



## 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

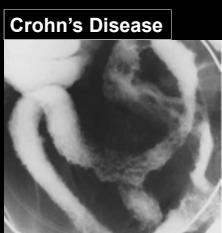
## Considerations in selecting imaging

- 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

Reference	Sensitivity	Specificity
Batres et al 2002 (n=84)	45%	96%
Lipson et al 1990 (n=46)	90%	96%

## Value of conventional CT

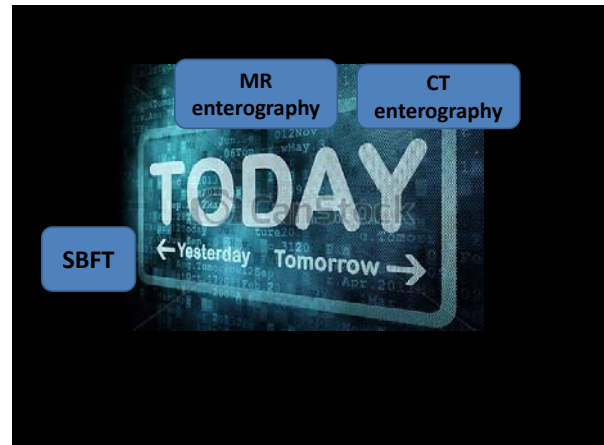
- \*Jabra et al, 1990s defined the role of CT in children with CD
- Advantages of CT include:
  - Evaluation of intraluminal and extraluminal disease
  - **24/7 availability at night in hospital**
  - **Detection of perforation/abscess in acutely ill pts**



\*Jabra AA et al 1991 AJR  
\*Jabra AA et al 1994 AJR

## 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

Clinical Condition: Crohn Disease			
Variant 2: Child or young adult. Initial presentation. Suspected Crohn disease.			
Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast (CT enterography)	9	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. MRI is the preferred modality for investigating perianal disease. See statement regarding contrast in text under "Anticipated Exceptions."	***
MRI abdomen and pelvis without and with contrast (MR enterography)	9		○
CT abdomen and pelvis with contrast (routine)	7		***
X-ray small-bowel follow-through	7	The RRL for the adult procedure is ***.	***
US abdomen and pelvis	6		○

Rating 5,6 may be appropriate  
Rating 7,8,9 are most appropriate

## MRE versus CTE

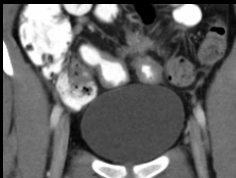


- Advantages of CTE (versus MRE):
  - Better spatial resolution
  - Fewer motion artifacts
  - Lower cost
  - Shorter exam time
  - Increased availability
- Advantages of MRE (versus CTE):
  - ---NO RADIATION
  - Better contrast resolution
  - Superior evaluation of perianal disease
  - Ability to evaluate peristalsis
  - Diffusion Weighted Imaging

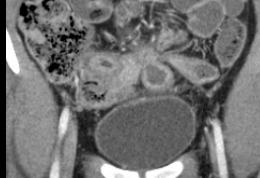
## CT Enterography (CTE)

- 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



## Closer Look - dose

Source	Estimated Effective Dose (mSv)
Cosmic & Background	3.0 mSv
Coast to coast round trip by plane	0.03 mSv
CXR	0.02-0.05 mSv
Abdominal Radiograph	0.5 mSv
UGI	0.5-0.9 mSv
UGI/SBFT	0.5-1.5 mSv
CT Abdomen/Pelvis	3-10 mSv (equi 50-360 CXR's) *(new technology- 1-2 mSv)

\* mSv= universal measurement of absorbed ionizing radiation taking into consideration type of radiation

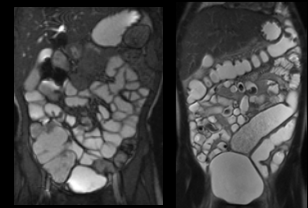
## Radiation Dose

- Effective doses for Crohn disease evaluation <sup>1</sup>
  - CT = ~3.5 mSv
  - SBFT = ~2 mSv
- CTE -performed at significantly reduced dose with advanced technology; effective doses ≈ 1-2 mSv range
- <sup>5</sup> 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

- <sup>1</sup> Gaca AM, et al. *Pediatr Radiol* 2008; 38:285-291
- <sup>2</sup> Kaza RK, et al. *AJR* 2012;198:1064-92
- <sup>3</sup> Kambadakone AR, et al. *AJR* 2011;196:W743-52
- <sup>4</sup> Goske MJ, et al. *Radiology* (in press)
- <sup>5</sup> Domina JG, et al. *AJR* 2013; 201:W133-W140

## MR enterography (MRE)

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



### MR Enterography Findings of Inflammatory Bowel Disease in Pediatric Patients

**OBJECTIVE:** The purpose of this article is to illustrate and describe the characteristic MR enterography findings in children with inflammatory bowel disease (IBD) and to present MR enterography as the best choice imaging modality in this setting.

**CONCLUSION:** Given the high sensitivity and specificity for IBD and lack of ionizing radiation, MR enterography is a valuable technique for monitoring, defining IBD.

### MR Enterography of Extraluminal Manifestations of Inflammatory Bowel Disease in Children and Adolescents: Moving Beyond the Bowel Wall

**OBJECTIVE:** The purpose of this review is to describe the extraluminal manifestations of inflammatory bowel disease (IBD) and to present MR enterography as the best choice imaging modality in this setting.

**CONCLUSION:** Given the high sensitivity and specificity for IBD and lack of ionizing radiation, MR enterography is a valuable technique for monitoring, defining IBD.

## Performance of MRE in Pediatrics

### Comparison of MR enterography and histopathology in the evaluation of pediatric Crohn disease

Jacobson RL, Dhillon M, Martin R, Ladhani-Savaris J, Aronson J, Miller C, Vera De-Munoz-Medina F, Jacobson B, McHugh J, Shekharish Khadilkar J, Peter J. *Stomach*

### Prospective Evaluation of MR Enterography as the Primary Imaging Modality for Pediatric Crohn Disease Assessment

Michael J. Goss\*

**OBJECTIVE:** The objective of this study was to prospectively evaluate the performance of MR enterography as the primary imaging modality for pediatric Crohn disease assessment.

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

\*Duigenan et al *AJR* 2012

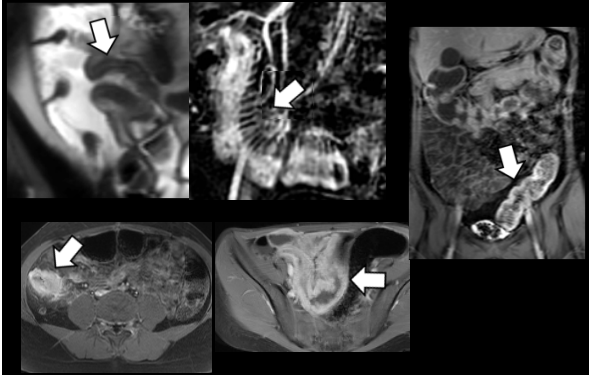
## MRE >>CTE



## MRE pathology

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

## MRI features of active bowel inflammation



## Perianal Disease

Examples

## Extraintestinal abnormalities on MRE

Examples

Strictures, abscess, PSC, musculoskeletal manifestations

## Pitfalls of MRE

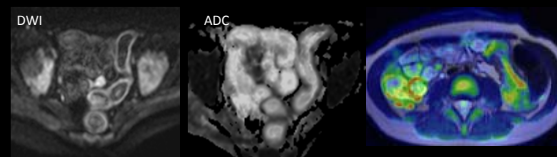


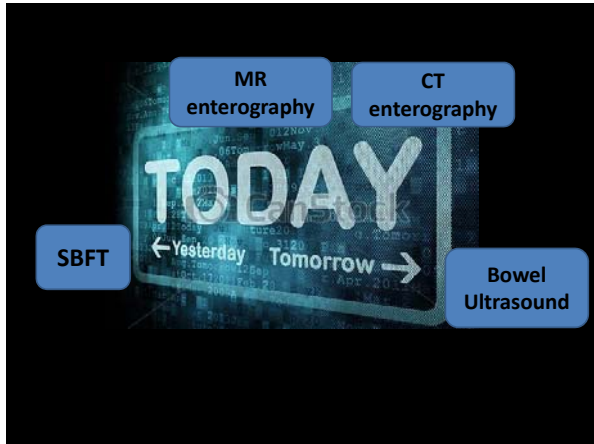
- Cost & length of study
- Sedation- younger patients
  - Options: child life, develop protocols with anesthesia, shorten study time
- Interpretation –variable among radiologists
- Conference-discuss cases

- ✓ 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





## US for IBD evaluation

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

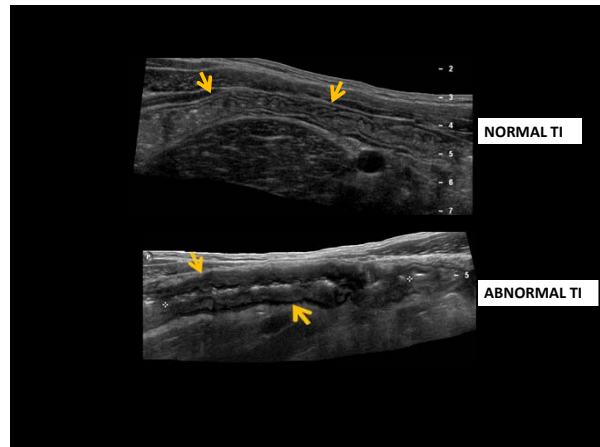
**Clinical uses (mostly CD)**

- 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  
K Darge, SA Anupindi et al. Pediatr Radiol (2010)*

## Ultrasound findings in CD

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



## US -Fistulizing CD

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

## Diagnostic Value of US for CD

*Reference: ileocolonoscopy + histology*

- **Metanalysis: 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]

\* Fraquelli M et al. [2005] Role of US in detection of Crohn disease: a metaanalysis. *Radiology* 236:96-101  
 \*\* Alison M et al. [2007] Ultrasonography of Crohn disease in children. *Pediatr Radiol* 37:1071-1082  
 \*\*\*Canani RB et al. [2006] Combined use of noninvasive tests is useful in the initial diagnostic approach to a child with suspected inflammatory bowel disease. *J Pediatr Gastroenterol Nutr* 42:9-15

## 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)

*\*\*Anupindi SA et al Comparison of High resolution bowel Ultrasound with MRE in children with CD presented at IPR 2011*  
*\*Alison et al 2007 Ped Radiology*

## 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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