Cross Examination of Cross-sectional Imaging in IBD

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Disclosures
• None

Objectives
• What is the current role of barium studies and Conventional CT?
• Radiation Risks from these examinations
• Current status of CT/MR enterography (CTE,MRE)
• Role of bowel sonography for IBD?

Role of imaging in IBD
• Initial diagnosis/ Disease distribution
  - Especially SB inaccessible to optical endoscopy
• Extraintestinal disease manifestations
• Disease activity
• Extraluminal complications requiring intervention
  – Fistula, abscess, perforation
• Response to treatment

Considerations in selecting imaging
• Patient age
• Accuracy for answering clinical question
• Patient comfort/compliance
• Exam availability
• Radiation exposure
• Cost

Traditional fluoroscopic small bowel follow-through (SBFT)
• High resolution evaluation of the SB wall
• Real-time evaluation of peristalsis
• Aids in diagnosing other causes of chronic abd pain
  – Malrotation
  – Obstruction
  – SMA syndrome
Diagnostic performance of SBFT for diagnosis of CD: Good specificity but variable sensitivity

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>Batres et al 2002</td>
<td>45%</td>
<td>96%</td>
</tr>
<tr>
<td>Lipson et al 1990</td>
<td>90%</td>
<td>96%</td>
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Value of conventional CT

- *Jabra et al, 1990s defined the role of CT in children with CD*
- Advantages of CT include:
  - Evaluation of intraluminal and extraluminal disease
  - 24/7 availability at night in hospital
  - Detection of perforation/abscess in acutely ill pts

Shortcomings of CT

- Radiation burden
- Poor soft tissue contrast
  - for detecting intrinsic bowel wall abnormality
- Single phase acquisition (portal venous)
  - Multiple acquisitions is increased radiation
- Difficulty assessing collapsed bowel

ACR Appropriate Criteria: IBD in Children and Young Adults

<table>
<thead>
<tr>
<th>Diagnostic Procedure</th>
<th>Rating</th>
<th>Comments</th>
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<td>CT enterography</td>
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<tr>
<td>MR enterography</td>
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<tr>
<td>SBFT</td>
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MRE versus CTE

- Advantages of CTE (versus MRE):
  - Better spatial resolution
  - Fewer motion artifacts
  - Lower cost
  - Shorter exam time
  - Increased availability

- Advantages of MRE (versus CTE):
  - No radiation
  - Better contrast resolution
  - Superior evaluation of perianal disease
  - Ability to evaluate peristalsis
  - Diffusion Weighted Imaging
CT Enterography (CTE)

- Thin section acq (2.5mm) / recon (1mm) intervals
- Large volume neutral oral contrast vs. positive contrast for conventional CT
  - assess for bowel wall

Conventional CT  CTE

Radiation Dose

- Effective doses for Crohn disease evaluation:
  - CT = ~3.5 mSv
  - SBFT = ~2 mSv
- CTE -performed at significantly reduced dose with advanced technology: effective doses = 1-2 mSv
- Published data shows increase in diagnostic exams in IBD, overall low cumulative dose per pt = 4.6 mSv
  - Primarily due to iterative CT reconstruction and other radiation dose reduction efforts in fluoroscopy and radiography

MR enterography (MRE)

- No ionizing radiation exposure
- Evaluation of intra- & extraluminal disease
- Superior soft tissue contrast
  - detecting fistulae, abscesses, and active inflammation

Performance of MRE in Pediatrics

* MRE for diagnosis of IBD:
  - sensitivity ranging between 81-91%
  - specificity between 67-89%

*Duigenan et al. AJR 2012
MRE pathology

- Bowel
- Mesentery
- Disease-related complications
- Other stuff: biliary tree, bones/muscles

Perianal Disease

Examples

Extraintestinal abnormalities on MRE

Examples
- Strictures, abscess, PSC, musculoskeletal manifestations

Pitfalls of MRE

- Cost & length of study
- Sedation- younger patients
  - Options: child life, develop protocols with anesthesia, shorten study time
- Interpretation –variable among radiologists
- Conference-discuss cases
  ✓ Consensus
  ✓ Collaboration
  ✓ Communication

Future of MRE

- MRE- developing imaging indices of disease/damage (ImageKids project)
- MRE- (perfusion/diffusion) movement of water molecules as a marker of inflammation of tissue ➔ fibrosis
SBFT

US for IBD evaluation

• Advantages
  - Real-time, no ionizing radiation, low cost, no bowel prep
  - Better for targeted surveillance of known areas of disease

Clinical uses (mostly CD)
  - Limited TI–cecal disease
  - Abscess, fluid collections
  - Follow-up to treatment
  - Active vs. fibrosis based on vascularity
  - Problem solving (fistulas)

Anupindi SA et al. AJR 2014

Ultrasound findings in CD

• Bowel wall thickening (BWT)
• Bowel wall irregularity
• Bowel wall echogenicity
• Loss of Stratification
• Hyperemia
• Bowel margins: transmural disease, disruption, phlegmon localized perforation
• Luminal narrowing-strictures

Diagnostic Value of US for CD

• Metaanalysis: 7 studies [adults]
  - Sensitivity: 75 - 94%
  - Specificity: 67 - 100%
• Range: 3 pediatric studies
  **Sensitivity: 74 - 88%**
  **Specificity: 78 - 93%**
• **PPV: Lab + US BWT**: 99.5% [*Bowel Wall Thickening]*

Reference: ileocolonoscopy + histology

• MRE suggested an enterovesical fistula which was resolved on bowel US
• US shows the enter-to-enter fistula b/w ileal loops and the fistula towards the dome of the bladder
• Real-time imaging helped confirm fistula

US - Fistulizing CD
Sensitivity of US in detecting disease by segment

- *TI > 90%
- **Anupindi et al compared US to MRE with histology
  - 19 children with CD
  - NPV 93-100% (small bowel and large bowel)

Future Bowel US applications

- US elastography – non-invasive assessment of tissue hardness
- **Contrast enhanced US (CEUS)** – intravenous contrast agent to look at the bowel wall
  - Quantitative assessment of disease activity

Imaging young IBD pts: minimizing radiation exposure

- Many pediatric hospitals have switched to MR enterography as primary imaging modality
- US starting to be used for evaluation of non-acute symptomatic CD pts where distribution of disease is known

Summary

- Moving away from Barium SBFT
- Radiation Risks are real - we are making concerted efforts to reduce
  - CT dose <<< SBFT
- MRE in many centers is the first line of imaging
- US has an emerging role
- Developing - imaging biomarkers by MRE and US
  - Assess intestinal damage
  - Active disease vs. fibrosis

Thank You!

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