

CT Angiography of Lower Intestinal Bleeding

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Learning Objectives

- General concepts:
 - Clinical Importance
 - Presentation, Location
 - Etiologies
- CT Techniques:
 - CT Angiography
 - CT Enterography
- Role of CT in acute setting

Importance

- Approximately 350K to 400K hospitalizations every year in the U.S.
- Up to 4B in costs
- Mortality:
 - Upper GI Bleeding: 10%, more common in younger patients
 - Lower GI Bleeding: 4 to 5%, more common in elderly patients
 - Majority of deaths due to exacerbation of comorbid conditions

Consequences of GI Bleeding

- 100 mL/day: No hemodynamic symptoms, chronic iron deficiency anemia
- 100 to 500 mL/day: Tachycardia, postural hypotension
- 15% blood volume or more: Shock
- Up to 80%: spontaneous cessation, expectant therapy with volume replacement only

Upper vs. Lower GI Bleeding

- 65% Upper, 35% Lower
- Anatomic landmark: ligament of Treitz
- Upper: hematemesis, blood in gastric contents/aspirate (NGT)
- Lower: Bright red blood (BRB) per rectum, hematochezia
- Either: Tar/maroon feces
- Intraluminal blood accelerates peristalsis: **clinical localization not always accurate**

Upper GI Bleeding: Causes

- Ulcer disease: 55 to 75%
- Variceal bleeding: 5 to 15%
- Gastritis: 5 to 10%
- Mallory-Weiss tear: 2 to 7%
- Neoplasms: 2 to 4%
- Vascular lesions, Trauma: <1%
- **75%** stop spontaneously

Lower GI Bleeding: Causes

- Diverticulosis : predominantly right colon: 20 to 55%
- Angiodysplasia: right colon more common: 10 to 40%
- Tumors: polyps, colon cancer, carcinoid: 10 to 25%
- Hemorrhoids: 10%
- Ischemia, Jejunal/ileal ulcers: <2%
- 80% stop spontaneously

Diagnostic Strategies

- Radionuclide Imaging: lower (++), upper (+), useful for screening prio to intervention or surgery
- Catheter Angiography: massive upper or lower bleed, unstable patient
- Endoscopy: upper bleed (++), lower (+/-)
- CT Angiography: growing use, mostly for lower GI bleed

Radionuclide Imaging

- Tc-99m-labeled RBC's or Tc-99m sulfur colloid
- Tc-99m- RBC scintigraphy: detects active bleeding $>.04$ mL/min (art and venous)
 - 93% sensit, 95% specific
- Advantages: good for detection, imaging over prolonged periods of time
- Disadvantages: imprecise localization, variable availability, time consuming

Catheter Angiography

- Selective angiography detects bleeding rates > 0.5 mL/min
- Sensit 63 to 90%, Specif up to 100%
- Provocative measures increase sensitivity: vasodilators, thrombolytics, anticoagulants
- Signs: extravasation, pseudoaneurysm, A-V fistula, hyperemia
- Cause: ?, findings often not specific
- Therapy: success rate approaches 90%

Endoscopy

- EGD/colonoscopy: first-line tests
- Multiple therapeutic procedures
- Accurate localization/characterization of site/cause in upper GI tract, colon and ileum
- ?? Distal duodenum and >> of small bowel
- Upper tract: sensit 90-98%, specif 30 to 90%
- Colonoscopy: rapid bowel prep (3 to 4 hs) but limited for identifying definitive source (20 to 30%)

Video Capsule Endoscopy

- 10 hour fast, ingestion of capsule
- Data interpreted after 8 hs (+/-) of transit time, + 1 -2 hours data download: limited use in acute setting
- Only method to directly visualize the entire small bowel mucosa
- Limited to mucosal evaluation
- Complication: capsule retention secondary to stricture

CT for GI Bleeding

- Acute presentation: active bleeding (hematemesis, BRBR) with/without hemodynamic repercussion
CT ANGIOGRAPHY
- Chronic presentation: dark stools, iron deficiency anemia from GI source, obscure cause
CT ENTEROGRAPHY

CT and CT Angiography

- Advances in CT technology:
 - speed
 - high spatial resolution (fine detail)
 - capacity for multi-phasic exams
 - growing availability
 - Improved quality of MPR and VR reformations
- Very useful tool in the emergency setting: site AND cause
- Porcine models: depicts colonic hemorrhage 0.3 mL/min

Acute Gastrointestinal Bleeding

- Dual (triple? Phase CTE), NO oral contrast
- Non-contrast, low radiation dose technique
- I.V. contrast: preferably high Iodine content (370 or 400 mgI/mL), 4 to 6 mL/sec, saline chaser also at fast rate
- Arterial phase: options
 - routine fixed delays (25 to 30 sec after contrast)
 - automatic bolus triggering (150 HU enhancement, acquire 20 sec later)
- Venous (70 sec) or delayed (3 to 5 min) phase

Interpretation of CT Angiography in Acute GI Hemorrhage

- Key finding: active extravasation of contrast
- Signs:
 - Extravascular (endoluminal) accumulation of contrast-enhanced blood on arterial phase not present OR larger than in non-contrast phase
 - Pool of contrast grows into later phase, attenuation > aorta (blood pool)
- MIP reformations: facilitate demonstration of focus of extravasation and potential source vessel

Use of CT Angiography in Acute GI Bleeding

- Main benefit: localizes bleeding site and directs therapy
- Provides vascular map for angiography and embolization
- Assists in determining best endoscopic approach
- Improved availability (vs. Nuclear Scintigraphy) has made CTA the screening test of choice in the ER setting

CT Angiography: Data

- Tew et al (AJR 2004): 13 consecutive patients, no false + or false -
- Yoon et al (Radiology 2006): 26 consecutive patients with bleeding and hemodynamic compromise
 - All performance parameters: >90%
- Zink et al (AJR 2008): 55 patients, CT and scintigraphy, high disagreement rate BUT no CTA phase

Angiodysplasia

- Cause: degenerative, >25% in 60 y.o. + (cause of >40% of ALGIB in this group)
- Dilation of venules and arterioles with loss of capillary sphincter function and A-V shunts
- Vast majority asymptomatic
- Symptoms:
 - more common recurrent, low grade hemorrhage
 - massive bleed less common
- Angiography (and CTA) hallmark : early venous drainage

Obscure GI Bleeding

- Definition: documented GI bleeding with neg upper and lower endoscopy (50%)
- CTE limited in evaluation of obscure GI bleeding but has a role
- Capsule best for mucosal lesions
- Capsule complementary exam for obscure GI bleed (finds lesion in 40-70% cases)
- Enteroclysis good for GI bleeding of obscure origin with negative CTE when strong suspicion of small bowel lesion (ie positive capsule)

CTE in Obscure GI Bleeding

- Huprich JE et al (Mayo), Radiology Feb/08
 - Retrospective study
 - 22 pts with OGIB
 - 3 phase CTE (arterial with bolus tracking, + 25 sec, + 75 sec)
 - Compared with capsule, surgery, angio
 - CTE positive in 10 patients, including 3 with neg capsule endoscopy results

Neutral Oral Contrast Material

- Volumen: very low density barium suspension: 0.1% w/v (450 mL bottles)
- + Sorbitol: promotes distension and limits absorption of water
- Well tolerated
- Occasional reports of diarrhea
- Produces more distention than water (no water reabsorption)¹
- Better tolerate than PEG/Methylcellulose

1. Megibow AJ et al. Radiology 2005;238:87-95.

CT Enterography Technique

- 0.6 mm slice thickness
- IV contrast mandatory
- 100-150 mL at 4-5 mL/sec
- VoLumen[®] 1350 (1800) mL (3-4 bottles) over 35-40 minutes: compliance critical
- Ideally drink in right lateral decubitus position
- Use of glucagon controversial

CTE Acquisition Technique

- Intravenous contrast essential: No IV access, prefer positive contrast
- Acquisition timing:
 - Single Phase: 45-60 sec post-injection (“enteric” phase), majority of indications
 - Dual Phase: (30 and 70 sec) advocate for patients with obscure GI bleeding
- Coronal and sagittal reformations (2-3 mm)
- Thin-section MIPs: useful

Pitfalls

- Hemorrhage is intermittent: only detectable if site is actively bleeding during contrast circulation time
- Clue: High attenuation material in non-contrast phase is evidence of recent bleeding (BUT, retained contents may cause false+)
- Mucosal enhancement in collapsed loop mimics extravasation