Management of Complications of Diverticulosis
Epidemiology

• Diverticular disease is the most common colon disease in Western nations.

• “Disease of Western Civilization and Diet”
  – Rare in rural Africa & Asia, common in US, Europe, Australia

• In the West, diverticulosis affects 33-50% of the population older than 50 years and more than 50% of the population older than 80 years.

• In underdeveloped nations in Asia and Africa, diverticulosis occurs in less than 0.2% of the population.
Diverticulosis: Epidemiology

• Prevalence has increased in the last century
  – 5-10% in 1920
  – 35-50% in 1969 autopsy series
• Prevalence increases with age
• Sex distribution equal with possible slight female preponderance in elderly
• Males more likely to have diverticulosis before age 50 and predominate in cases of diverticulitis under age 40
Incidence Increases with Age

Pathologic Anatomy

- A typical colonic diverticulum is a false or pulsion-diverticulum (does not include all layers of wall)
- Mucosa and submucosa herniate *through* the muscle layer, covered only by serosa
- Diverticuli typically arise in 4 well-defined points around the circumference of colon:
  - Along the mesenteric sides of the anti-mesenteric taenia and along both sides of the mesenteric taenia
  - Corresponds to sites of arterial penetration through smooth muscle
Taeniae coli

Circular muscle

Longitudinal muscle

Mesenteric blood supply

Taeniated part of large intestine

Rectum
Mechanism of Formation: Segmentation generates local high-pressure zones for diverticular development.

- “Segmentation” theory does not explain diverticulosis of the cecum and ascending colon seen more often in Asian/Pacific populations.
Diverticula Form at Sites of Vascular Penetration
Pathologic Anatomy

• Western individuals:
  – 90% left-sided  15% right-sided
• Asian individuals:
  – 25% left-sided  75% right-sided
• Vary in number from solitary to hundreds
• Typically 5-10mm in diameter, although ‘giant’ diverticula described.
Pathogenesis: Dietary Fiber

• Low dietary fiber consumption is suspected to be the most important factor in the development of diverticular disease
  – Striking geographic correlation w/ ↓ fiber intake
  – Emergence following introduction of milled grain
  – Vegetarians have lower prevalence of diverticulosis

• Rats fed diets of varying fiber content over natural lifespan:
  – Low-fiber diet: 45% developed diverticula
  – High-fiber diet: 9% developed diverticula
  – Histologically similar to human diverticula, but mainly right-sided
• Health Professionals Follow-up Study
• 43,881 US male health professionals 40-75 yrs & free of diagnosed colonic disease, f/u 6 years.
• 362 new cases of diverticular dz documented.
• The insoluble component of fiber was inversely associated with risk of diverticular disease relative risk (RR) = 0.63  \( p = 0.02 \)
• Association was particularly strong for cellulose (RR = 0.52,  \( p = 0.002 \)).

Natural History of Diverticulosis
Natural History of Diverticulosis

- Asymptomatic
  70-80%

- Diverticular Bleeding
  5-15%

- Diverticulitis
  15-25%

- Uncomplicated
  75%

- Complicated
  25%
Clinical Manifestations of Diverticulosis

- Asymptomatic
- “Diverticular Colitis”
- Diverticulitis
  - Uncomplicated
  - Complicated
    - Fistula
    - Abscess
    - Obstruction
    - Free Perforation
- Diverticular Bleeding
Asymptomatic Diverticulosis: Is Diet Modification Indicated?

- The vast majority of patients are asymptomatic.
- Although commonly associated with symptoms of IBS, there is little evidence that incidentally discovered diverticulosis causes gastrointestinal symptoms.
- High fiber diets frequently recommended to prevent symptomatic diverticulosis, but virtually impossible to prove by prospective clinical trials.
- Historically, physicians have advised individuals with diverticular disease to avoid nuts, seeds, popcorn, berries, and other particulate foods (i.e. seeds may get stuck and cause diverticulitis).
Asymptomatic Diverticulosis: Is Diet Modification Indicated?

- Health Professionals Follow-up Study is a cohort of US men followed up prospectively from 1986 to 2004
  - 47,228 men aged 40 to 75 years who at baseline were free of diverticulosis or its complications.
- During 18 years of follow-up, there were 801 incident cases of diverticulitis and 383 incident cases of diverticular bleeding.
- Multivariate Analysis (adjusted for total fiber, etc)
- Inverse associations between nut and popcorn consumption and the risk of diverticulitis (nuts RR 0.80 p= 0.04 ; popcorn RR 0.72 p= 0.007)
- Nuts and popcorn intake did not influence the development of asymptomatic diverticulosis or diverticular bleeding

*JAMA. 2008;300(8):907-914.*
Encourage Nuts and Popcorn
“Diverticular Colitis”

- Diverticular patients may have segmental sigmoid “colitis” on screening sigmoidoscopy.
- Range from focal erythema/edema to chronic active inflammation resembling IBD.
- Usually asymptomatic, incidental finding on screening sigmoidoscopy.
- No biopsy or treatment indicated in the absence of symptoms suggesting significant colitis (tenesmus, urgency, etc.).
- Pathogenesis unknown/treatment anecdotal (i.e. 5-ASA, cortenema).
“Diverticular Colitis”
Diverticulitis? Oh Noooooooo!
Acute Diverticulitis

- Diverticulitis represents a micro or macroscopic perforation of a diverticulum
- Thought to be due to erosion of diverticular dome by inspissated food (fecolith) or increased luminal pressure with focal necrosis
- The vast majority of perforations occur in the sigmoid colon
  - Right-sided diverticulitis occurs in only 1.5 percent of patients in Western countries but is more common in Asians
- Small perforations are frequently walled off by peri-colonic fat or omentum resulting in mild to moderate symptoms (75%)
Impacted fecolith with Inflammation
Acute Diverticulitis

- Affects 15-25% of patients with diverticulosis
- 450,000 US admissions / year
- M:F 60:40
- The incidence of hospital admissions for acute diverticulitis is increasing and the average age decreasing
- Medical and surgical mortality rates are generally low and have improved with time
  - Overall mortality decreased from 1.6% in 1998 to 1999 to 1.0% in 2004 to 2005
  - Surgical mortality for patients with acute diverticulitis decreased from 5.7% to 4.3% across the same periods.
  
The Median Age of Acute Diverticulitis is Decreasing

- University of Maryland Study: 104 consecutive cases of acute diverticulitis 1999-2003
  - 55 men 48 women
  - Age range 22-88
  - 54% age 50 or younger
  - 22 (21%) less than 40
  - 82.7% descending and sigmoid diverticulitis

- Median Age: 49

- Abdominal (central) obesity strongly correlated with acute diverticulitis in patients:
  - 82% prevalence overall and 85.9% in patients < 50
  - More severe obesity associated with younger age of onset
  - Only 11% had BMI < 25

Am. J. Roentenol 2006,187:689-694
The Median Age of Acute Diverticulitis 49

Central Obesity a Risk Factor for Acute Diverticulitis

CT Scan Sagittal Abdominal Diameter
>25 cm Indicative of Obesity
The Average Age of Patients with Diverticulitis is Rapidly Declining

267,000 US Admissions 1998-2005

Diverticulitis in the US: Changing Patterns of Disease and Treatment

• 1998 to 2005 nationwide inpatient sample to analyze the care received by 267,000 patients admitted with acute diverticulitis

• Overall annual age-adjusted admissions for acute diverticulitis increased from 120,500 in 1998 to 151,900 in 2005 (26% increase).

• Almost entirely the result in patients under the age of 65, especially those less than 45 years of age

• Rates of admission increased more rapidly within patients aged 18 to 44 years (82%) and 45 to 74 years (36%).

Diverticulitis in the US: Changing Patterns of Disease and Treatment

Diverticulitis: Symptoms

- LLQ pain is the most common presentation, often present for several days before diagnosis
- Up to 50% report prior similar episodes
- Nausea/Vomiting: 20-60%
- Obstipation: 50%
- Diarrhea: 25-35%
- Urinary symptoms: 10-15%
- Bleeding rare, suggests alternative dx (ischemia)
- Right-sided diverticulitis occurs in only 1.5% of “western” cases but more common in Asians
Diverticulitis: Signs and Lab

- LLQ tenderness common (RLQ tenderness may occur due to a redundant sigmoid colon, mimicking appendicitis)
- Palpable sigmoid mass in 20%
- Generalized tenderness or rebound suggests free perforation/peritonitis
- Low-grade fever and leukocytosis common but up to 45% can have a “normal” WBC
Acute Diverticulitis: Differential Diagnosis

- Acute appendicitis
- Colonic carcinoma with perforation
- Ischemic colitis
- Crohn’s Disease
- Left-sided tubo-ovarian pathology
  - Ovarian cyst / abscess / torsion
  - Ectopic pregnancy
Diverticulitis - Diagnostic Modalities

- **History and Physical**: often adequate to make the diagnosis
- **Plain Radiography**: Rule out free air, obstruction, ileus
- **Contrast Enema Examinations**: Generally avoid!
  - Use water soluble agents if perforation suspected (although costs more and less mucosal detail).
  - Gentle single-contrast study; terminate when findings demonstrated.
  - Findings: extravasated contrast into abscess or fistula, spasm, mucosal thickening, extensive tics, extra-luminal mass compressing bowel.
  - Sensitivity: 60-90%
**Diverticulitis of sigmoid colon**

Single contrast barium enema reveals spasm, rigidity, mural thickening, and lack of distensibility of a focal segment of sigmoid colon in a patient with sigmoid diverticulitis. Note the presence of a small diverticulum (arrow). Courtesy of Norman Joffe, MD.

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**Intramural diverticular abscess**

Double contrast barium enema in a patient with numerous sigmoid colon diverticulae demonstrates an air-containing intramural abscess cavity (arrow). Courtesy of Jonathan Kruskal, MD, PhD.
Diverticulitis - Diagnostic Modalities

- **CT with oral contrast**
  - Diagnostic study of choice
  - High sensitivity, specificity, and negative predictive value
  - Can identify complications such as free perforation, obstruction, abscess, fistula
  - Potentially therapeutic: percutaneous drainage of abscess
  - In <10% may be difficult to differentiate from colon cancer

- **Colonoscopy**:
  - Relatively contraindicated due to theoretical risk of worsening perforation.
  - May be useful when Dx unclear: Excludes ischemic colitis, carcinoma etc
Diverticulitis - Treatment

- Conservative treatment (bowel rest and antibiotics) is successful in approximately 70 to 100 percent of patients with acute uncomplicated diverticulitis

- **Outpatient treatment:**
  - Mild sx, no peritoneal signs, tolerating POs, & reliable patients with supportive home networks may be candidates for outpatient Rx.

- **Admission:**
  - Elderly, immunosuppressed, comorbid illness, or evidence of severe disease (high WBC or fevers): inpatient Rx.
Diverticulitis – Outpatient Treatment:

- Clear liquids for 48 hr; advance as tolerated
- Antibiotics: 7-10 days to cover gut organisms (eg GNRs & anaerobes, esp *E. coli* and *bacteroides*)
  - Ciprofloxacin 500 mg bid plus
    - metronidazole 500 mg tid
    - Amoxicillin/clavulanate (875/125) bid
    - Bactrim 500 bid
- Contact physician for increasing pain, fever, inability to maintain hydration
- If first episode, consider elective colonoscopy in 8-12 weeks to rule out other colonic pathology
Diverticulitis - Treatment Outcome I

- For those who respond, a complete colonic evaluation is required after resolution of clinically diagnosed case, to exclude other diagnoses, such as CA.

- Majority will respond to medical Rx; up to 25% will have complicated diverticulitis and possibly require surgery during admission.
Complicated Diverticulitis Abscess

- Suggested by persistent fever or WBC
- CT scan: diagnose & follow course
- Stage I (small pericolic abscesses): 70-80% success with medical tx alone
- Stage II (distant abscesses):
  - CT-guided percutaneous drainage
  - Allows for rapid control of sepsis without operative risk, allows for temporary drainage and single-stage procedure in 3-4 weeks.
  - 15-25% may still require primary surgical therapy if multiloculated or inaccessible.
Complicated diverticulosis

Fistulas

• Fistulas account for 20% of surgeries performed for diverticular disease.
• Only about half give a history of prior bout of acute diverticulitis
• **Colovesicular:** (65%) 2-3:1 M:F
  - fecaluria - pathognemonic
  - pneumaturia - suggestive
• **Colovaginal:** (25%) stool / flatus per vagina
  - Majority have had a prior hysterectomy
• **Coloenteric, colouterine, colocutaneous:** rare
Complicated Diverticulitis

**Fistulas:**

- The majority or colovesicular and colovaginal fistulas in women occur post-hysterectomy.
Complicated Diverticulitis

Fistulas

- No single diagnostic study ideal
- Barium enema visualizes fistula tract in only 20-26%
- Sigmoidoscopy/colonoscopy yield 1-3%
  - Valuable in ruling out other colonic diseases
- CT has highest sensitivity and specificity for colovesicular fistulas
- Fistulous disease cannot be cured with medical management
  - One or two stage resection of the sigmoid colon with primary anastomosis is feasible in most patients.
Colo-enteric and colo-vesicular fistulas: BE
Recurrent Diverticulitis Risk: Old Assumptions

- Following resolution of acute diverticulitis:
  - 30-40% remain asymptomatic long-term,
  - 30-40% have episodic abdominal pain without frank diverticulitis (post-infectious IBS?)
  - 22-67% recurrence rates over 3-9 years
    - Largest study 317 patients 1969: 24.6% recurrence
- Generally believed that recurrent attacks are less likely to respond to medical Rx and have higher mortality.
- Therefore, most recommended elective resection after 2nd attack of diverticulitis.
Acute Diverticulitis: Natural History

- **Kaiser Study:** 3165 cases of hospitalized AD (1992-97)
  - 54.5% female 45.6% male  Age range 23-99 (median 62)
  - Emergency surgery in 614 (19%)
  - 2551 (81%) managed medically

- 2366 of medically managed followed for a mean of 8.9 years (range 6-12)
  - 13.3% (314/2366) had recurrent AD (2% per year)
    - 3.9% (92) had a second recurrence
    - 9.4% (222) had a single recurrence
  - All 314 managed non-surgically
  - A prior percutaneous abscess drainage did not increase risk of recurrent AD

Arch Surgery 2005;140:576-83
Recurrent Diverticulitis: Not Associated with Greater Mortality/Morbidity

- Mayo Clinic study of all patients admitted with complicated diverticulitis (abscess, phlegmon, perforation, obstruction, fistula, bleeding) 1990-2003

- Two groups
  - Group A: 1-2 prior episodes of diverticulitis (118)
  - Group B: 3 or more prior episodes (32)

- Conclusion: Patients with multiple (>2) episodes of AD are not at increased risk for poor outcomes if they develop complicated diverticulitis.

- Group B was significantly less likely to present with free perforation or need for colostomy (p<0.001)

Annals of Surgery 2006;243(6):876
Multiply Recurrent Diverticulitis Not Associated with Higher Morbidity/Mortality

150 Cases of Complicated Diverticulitis 1990-2003

Peroration Colostomy Abscess Phlegmon Fistula Obstruction

Group A: 1-2
Group B: >2

Annals of Surgery 2006;243(6):876
Recurrent Diverticulitis: Conclusions

• The greatest risk of free perforation and/or emergent surgery is with the initial attack of AD (20%)
• Recent data suggest that the risk of recurrent diverticulitis is between 12-16% over 10 years
• Average 1.5%-2% per year
• Recurrent attacks can be medically managed in the vast majority and carry a lower risk of major complications
• Recent publications now recommend elective colectomy after the 3rd or 4th episode as the most cost-effective
Diverticulosis: Surgical Management: Single vs Two Stage

- Ideal operative goal is elective one-stage procedure
- Elective mortality 2-3%
- Emergent mortality up to 35%
Complicated diverticulosis

Hemorrhage I

- Most common cause of major LGIB (30-50%)
- 5-10% of patients with diverticulosis ultimately bleed
- While most tics in left colon, bleeding may occur more often from right colonic tics.
- *Arterial* bleed from vasa recta coursing over dome of tic.
  - 73% from the dome of the diverticulum
  - 27% from the mouth of the diverticulum
- Increased bleed risk with aspirin/NSAID as well as SSRI use.
Complicated diverticulosis

Hemorrhage II

• Rarely occurs with acute diverticulitis.
• Abrupt, painless onset of maroon / red blood or clots; melena uncommon.
• Mild lower abd cramps / urge to defecate
• 75-80% stop bleeding spontaneously.
• 25-35% recurrent bleeds; consider surgery after second episode.
• Never consider diverticulosis as the cause of occult heme (+) stool
Complicated diverticulosis
Hemorrhage III

**Diagnosis / Management**
- Fluid & blood product resuscitation
- Exclude UGIB with NGT or EGD
- Urgent Flex Sig, if negative for source:
  - Tagged RBC Nuclear Scan \(\Rightarrow\) angiography OR
  - “Rapid Purge” and colonoscopy; although endoscopic Rx much less effective than in UGIB
- Surgery if endoscopy or angiography fails-
  - segmental vs. subtotal colectomy.
Diverticular Hemorrhage: Endoscopic Therapy

- 53 reported cases of endoscopic therapy for diverticular hemorrhage with variable degrees of success
- The major impediment to successful treatment is difficulty in identifying the specific bleeding diverticulum
- Potential for perforation of the thin-walled diverticulum
- Available Options:
  - Thermal therapy (bicap)
  - Epinephrine
  - Endoclips
Endoscopic control of bleeding: Epinephrine injection
Endoscopic control of bleeding: Endoclips

Gastrointestinal Endoscopy 2004;59:433
Endoscopic control of bleeding: Thermal coagulation

Patient with LGIB, 'visible vessel' next to diverticulum, flattened with Gold Probe electrocautery
Diverticular Bleeding: Long Term Outcome & Risk Factors for Recurrence

- N=146 pts with index diverticular bleed (definite or probable) 1975-1989
- Avg F/U 9.7 years
- Mean age=69 yrs (range 50-92 yrs)
- 56% men
- 51% using aspirin/NSAIDs or anticoagulants at index bleed
- Overall rate of rebleeding 44.5%
- Mean time to rebleed: 43 months
- Rebleeds had ↑ surgical & death rates
- Age was the only characteristic associated with an ↑ risk of readmission (HR 1.03, p=0.03, CI 1.0-1.06).

SSRI Therapy Associated with Increased Risk of GI Hemorrhage

- Release of serotonin by platelets in response to vascular injury plays an important role in vasoconstriction and platelet aggregation
- Platelets cannot synthesize serotonin
- SSRI inhibit the serotonin transporter which leads to a depletion of platelet serotonin and impaired platelet function
- Numerous clinical studies have indicated an association between all types of SSRI and bleeding disorders
  - Prolonged bleeding time
  - Purpura
  - Epistaxis
  - Intracranial bleeding
  - GI Bleeding
Meta-analysis of four observational studies: 153,000 patients

- SSRI: Odds Ratio 2.4, P=0.0006
- NSAID: Odds Ratio 3.2
- SSRI/NSAID: Odds Ratio 6.3, P<0.00001

Median time to UGIB: 25 weeks

Aliment Pharmacol Ther. 2008;27:31
Bleed Risk Varies with Affinity of SSRI

Odds Ratio for UGI Bleed 1991-1995

<table>
<thead>
<tr>
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<th>SSRI</th>
<th>SSRI+ASA</th>
<th>SSRI+NSAID</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Affinity SSRI</td>
<td>3.6</td>
<td>5.2</td>
<td>12.2</td>
</tr>
<tr>
<td>Mixed SSRI</td>
<td>2.3</td>
<td>4.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Non-SSRI</td>
<td>1.7</td>
<td>2.5</td>
<td>6.3</td>
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</table>

Arch Int Med
2003 163 59
Diverticular Bleeding: Risk Factors for Recurrence

- Retrospective multicenter case-control study of SSRI, aspirin, NSAID, Plavix and GIB risk
- All agents associated with increased risk of GI bleed
- Significant interaction between SSRI, and NSAID and aspirin
- SSRI use was more strongly associated with LGIB (OR 1.8, p=0.003) than UGIB (OR 1.3)
Diverticular Disease

Summary I

- Diverticulosis common in Western societies and incidence increases with age.
- Majority of patients will remain asymptomatic throughout lifetime.
- High fiber diets may decrease development of symptomatic diverticular disease.
- Once complications occur, no proven benefit of high fiber diet in preventing recurrent diverticulitis or bleeding.
- No role for restricting consumption of nuts or seeds.
Diverticular Disease

Summary II

• Complications:
  – Diverticulitis (with abscess, fistula)
  – Hemorrhage
• Diverticulitis: initial Rx medical w/ gram negative and anaerobic coverage
• Abscesses: CT-guided percutaneous drainage
• Surgery generally utilized after recurrent attacks of diverticulitis or bleeding.
Colonic Wall Resistance

- No evidence that atherosclerosis or venous changes predispose
- >200% increase in elastin deposition, laid down in contracted form, $\Rightarrow$ shortening of taenia and bunching of circular muscle
- Precocious diverticulosis occurs in patients with connective tissue disorders (Ehlers-Danlos, Marfan’s)
Complicated diverticulosis

Diverticulitis - Diagnostic Modalities II

- **CT scanning**
  - More accurate, as mainly extra-luminal disease
  - Abd & Pelvic scans; oral / rectal / IV contrast
  - Findings: pericolic infiltration of fatty tissues, wall thickening, abscess
  - Sensitivity and Specificity: 75-95%
  - Severe disease predicts complications and poor prognosis.
BE with spasm, Endo with pus
### Complicated diverticulosis

#### Hemorrhage

<table>
<thead>
<tr>
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<th>Surgical (’86–’92)</th>
<th>Colonoscopic (’94–’98)</th>
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<tbody>
<tr>
<td>DEFINITE Div Hemorrhage</td>
<td>17 (23%)</td>
<td>10 (21%)</td>
</tr>
<tr>
<td><strong>ENDOSCOPIC FINDINGS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active bleeding</td>
<td>6 (35%)</td>
<td>5 (50%)</td>
</tr>
<tr>
<td>Non-bleeding VV</td>
<td>4 (24%)</td>
<td>2 (20%) Adherent Clot</td>
</tr>
<tr>
<td>7 (41%)</td>
<td>3 (30%)</td>
<td></td>
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<tr>
<td>Additional bleeding</td>
<td>9 (53%)</td>
<td>0 (0%)</td>
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<tr>
<td>Emergency colectomy</td>
<td>6 (35%)</td>
<td>0 (0%)</td>
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<tr>
<td>Median time to discharge</td>
<td>5 days</td>
<td>2 days</td>
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<tr>
<td>Complications</td>
<td>2 (12%)</td>
<td>0 (0%)</td>
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<tr>
<td>Late re-bleeding</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
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</tbody>
</table>

**Issues**: historical cohort only, small number of patients (n=10)
Complicated diverticulosis
Hemorrhage IV

- 121 pts w/ severe hematochezia & diverticulosis
- Rapid oral purge with PEG solution
- Colonoscopy within 6-12 hours
- 1986-1992: 73 patients treated medically and surgically, if recurrent or severe bleeding
- 1994-1998: 48 patients treated medically and with colonoscopic therapy for select stigmata
Barium Enema Detects Diverticuli with Greater Sensitivity Than Colonoscopy
Etiology / Pathogenesis: IBS?
Scopes trial?
Etiology / Pathogenesis: Curmudgeon
Endoscopic Presentation of Diverticulitis
BE and CT with Diverticular Abscess
Sigmoid (L) & Desc Colon (R)  
Diverticulitis: CT
Diverticulitis - The Young Patient

- Jan 1994-June 1999, prospective study 327 patients with left-sided colonic diverticulitis
  - Group 1: <50 years old (n=72) 22% M/F 3:1
  - Group II: >50 years old (n=255)
- No significant difference in need for emergency surgery (24%), elective surgery (7.0%), or recurrent diverticulitis (25% vs 22%; p=0.93)

- 2005 study 149 patients <40 with diverticulitis 1991-2002
  - M/F 3.8/1
  - Of those treated non-surgically, 5-year recurrence rate 55% vs 15% of those treated surgically

BJS 2002:89:1137

APT 2005;21:1225