Beyond Diverticulitis: Complications and Pitfalls Related to Colonic Diverticular Disease

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Objectives

- Discuss the epidemiology and imaging manifestations of Colonic Diverticular Disease (CDD)
- Review the imaging features of complicated diverticulitis
  - Peridiverticular Abscess
  - Perforation/Peritonitis
  - Pylephlebitis
  - Pyogenic Liver Abscess
  - Fistula Formation
  - Diverticular Bleeding
  - Diverticular Stricture and Obstruction
  - Giant Colonic Diverticulum
Definitions

- **Colonic Diverticula**
  - Focal sac-like outpouching of the colonic wall
  - True Diverticula: involve all 4 layers (submucosa, mucosa, muscle, serosa)
  - False Diverticula (pseudodiverticula): submucosa and mucosa herniated through the muscularis propria covered only by serosa
  - Vast majority are false diverticula

- **Diverticulosis**: presence of multiple false diverticula *without clinical symptoms*

- **Colonic Diverticular Disease (CDD)**: *symptomatic* diverticulosis, including diverticulitis

- **Diverticulitis**: inflammation of the diverticula
Epidemiology

- Common in Western industrialized nations, uncommon in developing nations
  - Series have varied on prevalence of colonic diverticula in Western industrialized nations, ranging from 5-45% depending on age of the population
  - ~10% in patients younger than 40; 50-75% of patients older than 80
  - Difference between the prevalence rates is thought to be due to fiber content
    - Slow transit time $\rightarrow$ increased intraluminal pressure $\rightarrow$ formation of diverticula
  - 95% in the sigmoid colon in Western industrialized nations
  - Most common finding on optical and virtual colonoscopy
Typical Imaging Features of CDD

CTC without positive oral contrast (A, soft tissue windows and B, polyp windows), contrast enhanced CT with positive oral contrast (C) demonstrating multiple focal outpouchings (arrows) and associated wall thickening compatible with diverticulosis in its most common location (sigmoid).
Typical Imaging Features of CDD

Optical Colonoscopy: multiple focal sac-like outpouching in the colonic wall (arrow, A) typifies diverticulosis. Material can become impacted in diverticula (*, B) which can mimic a polyp on CTC (arrowheads, C, D).
Acute Uncomplicated Left-sided Diverticulitis

Transverse CT image (A) demonstrates multiple sigmoid colonic diverticula with surrounding inflammatory changes in the fat (arrows, A, C) and segmental colonic wall thickening (arrowheads, coronal CT, B) as well as hyperemia of mesocolic vasculature (circle, C).
Acute Uncomplicated Left-sided Diverticulitis

Single contrast enema of the sigmoid colon demonstrates multiple focal outpouchings compatible with diverticula (arrows) with associated segmental narrowing (circle), fold thickening and multiple intramural fistulae (arrowheads).
Right-sided and Cecal Diverticulitis

- Right-sided diverticulitis represents only represents 3-5% of all diverticulitis in United States
- Small subset involves the cecum
- Incidence is increasing due to migration of Asian populations where right sided disease is much more common
- May mimic appendicitis clinically, often seen in younger patients than left sided disease
- May have more indolent course than left-sided disease

Double contrast enema (A) demonstrated focal cecal wall and fold thickening (arrowhead), with inflamed cecal diverticulum seen on axial (B) and coronal (C) CT images (arrows).
Acute Uncomplicated Right-sided Diverticulitis

Inflamed diverticulum (arrow, A) with surrounding stranding and associated segmental mural thickening (arrowheads, B) of hepatic flexure on sagittal (A), axial and (B) coronal CT with oral and IV contrast.
Complicated Diverticulitis

- No unifying definition for complicated diverticulitis
  - **American Society of Colon and Rectal Surgeons**: Diverticular inflammation with free perforation, abscess, fistula, obstruction or stricture without phlegmon
  - **European Association for Endoscopic Surgeons**: Acute diverticulitis associated with bleeding, abscess formation, phlegmon, fistula and obstruction
- Complications common (see graph)
  - 300,000 hospital admissions
  - 1.5 million inpatients days
  - 2.4 billion dollars in direct costs
Peridiverticular Abscess

• Most common manifestation of complicated diverticulitis
  • 4% of all diverticulitis admissions
  • 29.5% of all complicated diverticulitis
• Current recommended initial treatment is percutaneous drainage with antibiotics for abscesses greater than 3cm (as seen in images below)
• Treatment failure may necessitate surgery
• Most common location is peri-sigmoid or pelvic location

Peri-sigmoid abscess
Drain placement
Follow up with near complete resolution
Peridiverticular Abscess

- CT: initial imaging modality for evaluation of suspected colonic diverticulitis
  - Low density (0-10HU), loculated, rim-enhancing fluid collection
  - Fluid may be higher density if leakage of positive oral contrast or bowel contents
  - Findings are often in addition to uncomplicated diverticulitis
  - Size: variable ranging from microabscesses (<2cm) to 15cm.
  - Internal Gas: may or not be present; if +, highly suggests superimposed infection
- MR: fluid intensity (T2W, T1W) with peripheral rim enhancement

Contrast enhanced axial (A) and coronal (B) CT images demonstrating acute sigmoid diverticulitis with peridiverticular peripheral enhancing fluid collection (abscess, arrows)
Perforation and Peritonitis

- Infectious or inflammatory involvement of the peritoneum
- Seen in approximately 15% of cases
- **Hinchey classification system** proposed in 1978 grades colonic perforation by severity
- Aids in therapeutic/surgical decision making

**Hinchey Classification**
- Hinchey I: localized abscess
- Hinchey II: pelvic abscess
- Hinchey III: purulent peritonitis
- Hinchey IV: feculent peritonitis

- Hinchey I and II treated conservatively with percutaneous drainage, antibiotics and supportive therapy
- Hinchey III and IV may require emergent sigmoid resection, although laparoscopic peritoneal lavage may be first attempted

Contrast enhanced axial CT images (A, B) demonstrate free air, ascites (*) and smooth peritoneal and serosal thickening and enhancement (arrowhead) with associated stranding of the adjacent mesentery. Similar findings in a second pt (C).
**Definition:** Infective thrombosis of the portal system
- Universally fatal in the before advent of antibiotics

**Pathogenesis:** begins as a thrombophlebitis of a small vein draining the area of infection in the abdomen/pelvis

**Epidemiology:** diverticulitis accounts for 33% of cases.

**Imaging Features:**
- Focal venous filling defect +/- intravascular air with associated abdominal or pelvic infectious process (arrows, images)
- Filling defect can occur in any of the draining veins (IMV, SMV) extending to the main portal venous system
Hepatic Abscess

- Liver abscesses are the most common type of visceral abscesses
- Relatively rare complication of diverticulitis
- Usually secondary to pylephlebitis

**CT:** hypodense mass with peripheral rim enhancement (red arrows)
  - Often associated with transient hepatic attenuation difference (THAD) secondary to adjacent hyperemia or pylephlebitis

**MR:** central T2W (green arrow) with peripheral rim enhancement (purple arrow), commonly extensive T2 hyperintensity (pink arrow) adjacent to the abscess compatible with edema (; may or may not demonstrate restricted diffusion (orange arrows)}
Axial CT images demonstrate cecal/right-sided diverticulitis (circle, A) with extensive thrombus in the portal vein (arrow, B), heterogeneous enhancement in the central liver and multiple round low attenuation collections in the right hepatic lobe compatible with pylephlebitis and multi-focal hepatic abscess (arrowheads, B, C).
Fistula Formation

- Definition: abnormal communication between at least two structures
- Occurrence in 14.1% of all complicated diverticulitis
- Locations (in order of frequency):
  1. Colo-vesical (most common)
  2. Colo-cutaneous
  3. Colo-uterine
  4. Colo-enteric
  5. Colo-vaginal

**Imaging Features:**
- Majority of fistulae are better demonstrated with conventional fluoroscopic contrast enhanced exam owing to better resolution and difficulty visualizing fistulas with routine endoscopy
- CT is often used as a replacement or an adjunct to evaluate the extraluminal fistula
  - Consider retrograde urinary bladder and/or rectal contrast to increase chances of the visualization
Colo-vesical Fistula

A. Fluoroscopic exam with positive contrast instilled into the urinary bladder with no evidence of fistula identified.

B. Single column enema demonstrating a colo-vesical fistula (arrow). Contrast flows from the larger to smaller viscus (start with an enema).

C. CECT demonstrates gas filled tract extending anteriorly from the urinary bladder to the sigmoid colon (arrow).
Colovesicle fistulas in multiple different patients. Axial CT image (A) demonstrates inflamed sigmoid with gas in the bladder and marked bladder wall thickening and surrounding inflammatory stranding. Sagittal CT image (B) demonstrates similar findings with an inflamed sigmoid closely apposed to a thickwalled bladder containing gas. Axial CT image (C) demonstrates contrast and gas in the bladder communicating with a contrast filled thick walled colon. Axial CT image (D) demonstrates stool in the bladder (arrow) in a patient with a large colovesicle fistula.
Colo-colonic Fistula

A. Single contrast barium enema, demonstrating thin, contrast-filled tract connecting two loops of the sigmoid colon compatible with colo-colonic fistula

B. Barium enema (different projection), redemonstrating fistulous tract extending between two adjacent loops of sigmoid colon
Colo-uterine Fistula

A. Coronal CT, demonstrates sigmoid mural thickening and mottled gas in both the uterus and adjacent sigmoid colon without definite fistulous communication (arrow)

B. Sagittal CT, redemonstration of apposition of sigmoid and uterus with mottled gas in endometrial cavity (arrow)

C. Sagittal CT, placement of a uterine catheter and injection of positive contrast, demonstrating opacification of sigmoid (*) compatible with fistula (arrow)

D. Frontal Fluoroscopic view, redemonstrates injection of catheter in uterus with filling of sigmoid colon (S).
Colo-vaginal Fistula

Multiple contiguous axial CT images with positive oral contrast (A-E), demonstrating abnormal opacification of the vaginal cuff extending to the sigmoid colon compatible with a colovaginal fistula (arrows)
Uncommon Fistula Formation

Colovenous fistula

Gastrocolic fistula

Colourachal fistula

Barium enema demonstrating opacification of large bowel and venous structures draining the sigmoid, pathognomonic for a colo-venous fistula

Barium enema fluoroscopic view demonstrating fistula from the transverse colon to the stomach compatible with colo-gastric fistula

Sagittal CT image, shows abnormal thick-walled, gas-filled communication from the sigmoid colon to a urachal remnant, a colo-urachal fistula
Diverticular Bleeding

- Lower gastrointestinal bleeding has an annual incidence 36/100,000
  - Most commonly due to diverticular disease
- Mechanism is not completely understood, but likely due to penetrating arteries with endothelial damage
- 3 to 15% of patients with diverticular disease will develop bleeding
- Majority (90%) of cases resolve spontaneously with conservative treatment; many recur
- May require endoscopy or interventional radiology
- In recurrent cases colectomy may be performed

Pre (A) and post (B) contrast axial CT images of the cecum demonstrate serpiginous high attenuation material arising from a diverticulum (arrow), tracking into the colon (***), compatible with active diverticular bleeding.
Diverticular Bleeding

Non contrast (A), portal venous (B) and delayed (C) post contrast images demonstrate a diverticulum with active extravasation (arrow) into the colon and into the adjacent pelvis with a large amount of associated hemoperitoneum (*) compatible with acute diverticular bleed in this hypotensive and critically ill patient. Patient subsequently underwent embolization (not shown).
Diverticular Stricture and Obstruction

- Diverticulitis results in approximately 10% of bowel obstructions.
- Causes include stricture due to spasm, edema, abscess, or fibrous stricture from recurrent/chronic disease.

- **CT:** Abnormal dilation of the bowel (A, red arrow) proximal to focal site of diverticulitis (B, green arrow).
- **Fluoroscopy:** Luminal narrowing (C, purple arrow) prior to placement of a fluoroscopically guided stent (D, pink arrow).
- Resection may ultimately be required (E, colon, orange arrow).
Axial CT images (A, B) demonstrated dilated small bowel and colon with transition seen in the region of the sigmoid colon (arrow, B). Enema confirmed diverticular stricture (arrows, C) as the cause of the obstruction with colonoscopy and subsequent resection demonstrating benign fibrotic stricture due to diverticular disease.
Giant Sigmoid Diverticulum

- Despite the high prevalence of colonic diverticular disease, giant colonic diverticula are relatively rare with only 135 cases described
- Vast majority (93%) occur in the sigmoid colon
- Most frequent clinical symptoms are chronic abdominal pain, nausea, vomiting, and melena
- Definitive treatment is resection with primary anastomosis

Axial CT images (A-C) demonstrate a large thickwalled diverticulum (*) arising from the sigmoid colon (arrow). Patient subsequently underwent percutaneous drainage (D-F).
Giant Sigmoid Diverticulum

- Radiography: generally large, nonspecific lucency or collection of gas (* A, B)
- Single Contrast Enema: only 60% will fill with contrast (C, *, no filling)
  - Smooth walls (if irregular, consider coexisting neoplasm)
- CT: thin walled cavity filled with gas, fluid and/or stool (*, D)
  - If thick wall and enhancement, consider coexisting diverticulitis
Colonic Diverticulosis is ubiquitous in Western countries and increasing in developing nations.

Diverticular disease is a symptomatic manifestation of diverticulosis.

Acute uncomplicated diverticulitis is a common reason for hospital admissions, prolonged inpatient stay, and results in consumption of significant healthcare resources.

Complicated diverticulitis (abscess, bleeding, fistula, obstruction, stricture, peritonitis, hepatic abscess, pylephlebitis) can prolong hospital stay and often require a surgical approach for definitive treatment.

Imaging features are important to recognize in order to triage appropriate management.
**References**