2D and 3D Abdominal Vascular Anatomy and Pathology

Dominik Fleischmann
Department of Radiology
Stanford University

Principles of CT – Angiography
(Cardiovascular MDCT)

- fast, high resolution, volumetric CT Acquisition (+ EKG gating)
- strong arterial Contrast medium enhancement
- Post-processing 2D, 3D, (4D)

Abdominal CT – Angiography
Indication

Abdominal aorta
- AAA: pre OP / pre Stentgraft evaluation
- Stent-graft f/u
- aortoiliac occlusive disease (± runoff)
- infection / inflammation

Aortic branches
- renal CTA
- mesenteric CTA (acute/chronic)
- anatomic mapping (organ donor)
- congenital (abd. coartctation)
- systemic diseases (vasculitis, ED, MF, FD)
- ....

Abdominal CT – Angiography
Imaging Strategy

<table>
<thead>
<tr>
<th>Precontrast series</th>
<th>Thick./Rec.-Int.</th>
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<tbody>
<tr>
<td>acute setting (bleeding)</td>
<td>2.5mm/2.5mm</td>
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<tr>
<td>post-stent-gr. / post-embo</td>
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<th>CTA series</th>
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<td>CTA abdomen/pelvis 'CTA non-contrast' (seriously)</td>
<td>1.25mm/0.8mm</td>
</tr>
<tr>
<td>Delayed series</td>
<td></td>
</tr>
<tr>
<td>post stent-graft delays</td>
<td>2.5mm/2.5mm</td>
</tr>
<tr>
<td>parenchymal phase</td>
<td>5 mm / 5 mm</td>
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AAA rupture
64 y/o man


Crescent Sign
**Abdominal CT - Angiography**

**Imaging Strategy**

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**CTA of the abdominal Aorta**

**Contrast Medium Injection**

**64 - channel MDCT**

- **Scantime:** 10s for ALL patients (pitch variable)
- **Inj. duration:** 18s for ALL patients
- **Delay:** ‘care-bolus’ w/ 8s delay (t$_{CMT}$+8)

<table>
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<tr>
<th>Weight (lb)</th>
<th>Flow (mL/s)</th>
<th>Volume (mL)</th>
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<tr>
<td>&lt;121 lb</td>
<td>4.0 mL/s</td>
<td>72 mL</td>
</tr>
<tr>
<td>121-145</td>
<td>4.5 mL/s</td>
<td>81 mL</td>
</tr>
<tr>
<td>146-185</td>
<td>5.0 mL/s</td>
<td>90 mL</td>
</tr>
<tr>
<td>186-209</td>
<td>5.5 mL/s</td>
<td>99 mL</td>
</tr>
<tr>
<td>&gt;210 lb</td>
<td>6.0 mL/s</td>
<td>108 mL</td>
</tr>
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</table>

+ saline flush

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**Post AAA Stent-graft Surveillance**

- CTA and radiographs* (4views) at 1, 3, 6, 12 months, and annually thereafter
  - limb occlusion
  - endoleaks (type I – IV)
  - aneurysm sac enlargement
  - endograft migration*
  - structural failure*
  - AAA rupture

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**AAA - stent-graft migration**

- 58 y.o. man
- Feb 2004
- Feb 2005

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**st. p. emergent stent-graft for acute AAA rupture**

- 68 y/o man, decreased right fem. pulse
AneuRx Stent-Graft

- Nitinol exoskeleton, woven polyester fabric
- Modular system:
  - Bifurcation module ('body' and one long and one short limb [gate])
  - Iliac module
- 1-cm stent rings (each diamond has four struts)
- Prototype (stiff)
- Commercial (flexible, segmented)

Explanted AneuRx Device

- A broken suture between stent rings
- B Fatigue fracture w/ fault lines (electron microscopy)
- C Reduced porosity material (RPM) fabric
- D Pre-RPM fabric (prototype)
Stent-graft fracture

- 89 y/o woman
- 25 months after AneuRx

- 76 y/o woman
- 15 months after Talent

Mesenteric CT - Angiography

**Indications**

- Arterial anatomy (transplantation/surgery/embolisation)
- Acute mesenteric ischemia
- Chronic mesenteric ischemia
- Aneurysms / dissections
- Before / after liver embolization

Mesenteric CT - Angiography

**Principle**

CTA combined with (upper) abdominal CT

- early arterial phase $\rightarrow t_{\text{CT}} + 2\text{s}$
  - or late arterial phases $\rightarrow t_{\text{CT}} + 10$ to $15\text{s}$
- thin collimation
- portal / parenchymal phase ($t_{\text{CT}} + 40$ to $50\text{s}$)
- medium collimation
- large contrast dose ($45\text{g J}$) / high injection rates

Up to 50% of patients have anatomic variants
Aberrant vascular supply

Celiac trunk occlusion (asymptomatic)

Mesenteric CTA Aneurysms

Superior mesenteric artery aneurysm

Mesenteric CTA Aneurysms

Splenic artery aneurysm

Mesenteric CTA Aneurysms

Hepatic artery aneurysm

Splenic artery aneurysm

pre-embolization CTA
Mesenteric CTA
Acute Intestinal Ischemia

- difficult clinical problem
- mortality high
- better prognosis if revascularization prior to infarction

Mesenteric CTA
Causes of Acute Intestinal Ischemia

- embolic occlusion of SMA (CA or IMA tolerated), mostly cardiac origin (30-50%)
- in situ SMA thrombosis (atherosclerosis) (15-30%)
- non-occlusive (vasospastic) ischemia (20-30%)
- acute mesenteric vein thrombosis (5-10%)
- spontaneous dissection (rare)

Mesenteric CTA
Acute Intestinal Ischemia

Additional CT findings
- bowel wall thickening
- intestinal pneumatosis
- portal venous gas
- mesenteric hemorrhage
- other organ infarctions

Mesenteric CTA
Acute Intestinal Ischemia

Fatal intestinal ischemia in 77 y.o. woman

Acute thrombotic SMA occlusion
Acute intestinal ischemia in aortic dissection

Mesenteric CTA
Acute Mesenteric Vein Thrombosis
55 y.o. man; after surgery for acute abdomen

Mesenteric CTA
Chronic Intestinal Ischemia
- atherosclerotic
- abdominal angina

CT findings
- high grade stenosis / occlusion of 2 of 3 main arteries
- collateral vessels

Chronic mesenteric ischemia

Origin of SMA post-contrast

Origin of IMA post-contrast
**Mesenteric CTA**

*Chronic Intestinal Ischemia*

- CT very sensitive to detect stenosis / obstructions of mesenteric arteries
- Specificity?

**Role of CT**

- Treatment planning
- Negative CTA rules out arterial obstruction

**70 y.o. woman (VIP)**

*Chronic unclear upper abdominal pain*

**MDCT of pancreas**

(normal)

- Incidental ...
- Celiac artery stenosis
- Replaced hepatic artery,

1.25 mm / 0.8 mm
• 43 y.o woman
• hx of spontaneous hematomas, referred for new large hemorrhage in lesser sac
• lupus anticoagulant antibodies

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1. celiac a.
2. comm.hep.a.
3. proper hep.a.
4. splenic a.
5. gastroduped.a
6. left gastric
7. gastroepiploic a.

3rd Stanford Computed Tomography Workshop
RADIATION DOSE AND CONTRAST MEDIA IN NEURO & BODY CT
Lucas Learning Center, Jun 05, 2010

... thank you!
Department of Radiology
Stanford University