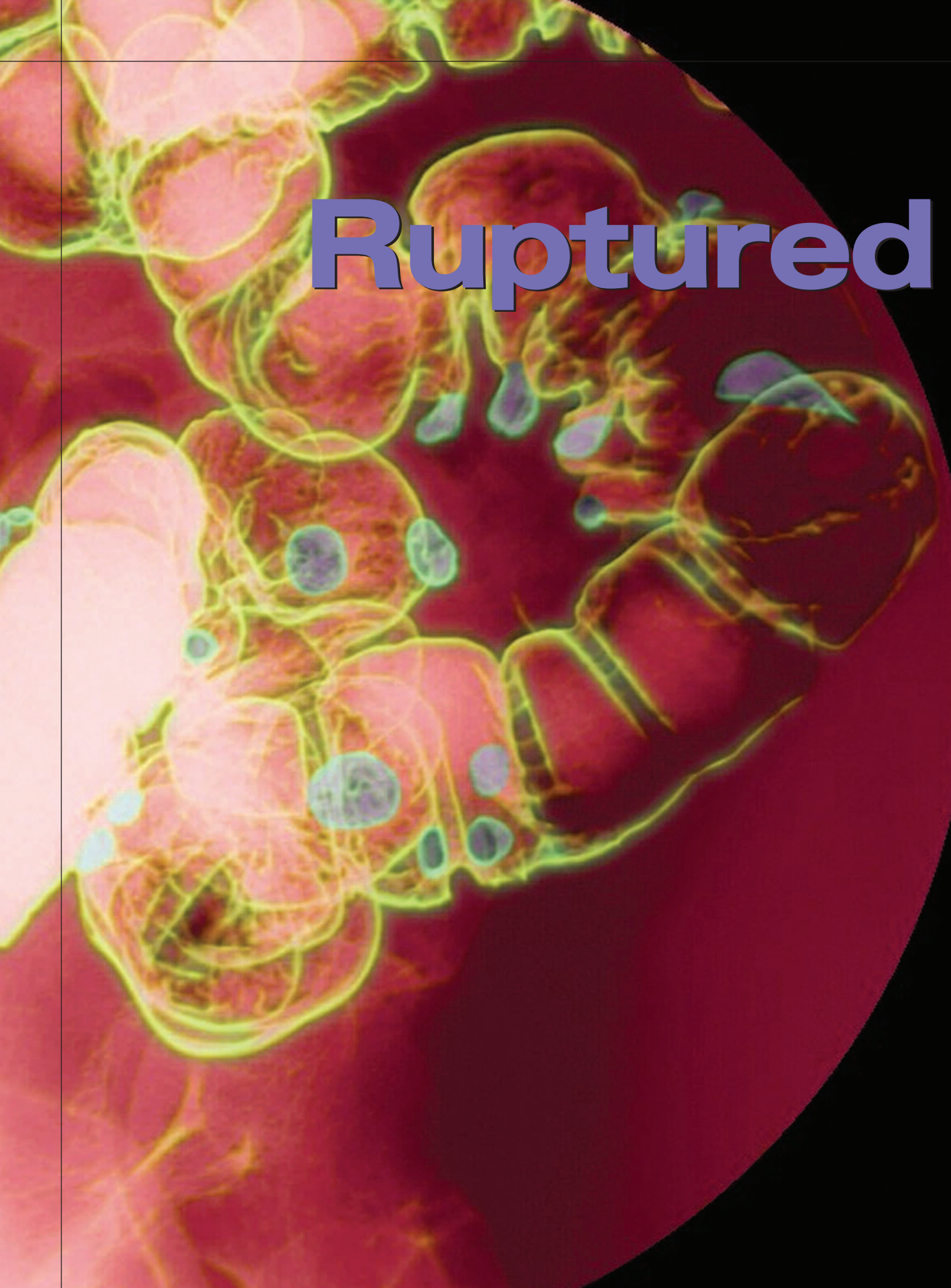
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diverticulum

Issues in surgical management

Janice M. Beitz, RN, CNOR, CS, CWOCN, PhD

Diverticular disease is a common disorder in the United States, Europe, and developed/industrialized nations, and has been referred to as a disease of Western society and a modern malady.[1,2] A clear association occurs between its prevalence and the aging of a country's population. Diverticulosis (the condition of having diverticula) affects 50% of people by age 50 and approximately 66% by age 80.[3,4] The disorder occurs with similar frequency in men and women and poses a clinical problem because of its ubiquity. Diverticular disease is the fifth most costly digestive disease, following gastroesophageal reflux disease, gallbladder disease, colorectal cancer and peptic ulcer disease.[5,6]

Diverticulosis has a generally mild progression. Approximately 75% of patients remain symptom-free during their lifetime. For most patients, the disorder is incidentally discovered during screenings for colonic disorders. For the remaining symptomatic 25%, three-quarters will develop diverticulitis only. Approximately 10% to 25% develop further complications from the diverticulitis.[4,5,7,8] Several sources suggest the use of aspirin and nonsteroidal anti-inflammatory drugs (NSAIDs) as risk factors for developing diverticulitis. Increased use of low-dose aspirin for cardiovascular prophylaxis may also be a reason for the rising incidence of perforated diverticular disease.[5,9]

Pathophysiology

Diverticulosis is a disorder in which the intestine, usually the large bowel, develops weakened areas over time. These weakened areas balloon out and resemble little bulges or pouches along the intestinal tract and often occur in multiples. These outpouchings of mucosa are often found at sites of penetration of the colonic wall by blood vessels.[10] Notably, these diverticula are acquired and aren't congenital in nature.

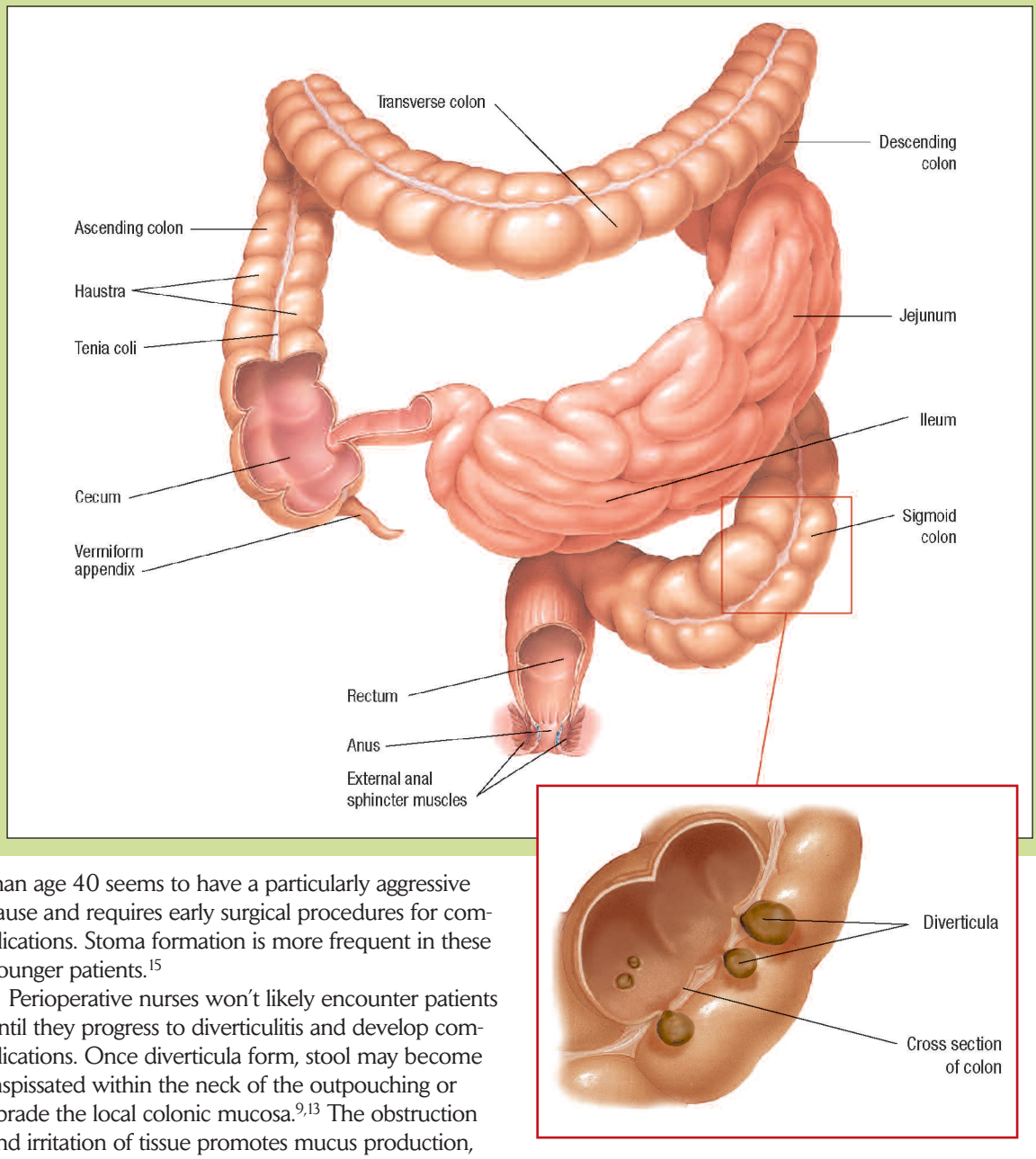
Because of the anatomy of the bowel's blood supply, it's common to identify two rows of diverticula, one on each side of the bowel wall between the mesenteric and antimesenteric taeniae.[5] Diverticula can also vary in size. The average diameter is 5 to 10 mm but may surpass 20 mm.[2,11] The sigmoid colon is involved in 90% of diverticulosis.[12] (See *Diverticulosis of colon*.)

The etiology of diverticular disease is multifactorial and not completely understood.[4,9,13] Several factors are believed to promote diverticula formation, including low dietary fiber intake, cigarette smoking, alcohol intake, corticosteroids, altered collagen structure in the bowel, increased acetylcholine activity in the sigmoid colon, and aging.[7,10] Low-dietary fiber, the most commonly discussed etiology, is thought to prolong stool transit time, producing harder, more pellet-like stool. The bowel must contract harder to pass the feces. This increased pressure on the bowel wall may lead to diverticula formation.[3,14] Some studies suggest that muscle-wall thickening and contraction of the taeniae coli precede diverticula formation and may be the primary pathogenic mechanism.[4] Other research describes the up-regulation of cholinergic activity with increased bowel-wall muscle tone as a possible predecessor.[10] Aging is clearly related to diverticula formation, possibly because the bowel wall weakens with age. Conversely, the other previously described factors may exert their influence over time and simply become manifest in older people.

The location of diverticula formation has an interesting predilection related to place of residence and race. The sigmoid colon is the most common site of diverticula formation in Western populations. The sigmoid segment has the smallest diameter of the colon and a different motility pattern from the rest of the bowel. However, right-sided (cecum and ascending colon) diverticula are more common in Asia and Hawaii.[3,5] Notably, adoption of a Western lifestyle in Asian countries results in a higher prevalence of diverticulosis located mainly in the right colon.[13]

Not all diverticulitis patients are elderly. Controversy exists about the virulence and management of acute diverticulitis in young patients. Recent research suggests that acute diverticulitis in patients younger

Diverticulosis of colon



than age 40 seems to have a particularly aggressive cause and requires early surgical procedures for complications. Stoma formation is more frequent in these younger patients.[15]

Perioperative nurses won't likely encounter patients until they progress to diverticulitis and develop complications. Once diverticula form, stool may become inspissated within the neck of the outpouching or abrade the local colonic mucosa.[9,13] The obstruction and irritation of tissue promotes mucus production, bacterial overgrowth, and resulting distention. Localized ischemia results and, if not treated, ultimately perforation occurs. Corticosteroids and NSAIDs may predispose a patient to this process or increase its severity.[9] A classification system can help stratify the degree of peritoneal contamination in diverticular perforation or rupture (see *Hinchey classification of peritoneal contamination*).[16]

Most perforations in diverticulitis are microperforations and are contained within the pericolic fat, causing a small pericolic abscess. Progression to full-blown fecal peritonitis depends on whether the obstruction and irritation of the diverticula continue.[4]

Clinical presentation

Symptomatic disease or diverticulitis presents in a rela-

tively classic pattern. Patients with sigmoid diverticulitis will develop left lower-quadrant pain (93% to 100%), fever (57% to 100%),and leukocytosis (69% to 83%).[7] Some patients will present with dysuria and frequency if the inflammatory area is adjacent to the bladder.[2] The progression of symptoms depends on the progression of the perforation and response to medical treatment. Nausea, vomiting, and changes in bowel habit may also be reported. Depending on the severity of perforation progression, abdominal examination may show tenderness, a palpable mass, and guarding.[2,5]

A major challenge to correct diagnosis is the fact that the clinical features of diverticulitis are similar to other disorders. Differential diagnosis includes irritable bowel syndrome, ischemic colitis, pseudomembranous colitis, inflammatory bowel disease, bowel neoplasm, cystitis, incarcerated hernia, small-bowel obstruction, and gynecologic disorders.[2,5,7,11] Complications of diverticulitis can include sepsis, bowel abscess, fistula formation, obstruction, and peritonitis. Hemorrhage can also complicate diverticular disease. Diverticular bleeding, the most common cause of lower gastrointestinal (GI) bleeding, occurs because of thinning colon walls eroding into blood vessels. The bleeding is typically painless, abrupt in onset, and involves large volumes of blood.[11]

Diagnostic tests

Diagnostic approaches depend on the place of the disorder on the spectrum of morbidity. For asymptomatic diverticulosis, colonoscopy is the recommended approach so that other pathology can be differentiated and tissue samples taken as necessary. Barium enema is no longer the gold standard.[11] Colonoscopy is contraindicated if diverticulitis is suspected due to perforation risk.

The recommended diagnostic test for diverticulitis is CT scan with contrast. This avoids the risk of perforation that could occur with either colonoscopy or barium enema. Also, CT scanning demonstrates high sensitivity (97%) and specificity (100%) for diverticulitis.[10] Laboratory tests include complete blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP).[11] Findings may include elevated white blood cell count, elevated CRP and ESR.[7]

Medical management

The first step in medical management is appropriate diagnosis of the disorder via a thorough history and physical examination, including abdominal, pelvic, and rectal examinations.

Hinchey classification of peritoneal contamination[16]

Stage	Condition
Stage I	Pericolic or mesenteric abscess
Stage II	Walled-off or pelvic abscess
Stage III	Generalized purulent peritonitis
Stage IV	Generalized fecal peritonitis

Medical management of diverticular disease also depends on the clinical presentation of the patient. For the person with asymptomatic diverticulosis, treatment consists of high dietary fiber and bulk laxatives (for example, Psyllium) to encourage expedient bowel transit time. Adequate fluid intake is encouraged.[1,14] For persons with mild pain, mesalazine and calcium channel blockers have been shown to reduce diverticular symptoms.[4]

For the person with diverticulitis, medical management is determined by symptomatology. Patients who aren't acutely ill (mild pain without evidence of abscess, peritonitis, etc.) may be treated on an outpatient basis. Treatment includes a soft, low-residue diet (clear or full liquids) and broad-spectrum oral antibiotics for 7 to 10 days targeted at eradicating any infection and inflammation.[11] Oral antibiotic therapy includes sulfamethoxazole/trimethoprim (Bactrim DS), ciprofloxacin (Cipro), or amoxicillin/clavulanic acid combined with metronidazole (Flagyl).[2,9] Immunosuppressed patients on steroid therapy aren't treated on an outpatient basis.[7]

A person with more ominous signs of diverticulitis will be admitted to the hospital. Therapy includes bowel rest (with N.P.O. or clear liquid diet), pain management, and I.V. antibiotics targeting bowel flora (combinations of ciprofloxacin and gentamicin or metronidazole or amoxicillin/clavulanic acid or sulfamethoxazole/trimethoprim).[3] I.V. therapy may also include levofloxacin (Levaquin) with metronidazole, ampicillin or gentamicin with metronidazole, cefotetan (Cefotan), clindamycin (Cleocin), piperacillin-tazobactam (Zosyn), or ampicillin-sulbactam (Unasyn). The antibiotics must cover colonic pathogens, such as Enterobacteriaceae (*Escherichia coli, Klebsiella, Serratia, Citrobacter, Enterobacter*), enterococci, and bacteroides.[9]

For pain management, morphine should be avoided because it increases intraluminal pressure in the

bowel. Meperidine (Demerol) is the drug of choice since it decreases pressure in the intestine.[2,11]

Because of the need for a definitive diagnosis of the severity of the diverticulitis attack, a computed tomography (CT) scan with contrast is used to elucidate the pathology. Areas of inflammation and the associated mesenteric soft tissue is identified along with any abscesses.[17] Since abscesses take time to form, they may be missed on an initial scan.[3] It's noteworthy that recurrent attacks are less likely to respond to medical therapy and have a higher mortality rate.

Once the medically managed diverticulitis subsides and after a minimum of 3 weeks, colonoscopy, CT colonography, or contrast enema with sigmoidoscopy is recommended to exclude colon cancer and inflammatory bowel disease, as well as confirm the presence of diverticula.[9]

Surgical management

Whether emergent or elective, the goals of surgery are to control sepsis, eliminate future complications, remove the diseased colon segment, and restore intestinal continuity.[7] Surgical interventions are usually reserved for cases of complicated diverticulitis (for example, patients with perforation and peritonitis, abscess, obstruction, or fistula). Emergent surgery is indicated when the patient displays clear signs of perforation and diffuse peritonitis (purulent or feculent).[7]

In other instances standard surgical treatment includes a longer period of observation (to determine if antibiotics are controlling the inflammation and infection) or CT-guided percutaneous drainage of abscesses that are identified. For many patients this conservative approach has kept them from surgery.[3]

Surgical management of ruptured or perforated diverticulum has undergone a historical metamorphosis since drainage and proximal colostomy was first described in 1907.[7] Traditionally, a three-part surgery was used. One to drain the abscess and create a transverse loop colostomy, one to resect the affected bowel, and a third to close the colostomy that was created to protect the bowel anastomoses. The morbidity and mortality associated with three surgeries in a relatively short time period was substantial. This approach was abandoned when the Hartmann's approach was instituted.[9]

The Hartmann's procedure is now considered the gold standard approach. In step one, the abscess and infected material of the perforated diverticulum is drained and the affected bowel (sigmoid) segment is removed. The proximal end of the colon is exteriorized as a colostomy and the rectal stump is closed over via stapling or suturing, which is then left in place. This stump isn't externally visible. Special care is taken to extend the distal margin of the resection to the upper rectum.[9] In step two, the segments of bowel are reconnected when the patient's overall state is improved and infection has been eradicated. This usually occurs 12 to 16 weeks after step one. By 1980, the Hartmann's procedure was generally accepted as correct management of acute diverticulitis requiring surgery.[18] The Hartmann's procedure is still recommended in patients with significant feculent or purulent peritonitis.[10]

The Hartmann's procedure with diverting colostomy has a noteworthy downside. Recent research done in a retrospective population-based study in California showed that over 35% of patients who have had the procedure for sigmoid diverticulitis didn't have their diversions revised at a 4-year follow-up.[19] These patients tended to be older, female, and have more comorbidities.

Newer procedures are also being used. These include a simple washout of the abdomen with drainage (no resection), primary resection with anastomosis, and a covering diverting ileostomy to protect the anastomosis, and most recently, primary resection with anastomosis and no temporary stoma.[10] When resection does occur, it's recommended that the entire sigmoid be removed.[3] Currently, the controversy of single-stage operation, with primary resection and anastomosis, is still a hotly debated topic. Advantages and disadvantages are described and debated in the literature.[7] Potential contraindications to primary anastomosis at the time of sigmoid colectomy include unexpected intraperitoneal contamination, residual abscess, and unforeseen intraoperative complications.[9]

An extensive review of the literature by Salem and Flum[20] posits that primary anastomosis compares favorably to the Hartmann's procedure for patients with diverticulum perforation or peritonitis. Lower mortality, wound infection, and other complications are reported in primary anastomosis patients.

Surgery may also be prophylactically used. The American Society of Colon and Rectal Surgeons guidelines suggest preemptive surgery for any patient who's had two attacks of acute diverticulitis with the intention of preventing a third attack and its attendant risk of perforation.[10,21]

Surgery may be used electively for other situations

as well, including:

- patients with one attack who develop a contained perforation, colon blockage, or fistula
- patients with suspicions of colonic carcinoma
- patients under age 50 who are hospitalized for a single attack.[7]

Implications for perioperative nurses

Perioperative nurses should have an understanding of the disease process of diverticulitis to anticipate selected surgical approaches, or to ask which procedural approach will be used by the surgeon. Presently, the most commonly performed diverticulitis surgical procedures are single- or two-stage operations. They can be performed open, laparoscopically, or laparoscopically assisted.

A single-stage approach involves primary resection of the diseased segment and anastomosis without a protective stoma. This method is more commonly used for patients without immunosuppression or immunocompromised status, who present as a Hinchey I or II, and who are generally more stable.

A two-stage procedure is usually used for patients with fecal peritonitis, inflammation, and immunocompromised status.

A two-stage procedure is usually used for patients with fecal peritonitis, inflammation, and immunocompromised status. The two-stage procedure can be comprised of the Hartmann's procedure with a primary resection and creation of a descending or transverse colostomy with closure of the rectal stump. Another option is to complete a resection with primary anastomosis with a proximal loop ileostomy that is closed 3 to 4 months later.

The perioperative nurse needs to be ready with the instruments for an open case, including long bowel-specific instruments, abdominal retractors, such as the Bookwalter, and GI staplers of various sizes and types. Conversely, laparoscopic systems may be used. Long laparoscopic and open instruments should be available since the sigmoid colon is deep in the pelvis. Laparoscopic, long GI staplers should be available. In general, laparoscopic approaches to diverticulitis surgery have resulted in safe patient outcomes, shorter length of stay, and less pain and morbidity. Many surgeons feel laparoscopic colectomy is the treatment of choice for uncomplicated disease.[5,22,23]

Since the pelvis is a deep cavity and the inflammatory process of diverticulitis may obscure or distort tissue, the surgeon may want to take preventive measures by performing cystoscopy with placement of ureteral stents to avoid or minimize the risk of injury. The pertinent setup should be available.

Another intraoperative intervention that may be used is on-table, intraoperative colonic irrigation. On-table lavage diminishes the fecal loading of the proximal colon and permits anastomosis under conditions in which microbial count would otherwise make anastomosis risky. The lavage process stands in for the lack of bowel preparation and preoperative antibiotics that would be given in an elective bowel resection.

The lavage process entails several steps.[7] The diseased segment of the colon is mobilized and resected as per routine and a tape is placed around the colon proximal to the resected area to occlude the lumen. Sterile anesthesia tubing is inserted through the cut end of the colon and secured with the tape to prevent spillage. This is the "outflow" segment.

Further up the colon, a #32 French catheter is passed through an enterostomy site in the terminal ileum (at the site of the preplanned diverting ileostomy) and the balloon is inflated. Three to six liters of warm saline solution are used to irrigate the colon. A 10% solution of povidone iodine may be added to the last liter of fluid (if the patient isn't allergic). When the lavage is completed, the tubes are removed, the primary anastomosis can proceed, and the enterostomy is closed (or the ileostomy completed).

The surgeon may also irrigate the abdomen to remove any residual abscess material and may place a drain in the pelvis. The perioperative nurse should have warmed irrigation solution and a variety of drains in various sizes available (for example, Jackson-Pratt).

Since the diverticulitis procedures may involve the creation of a descending colostomy or a covering diverting ileostomy, the perioperative nurse should have ostomy appliances available. Clear pouches should be used (so the stoma can be postoperatively assessed for color) and, more often, two-piece appliances applied to give access to the stoma. The appliance should be cut to fit the stoma so that the peristomal skin is fully protected.

Commonly used antibiotics[2,24]

metronidazole (Flagyl) or clindamycin (Cleocin)
Plus
an aminoglycoside (gentamicin [Garamycin]) or (tobramycin [Nebcin])
Or
monobactam (aztreonam [Azactam])
Or
third-generation cephalosporins (ceftriaxone [Rocephin], ceftazidine [Fortaz], cefotaxime [Claforan])

Alternatively
second-generation cephalosporins (cefoxitin [Mefoxin], cefotetan [Cefotan])

beta-lactamase inhibitor combinations (ampicillin-sulbactam [Unasyn], ticarcillin-clavulanate [Timentin])

Another implication for care is that the patient will most likely be elderly. Specialized care needed for elders, such as meticulous skin protection and pressure redistribution (padding and use of special mattresses), maintenance of body warmth with a forced-air warming device, and use of warmed irrigation/lavage fluids during surgery.

Because the patient with a perforated diverticulum requires antibiotic therapy, the perioperative nurse should ask the surgeon, or consult a preference card or standing orders for postoperative colorectal surgery patients for appropriate antibiotics to have available (see *Commonly used antibiotics*).[2,24] Since the procedure is major pelvic surgery, the surgeon may want to use pain control methods, such as subcutaneous pain control pumps (for example, On-Q Pump).

The perioperative nurse should be conversant with new dissection technologies since they have excellent applicability in both open and laparoscopic approaches. Obtaining reliable hemostatic control in mesocolic or mesorectal dissections is challenging, particularly when inflammatory processes such as diverticulitis are present.[22]

Traditionally, multiple methods have been used to achieve hemostasis. These include familiar methods such as monopolar and bipolar coagulation, clips, staples, and sutures. Two novel technologies, the high-frequency ultrasonic scalpel and the electrothermal bipolar vessel sealer, offer excellent hemostasis with good patient safety. For example, the Harmonic Scalpel[25] and the electrothermal bipolar vessel sealer (LigaSure device)[26] offer excellent hemostasis with no need for patient grounding. The Harmonic Scalpel uses high-frequency vibration to achieve hemostasis at a low temperature by denaturing proteins and producing a sticky coagulum that seals blood vessels up to 5 mm in diameter.[25]

LigaSure uses high current and low voltage to denature collagen and elastin across a collapsed vessel wall. This instrument effectively seals vessels up to 7 mm in diameter that can be cut using the internal blade of the LigaSure device. Both technologies are well suited for laparoscopies but can also be used in open colon cases.[26]

Perioperative nurses must be familiar with the setup of the Harmonic Scalpel, which involves the use of a torque device to lock the blade into place, as well as the need to test the device before it is ready for use. The LigaSure device doesn't need such manipulation. Its connection is passed off the field, attached to the generator source, and turned to the desired setting. Both systems offer the benefit of reduced needle sticks in the OR and eradicate the risk of grounding-site burns that accompany the use of monopolar electrocautery.

Implications for future research

Much research is needed to elucidate the pathomechanisms of diverticular disease, its natural history, and the best modes of treatment. Questions to be answered include:

- Why are colonic diverticula so common in industrialized nations?
- How can diverticula development be prevented?
- Why do only a small group of affected persons develop diverticulitis symptoms?
- What leads to infection/inflammation of diverticula?
- How can medical treatment be improved?
- What's the best surgical treatment in selected patient circumstances?
- What's the most effective surgical treatment overall?
- Is primary anastomosis better with or without intraoperative lavage?[4]

Summary

Perioperative nurses will inevitably encounter a patient with diverticulitis requiring surgical intervention. Optimal care involves a thorough knowledge of the disease process, its medical therapy, and possible surgical therapies. Advanced clarification of surgical approaches and necessary equipment can make for a streamlined, efficiently enacted perioperative experience. The future will

likely witness innovative therapies in the comprehensive care of patients with diverticular disease. **OR**

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