Infection in the Terminal Ileum: Typhoid Fever

John Weems, Harvard Medical School Year III
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Agenda

• Patient Presentation
• Menu of Radiologic Tests
• Imaging Findings
• Anatomy and Histology: Terminal Ileum
• Differential Diagnosis: Terminal Ileitis
  – Exhaustive differential
  – Narrowed differential
• Companion Cases
• Typhoid Fever:
  – Pathophysiology and Radiographic Features
• Patient Outcome
  – f/u CT scan comparison
Patient Presentation

CC: 32F p/w 6 days of fevers, malaise, headache

HPI: Spent 2 months in Haiti, returned to US day of presentation. Ate raw salad approx. 21 days ago.

No significant PMH

ROS: Denies n/v, diarrhea
Patient Presentation

Focused Physical Exam:
- Tm 102 HR 114 BP 109/64 RR 16

Labs:
- WBC 3.8 ALT 193 AST 164
- Negative hepatitis serologies
- Negative parasite smear
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Menu of Radiologic Tests: RUQ Pain

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
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</thead>
<tbody>
<tr>
<td>US abdomen</td>
<td>9</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>CT abdomen with contrast</td>
<td>7</td>
<td>See statement regarding contrast in text under “Anticipated Exceptions.”</td>
<td>⬤⬤⬤⬤</td>
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<tr>
<td>MRI abdomen without and with contrast</td>
<td>6</td>
<td>This is performed if US is inconclusive.</td>
<td>O</td>
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<tr>
<td>Cholecintigraphy</td>
<td>6</td>
<td>This can be both diagnostic and therapeutic, particularly with ICU patients. Consider using this for the nonoperative patient or if other causes of sepsis have been excluded. This usually requires imaging first. It is performed only in certain patients (elderly, immunocompromised, etc.).</td>
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<tr>
<td>Percutaneous cholecystostomy</td>
<td>6</td>
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<td>Varies</td>
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<td>MRI abdomen without contrast</td>
<td>5</td>
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<tr>
<td>CT abdomen without contrast</td>
<td>4</td>
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<td>CT abdomen without and with contrast</td>
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Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Advantages of Ultrasound: convenience, lack of ionizing radiation, ability to confirm absence of gallstones, evaluation of bile ducts, and identification OR exclusion of acute cholecystitis

UNDERLYING MEDICAL CONDITION:
History: 32F with left abnormalities, fever
REASON FOR THIS EXAMINATION:
evaluate for acute hepatobiliary disease, evaluate for splenomegaly. no need for aorta or renal eval
CONTRAINDICATIONS FOR IV CONTRAST:
None.

Results: NORMAL
Menu of Radiologic Tests cont’d

Computed Tomography
Although it has not been advocated as a primary imaging examination for acute right upper quadrant pain, CT can confirm or refute the diagnosis of AC in equivocal cases based on US and/or scintigraphy and reveal such complications as gangrene, gas formation, intraluminal hemorrhage, and perforation [6-8,15-19]. Furthermore, CT has been advocated as a useful modality in preoperative planning, with the absence of gallbladder wall enhancement and/or presence of a stone within the infundibulum associated with conversion from laparoscopic to open cholecystectomy. Prior knowledge of these imaging findings may therefore help guide appropriate surgical approach [20].

Clinical conditions that can mimic AC, in terms of presentation with acute right upper quadrant pain, include chronic cholecystitis, peptic ulcer, pancreatitis, gastroenteritis, and bowel obstruction, among others. If US and/or scintigraphy are negative for AC and there is no alternative diagnosis, CT, preferably with intravenous contrast, is the next preferred imaging examination for identifying those disorders. When a diagnosis of AC is not prospectively suspected, CT may also be used to demonstrate AC in patients who have nonspecific abdominal pain.

? Small Bowel Follow-Through?
• Indicated for evaluation of upper abdominal pain
• Time is required for prep
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Our Patient: Terminal Ileitis on CT

Symmetric, homogenous wall thickening with associated fat stranding suggesting inflammation of TI and Cecum

Axial C+ Abdominal CT *PO contrast withheld, BIDMC PACS

Coronal C+ Abdominal CT *PO contrast withheld, BIDMC PACS
Our Patient: Luminal Narrowing on CT

Comparative lumen aperture in terminal ileum vs. proximal small bowel

Coronal C+ Abdominal CT *PO contrast withheld

BIDMC PACS
Our Patient: Bowel Wall Thickening on CT

Wall thickening in Terminal Ileum and Cecum
Our Patient: Additional Imaging Findings

Gallbladder wall and periportal edema

Free intraperitoneal fluid

Coronal C+ Abdominal CT *PO contrast withheld
Our Patient: Mesenteric Lymphadenopathy

Mesenteric Lymph nodes

Warning: Not for diagnostic use

Coronal C+ Abdominal CT *PO contrast withheld, BIDMC PACS
Our Patient: Summary of Findings

Symmetric, homogenous wall thickening with associated fat stranding suggesting inflammation of TI and Cecum

Gallbladder wall and periportal edema

Free intraperitoneal fluid

Mesenteric lymphadenopathy
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Terminal Ileum: Anatomy and Histology

Superior Mesenteric vein
Terminal Ileum
Cecum
Appendix

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• **Differential Diagnosis: Terminal Ileitis**
  – Exhaustive differential diagnosis
  – Narrowed differential diagnosis
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Terminal Ileitis: Differential Diagnosis

Appendicitis
Carcinoid
Crohn’s disease
Intussusception
  Mass, extrinsic (e.g., ovarian or other pelvic neoplasm; aneurysm of iliac artery)
Meconium ileus (cystic fibrosis {mucoviscidosis})
Nodular lymphoid hyperplasia; normal lymphoid follicles
Diverticulitis
Endometrial implant
Food particles; foreign body; gallstone
Fungus disease (e.g., actinomycosis; histoplasmosis)
Intramural hematoma
Laxative abuse
Meckel’s diverticulum
Mesenteric infarction; ischemic enteritis
Metastasis (esp. from gastric, colonic or ovarian neoplasm)
Neoplasm, benign or malignant (e.g., gastrointestinal stromal tumorg; carcinoma; sarcoma; lymphomag)

Parasitic disease
  Intraluminal worms (e.g., Ascaris; tapeworm—
  Taenia saginata)
  Inflammatory changes (e.g., schistosomiasis;
  amebiasis; strongyloidiasis; rarely giardiasis; intestinal
capillariosis; anisakiasis; angiostrongyliasis costaricensis)
Polyp
Radiation enteritis
Tuberculosis
Typhoid fever
Ulcerative colitis (“backwash ileitis”)
Yersinia enterocolitis

Differential Diagnosis: Pertinent Positives

Appendicitis
Carcinoid
Crohn's disease
Intussusception
Mass, extrinsic (e.g., ovarian or other pelvic neoplasm; aneurysm of iliac artery)
Meconium ileus (cystic fibrosis [mucoviscidosis])
Nodular lymphoid hyperplasia; normal lymphoid follicles
Diverticulitis
Endometrial implant
Food particles; foreign body; gallstone
Fungus disease (e.g., actinomycosis; histoplasmosis)
Intramural hematoma
Laxative abuse
Meckel's diverticulum
Mesenteric infarction; ischemic enteritis
Metastasis (e.g., from gastric, colonic or ovarian neoplasm)
Neoplasm, benign or malignant (e.g., gastrointestinal stromal tumor; carcinoma; sarcoma; lymphoma)
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Polyp
Radiation enteritis
Tuberculosis
Typhoid fever
Ulcerative colitis ("backwash ileitis")
Yersinia enterocolitis

Mesenteric Lymphadenopathy + symmetric, homogenous wall thickening

Age, travel history, onset, immune status, accompanying symptoms

Yersinia enterocolitis

Narrowed Differential Diagnosis

Crohn’s disease

Lymphoma

Tuberculosis

Typhoid fever

Yersinia enterocolitis

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Companion Case 1: Crohn’s Disease

- Wall thickening and mucosal enhancement
- Dilated Loops with air/fluid levels
- Transition point

Sagittal C+ Abdominal CT *PO contrast withheld
Axial C+ Abdominal CT *PO contrast withheld

*BIDMC PACS*
Companion Case 2: Yersinia Enterocolitis

Normal appearance of Appendix

Wall thickening

Enlarged mesenteric lymph node

Coronal C+ Abdominal CT

http://radiopaedia.org/cases/ileitis-yersinia-enterocolitica-infection
Companion Case 3: Small Bowel Lymphoma

Homogenous bowel wall thickening + Infiltration of myenteric plexus → aneurysmal dilatation

Coronal C+ Abdominal CT

Courtesy of Dr. Kung
Companion Case 4:
Gastrointestinal Tuberculosis

Dilated Terminal Ileum with prominent wall enhancement

Multiple hypodense, necrotic lymph nodes with associated mesenteric fat stranding.

Coronal C+ Abdominal CT
Axial C+ Abdominal CT

http://radiopaedia.org/cases/tuberculous-appendicitis-terminal-ileitis-and-necrotic-mesenteric-lymph-nodes
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Typhoid Fever

Microbiology:

• Typhoid or Enteric fever only arises from Salmonella typhi and S. paratyphi serovars. Humans are only known hosts

• Distinct from gastroenteritis-causing strains of Salmonella, a common cause of diarrheal illness in the US

Epidemiology:

• Typhoid fever in the US found only in travellers and immigrants from endemic regions (including Haiti)

**Most patients present WITHOUT GI Symptoms!**

Source: Harrison’s Principles of Internal Medicine
Typhoid Fever: Pathophysiology

Inoculum must be sufficient to overcome gastric pH

Invades mucosal cells via injectosome, actin rearrangement, and phagocytosis. Transits through enterocytes into underlying lymphoid tissue.

*Source: Harrison’s Principles of Internal Medicine*
Typhoid Fever: Pathophysiology

Phagocytosed by macrophages, then travel throughout mesenteric lymphatics to reticulo-endothelial system

Colonize to liver, spleen, through thoracic duct into blood stream

Ileal inflammation and clinical consequences due to monocyte infiltration
Typhoid Fever: Terminal Ileitis

Coarsely nodular and serpiginous mucosal pattern of terminal ileum

Small Bowel Follow Through

Complications of Typhoid Fever: Perforation

Perforation → Free Peritoneal Air

Mesenteric lymphadenopathy

Axial C+ Abdominal CT

Coronal C+ Abdominal CT

Ulceration and Perforation of Ileum → Contrast Extravasation

Pathophysiology of Perforation

Early stage: Peyer patches of ileum swollen and inflamed

Advanced: slough cast off; ulcer base on muscularis

Perforation
Complications of Typhoid Fever

Splenic Abscess

Hepatosplenomegaly

Renal abscess, before and after IV antibiotics

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Our Patient: Outcome

Initial blood tests returned positive for GNR--> IV ABx

Cultures returned positive for S. Typhii

Discharge after stabilization

f/u imaging at 8 weeks
Follow-Up CT Abdomen with Contrast

Recv’d typhoid vaccine before returning to Haiti

DPH required negative stool culture x3 before returning to work

Resolving lymphadenopathy 13.4mm x 8.7mm from 18.5mm x 25.4mm
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Acknowledgements

Justin Kung, MD
Gillian Lieberman, MD
Yuri Shif, MD
Joseph Singer
Komal Talati, MD
Amanda Trotter, MD
Numa Perez
Brian Powers, Kyle Checchi, Ana Warner