Acute Abdominal Bleeding: Detection with MDCT

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Lecture Objectives

• To review the role of MDCT in the assessment of acute bleeding from solid abdominal organs after blunt or penetrating trauma
• To discuss the MDCT imaging features of acute bleeding after rupture of an abdominal neoplasm
• To illustrate the value of MDCT in defining the site and cause of acute gastrointestinal bleeding

Diagnostic Criteria of Acute Bleeding on CE-MDCT

• Evidence of CM pooling caused by vascular or visceral organ pathology
• Attenuation of CM pooling
  - similar aorta / major adjacent arteries
  - greater than surrounding parenchyma
• Types of CM pooling:
  - focal, diffuse or "jet" of extravasated CM surrounded by hematoma

Blunt Trauma: Spleen

Snowboard accident: multiple lacerations, extravasated CM & surrounding hematoma, hemoperitoneum

Blunt Trauma: Kidney

Multiple kidney lacerations, extravasated CM & surrounding hematoma, retro-hemoperitoneum
Kidney laceration in preexisting hydronephrosis, acute bleeding from capsular artery

Mesenteric avulsions, „jet“ type CM extravasation

• Prevalence of acute bleeding detected on MDCT after BAT 13-18% (Willmann, AJR 2002; Yao, AJR 2002)
• Spleen > liver > kidney > adrenal > mesentery
• MDCT diagnosis requires rapid i.v. (>3.0 ml/sec) CM bolus via automated power injector
• Exact bleeding rate for diagnosis unknown
• When visualized on MDCT: significant finding, may mandate immediate surgery or image-guided embolization

22/165 pts (13%) acute bleeding on MDCT after BAT (Willmann, AJR 2002)

Surgery
13 (59%)

Selective embolization
3 (14%)

Delayed selective embolization
1 (5%)

Death
5 (22%)

Emergency therapy
16 (73%)

Conservative therapy
6 (27%)

Penetrating Trauma: Spleen

Gunshot

2 days after TIPS procedure

Penetrating Trauma: Liver
Penetrating Trauma: Liver

Leriche syndrome, 1 day after laparotomy and extraanatomic aorto-bifemoral Y-Graft

Bleeding from falciform ligament, perihepatic & perisplenic hematoma

Penetrating Trauma: Liver

Bleeding incidence after ESWL 0.28% (Collado, Scand J Urol Nephrol 1999)

Penetrating Trauma: Kidney

A few hours after ESWL for left-sided kidney stones

Spontaneous Rupture HCC

Incidence spontaneous rupture HCC 3-15% (Lai, Arch Surg 2006)

Spontaneous Rupture Liver Metastasis

Undifferentiated pancreatic carcinoma + oral anticoagulation
Spontaneous Rupture Renal Arteriopathy

- Polyarteritis nodosa

Spontaneous Rupture Sporadic Renal AML

- Angiomyolipoma >4 cm
- Bleeding in 50-60%

Spontaneous Rupture TS Associated Renal AML

- 20 yo, f: multiple & bilateral tumors

Characteristics of Renal AML

<table>
<thead>
<tr>
<th></th>
<th>Tuberous Sclerosis Associated AML</th>
<th>Sporadic AML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>30</td>
<td>52</td>
</tr>
<tr>
<td>Tumor diameter</td>
<td>9 cm</td>
<td>5 cm</td>
</tr>
<tr>
<td>Multiple tumors</td>
<td>97%</td>
<td>13%</td>
</tr>
<tr>
<td>Symptomatic acute hemorrhage</td>
<td>44%</td>
<td>14%</td>
</tr>
</tbody>
</table>

(Nelson, J of Urol 2002)

Spontaneous Rupture Ectopic Pregnancy

- Right tube: ectopic pregnancy
- Left tube: hydrosalpinx
- β-HCG 15'034

Acute Abdominal Bleeding: Summary (1)

Contrast-enhanced MDCT

- Rapid, noninvasive, and accurate in localizing acute bleeding from solid organs in traumatic and in non-traumatic conditions
- Can be used as a guidance for subsequent angiographic intervention
Gastrointestinal (GI) Bleeding: Definitions

- Upper GI bleeding / lower GI bleeding:
  proximal / distal ligament of Treitz
- Acute/active/massive: clinically stable - unstable
- Obscure GI bleeding: clinically stable
  Persisting or recurring bleeding of unknown origin
  after negative endoscopy of upper and lower GI tract
  - Overt: see blood (hematemesis, hematochezia, melena)
  - Occult: + fecal occult blood testing, do not see blood

(American Gastroenterological Association, Gastroenterology 2007;133:1697-1717)

GI Bleeding: Diagnostic Imaging Modalities

- Small bowel barium examination
- Enteroclysis
- Tc-labeled RBC scintigraphy
- Catheter angiography
- Wireless capsule endoscopy
- CT enteroclysis
- Catheter-directed CT angiography
- MDCT angiography

GI Bleeding: Sensitivity Imaging Modalities

<table>
<thead>
<tr>
<th>MDCT angiography</th>
<th>RBC scintigraphy</th>
<th>Catheter angiography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute GIB</td>
<td>91-92%(^1,2)</td>
<td>93%(^3) 40-90%(^4)</td>
</tr>
<tr>
<td>Obscure GIB</td>
<td>24%(^6)</td>
<td>40-70%(^6) 14-56%(^6,7)</td>
</tr>
</tbody>
</table>

1. Yoon, Radiology 2006;239:160-167
4. Lang, Radiographics 2007;27:1055-1070

GI Bleeding: Comparison of Imaging Modalities

<table>
<thead>
<tr>
<th>Method</th>
<th>Iodinated LVP</th>
<th>Bleeding rate detected</th>
<th>Imaging time</th>
<th>Localization</th>
<th>Invasive Can treat</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBC scintigraphy</td>
<td>No</td>
<td>0.1-0.2</td>
<td>Up to 48 hrs</td>
<td>worst</td>
<td>No</td>
</tr>
<tr>
<td>MDCT angiography</td>
<td>Yes</td>
<td>0.3</td>
<td>Up to 1.5 min</td>
<td>better</td>
<td>No</td>
</tr>
<tr>
<td>Catheter angiography</td>
<td>Yes</td>
<td>0.5-1.0</td>
<td>Up to 1 min</td>
<td>best</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Obscure GI Bleeding: Etiologies

Commonly overlooked lesions

Upper GI lesions  Lower GI lesions
Cameron’s erosions in Angiectasia
   large hiatal hernias Neoplasms
Fundic varices Peptic ulcer
Angiectasia Dieulafoy’s lesion
Gastric antral vascular ectasia

(American Gastroenterological Association, Gastroenterology 2007;133:1697-1717)

Small intestinal bleeding

<40 yo  >40 yo
Tumors  Angiectasia
lymphoma  NSAID enteropathy
carcinoid  Celiac disease
adenocarcinoma
Meckel diverticulum Uncommon
Dieulafoy’s lesion Hemobilia
Crohn disease Hemosuccus pancreaticus
Celiac disease  Aortoenteric fistula

(American Gastroenterological Association, Gastroenterology 2007;133:1697-1717)
Acute Upper & Lower GI Bleeding

- Acute = hematemesis, melena or hemochezia within 24 hours before MDCT
- Severe = hemodynamic instability (systol. pressure <100 / pulse rate >100); mild = no hemodynamic instability
- MDCT (pts) January 2001 - May 2006:
  - 4-row (6), 16-row (11), 64-row (1)
  - MDCT protocol: iv CM, arterial & portal venous phase
    (additional unenhanced scans in 9 pts), no oral CM

<table>
<thead>
<tr>
<th>Bleeding source / Pathology</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Severe / aortoenteric fistula</td>
<td>duodenum, excision</td>
</tr>
<tr>
<td>2. Severe / aortoenteric fistula</td>
<td>duodenum, stent graft</td>
</tr>
<tr>
<td>3. Severe / aortoenteric fistula</td>
<td>duodenum, stent graft</td>
</tr>
<tr>
<td>4. Severe / aortoenteric fistula</td>
<td>duodenum, stent graft</td>
</tr>
<tr>
<td>5. Severe / pseudoaneurysm hepatic art.</td>
<td>biliodigest. anastomosis, coiling</td>
</tr>
<tr>
<td>6. Mild / pseudoaneurysm hepatic art.</td>
<td>biliodigest. anastomosis, coiling</td>
</tr>
<tr>
<td>7. Mild / pseudoaneurysm gastroduodenal art.</td>
<td>duodenum, coiling</td>
</tr>
<tr>
<td>8. Mild / pseudoaneurysm splenic art.</td>
<td>cysteopetal anastomosis, coiling</td>
</tr>
<tr>
<td>9. Severe / artero-biliary fistula</td>
<td>duodenum, -</td>
</tr>
<tr>
<td>10. Severe / ischemic anastomotic ulcer</td>
<td>duodenum, embolization</td>
</tr>
</tbody>
</table>

Aortoduodenal Fistula

- Melana since 3 weeks, aorta-bifemoral Y-graft 11 years ago

Pseudoaneurysm Hepatic Artery

- 7 weeks after laparotomy & biliodigestive anastomosis for pancreatic carcinoma

Hypovolemic shock ➔ non-occlusive mesenteric ischemia & pneumatosis
<table>
<thead>
<tr>
<th>Pseudoaneurysm Hepatic Artery</th>
<th>Bleeding Complications after Pancreatic Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coiled embolization, stent-grafting</td>
<td><strong>Postoperative arterial bleeding</strong> 3-4%</td>
</tr>
<tr>
<td></td>
<td>(Sohn, J Gastrointest Surg 2003)</td>
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<td></td>
<td><strong>University Hospital Zurich 1998-2004</strong> (Pfammatter, CIRSE 2005)</td>
</tr>
<tr>
<td></td>
<td>N = 11, average delay surgery – bleeding = 54 days (range 10-250 days)</td>
</tr>
<tr>
<td></td>
<td><strong>Type of surgery:</strong></td>
</tr>
<tr>
<td></td>
<td>Whipple’s procedure 6</td>
</tr>
<tr>
<td></td>
<td>Partial pancreatic resection 3</td>
</tr>
<tr>
<td></td>
<td>Pancreatic head mobilization 1</td>
</tr>
<tr>
<td></td>
<td>Hepaticojejunostomy 1</td>
</tr>
<tr>
<td></td>
<td><strong>Presentation of acute bleeding:</strong></td>
</tr>
<tr>
<td></td>
<td>Upper GI 2</td>
</tr>
<tr>
<td></td>
<td>Lower GI 3</td>
</tr>
<tr>
<td></td>
<td>Intraabdominal 6</td>
</tr>
<tr>
<td></td>
<td><strong>Initial diagnosis of bleeding source:</strong></td>
</tr>
<tr>
<td></td>
<td>MDCT 7</td>
</tr>
<tr>
<td></td>
<td>DSA 3</td>
</tr>
<tr>
<td></td>
<td>Scintigraphy 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pseudoaneurysm Gastroduodenal Artery</th>
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</thead>
<tbody>
<tr>
<td>Chronic tuberculous ulceration of duodenum</td>
<td></td>
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</table>

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<thead>
<tr>
<th>Arterio-biliary Fistula</th>
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</thead>
<tbody>
<tr>
<td>Liver cirrhosis &amp; portal hypertension, 1 week after transjugular liver biopsy</td>
<td>Liver cirrhosis &amp; portal hypertension, 1 week after transjugular liver biopsy</td>
</tr>
</tbody>
</table>
Penetrating Subacute Duodenal Ulcer

Arrosion gastroduodenal art.

Acute Lower GI Bleeding: MDCT Detection

<table>
<thead>
<tr>
<th>Blood loss / Pathology</th>
<th>Bleeding source</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Severe / mucositis</td>
<td>jejunum</td>
<td>coiling</td>
</tr>
<tr>
<td>2. Mild / stromal tumor</td>
<td>ileum</td>
<td>excision</td>
</tr>
<tr>
<td>3. Mild / neuroendocrine carcinoma</td>
<td>ileum</td>
<td>excision</td>
</tr>
<tr>
<td>4. Mild / nonocclusive ischemic ulcer</td>
<td>cecum</td>
<td>embolization</td>
</tr>
<tr>
<td>5. Severe / nonocclusive ischemic ulcer</td>
<td>cecum</td>
<td>endoscopical clipping</td>
</tr>
<tr>
<td>6. Severe / ischemic ulcer</td>
<td>transverse colon</td>
<td>embolization</td>
</tr>
<tr>
<td>7. Severe / diverticulum</td>
<td>ileum</td>
<td>embolization</td>
</tr>
<tr>
<td>8. Mild / varices</td>
<td>rectosigmoid</td>
<td>TIPS</td>
</tr>
</tbody>
</table>

Ischemic Mucositis Jejunum

Stromal Tumor Ileum

Nonocclusive Ischemic Ulcer Cecum

Anticoagulation, 10 d after myocardial infarction: sepsis, acute abdomen
Cardiogenic shock 14 d after myocardial infarction

Nonsteroidal anti-inflammatory drugs (NSAID) since 5 weeks

Abdominal aortic aneurysm, Plavix loading dose after coronary stent, diverticulosis of sigmoid colon

Coil-embolization
Acute Upper & Lower GI-Bleeding

University Hospital Zurich (N=18)
- MDCT identification of bleeding source:
  prospectively 15/18 (83%)
  retrospectively 3/18 (17%)
- CM extravasation:
  11/11 pts with severe bleeding
  1/7 pts with mild bleeding
- Identification of underlying pathology:
  15/18 (83%)

Acute Abdominal Bleeding: Summary (2)

Contrast-enhanced MDCT
- Accurate localization of acute upper GI or lower GI bleeding
- Plays a complementary role to endoscopy for localization of obscure GI bleeding
- Can be used as a guidance for subsequent angiographic intervention