Pain initially of a visceral nature and poorly localized
- Nausea
- Vomiting
- Diarrhea
- GI bleeding may be present
Mesenteric Ischemia
Laboratory Findings

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Elevated WBC (mean of 18.7)</td>
<td>93%</td>
</tr>
<tr>
<td>WBC &gt; 15K</td>
<td>90%</td>
</tr>
<tr>
<td>Metabolic acidosis</td>
<td>50%</td>
</tr>
<tr>
<td>Elevated Lactate (mean of 4.2 mmol/L)</td>
<td>93-100%</td>
</tr>
</tbody>
</table>

No specific marker for AMI
D-dimers elevated in small study

Ritz 2005; Martinez 2005; Lange 1994
Procalcitonin for Bowel Ischemia

• Prospective: 100 patients with small or large bowel obstruction who went to the OR
• Levels greater in ischemia vs. non-ischemic patients
  – < .25 ng/mL
    • NPV 83% and 95% for ischemia, necrosis
  – > 1 ng/mL
    • PPV 95% and 90%

Markogiannakis, Surgery 2011
Imaging

• Plain abdominal radiographs (abnormal in 20-60% of cases)
• CT Scan
  – Thumbprinting
    • Non-specific finding indicating intestinal wall edema with hemorrhage in the setting of acute mesenteric ischemia
  – Pneumatosis
  – Portal venous gas
  – Pneumoperitoneum
• All are indicative of infarcted bowel
CT

- Bowel wall thickening from edema or hemorrhage
- Lack of enhancement indicates infarction

Absence of contrast in superior mesenteric artery due to thrombosis of this vessel (blue arrow)
CT

- Pneumatosis, portal venous gas, pneumoperitoneum
- Intraluminal thrombus in involved vessel
- Mesenteric edema
CT Scan

- Helical (multi-detector) CTA as good as mesenteric angiograms
- Inform radiology tech what you are looking for
- Interventional radiologist vs surgeon
- Thrombectomy, embolectomy, bowel resection, etc
Treatment

• Volume resuscitation
• Antibiotics (bacterial translocation)
• Avoid vasoconstrictors/vasopressors
  – Avoid pure alpha agonists
  – Use dopamine and epinephrine
• IR
  – Vasodilator/stent therapy
  – Thrombectomy/Embolectomy
• Surgery
  – Arterial bypass
  – Resection of necrotic bowel
Complications

• Sepsis/septic shock
• Multiple system organ failure
• Death
Mortality

- 70-90% overall
- From arterial embolism: 60-80%
- From arterial thrombosis: 70-100%
- From nonocclusive mesenteric ischemia: 40%
- From mesenteric venous thrombosis: 25-30%
Pearls and Pitfalls

- High clinical suspicion based on patient profile and presentation
- Labs and routine imaging not helpful (except multi-detector CTA)
- Abnormal exam, labs, and x-rays often do not occur until ischemia progresses to infarction
- Elderly patients with abdominal pain disproportionate to physical exam
- Follow your gut instinct
Questions ?