MRE

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Disclosure
• Nothing to disclose

Educational Objectives
• To review the indications for MRE and how it compares to other modalities used for the evaluation of the small bowel
• Review basic protocol and techniques for MRE
• Understand the imaging findings of the multiple inflammatory stages of Crohn disease and their basic treatment strategies
• Discuss the role of MRE in evaluating the colon
• Be able to identify and avoid pitfalls of MRE imaging

What is MRE used for?
• Imaging of the small bowel, typically Crohn disease.
  • Approx. 400,000-600,000 people affected in North America
  • Peak age of onset in the 2nd-4th decades of life.
• Imaging is commonly used to distinguish Crohn disease from other conditions.
• Imaging provides supportive evidence for the diagnosis along with clinical assessment

What is MRE used for?
• Less commonly used for other small bowel diseases
  • Enteritis
  • Celiac disease
  • Ischemia and vasculitis
  • Neoplasm
  • Small bowel obstruction and adhesions
  • Systemic sclerosis
Imaging Modalities Used for Evaluation of the Small Bowel

<table>
<thead>
<tr>
<th>Modality</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoroscopy - Small bowel follow through and enteroclysis</td>
<td>• Good depiction of early bowel disease, ulceration and fistula • Good distension with enteroclysis</td>
<td>• No extraluminal findings • Radiation • Time consuming • Operator and patient dependent</td>
</tr>
<tr>
<td>CT Enterography</td>
<td>• Fast • Multiplanar reformats • Extraluminal findings</td>
<td>• Radiation • Iodinated contrast • Limited multiphasic ability</td>
</tr>
<tr>
<td>Capsule endoscopy</td>
<td>• Direct visualization of mucosa • Ability to biopsy • Minimal patient discomfort</td>
<td>• No extraluminal findings • Restricted use in cases of bowel structure • Difficult lesion localization</td>
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<tr>
<td>Ileocolonoscopy</td>
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Ultrasound

- No radiation
- Cost effective
- Widely available
- Operator dependant
- Not all portions of the bowel are able to be imaged
- Difficult comparing across studies

Scintigraphy (Tc-99m white blood cell)

- Radiation
- Long duration of exam

Benefits of MRE

- No radiation
- Good for young patient population who are imaged frequently
- Demonstrates mural and extra mural changes
- Distinguishes active disease and treatment response
- Multiplanar primary imaging datasets
- Safer contrast profile
- Can depict bowel motility
- Differentiate fixed stenosis versus transient peristalsis
- Differentiate need for surgical versus medical management

Disadvantages of MRE

- Long scan times
- Difficulty with adequate bowel distension and patient motion
- May not be readily available outside of the US
- Higher cost

Diagnostic Accuracy across Modalities

<table>
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<tr>
<th>Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
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<tbody>
<tr>
<td>MRE</td>
<td>93.0%</td>
<td>99.8%</td>
</tr>
<tr>
<td>CTE</td>
<td>84.1%</td>
<td>95.1%</td>
</tr>
<tr>
<td>US</td>
<td>89.7%</td>
<td>95.6%</td>
</tr>
<tr>
<td>Scintigraphy</td>
<td>87.8%</td>
<td>84.5%</td>
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American College of Radiology: ACR Appropriateness Criteria®

http://www.acr.org/~/media/d407b89280354e86b0d90f9177b195de.pdf
Protocols and Techniques

- Oral contrast
  - Low density barium biphasic oral contrast medium
  - Low signal on T1WI, creating contrast between the enhancing bowel wall and the lumen
  - High signal on T2WI, allowing evaluation of the lumen diameter and bowel wall defects
- Other biphasic agents:
  - Water, methylcellulose, mannitol (2.5%), sorbitol (2%), and polyethylene glycol

Protocols and Techniques

Pros Cons

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<td>-Improved bowel distension and depiction of strictures</td>
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Protocols and Techniques

- Distension of the small bowel is key
- Patients are asked to fast for 6 hours allowing for better tolerance of oral contrast ingestion
- Ingestion is done 45 minutes prior to the exam giving time for distal transit
  - Oral contrast volume can vary up to 2L
  - At my institution: 900ml over the course of 30min
  - Followed by a cup of water just prior to scan

Protocols and Techniques

- Glucagon- relaxes the smooth muscles of the GI tract and decreases peristalsis
  - Typically 1mg of glucagon. Timing and route of administration (IM vs. IV) varies
  - At my institution: .5mg IM prior to scan and .5mg IV prior to post contrast imaging

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<td>-Variable bowel distension</td>
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Protocols and Techniques

- Sequences
  - At my institution:
    - 1.5T GE scanner using a body array coil
    - Axial and coronal SSFP (FIESTA) with and without fat saturation (delineates the bowel from the mesentery)
    - Axial and coronal T2 SSFSE fat sat with breath hold (to assess for mural edema)
    - Axial and coronal T1 Gradient Echo fat sat with breath hold pre- and post contrast
    - Coronal at 30s, axial at 60 and 90s, coronal at 2 and 3min.

Protocols and Techniques

- Peak bowel enhancement varies
- Some institutions perform Cine SSFP (FIESTA) sequences

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<td>-Improved gastric emptying and bowel distention</td>
<td>-Variable bowel distension</td>
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Protocols and Techniques
- DWI/ADC sequences are also being studied
  - Increased detection of active inflammation and differentiation from fibrosis
  - Extent of disease

Imaging Classification

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<tr>
<th>Subtypes</th>
<th>Active Inflammatory</th>
<th>Fistulizing/Perforating</th>
<th>Fibrostenotic</th>
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<td>Active Inflammatory</td>
<td>Superficial aphthous ulcers, Deep ulcers, Wall edema, Obstruction, Increased mesenteric vascularity, Reactive mesenteric lymphadenopathy</td>
<td>Sinus tract, Fistula formation, Abscess</td>
<td>Mild versus severe stenosis, Lack of wall edema, Post stenotic dilatation</td>
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Active Inflammation
- Superficial aphthous ulcers can be difficult to detect at MR imaging
  - Can be seen at colonoscopy
- Secondary signs of inflammation are more conspicuous.
  - Bowel wall thickening
  - Target sign
    - Mucosal hyperemia
    - Submucosal/serosal edema- intermediate SI on T1 and high SI on T2
    - Serosal hyperemia
Active Inflammation

- Increased mesenteric vascularity
  - Comb sign
- Mesenteric lymphadenopathy
Active Inflammation

- Deep ulcers
  - When interspersed between normal mucosa create a cobblestone pattern
  - Mesenteric border preferentially affected
- “Skip lesions”
- Fat proliferation
  - Separation of bowel loops

Active Inflammation: Treatment

- Managed medically
  - Corticosteroids
  - Antibiotics
  - Aminosalicylates
  - Immune modulators
- Approaches vary depending on the severity
Fistulizing/Perforating

- Sinus tract
  - Enhancing walls

- Fistula formation
  - May contain air or proteinaceous fluid
  - Enhancing walls
  - High T2 SI tract
  - Can have a stellate configuration

Fistulizing/Perforating

- Abscess
  - Enhancing walls
  - May contain air and proteinaceous fluid
  - Restricts diffusion
Fistulizing/Perforating: Treatment

- Antibiotics
- Percutaneous drainage if accessible
- Surgical drainage if necessary
- Contraindicated to use corticosteroids or anti-TNF therapy if abscess present

Fibrostenotic

- Mural Fibrosis
  - Fixed mural thickening
  - No increased T2 signal intensity
  - Low level heterogeneous enhancement

- Stricture formation
  - Fixed luminal narrowing
  - Functionally significant-upstream bowel dilatation
  - Nonfunctional- >10% narrowing without dilatation

- Obstruction
Fibrostenotic: Treatment

- Surgical resection
- Stricturoplasty
  - Prevents multiple resections and short bowel syndrome

Active Inflammation vs. Fibrostenotic

<table>
<thead>
<tr>
<th>Feature</th>
<th>Active Inflammation</th>
<th>Fibrostenotic Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucosal inflammation</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Mucosal enhancement</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Non-enhanced enhancement</td>
<td>absent</td>
<td>Present</td>
</tr>
<tr>
<td>Mucosal edema</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Intestinal stenosis</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Neutrophil infiltration</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Lymphoid hyperplasia</td>
<td>No</td>
<td>Present</td>
</tr>
<tr>
<td>Fatty infiltration</td>
<td>Present</td>
<td>Absent</td>
</tr>
</tbody>
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Following Treatment Response and Disease Recurrence

- Clinical determination of disease progression/regression is imperfect
- MRE findings include a reduction in:
  - Wall thickness
  - Submucosal edema
  - Mucosal enhancement
  - Size and number of lymph nodes and mesenteric hyperemia

Following Treatment Response and Disease Recurrence

- Neoterminal ileum disease recurrence is seen in 80% of postsurgical iliocolonic resection cases within the first year
- Patients with more severe disease after resection have a worse prognosis
- Mucosal healing is associated with improved long term outcome and a lower need for abdominal surgeries
Colon Findings

- Colon only involvement is present in 20%-30% of patients with Chron disease
- 40%-50% of patients have combined involvement of the colon and the small-bowel
- The large bowel is not the focus of MRE because of its accessibility via endoscopy
  - MRE is a compliment to colonoscopy not a replacement

Colon Findings

- Limitations of colonic evaluation
  - No bowel preparation with MRE, so feces can limit evaluation
  - Colonic distension is not optimized

- Imaging findings similar to small bowel
  - Bowel wall hyperemia and increased thickness
  - Pericolonic lymph nodes
  - Loss of haustral folds
Imaging Pitfalls

- **Poor distention**
  - May mask early inflammatory changes or mimic disease
  - Cine images helpful
  - Can repeat with additional oral contrast

- **Food debris or increased peristalsis causing intra-luminal filling defects**
  - Can be mistaken for polyps
  - Use antispasmodic agents

Sequela

- **60% fold increased risk for small bowel adenocarcinoma**
  - Patients are of a younger age than de novo
  - Men 2-3 times greater risk than women

- **Increased risk for colonic adenocarcinoma**
  - With longer duration of colitis
  - Greater anatomic extent of inflammation
  - Concomitant presence of other inflammatory manifestations

- **Anti-inflammatory drugs may prevent the development of colorectal cancer**

References

References


References

• American College of Radiology Appropriateness criteria: Last review date 2011.

References