Evaluation of the Aorta and Iliac Arteries

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Indications

• Palpable or pulsatile abdominal mass
• Unexplained lower back pain, flank pain, or abdominal pain
• Follow-up of a known AAA
• Follow-up of patients after endovascular repair

Aorto-Iliac Duplex Ultrasound

Indications

AAA
- Known peripheral aneurysm
- Evidence of distal emboli
- Back pain

Occlusive Disease
- Leg pain with walking / exercise
- Leg pain at rest
- Abdominal / groin bruit

Surveillance
Known obstructive disease
Known AAA or iliac aneurysms
Prior intervention (endografts / iliac stents)

Screening (AAA)
Dissection
Aortic coarctation

Aortic coarctation

Other, less common pathology

What is an Abdominal Aortic Aneurysm?

A focal dilatation with at least a 50% increase over normal arterial diameter

or

An aorta has a diameter of > 3cm

Clinical S/Sx – Intact AAA

• Rare to have more than minimal symptoms
• Painless throbbing mass – may be only finding on PE
• May produce back pain secondary to compression of nerves or erosion of vertebral bodies
There are no absolute contraindications to ultrasound of the aorta. If aortic rupture or dissection is clinically suspected, ultrasound is “usually” not the examination of choice.

History

• Most AAAs are asymptomatic and are detected during physical exam or evaluation for other disease processes
• Sometimes suspected only after they have ruptured
  – Acute onset pain (back, flank, abdominal, groin)
  – Known AAA or pulsatile abdominal mass
  – Hypotension or syncope

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Ruptured AAA

The Least Known Cause of Death

14th most common COD in men in U.S.
9-15K rAAA deaths / yr documented

Of 450,000 sudden deaths outside hospital, rAAA must be a proportion
70% ruptured AAA deaths occur at home
Actual rAAA may be as many as 30,000

How Are AAAs Detected?

• 243 patients underwent elective AAA repair
• AAA detected by:
  – Physical examination: 38%
  – Incidental abdominal imaging: 62%
• Of those detected by imaging, 23% were not detectable on physical exam even though the diagnosis was known
• In obese patients, 2/3 were not detectable

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Physical Examination

• Success depends on patient’s body habitus & experience of the examiner
  – Difficult in the obese patient
• Can be detected in the lean patient but will be overestimated
• Pulsatile abdominal mass above the umbilicus to the left of the midline

Physical Examination

Screening Evaluation for an Abdominal Aortic Aneurysm

1. Men 65 years or older.
2. Women 65 years or older with cardiovascular risk factors.
3. Patients 50 years or older with a family history of aortic and/or peripheral vascular aneurysmal disease.
4. Patients with a personal history of peripheral vascular aneurysmal disease.

Aortic Examination

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**Risk Factors**

- Age > 50 with peak incidence at 70
- Gender
  - male:female 5:1
  - when age >80 1:1
- Ethnicity
  - male Caucasian:African-American 3:1
  - female 1:1
- Smoking
- Popliteal Aneurysm – 50% have AAA
- Genetics
  - 15–25% incidence in 1° relative

**Aorto-Iliac Duplex Ultrasound**

**Patient assessment – History**

- Review of vascular risk factors and signs / symptoms of aorto-iliac disease
- Prior vascular history
- Prior surgeries
- Current medical status
- Current medications or therapies

**Aorto-Iliac Duplex Ultrasound**

- Examination guidelines – General
  - Select appropriate imaging and Doppler transmit frequencies to allow adequate penetration

  Note: Use the highest frequency possible to maximize image resolution and Doppler signal quality

**Aorto-Iliac Duplex Ultrasound**

- Limitations
  - Patient body habitus
  - Bowel gas
  - Doppler angle
  - Patient cooperation

**Aorto-Iliac Duplex Ultrasound**

- Patient preparation
  - Morning examinations
  - NPO after midnight
  - No smoking, candy or gum chewing the morning of the examination

**Technical Protocol**

The examination includes the following when feasible:

<table>
<thead>
<tr>
<th>Transverse images:</th>
<th>Longitudinal images w/ (AP) measurements:</th>
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<tbody>
<tr>
<td>i. Proximal (near diaphragm)</td>
<td>i. Proximal</td>
</tr>
<tr>
<td>ii. Mid</td>
<td>ii. Mid</td>
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<tr>
<td>iii. Distal</td>
<td>iii. Distal</td>
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</table>
Aorto-Iliac Duplex Ultrasound

Examination technique
- Obstructive disease
- AAA
- Endovascular stent graft

Approach will vary
- Protocols should be specific to each
- Information needed will vary

Aorto-Iliac Duplex Ultrasound

Examination technique – General
- Pick the right preset
- Don’t struggle and get frustrated
- Know your equipment and optimize your settings:
  - B-mode gain, color gain, color PRF, Doppler sample volume and gain, focal zones, filters, packet size, persistence, line density
- Don’t hesitate to move the patient around

Aorto-Iliac Duplex Ultrasound

Patient positioning
- Patient supine
- Head slightly elevated for comfort

Lateral decubitus positions may be necessary to provide adequate acoustic windows in many cases, particularly in patients with large abdominal girth

Evaluation of the Abdominal Aorta

Protocol
- Evaluate the proximal, mid, and distal aorta
  - Long and transverse
- Measurements are taken at the greatest diameter of the aorta
- Location of the aneurysm should be documented
  - The relationship of the dilated segment to the renal arteries and to the aortic bifurcation
  - A measurement of the length of the aneurysm is not necessary

Imaging Studies to Detect AAAs

- Ultrasound
  - Least expensive, least invasive
  - Interobserver variability < 5 mm in 84%
  - View may be obscured by gas, obesity
- CT
  - More expensive, radiation, IV contrast
  - Interobserver variability < 5 mm in 91%
  - More precise delineation of anatomy

Jaakola et al, Eur J Vasc Endovas Surg, 1996

Technical Protocol

- Evaluate the common iliac arteries
  - Transverse image of proximal common iliac arteries at the bifurcation
  - Longitudinal images with AP measurements at the bifurcation
- Color Doppler imaging and/or spectral Doppler imaging
- Document mural thrombus, if present
**Technical Protocol**

- All measurements are made from outer wall to outer wall perpendicular to the long axis of the aorta.
  - The transverse diameter should also be measured when the margins of the aneurysm are clearly seen.
- The relationship of the dilated segment to the renal arteries also should be determined if possible.

**Evaluation of the Abdominal Aorta**

- Diameter normally tapers distally
- Infra-renal diameter averages
  - 2.0 – 2.3 cm in men
  - 1.5 - 2.0 cm in women
- Ectatic: diameter between 2 and 3 cm
- >3 cm considered aneurysmal

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**Evaluation of the Abdominal Aorta**

- Aorta
  - -> 3 to 4.9 cm gets US follow-up
  - -> 5 cm, intervention indicated
- Common iliac > 3 cm, intervention indicated
- Transverse, sagittal and coronal planes
- Measure from outer to outer wall
  - Orthogonal

**Evaluation of the Abdominal Aorta**

- Most AAAs are infrarenal (90%)
  - Most asymptomatic
  - Most in men (70-90%)
- Aorta
  - -> 3 to 4.9 cm gets US follow-up
  - -> 5 cm intervention indicated
- Risk of rupture increases with increasing size

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**Interpretation Of The Screening Examination**

Should Include At Least 3 Categories

1. **Positive** - Infrarenal AAA > or equal to 3 cm in diameter or > or equal to 1.5 times the diameter of the more proximal aorta.
   - The latter definition is particularly important in women.
2. **Negative** - No infrarenal AAA.
3. **Indeterminate** – Aorta size not defined because of non-visualization or only partial visualization of the infrarenal abdominal aorta.

**Evaluation of the Abdominal Aorta**

- Fusiform or Saccular in shape
Evaluation of the Abdominal Aorta

Normal Aorta

Ectatic Aorta

Evaluation of the Abdominal Aorta

Fusiform aneurysm

Iliac Diameter Measurements

• Common Iliac
  – 15mm in men
  – 13 mm in women

Techniques For Iliac Mapping

Aorta and Iliac arteries

NPO and a low frequency transducer (2.0-3.5 MHz) for the proximal segment of examination

Aortic bifurcation is best seen with the patient turned to the left side with the transducer just in front of right iliac crest

Turn the patient into a lateral decubitus position (side being evaluated up)

or... start at the groin level and follow the arteries proximally

Aorto-Iliac Duplex Ultrasound

Examination technique –

“Breath holding (not a deep breath)

“You only get “A Few Good Breaths”

“Acquire what you can when you can
Triphasic waveform in the CFA excludes significant aortoiliac disease with NPV >95%

**Iliac Imaging**

Inconclusive Duplex Scanning

- Obesity
- Bowel gas
- Calcification
- Tortuosity
- Depth
- Low flow with multilevel significant disease

In expert hands the above causes pose a problem in about 5-10% of the patients
Endovascular surgery defined as treatment of disease from within the vessel from a remote site.

Endografting in the form of AAA repair currently on the cutting edge of this technology.

Most complex of all the endovascular repairs.

Minimally invasive, small bil groin cutdown.

Faster recovery time to ambulation; shorter hospital stays.

Endoleak Classification

- **Definition**: persistent flow in the aneurysm sac after graft implantation.
- **Persistent risk of growth & rupture**.

Type V - Endotension


Endograft Scanning

**Objective**

Endoleak → Source

- Max aneurysm diameter
- Inflow vessels
- Outflow vessels
- Graft flow

**Inflow** → **Outflow**

**Proximal Type I Endoleak**