DIVERTICULAR DISEASE

DIAGNOSIS, COMPLICATIONS, AND MANAGEMENT

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LEARNING OBJECTIVES

• Review the anatomy and physiology of the large intestine
• Discuss diverticular disease and how it develops
• Recognize physical examination, diagnostic, and imaging tests for diverticulitis.
• Review complications of acute complicated diverticulitis
• Identify and implement appropriate antibiotic, conservative, and surgical therapies for diverticulitis.
ANATOMY

• Size:
  • 3 inches in diameter
  • 6 feet long

• Versus - Small intestine
  • One inch in diameter
  • 22 feet long

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ANATOMY

- Muscles:
  Separate layers of circular muscles and longitudinal muscles allow the intestine to contract in different ways
LARGE INTESTINE

- Includes:
  - Colon
  - Rectum
  - Anus

- Colon:
  - Cecum
  - Ascending
  - Transverse
  - Descending
  - Sigmoid

- No true division
### PERITONEAL SPACES

<table>
<thead>
<tr>
<th>Intraperitoneal</th>
<th>Retroperitoneal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures within the peritoneum</td>
<td>Structures outside the peritoneum</td>
</tr>
<tr>
<td>Organs are mobile</td>
<td>Organs are fixed into their location</td>
</tr>
<tr>
<td><strong>Includes:</strong></td>
<td><strong>Includes:</strong></td>
</tr>
<tr>
<td>esophagus, stomach, jejunum, ileum, cecum, appendix, transverse and sigmoid colon</td>
<td>duodenum, pancreas, kidneys, ascending and descending colon</td>
</tr>
</tbody>
</table>

- **Retroperitoneal:**
  - Ascending and descending colon

- **Intraperitoneal:**
  - Transverse colon and sigmoid colon, anterior upper two-thirds of rectum (remainder extraperitoneal)
Colon:
- Dehydrate liquified food to form stool – absorbing water and electrolytes during peristalsis
- Starts in cecum (first 6 inches of the colon) – ileocecal valve – when full this triggers peristalsis to begin
- Mostly solid when it arrives to the descending colon.
- Secretes mucus to bind and lubricate the food and help it pass smoothly as it is dehydrated
- Peristalsis process is much slower in colon than small intestine.
ARterial Anatomy

• Vascular anatomy of the ascending colon is more complex, and variable as compared to the left.

• Variations range from the mode of origin, branching to territorial supply.
DIVERTICULAR DISEASE
WHAT IT IS

- Outpouchings of mucosa and submucosa (false diverticula) that herniate through the colonic muscle layers
- Areas of high intraluminal pressure
- Sigmoid colon (ascending in Asian countries)
EPIDEMIOLOGY

• Incidence increasing
  • 1980 to 2007, the incidence increased from 115 to 188 per 100,000 person-years

• Prevalence of diverticular disease:
  • <10% in people 40 years vs. 80% in those older than 85 years

• Only 1% to 4% of patients with diverticular disease will develop diverticulitis in their lifetime.

• 88% uncomplicated, 12% complicated

RISK FACTORS/CAUSES

- Increasing age, constipation, low-fiber diet, smoking, red meat consumption, obesity, weight gain, lack of exercise, genetic susceptibility, and nonsteroidal anti-inflammatory drug and aspirin use.

- Infection or Inflammation???

- Possible causes include abnormal colonic motility, colonic wall resistance, intraluminal pressures, and colonic wall defects.

**MYTH:** Consumption of popcorn, nuts, and seeds is NOT a risk factor for developing diverticulitis.
SIGNS AND SYMPTOMS

- LLQ pain – most specific
- Fever
- CRP
- Other nonspecific: abdominal rigidity, anorexia, dysuria, hypoactive bowel sounds, rectal bleeding, or tenderness on rectal examination.
- Fecaluria, pneumaturia, pyuria, and stool per vagina should raise suspicion for fistula formation.
- Studies have found that right-sided diverticulitis is more common in Asian countries.

### TABLE 1

**Accuracy of Signs and Symptoms for the Diagnosis of Acute Diverticulitis**

<table>
<thead>
<tr>
<th>Signs and symptoms</th>
<th>LR+</th>
<th>LR−</th>
</tr>
</thead>
<tbody>
<tr>
<td>Localized tenderness only in the left lower quadrant</td>
<td>10.4</td>
<td>0.7</td>
</tr>
<tr>
<td>History of left lower quadrant pain</td>
<td>3.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Absence of vomiting</td>
<td>1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>History of fever</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Laboratory or imaging findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computed tomography*</td>
<td>94</td>
<td>0.1</td>
</tr>
<tr>
<td>Ultrasonography*</td>
<td>9.2</td>
<td>0.09</td>
</tr>
<tr>
<td>Magnetic resonance imaging*</td>
<td>7.8</td>
<td>0.07</td>
</tr>
<tr>
<td>C-reactive protein level &gt; 5 mg per dL (50 mg per L)</td>
<td>2.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Combination of left lower quadrant pain, the absence of vomiting, and a C-reactive protein level &gt; 5 mg per dL</td>
<td>18</td>
<td>0.65</td>
</tr>
</tbody>
</table>

LR− = negative likelihood ratio; LR+ = positive likelihood ratio.
* = LR+ relates to positive findings on imaging and LR− relates to negative findings on imaging.

Adapted with permission from Wilkins T, Embry K, George R. Diagnosis and management of acute diverticulitis. Am Fam Physician. 2013;87(9):614.
<table>
<thead>
<tr>
<th>Gastrointestinal</th>
<th>Gynecologic</th>
<th>Urinary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowel obstruction</td>
<td>Ectopic pregnancy</td>
<td>Nephrolithiasis</td>
</tr>
<tr>
<td>Colitis (infectious and ischemic)</td>
<td>Endometriosis</td>
<td>Urinary tract infection</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>Ovarian cyst</td>
<td></td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
<td>Pelvic inflammatory disease</td>
<td></td>
</tr>
<tr>
<td>Irritable bowel syndrome</td>
<td>Torsion</td>
<td></td>
</tr>
<tr>
<td>Perforation</td>
<td>Tubo-ovarian abscess</td>
<td></td>
</tr>
</tbody>
</table>
DIAGNOSTIC EVALUATION
INITIAL BLOOD TESTS

- Complete blood count
  - (White blood cell count may be normal in 45% of patients)
- Basic metabolic panel
  - Evaluate electrolyte and renal status
- Urinalysis
  - Rule out urinary tract infection
- C-reactive protein
  - (Level greater than 20 mg per dL [200 mg per L] is suggestive of perforation).
- Beta-human chorionic gonadotropin
  - Rule out pregnancy
- Lipase
  - Rule out acute pancreatitis.
  - Mild elevation in perforations
• Imaging should be considered if the diagnosis is uncertain or there is concern for complicated diverticulitis.

• If imaging is performed, **computed tomography with contrast is the diagnostic test of choice** because of its availability and high sensitivity (94%) and specificity (99%).

• Magnetic resonance imaging has good diagnostic accuracy and avoids radiation exposure but may not be as readily available as computed tomography.

• Ultrasonography can be effective in the diagnosis of diverticulitis, but operator experience affects accuracy. Its ability to assess for free air or the extent of large abscesses is limited.
GIANT DIVERTICULUM

sigmoid colon - 10.5 x 6.7 x 6.6 cm
MODIFIED HINCHHEY CLASSIFICATION SYSTEM

- Stage 0: mild clinical diverticulitis
- Stage 1a: confined pericolic inflammation-phlegmon
- Stage 1b: confined pericolic abscess (within sigmoid mesocolon)
- Stage 2: pelvic, distant intra-abdominal or intraperitoneal abscess
- Stage 3: Generalized purulent peritonitis
- Stage 4: Fecal peritonitis
Diverticula develop at sites of weaknesses in the colonic wall that occur where the vasa recta penetrate the circular muscle layer.

As a diverticulum herniates, the vasa recta drape over the dome of the diverticulum and become susceptible to trauma and disruption.
• Most common cause of lower gastrointestinal tract bleeding in adults

• Although diverticula typically occur throughout the colon, diverticular bleeding tends to occur in the thinner-walled ascending (right) colon

TREATMENT
UNCOMPLICATED ACUTE DIVERTICULITIS
For patients who have normal vital signs, are able to maintain oral intake, and have no signs of complications (e.g., peritonitis, fever), outpatient management is appropriate.

Antibiotics should not be used routinely in the treatment of uncomplicated diverticulitis.

A meta-analysis of nine randomized controlled trials with 2,505 patients showed that those treated without antibiotics had shorter hospital stays than those treated with antibiotics, and there was no difference in complication or readmission rates.

If symptoms do not improve after 48 to 72 hours, a broad-spectrum antibiotic against anaerobic and gram-negative rods should be initiated and typically continued for seven to 10 days.
OUTPATIENT: ORAL ANTIBIOTICS SHOULD BE CONSIDERED FOR UNCOMPPLICATED DIVERTICULITIS ONLY IF SYMPTOMS PERSIST OR WORSEN AFTER 48 TO 72 HOURS

- Trimethoprim/sulfamethoxazole, 160 mg/800 mg orally twice daily + metronidazole, 500 mg orally three times daily
- Amoxicillin/clavulanate (Augmentin), 875 mg/125 mg orally (extended-release formulation twice daily, regular formulation three times daily)
- Ciprofloxacin, 500 mg orally twice daily + metronidazole, 500 mg orally three times daily
- Moxifloxacin (Avelox), 400 mg orally once daily [CR]
- Levofloxacin, 750 mg orally once daily + metronidazole, 500 mg orally three or four times daily
TREATMENT

COMPLICATED ACUTE DIVERTICULITIS
<table>
<thead>
<tr>
<th>Complication</th>
<th>Diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fistula</td>
<td>Can develop between bowel, bladder, vagina, uterus</td>
<td>Surgical consultation</td>
</tr>
<tr>
<td>Microperforation</td>
<td>Small air bubbles in gastrointestinal wall or adjacent to it, but no oral contrast seen outside of the bowel</td>
<td>IV antibiotics and inpatient observation; consider surgical consultation</td>
</tr>
<tr>
<td>Obstruction</td>
<td>Appearance of obstructive diverticulitis and colon cancer are very similar on computed tomography</td>
<td>Surgical resection to relieve obstruction and pathology to confirm diagnosis</td>
</tr>
<tr>
<td>Perforation</td>
<td>Free air under diaphragm</td>
<td>Surgical consultation; can be life-threatening</td>
</tr>
<tr>
<td>Small abscess (&lt; 3 cm)</td>
<td>Abscess seen on computed tomography</td>
<td>IV antibiotics and inpatient observation; percutaneous drainage or surgery if symptoms worsen</td>
</tr>
<tr>
<td>Large abscess (≥ 3 cm)</td>
<td>Abscess seen on computed tomography</td>
<td>IV antibiotics and percutaneous drainage is first-line treatment; surgery if symptoms worsen (e.g., continued fever after 24 to 48 hours, worsening pain) or location not amenable to percutaneous drainage</td>
</tr>
</tbody>
</table>
COMPLICATED ACUTE DIVERTICULITIS

- Complicated IF: abnormal vital signs, signs of perforation with or without abscess, fistula or obstruction, or the inability to maintain oral intake.

- Admit to the hospital

- CT with IV contrast: patients with vital sign abnormalities or if there is a concern for abscess, perforation, or fistula.

- Intravenous antibiotics

- Bowel rest or clear liquid diet

- Abscesses smaller than 3 cm should be treated with intravenous antibiotics, and reevaluation if there is clinical deterioration.

- Imaging-guided percutaneous drainage is recommended for abscesses that are 3 cm or larger, with surgical consultation if needed.

- Surgical consultation is required for management of bowel perforation
INPATIENT: COMPLICATED DIVERTICULITIS IS INITIALLY TREATED WITH INTRAVENOUS ANTIBIOTICS, TRANSITIONED TO ORAL ANTIBIOTICS AFTER PATIENT SHOWS IMPROVEMENT (USUALLY TWO TO FOUR DAYS)

- **Piperacillin/tazobactam (Zosyn),** 3.375 g IV every six hours or 4.5 g every eight hours
- **Ticarcillin/clavulanate** (not available in the United States), 3.1 g IV every six hours
- **Ertapenem (Invanz),** 1 g IV once daily
- **Moxifloxacin,** 400 mg IV once daily
- **Cefazolin,** 1 g to 2 g IV every eight hours + metronidazole, 500 mg IV every eight hours
- **Cefuroxime,** 1.5 g IV every eight hours + metronidazole, 500 mg IV every eight hours
- **Cefotaxime,** 1 g to 2 g IV every eight hours + metronidazole, 500 mg IV every eight hours
- **Levofloxacin,** 750 mg IV once daily + metronidazole, 500 mg IV every eight hours
- **Ciprofloxacin,** 400 mg IV every 12 hours + metronidazole, 500 mg IV every eight hours
## Severe, Life-Threatening: Patients with Severe Sepsis or Admitted to Intensive Care

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage/Regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imipenem/cilastatin (Primaxin)</td>
<td>500 mg IV every six hours</td>
</tr>
<tr>
<td>Meropenem (Merrem)</td>
<td>1 g IV every eight hours</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>1 g IV once daily</td>
</tr>
<tr>
<td>Doripenem (not available in the United States)</td>
<td>500 mg IV every eight hours</td>
</tr>
<tr>
<td>Piperacillin/tazobactam</td>
<td>4.5 g IV every six hours</td>
</tr>
<tr>
<td>Cefepime</td>
<td>2 g IV every eight hours + metronidazole, 500 mg IV or orally every eight hours</td>
</tr>
<tr>
<td>Ceftazidime (Fortaz)</td>
<td>2 g IV every eight hours + metronidazole, 500 mg IV or orally every eight hours</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>2 g IV every six hours + metronidazole, 500 mg IV or orally every eight hours + ciprofloxacin, 400 mg IV every 12 hours (or levofloxacin, 750 mg IV once daily)</td>
</tr>
</tbody>
</table>
IMAGING-GUIDED PERCUTANEOUS DRAINAGE
CASE

- CC: abdominal pain
- CT scan (w/o contrast – allergy)
  - Mural thickening of the sigmoid colon with surrounding stranding. Adjacent localized gas and fluid structure in the right pelvis measuring approximately 1.5 x 1.3 x 1.1 cm
Dx: Complicated acute diverticulitis - perforated

CT scan

- New intraperitoneal fluid collections, with air-fluid levels poorly delineated from the adjacent bowel. Fluid collections measure 6.8 x 8.2 cm in the deep right lower, 8 x 7.6 cm in the anterior pelvis and 5.9 x 8.2 cm in the superficial right lower quadrant.
IR DRAINAGE PROCEDURE

• Fluoroscopic guidance: placement of 10.2 French by 25 cm multipurpose drains (x2)
SURGICAL INTERVENTION
WHO NEEDS IT AND WHEN?
SURGERY

• Not everyone

• After successful nonoperative treatment of a diverticular abscess, elective surgery should be considered

• Elective resection based solely on a young age at presentation is not recommended

• Optimal surgical approach for perforated diverticulitis with purulent or fecal peritonitis (Hinchey grade III or IV) remains debated

STAGED SIGMOIDECTOMY

- Hartmann’s Pouch
- Perforation, acute complicated
- Diseased colonic segment is drained
- End colostomy created
- Allows for fecal diversion, drainage of infection
- 4-6 months later -> reconnect
CASE: TWO MONTHS LATER

ROBOTIC-ASSISTED SIGMOID COLECTOMY WITH DIVERTING LOOP ILEOSTOMY
ANASTOMOSIS

• Shaft of circular stapler introduced through anus, into rectum, where trocar is advanced sharply, adjacent to linear staple line.

• Proximal anvil is attached to shaft of stapler. Anastomosis is completed laparoscopically.
AFTERCARE

- Stoma therapy/HHC to assist with stoma management
- If resection from perforation = 6 months before next procedure
- Colonoscopy
  - six to eight weeks after symptom resolution in patients with complicated diverticulitis
  - unless the patient has had a high-quality colonoscopy in the past year
  - colorectal cancer risk is 1.3% in uncomplicated diverticulitis and 7.9% in complicated diverticulitis
PROGNOSIS

• Initial episode of diverticulitis, risk of second flare-up is 22% at 10 years.
• Second occurrence - 55% chance of a third occurrence in the next 10 years.
• The overall risk of developing a complicated flare-up does not increase with subsequent flare-ups.
SCREENING? AND PREVENTION

- Screening not recommended. Incidental
- Decrease risk of recurrence of diverticulitis:
  - vegetarian diet or high-quality diet (high in fruits, vegetables, whole grains, and legumes)
  - limit red meats, sugar
  - a body mass index of 18 to 25 kg per m²
  - physically active
  - Avoid tobacco and long-term nonsteroidal anti-inflammatory drugs.
- High-fiber diet - lower incidence of diverticular disease
  - evidence lacking, prevents the recurrence of diverticulitis
TAKE HOME POINTS

• CT scan - most appropriate initial imaging modality in terms of image detail and ease of access

• Patients who are otherwise healthy and have uncomplicated sigmoid diverticulitis can be safely managed without antibiotics

• Retroperitoneal perforations are more likely to be contained, confusing presenting symptoms, manage conservatively.

• Antibiotic treatment for acute complicated diverticulitis

• Emergent surgical resection recommended for unstable patient, complicated fecal peritonitis.

• Primary anastomosis seems to be the preferred option over Hartmann's procedure in selected patients with Hinchey III or IV diverticulitis
REFERENCES


THANK YOU!
Questions: stanton.amanda@mayo.edu