Disclosures:

Speaker:
Jonathan A. Leighton, MD, FACG
Dr. Leighton has no conflicts of interest related to this talk.

Moderator:
Edith Y. Ho, MD, MS, FACG
Dr. Ho has no conflicts of interest related to this talk.

Cross Sectional Imaging in Crohn’s Disease and Small Bowel Bleeding: What Every Gastroenterologist Should Know

Jonathan A. Leighton, MD, FACG
leighton.jonathan@mayo.edu

ACG’s Virtual Grand Rounds
February 4, 2021
Paradigm Shift in Management of Crohn’s Disease

- **Old:** Treat based on symptoms

- **New:** Treat based on objective markers of inflammation with the goal being mucosal healing
  - Fecal calprotectin
  - CRP
  - Endoscopy
  - Radiology
42 year-old male with history of terminal ileal CD presents with abdominal pain and fevers

Indications for Small Bowel Imaging in CD

- Diagnosis of suspected CD
- Evaluation of established CD
  - Extent and activity of disease
  - Complications (penetrating and fibrostenotic)
- Evaluation for postoperative CD recurrence
- Assessment of mucosal healing

Ideal imaging study – noninvasive, cost-effective, assess SB and extramural findings, minimal complications

Single-Phase CT and MR Enterography are ideal
CT Enterography (CTE)

- Oral contrast: Neutral
- Rate: 450 cc every 15 min
- Amt: 1350 cc over 45 min

CTE Finding

<table>
<thead>
<tr>
<th>CTE Finding</th>
<th>Sens (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mural hyperenhancement</td>
<td>80</td>
</tr>
<tr>
<td>Bowel wall thickening</td>
<td>75</td>
</tr>
<tr>
<td>Mural stratification</td>
<td>60</td>
</tr>
<tr>
<td>Comb sign</td>
<td>35</td>
</tr>
<tr>
<td>Inc. mesenteric fat atten</td>
<td>10</td>
</tr>
</tbody>
</table>

Bodily K et al: Radiology 2006;238:505-516
Small Bowel
Normal vs Crohn’s Disease

Enhancement – Homogeneous
Distended bowel wall thickness <3 mm

Enhancement – Increased
Distended bowel wall thickness >3 mm

Bruining DH et al. Gastro 2018;154:1172-1194

Both CTE and MRE are Excellent for Detecting SB Inflammation

CTE

MRE

Less Radiation with MRE
Dual energy CT; less contrast, less radiation
CTE better for small fistulas
CTE better for patients who can’t hold their breath
## Comparison of Rad Imaging in CD

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Enterography</td>
<td>Quick imaging</td>
<td>Radiation burden</td>
</tr>
<tr>
<td></td>
<td>Better spatial resolution than MRE</td>
<td></td>
</tr>
<tr>
<td>MR Enterography</td>
<td>No radiation burden</td>
<td>Longer scan time</td>
</tr>
<tr>
<td></td>
<td>Can be combined with perianal imaging</td>
<td>Lower patient acceptance and compliance</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>No radiation</td>
<td>Operator dependent</td>
</tr>
<tr>
<td></td>
<td>Point-of-Care Imaging</td>
<td>Not easy to interpret</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not many trained radiologists</td>
</tr>
</tbody>
</table>

Adapted from Eliakim R, Magro F: Nat Rev Gastroenterol Hepatol 2014;11:722

## Comparison of Rad Imaging in Active CD

<table>
<thead>
<tr>
<th>Patients (no.)</th>
<th>CTE (sens/spec)</th>
<th>MRE (sens/spec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siddiki H</td>
<td>33</td>
<td>95/89</td>
</tr>
<tr>
<td>Lee SS</td>
<td>30</td>
<td>90/89</td>
</tr>
</tbody>
</table>

**Ultrasound:** sensitivity (86% to 97%) and specificity (83% to 97%)

**MRE** superior to US for disease extent (correlation with surgery 0.71 and 0.66)

MRE and CTE Correlate With Colonoscopy

- MRE findings compared to colonoscopy and ileoscopy – MRE correlates with CDEIS and this was validated in a subsequent study
- MRE vs CTE vs Ileocolonoscopy – CTE and MRE were equally accurate for assessing disease activity

What we don’t know…
Is mucosal healing or transmural healing or histologic remission responsible for better clinical outcomes?


MRE Correlates With Ileocolonoscopy and Can Assess Crohn’s Severity (MaRIA* Score)

Index based on wall thickness, relative contrast enhancement, MRI edema, and MRI ulcers

*MaRIA = Magnetic resonance index of activity
Rimola J et al: Inflamm Bowel Dis 2011;17:1759
Mucosal Healing After Treatment as Predictor of Subsequent Disease Course in Crohn’s Disease

Frøslie KF et al. Gastroenterology. 2007;133:412.

MRE Can Assess Response to Therapy and Mucosal Healing in CD

- Prospective multicenter study of 48 patients with active CD who underwent MRE and ileocolonoscopy at baseline and 12 weeks after treatment
- Results
  - MRE determined ulcer healing with 90% accuracy and endoscopic remission with 83% accuracy
  - The magnitude of change in CDEIS scores correlated with MaRIA scores ($r=0.51; P<0.001$)

Ordas I et al: Gastro 2014;146:374-382
CTE Healing: Equivalent to Mucosal Healing at Endoscopy?

Before Remicade

After Remicade

Resolution of intramural inflammation on maintenance infliximab


CTE/MRE Can Predict Long Term Outcomes in CD

• 150 patients with known CD, 49% ileal distribution
• Complete and partial response on CTE/MRE were associated with a decreased risk for steroids by >50%; (HR 0.37;95%CI 0.15-0.50) (HR 0.45;95%CI 0.26-0.79)
• Complete response was associated with a decreased risk of subsequent hospitalization and surgery (HR 0.28, 95%CI 0.15-0.50) (HR 0.34, 0.18-0.63)

These studies show that both MRE and CTE can assess for mucosal healing and may predict long term outcomes

Deepak P: AM J Gastroenterol 2016; 111:1006
SB Strictures in CD

- Up to 30% of patients with CD are prone to develop strictures
- 78% have significant narrowing requiring strictureoplasty or segmental resection
- Strictures can recur, often leading to multiple surgeries and risk for short bowel syndrome

Cross-Sectional Imaging for Strictures – Assessing for Inflammation vs Fibrosis

CTE

MRE

Some studies suggest MRE better than CTE for fibrosis vs inflammatory stricture. But in most cases strictures are mixed.
Comparison of Rad Imaging for Strictures

<table>
<thead>
<tr>
<th></th>
<th>Sens (%)</th>
<th>Spec (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTE</td>
<td>85-93</td>
<td>100</td>
</tr>
<tr>
<td>MRE</td>
<td>75-100</td>
<td>91-100</td>
</tr>
</tbody>
</table>

- MRE more accurate than CTE to predict fibrosis (80.8 vs 55.6, P=0.058) with histopathology as gold standard
- High accuracy of US for fibrotic and inflammatory strictures (sens 75%–91.67% and spec 62.5%–100%)
- MRE superior to US to detect strictures (improved with SICUS)

Perianal Fistulas

- Occurs in 17–43 % of CD pts
- Etiology is NOT the same as other SB fistulas
- Does not follow inflammation-striction-penetrating progression like SB CD
- Important features: ± abscess
- Order MRI of pelvis

De Zoeten EF et al: J Pediatr Gastroenterol Nut 2013;57(3): 401-412
Perianal Fistulas

T2 w/Fat Saturation (Black): Perianal fistula is bright

MRI: T1 post Contrast (fistula wall enhances, good for abscess)

De Zoeten EF et al: J Pediatr Gastroenterol Nut 2013;57(3): 401-412
Bruining DH et al. Gastro 2018;154:1172-1194

Cross-Sectional Imaging in Small Bowel Bleeding
Small Bowel Bleeding

Background

• SB bleeding accounts for 5-10% of gastrointestinal bleeding
• Capsule endoscopy (CE), Device-assisted enteroscopy (DAE) and Multiphase CT scanning (MCT) identify a SB source in 40-75% of cases of Obscure GIB
• Therefore, most cases of Obscure GIB can now be termed “Suspected small bowel (SB) bleeding”
• Obscure GIB is reserved for cases where no source is identified after a SB evaluation

Techniques to Evaluate the SB

• Capsule Endoscopy
• Deep Enteroscopy
• Cross Sectional Imaging
When Should Radiologic Imaging Be Considered in SB Bleeding?

- Indications for radiologic imaging
  - When CE is negative or contraindicated
  - Brisk bleeding and hemodynamic instability
  - Suspected Crohn’s disease or mass lesions

- Current options
  - Multi-phase CT scan (CTA or CTE)
  - MR enterography
  - Bleeding scans
  - Mesenteric angiogram
  - Meckel’s scan

What Do I Mean by Multi-Phase?

Small Bowel Bleeding Case

Non contrast  Arterial  Venous
Multiphase CT Scanning is Useful for SB Bleeding

- Complimentary to capsule endoscopy
- CTA Three phases: Pre-IV contrast imaging is followed by rapid bolus of IV contrast followed by arterial and venous phase imaging
  - CT Angiogram (without oral contrast) is preferred for active bleeding. If positive, can direct mesenteric angiography and embolization
- CT Enterography (oral neutral contrast) best for chronic bleeding (sensitivity 45-52%): bolus-triggered arterial phase, enteric phase, delayed phase
- New techniques
  - Dual energy CT (reduces radiation dose)

Multiphase CT Angiography – Technique

- No oral contrast given (acute bleeding)
- Three Phases
  - Non contrast scan (low dose)
  - Arterial phase (4 mL/sec 1mL/lb) Bolus Tracking (aorta)
  - Venous phase (50s after the arterial scan)
- Coronal and Sagittal Reconstructions

Non Contrast  Arterial  Venous
Capsule endoscopy detects more angioectasias & CTE detects more tumors

Diagnosis Using Radiographic Techniques for Suspected SB Bleeding (Guideline)

- Barium studies should not be performed
- CTE is preferred over MR imaging
- Multi-phase CT Enterography (CTE, with negative oral contrast) should be performed if CE is negative for chronic bleeding
- Single-phase CTE should be considered before CE in the setting of Crohn’s disease, prior radiation therapy, and/or obstructive symptoms
- CTE should also be performed if there is a high clinical suspicion despite the performance of a prior standard abdominal CT

Cross-Sectional Imaging With CT

CT Angiogram (Acute bleeding)
- Rapid bolus of intravenous contrast without oral contrast
- Non-contrast, arterial, and venous phase
- Detects bleeding at rate of ≥0.3 ml/min
- Quicker and accurate localization of source than RBC scan

CT Enterography (Chronic bleeding/IDA)
- Administration of large volume neutral oral contrast
- Arterial, enteric + delayed phase imaging
- Visualization of mucosal details & detection of tumors

Active Jejunal Bleed – No Oral Contrast

Precontrast  →  Arterial  →  Venous

Multiphase CT Angio without oral contrast should be considered especially when endoscopy is not diagnostic
Value of Pre-Contrast Imaging

• For most SB bleeding patients, CE should be performed before Deep Enteroscopy
• For active bleeding, would recommend Deep Enteroscopy
• If no source identified with CE or Deep Enteroscopy, consider multi-phase CTE
• For active bleeding, recommend multi-phase CTA
• For obstructive symptoms or suspicion of IBD, would recommend single-phase CTE/MRE
63-year-old male with recurrent IDA. Negative studies. Multiphase CTE Scan

Images: Courtesy Dr. Amy Hara

CT GI Studies

<table>
<thead>
<tr>
<th>Indication</th>
<th>CD or Mass</th>
<th>3 Phase CTA for GI Bleed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral contrast</td>
<td>1350 negative oral agent</td>
<td>Active</td>
</tr>
<tr>
<td>(mL)</td>
<td>None</td>
<td>Not active</td>
</tr>
</tbody>
</table>

©2019 MFMER  | 3873457-38
Multi-Phase CT Angiography Performance

For Active GIB

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>79-100</td>
</tr>
<tr>
<td>Specificity</td>
<td>95-99</td>
</tr>
<tr>
<td>Negative Predictive Value</td>
<td>77-100</td>
</tr>
</tbody>
</table>

Negative Predictive Value
• Of the 64 negative CT angiograms, 59 (92%) required no further intervention
• 48/62 (77%) lower GI bleed patients who had a negative CTA had no further intervention
• 20 negative CTA studies followed by mesenteric angiography
  • 18 were negative
  • Of the 2 positive, both were upper GI bleeds

What If CT Scanning is Contraindicated?

Consider radioisotope bleeding scan
• False localization rate of up to 30%
• Accuracy improved if there is a positive scan in the first 2-3 hours
• If positive, quickly move to therapeutic angiography
• Good for a second-look study
Tagged RBC Scan

**Advantage**
- Very sensitive – 0.1mL/min
- Long scan time – good for intermittent bleeding
- No contrast needed

**Disadvantage**
- Blood drawn and tagged with Technetium 99
- Up to 5 hours
- Imprecise anatomic detail

Comparison between Tagged RBC and CT Angiography

<table>
<thead>
<tr>
<th></th>
<th>CT Angio</th>
<th>Tagged RBC Scan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Speed/efficiency</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Detail/cause of bleed</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Procedure planning</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Contrast administration</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Radiation</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>

Cross-sectional Imaging Approach to Gastrointestinal Bleeding

Conclusions

- Cross-sectional imaging has revolutionized the way we assess Crohn’s disease and small bowel bleeding.
- With regard to Crohn’s disease, single-phase cross-sectional imaging with CT and MR compliments endoscopy and can help manage patients non-invasively.
- In small bowel bleeding, multiphase CT Enterography and Angiography compliments endoscopy in the management of acute and chronic bleeding.
Thank You

Questions?

Speaker:
Jonathan A. Leighton, MD, FACG

Moderator:
Edith Y. Ho, MD, MS, FACG
CONNECT AND COLLABORATE IN GI

ACG & CCF IBD Circle

ACG Hepatology Circle

ACG Functional GI Health and Nutrition Circle

ACG Women in GI Circle

ACG GI Circle
Connect and collaborate within GI

ACG’s Online Professional Networking Communities
LOGIN OR SIGN-UP NOW AT: acg-gi-circle.within3.com

American College of Gastroenterology