DIRECT MR AND CT CORRELATION IN PATIENTS PRESENTING EMERGENTLY WITH ACUTE ABDOMINAL PAIN

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Background and Purpose

- MR is becoming increasingly relevant for the evaluation of patients presenting emergently with non-traumatic acute abdominal pain.
- Compared to CT, which remains the workhorse for acute abdominal pain, MR offers increased soft tissue contrast as well as zero ionizing radiation, which can be desirable in younger patients and pregnant patients.
Background and Purpose

• The purpose of this exhibit is simple: to show examples of MR emergently presenting acute abdominal pathology with CT (and occasionally other imaging modality) correlation.

• Our current acute abdomen MR protocol requires less than 15 minutes of table time and includes:
  – Coronal (Cor) and Axial (Ax) T2 Single Shot Fast Spin Echo (SSFSE) pre-contrast
  – Ax T2 SSFSE with fat suppression (FS) pre-contrast
  – Ax T1 (FS) pre-contrast
  – Cor T1 post-contrast (+C, 90 sec delay)
  – Ax T1 +C (3 min delay)
  – Diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) map
Background and Purpose

• All cases are from our prospective MR-CT clinical trial evaluating non-pregnant teenage and adult patients who present to our Emergency Department with signs and symptoms concerning for acute appendicitis.

• As you will see, MR is capable of diagnosing not only acute appendicitis but a number of similarly-presenting alternative diagnoses as well.

• MR and CT images are shown side-by-side to illustrate differences and similarities between the modalities. Enjoy!
Diagnosis: **Uncomplicated acute appendicitis**. MR images show appendiceal wall thickening and enhancement (→). An appendicolith is seen near the appendiceal tip (→). The patient underwent appendectomy and recovered uneventfully.
Case 2: 33-year-old male with LLQ pain and leukocytosis.

Diagnosis: **Uncomplicated sigmoid diverticulitis.** MR demonstrates sigmoid colon wall thickening (→) and surrounding inflammatory change (→). The diagnosis is confirmed at CT. The patient received antibiotics and recovered.
Case 3: 65-year-old male with crampy abdominal pain and vomiting.

Diagnosis: **Acute cholecystitis.** MR images show a thickened, enhancing gallbladder (→) with pericholecystic inflammation (→), confirmed at CT and ultrasound. Note that gallbladder sludge (→) is better seen on MR while the patient’s gallstone (→) is better seen at CT.
Case 4: 27-year-old female with sharp RLQ pain.

Diagnosis: **Ovarian torsion.** MR and CT show enlargement of the right ovary (→) compared to the left (→). A prominent cyst better seen at MR (→) may have served as a lead point. Power Doppler ultrasound shows preservation of flow. The ovary was salvaged with operative detorsion and ovarian cystectomy.
Case 5: 24-year-old male with RLQ pain and vomiting.

Diagnosis: **Symptomatic urolithiasis.** MR shows right pelvocaliectasis (→) but little else. CT confirms hydronephrosis with multiple kidney stones, including a 3-4 mm stone in the distal right ureter (→), as well as a delayed right nephrogram. Note the normal appendix on both CT and MR images (→).
Case 6: 27-year-old male with high fever and four days of abdominal pain.

Diagnosis: **Perforated acute appendicitis with early abscess formation.** MR and CT images demonstrate an enlarged, hyper-enhancing appendix (→) with surrounding inflammatory changes. A small rim enhancing fluid collection represents early abscess formation (→).
Case 7: 22-year-old female with LLQ pain with vomiting.

Diagnosis: **Epiplioic appendagitis.** MR images show a focus of peripheral T2 hyperintensity and enhancement with central fat signal (→), associated with the descending colon (→). Findings are consistent with a torsed and inflamed epiploic appendage, confirmed at CT.
Case 8: 18-year-old female with diarrhea and RLQ pain.

Diagnosis: **Infectious colitis.** Colonic wall thickening (→) and pericolonic inflammatory changes (→) are noted within the right colon. The appendix is difficult to visualize on MR but is normal at CT (→). The patient recovered with conservative management.
Case 9: 30-year-old female with abdominal pain, fever, and leukocytosis.

Diagnosis: Pelvic inflammatory disease with ovarian abscess. MR images show a rim-enhancing fluid collection (→) within the right ovary (→), not well seen on CT. Ultrasound confirms MR findings (→). While a corpus luteum could appear similarly, clinical suspicion was high. *Chlamydia* PCR was positive.
Case 10: 81-year-old female with generalized abdominal pain and diarrhea.

Diagnosis: **Ischemic Colitis.** MR images show edema and increased enhancement of the distal transverse and descending colon (→), confirmed at CT. Note diffusion restriction on DWI (→) with signal dropout on ADC (→). The proximal colon enhances normally on both MR and CT (→).
Case 11: 33-year-old male with RLQ pain, anorexia, and nausea.

Diagnosis: **Acute uncomplicated appendicitis.** MR images show a vividly enhancing appendix within the right lower quadrant (→). Increased T2 signal in the right lower quadrant reflects periappendiceal edema (→). The appendix is minimally dilated (→) with only subtle stranding at CT.
Case 12: 21-year-old male with periumbilical abdominal pain.

Diagnosis: **Meckel’s diverticulitis.** In a challenging case for MR, a fluid-filled, inflamed Meckel’s diverticulum is visualized (→) and is significantly easier to see on CT with positive oral contrast. Enhancement in the region of the Meckel’s diverticulitis is noted on post-contrast T1 images (→).
Case 13: 23-year-old female, previously healthy, with new abdominal pain.

Diagnosis: **Terminal ileitis in Crohn’s Disease.** MR images show thickening and inflammation of the terminal ileum (→) with lymphadenopathy (→), confirmed at CT. DWI images show diffusion restriction (→) with signal dropout at ADC (→). Endoscopic biopsy revealed a new diagnosis of Crohn’s disease.
Diagnosis: **Acute cholecystitis.** In this relatively subtle example, MR demonstrates cholelithiasis (→) with a sliver of pericholecystic fluid (→) on T2 images. CT demonstrates subtle pericholecystic inflammation (→). The gallbladder is never visualized at scintigraphy (→), confirming acute cholecystitis.

Case 14: 47-year-old male with abdominal pain, nausea, and vomiting.
Diagnosis: **Dermoid with ovarian torsion.** MR shows a right ovarian with a prominent cystic component (→), confirmed at ultrasound. Careful evaluation reveals a small focus of fat, which is suppressed on fat saturated images (→), and is also seen at ultrasound. CT also confirms foci of calcification (→).
Case 16: 45-year-old male with right abdomen/flank pain and leukocytosis.

Diagnosis: **Symptomatic urolithiasis.** MR images demonstrate right perinephric stranding (→) and mild right pelviectasis (→). CT confirms these findings and additionally reveals the offending 3 mm kidney stone within the distal right ureter, which is not well-seen on MR (→).
Case 17: 43-year-old female with RLQ pain and mild leukocytosis.

Diagnosis: **Possible tip appendicitis.** MR images show a normal-diameter appendix with enhancement of only the appendiceal tip (→). No findings of acute appendicitis are seen at CT (→). The patient was given antibiotics empirically and improved.
Case 18: 22-year-old female with RLQ abdominal pain during menstruation.

Diagnosis: **Hemorrhagic endometrioma.** MR images show a non-enhancing mildly T1 hyperintense right adnexal mass (→) with fluid-fluid level on T2 (→). CT findings are nonspecific. Note the through transmission (→) and lack of flow at ultrasound. Pathology yielded endometriosis with hemorrhage.
Case 19: 55-year-old male with lower abdominal pain, diarrhea, and nausea.

Diagnosis: **Right colon diverticulitis.** MR images show a focus of gas (→), manifesting as susceptibility artifact, within a region of inflammation (→) adjacent to the ascending colon. CT confirms acute diverticulitis with possible small perforation. A normal appendix (→) is seen on both MR and CT.
Case 20: 43-year-old male with periumbilical pain.

Diagnosis: **Omental Infarction.** MR demonstrates focal inflammation adjacent to the anterior abdominal wall (→). Note that the lesion contains fat, which is suppressed on fat-saturated images.
Case 21: 48-year-old female with RLQ pain and history of menorrhagia.

Diagnosis: **Degenerating uterine fibroid.** MR images demonstrate multiple uterine masses which are low in signal on both T1 and T2 (→), consistent with uterine fibroids. However, a single centrally non-enhancing mass is also noted at both CT and MR (→), consistent with fibroid degeneration.
Case 22: 13-year-old male with RLQ pain, vomiting, and fever.

Diagnosis: **Uncomplicated acute appendicitis.** MR images show a dilated, enhancing appendix (→) with periappendiceal inflammation (→). Diffusion restriction on DWI (→) is confirmed by signal dropout on ADC (→). While often reassuring, note the presence of gas within this clearly abnormal appendix.
Diagnosis: **Angioedema related to ACE inhibitor use.** MR images show multiple loops of edematous bowel (→) and ascites (→) in the lower abdomen. Note diffusion restriction within the wall of the edematous bowel (→). The patient had a history of hypertension treated with ACE inhibitors.
Case 24: 59-year-old female with lower abdominal pain and fullness.

Diagnosis: **High grade ovarian carcinoma**. MR images show an enhancing, heterogeneous, T1 isointense, T2 hypointense left adnexal mass (→), confirmed at CT. Ultrasound shows a heterogeneous solid mass with internal flow (→). Biopsy revealed high grade serous ovarian carcinoma.
Conclusions

• As MR techniques continue to improve and the modality becomes more available, the role of MR in emergent imaging of the acute abdomen will continue to increase, especially in younger and pregnant patients.

• Specific diagnoses can be made at MR for a number of commonly presenting causes of acute abdominal pain.

• However, as demonstrated, some entities can be subtle at MR and judicious selection of initial and follow-up imaging modality is critical for optimal patient care.

• We hope you have enjoyed this presentation of acute abdomen MR imaging findings with multimodality correlation.
Thank you!