Small Bowel Imaging

EVIDENCE BASED IMAGING

MSU STATEWIDE CAMPUS SYSTEM – SURGERY SUMMER 2020

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Objectives

• Evidence Based Approach to Small Bowel Obstruction
• Evidence Based Approach to Crohn Disease
• Overview of CT/MR Enteroenterography findings

Modalities for Small Bowel Imaging

• Abdominal Radiographs
• Small Bowel Follow Through (SBFT) +/- Fluoroscopy
• Enteroclysis
• CT/MR Enterography

Imaging Small Bowel Obstruction (SBO)

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HIGH GRADE OBSTRUCTION

LOW GRADE OR INTERMITTENT OBSTRUCTION
Abdominal Radiographs

Traditional Starting Point for many workups

**PROS:**
- Cheap
- Fast
- Well Tolerated
- Repeatable
- Low radiation exposure
- Availability

**CONS:**
- Accuracy only 30–70%

Role: Triage, Screening in low risk patients, Serial Follow up of cross sectional imaging

SBFT

Controversial Role

Variable accuracy reported in literature, varying criteria for diagnosis and treatment strategy. Meta-analysis of 14 prospective studies: if contrast in colon within 4–24 hours (often within 8 hours), then 96% sensitivity and 98% specificity predicting resolution of the SBO.

**Pros:**
- Cheap, relatively easy to perform, widely available (serial exam)

**Cons:**
- Long exam, nonuniform distribution, variable tolerance by patients, variable radiation depending on protocol and use of addt’l flouro, low sensitivity (predicting NEC/closed loop)

Role: Best is for following the oral contrast and opacified SBFT findings eg. NEC/closed loop

CT ABDOMEN AND PELVIS

Current Imaging Workhorse for SBO

Accuracy >90% across multiple published studies

**Pros:**
- Fast
- Widely available
- Identify operable SBO (ischemia/closed loop)
- Unexpected etiologies: tumor, internal hernia, malrotation, Crohn dz etc.
- Site of obstruction/transition

**Cons:**
- Expensive and radiation exposure (limits serial exams)

Interestingly for findings of early ischemia CT is highly specific but poorly sensitive: 14.8–51%

Oral contrast rarely necessary

IV contrast improves sensitivity for ischemia but noncontrast exams in patients with IV allergy or low GFR had similar overall accuracy for diagnosing or excluding SBO

Imaging Crohn Disease

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ABD XR and SBFT

**Abdominal XR**
- Little role in assessing IBD aside to search for obvious complication (free air, acute obstruction, or perforation)

**SBFT**
- Traditionally most used modality, especially useful for detecting fistulas but CT/MR have proven far superior in assessing disease, now SBFT continues to have decreasing role.
- Fluoroscopic assessment of bowel motility useful in select situations (newer MR techniques will likely replace)

**ENTEROCLYSIS**

**Pros:**
- Superior to SBFT in assessing bowel loops and improves contrast throughout bowel loops
- Real time assessment of bowel loop motility

**Cons:**
- Requires nasojejunal tube
- Limited patient tolerance
- Increased radiation dose
- Still suffers from overlapping loops and limited to assessing bowel lumen
- Limited availability

**CT ENTEROGRAPHY**

**Technique:** Large volume neutral contrast (1200-1500 cc)
- 3d volume
- Multiplanar reconstructions
- +/- multiple phases

**Pros:**
- Sensitivity 75-90%
- Specificity >90%
- Useful in most clinical situations to assess status/presence of active Crohn disease
- Availability +/-
- Fast
- Detecting complications: fistula, abscess, perforation, obstruction
- Direct management/image guided procedures
- Relative consistent exam quality

**Cons:**
- Patient Tolerance of PO contrast
- Expensive
- Radiation exposure

**MR ENTEROGRAPHY**

**Technique:** Large volume neutral contrast (1200-1500 cc)
- 3d volume
- IV contrast
- Multiplanar reconstructions
- Multiple phases, new steady state techniques can assess bowel motility

**Pros:**
- Sensitivity 75-90%
- Specificity 80-100%
- Useful in most clinical situations to assess status/presence of active Crohn disease
- No radiation exposure
- Detecting complications: fistula, abscess, perforation, obstruction
- Direct management/image guided procedures

**Cons:**
- Patient Tolerance of PO contrast
- Very Expensive
- Slow (avg. exam time 40-60 min)
- Availability
- Variable exam quality esp. w/ acute ill patients

FYI: MR pelvis for rule out perianal disease is completely separate type of exam than MRE. Patient will need to be in magnet for additional 45 minutes. Poorly tolerated, results often in poor image quality for both studies. Best done as two separate studies on different days.

**MR ENTEROGRAPHY Findings for IBD**

- Wall thickening >3mm in a distended loop (typically <3mm in Crohn's if >3mm disease is either severe or an alternate diagnosis should be considered
- Fold Patterns
  - Picket fence
  - Reduced or Distorted folds
  - Cobblestoning
  - The mesenteric border is often preferentially involved w/ Crohn's

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Each MR sequence has strengths and weaknesses. So we combine them in such a way as to complement each other.
Duodenal Fibrostenotic Crohn’s w/ upstream dilatation and absent edema in the thickened walls.

Focal Wall thickening >10mm. This was Colonic Carcinoma. Just because its MRE don’t forget about other diseases just like you would if it were CT.

MR ENTEROGRAPHY Findings for IBD

- **Ulceration**
  - Detection is dependent on good luminal distension. Moderate and deep ulcerations are seen as linear transversely or longitudinally oriented areas of high T2 signal within areas of wall thickening.
  - Early superficial ulceration is not visible on MR only on endoscopy regardless of distension.

- **Strictures**
  - Wall demonstrated w/ MRE
  - Functionally significant if dilatation >3cm upstream of stricture
  - Nonfunctional if ≥50% narrowing in lumen compared with nml adjacent bowel w/o dilatation

34 yo woman with Crohn’s Dz. T2 HASTE Axial shows wall thickening with curvilinear “Rosenthorn” ulceration. Coronal VIBE demonstrates stratified pattern of enhancement.

Jejunal Adhesive Stricture resulting in Pre-Stenotic Dilation

Multiple Adhesions w/o obstruction
MR ENTEROGRAPHY Findings for IBD

- Acute Wall Edema
  - Longitudinally oriented intermediate T2 signal compared with normally hypointense wall signal with wall thickening
  - Mucosal or Submucosal
  - Unilateral or bilateral representing chronic disease but absence of high T2 edema within an area of wall thickening does NOT totally exclude active disease

- Chronicity and Wall Fat
  - Fatty infiltration in the submucosa suggests subacute to chronic IBD
  - Small bowel and Colon can be affected.
  - Detected comparing fat-sat and non-FS sequences or using chemical shift comparing HASTE with FISP images.
  - This finding in isolation without history of IBD is much more likely to be seen in obese patients so interpret with caution if found incidentally.

T2 HASTE and FISP demonstrate use of chemical shift artifact to detect submucosal fat.

Progressive enhancement on multiple sequential Ax VIBE post-contrast images.

Stratified Enhancement

Homogeneous Transmural Enhancement
MR ENTEROGRAPHY Findings for IBD

• Pseudosacculation/Pseudodiverticula
  • Result of relative sparing of the antimesenteric border w/ asymmetric fibrosis

• Comb Sign
  • Increased mesenteric vascularity
  • FISP – short low signal parallel lines perpendicular to bowel.
  • VIBE – Intensely enhancing parallel lines

• Mesenteric Edema
  • Advanced active disease
  • Edema tracks centrally from involved inflamed loop.

Multiple Pseudodiverticula with asymmetric thickening and enhancement along the mesenteric border and mesenteric edema.

Comb Sign on FISP

Mesenteric Edema assoc with Terminal Ileal wall thickening

Fat Wrapping/hypertrophy

• Increased mesenteric fat producing mass effect
• Asymmetrically involved mesenteric border
• Longstanding transmural inflammation

• Lymph Nodes
  • Best seen on FISP sequence
  • Hyperenhancing, Enlarged, or Edematous nodes especially seen on HASTE images are highly suggestive of active disease.
  • Necrotic nodes are rare and suggest an alternate diagnosis such as Histo or TB

Lymphadenopathy on T2 HASTE and FISP Coronal

MR ENTEROGRAPHY Findings for IBD
MR ENTEROGRAPHY Findings for IBD

- Fistulae
  - High T2 signal tracts between structures
  - Typically intensely enhance with GAD
  - Enterocolic and Enteroenteric: detection using these two sequences has sensitivity of 71-83%.
  - Connection to other hollow viscera (e.g., bladder) may be better assessed with a dedicated examination.
- Sinuses
  - Blind-ending tracts. May be associated with or mislead as abscesses.
- Enterocolonic fistula
  - Offices the colon accurately. Due to field inhomogeneity at edge of FOV, differences in SNR between patient and in-room calibration may occur. Fistulography with patient in different position may help.
- Enterocutaneous fistulae
  - Small fistulae may not be detected by MR but may be visible with dynamic contrast imaging, which can detect early filling of segments.

Abscess
- Abnormal rim-enhancing fluid collection which may or may not contain low signal gas.
- MR detection approaches 100% sensitivity.
- Detection is critical as this is a contraindication to anti-TNF therapies such as Remicade.

Colon
- Often suboptimally evaluated due to retained feces. Bowel prep may help but patient compliance becomes a problem with exam. Usually not a clinical issue as these patients typically have had a recent colonoscopy.

Perianal disease
- Abscesses/Fistulae/Sinuses are all well demonstrated with MR and a dedicated perianal exam can be performed concurrently with MRE if necessary for surgical planning.

Summary
- Reviewed the types of imaging findings visible on MR enterography, also applicable to CT enterography.

Questions?
THE END