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## Literature Overview

Editor: Lewis Flint, MD, FACS  
Associate editor: Michael McGee, MD, FACS

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1. Each of the following is a nonpharmacologic measure for the prevention of surgical site infection (SSI) except which one?
   a) Incision site cleansing with chlorhexidine and 70% isopropyl alcohol
   b) Maintenance of normothermia
   c) Use of separate instrument sets for wound closure
   d) Clear liquid diet for three days preoperatively
   e) Selective hair removal with clippers just prior to skin incision

2. Amyand hernia is:
   a) A diaphragmatic hernia
   b) A ventral hernia
   c) An incarcerated hernia
   d) An inguinal hernia containing a normal appendix
   e) An inguinal hernia containing a normal ovary

3. The pathologic features of appendicitis were first described in the nineteenth century by:
   a) Samuel David Gross
   b) William Stewart Halsted
   c) Reginald Fitz
   d) Charles Mayo
   e) Hunter McGuire

4. Each of the following statements concerning appendicitis is true except which one?
   a) 250,000 appendectomies are performed annually in the United States
   b) Appendiceal carcinoid is the most common cause of appendicitis
   c) The incidence of appendicitis is 6%-8%
   d) Appendicitis is more common in males
   e) Mortality for appendectomy rises to 15% in patients older than 75 years

5. A 28-year-old woman who is 26 weeks pregnant presents to the emergency room with lower abdominal pain. The clinical evaluation is suspicious for appendicitis. Which of the following is the most appropriate initial imaging study?
   a) Multidetector contrast enhanced CT
   b) Flat and upright abdominal film
   c) Upright chest radiograph
   d) Ultrasound
   e) Magnetic resonance imaging

6. Outcomes analyses of laparoscopic appendectomy compared to open appendectomy have consistently shown which of the following?
   a) Shorter duration of operation with laparoscopic approach
   b) Shorter hospital length of stay with laparoscopic approach
   c) Greater use of postoperative narcotic analgesics with laparoscopic approach
   d) Higher frequency of incisional infection with laparoscopic approach
   e) Longer recovery time with laparoscopic approach
7. Simple mucocele of the appendix is defined as:
   a) Obstructed appendix with the lumen filled with mucous
   b) Mucous drainage from the appendiceal stump
   c) Mucous-filled appendix with cystadenocarcinoma identified on histologic examination
   d) Ruptured appendix with mucous deposits on the peritoneal surfaces
   e) Mucous collections in periappendiceal lymph nodes

8. The most effective therapy for pseudomyxoma peritonei is which of the following?
   a) Right hemicolectomy
   b) Appendectomy
   c) Complete debulking of peritoneal myxoma deposits with hyperthermic intraperitoneal chemotherapy
   d) Debunking with liver resection
   e) Intraperitoneal chemotherapy without debunking

9. Each of the following statements regarding colonic diverticula is true except which one?
   a) Diverticula occur at points where nutrient blood vessels penetrate the colonic taenia
   b) Diverticula are common when a low-fiber diet is consumed
   c) Diverticula are congenital weaknesses of the colon wall
   d) Diverticula develop in high-pressure segments of the colon
   e) Diverticula are rare in the rectum

10. Which of the following statements regarding colonic diverticular bleeding is false?
    a) The site of bleeding is most commonly in the right colon
    b) Risk of bleeding is increased in patients older than 70
    c) Bleeding risk is associated with the use of nonsteroidal antiinflammatory agents (NSAIDs)
    d) Bleeding risk is increased in patients taking antiplatelet medications
    e) Diverticular bleeding is a rare cause of lower gastrointestinal hemorrhage

11. The overall risk of mortality from recurrent attacks of sigmoid diverticulitis over long-term follow-up is?
    a) 8%
    b) 15%
    c) 22%
    d) 4%
    e) 1.6%

12. Current practice parameters recommend elective sigmoid resection in which of the following situations?
    a) Successful treatment of acute sigmoid diverticulitis with antibiotics
    b) After the second episode of acute diverticulitis
    c) In patients younger than 65
    d) After nonoperative management of patients with diverticulitis complicated by fistula
    e) In female patients with a history of acute diverticulitis

13. Each of the following is a known risk factor for mortality due to diverticular bleeding except which one?
    a) Female gender
    b) Age >75 years
    c) Atherosclerotic cardiovascular disease
    d) Use of antiplatelet medications
    e) Clinical signs of hypovolemic shock

14. Which is the most dependable way to differentiate rectal prolapse from prolapsed hemorrhoids?
    a) Concomitant bleeding is present with rectal prolapse
    b) Perineal irritation is commonly seen in patients with prolapsed hemorrhoids
    c) The prolapsed rectum has visible concentric mucosal folds
    d) Patients with prolapsed hemorrhoids rarely complain of constipation
    e) Patients with rectal prolapse are usually male
15. Each of the following is a transabdominal operation for rectal prolapse except which one?
   a) Laparoscopic ventral rectopexy
   b) Ripstein procedure
   c) Sigmoid resection without mesh fixation
   d) Sigmoid resection with rectosacral suture fixation
   e) Delorme procedure

16. Rubber band ligation of external hemorrhoids is discouraged because of which of the following?
   a) The risk of sepsis and death exceeds 20%
   b) Ligation of external hemorrhoids is associated with persistent bleeding in more than 10% of patients
   c) Thrombosis of the external hemorrhoid occurs after rubber band ligation
   d) External hemorrhoids have normal skin pain sensation and rubber band ligation is very painful
   e) Recurrence of hemorrhoids is common after ligation

17. The internal opening of a fistula-in-ano can be demonstrated by hydrogen peroxide injection into the external opening in which percentage of patients?
   a) 10%
   b) 80%
   c) 25%
   d) 5%
   e) 35%

18. An acute fissure-in-ano is most commonly located in which area?
   a) Left lateral anus
   b) Right lateral anus
   c) Ventral anus to the left of the midline
   d) Ventral anus to the right of the midline
   e) Dorsal midline of the anus

19. Healing of fissure-in-ano after botulinum toxin injection is mainly the result of which of the following?
   a) Stimulation of blood flow
   b) Upregulation of T-lymphocytes
   c) Improved local wound healing
   d) Relaxation of the anal sphincter
   e) Acceleration of dermal growth over the exposed sphincter muscle

20. All of the following are accepted operative approaches to pilonidal disease except which one?
   a) Altemeier procedure
   b) Excision with secondary healing
   c) Excision with marsupialization
   d) Rhomboid flap procedure
   e) Cleft-lift procedure

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This issue of Selected Readings in General Surgery (SRGS) begins a three-part series dealing with diseases of the colon, rectum, and anus. We open this first issue with a discussion of the use of bowel preparation for reducing the risk of infectious complications after elective colon resection. Several recent articles have focused on the health burden imposed by these complications, as well as the potential benefit of oral antibiotics and mechanical bowel preparation in reducing complication risks.

Additional discussions in this issue include diseases of the appendix, diverticular disease, colon obstruction, hemorrhoid disease, and perirectal infection (with emphases on anal fistulas and fissures).

I am grateful for the editorial assistance of Michael McGee, MD, FACS, of the Department of Surgery at Northwestern University Feinberg School of Medicine in the preparation of this three-issue series.
Bowel preparation for elective colon procedures

Surgical site infection (SSI) is an important postoperative complication of elective colon resection. Recent articles reviewed in this section of the overview confirm that surgeons are continuing their efforts to reduce SSI risk, but there is significant variation in preventive approaches.

A review article dealing with the pathophysiology of SSIs following colon and rectal procedures, as well as evaluations of measures for SSI prevention, was presented by Fry in *Scientifica (Cairo)*, 2013. The article’s first points of emphasis were the factors contributing to the risk and severity of SSIs. The size of the bacterial inoculum that contaminates the surgical site was the most important and determinant infection factor: the colon can contain up to $10^{12}$ bacteria per gram of colonic content, and the bacteria inside the colon lumen are a major source of contamination to the surgical wound. The wound can also be contaminated by skin bacteria. The second factor was the virulence of the bacteria in the contaminating dose. The aerobic and anaerobic bacteria within the colon lumen can function synergistically to increase the virulence of both types of organisms; this feature forms the basis of preventive efforts directed toward reducing both types of bacteria—in the preoperative preparation of the patient, and in the use of systemic antimicrobials in the perioperative period. Local aspects of surgical contamination sites, such as hematomas, necrotic tissue, and foreign bodies, comprised the third factor contributing to infections. The final factor was the effectiveness of the host response; although some surgical site contamination almost certainly occurs in most patients, infection is diagnosed in a relatively small proportion of patients within the first 30 days following operation. This fact demonstrates the effectiveness of the host response. Determinants of host response include an intrinsic, genetically determined (but poorly understood) component, and the effects of infection risk factors, including certain chronic conditions (diabetes, lung disease, renal disease, liver disease, and congestive heart failure) and acute perioperative conditions, such as anemia, hypothermia, hyperglycemia, and hypoxia.

A method for estimating SSI risk after colon and rectal procedures is the focus of an article by Hedrick and coauthors in *Diseases of the Colon and Rectum*, 2013. The authors reported methods for the development of scoring nomograms based on data from the National Surgical Quality Improvement Program (NSQIP) database for the authors’ institution; the scoring nomograms were then used to predict the risk of superficial and deep wound space SSIs; the scoring nomograms are reproduced here as Figure 1 and Figure 2. The authors chose to predict these two types of SSIs since they are observed most often in patients who have undergone colon and rectal procedures. Important risk factors identified for superficial wound SSIs in the study included nonindependent functional status, preoperative anemia, alcohol use, open operative

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**Figure 1** Predictive score for superficial wound space infection. Reproduced from Hedrick and coauthors with permission.
technique, stoma closure procedure, increased American Society of Anesthesiologists (ASA) score, and increased BMI. Of interest was the finding that patients 75 years or older had a reduced risk of superficial wound SSI. Factors associated with increased risk of deep-incisional SSI included diabetes, increased BMI, the need for open operation, current smoking, and the presence of disseminated malignancy. The authors emphasized the need to prospectively verify these nomograms. If risk prediction is accurate, the use of interventions such as delayed primary closure and wound-protective devices could be used in patients with scores that indicate increased SSI risk.

Additional data confirming differences in risk factor patterns for different types of SSI were presented in an article by Segal and coauthors in Surgery, 2014. This article is included as a full-text reprint accompanying some formats of SRGS. The authors used data from the NSQIP database to evaluate factors associated with increased risk for superficial wound, deep wound, and organ space infections in a group of nearly 60,000 patients whose operative procedures occurred during the 2007–2009 interval. Their analysis confirmed the effects of alcohol use, chronic obstructive pulmonary disease, prolonged operative duration, increased BMI, and diabetes in increasing the risk of superficial wound SSI; factors that increased deep-wound SSI risk included smoking, increased BMI, ASA score >2, and need for urgent operation. Systemic factors that could be expected to reduce the effectiveness of host response were important to the increased risk of organ-space SSIs; these included the presence of disseminated malignancy, preoperative radiation therapy, steroid use, chronic renal disease, and weight loss >10%. The authors hypothesized that the presence of these systemic factors, as well as patient frailty, might adversely impact anastomotic healing, since most organ space SSIs are thought to result from clinically occult or overt anastomotic leaks. The authors concluded that considering the three SSI types as separate entities could lead to improved SSI surveillance and improved planning of preventive interventions.

An article by Tserenpuntsag and coauthors in Infection Control and Hospital Epidemiology, 2014 analyzed single-state patient surveillance data. The study was designed to identify SSI risk factors following colon and rectal procedures. A total of 2,656 procedures were analyzed; both emergency and elective procedures were included and the total SSI rate was 26.3%. The main risk factors identified were increased BMI, ASA score >3, prolonged operative duration, and male gender; the authors speculated that male gender was a risk factor because of the high proportion of urgent and emergency procedures in male patients.

Additional data confirming that increased BMI is associated with a higher SSI risk were presented in an article by Amri and coauthors in the American Journal of Surgery, 2014. The authors retrospectively reviewed a single-institution experience over a seven-year interval. Data from 1,048 patients who underwent colon and rectal procedures for colon or rectal cancer were included. The authors found a linear relationship between increased BMIs and increased SSI risks for both laparoscopic and open operations. For BMI >30, SSI risk increased by 60%.

Fry noted that an accurate estimation of the rate of SSIs following colon and rectal procedures is challenging because of the varying definitions of SSIs used in different hospitals, and because capturing SSIs diagnosed after hospital discharge in hospital databases is inconsistent. Analyses of administrative databases have disclosed a range of SSI rates of 4%–10%. Single-institutional studies cited by Fry have disclosed SSI rates of approximately
20%. These variations are likely the result of institutional data capture practices (mentioned previously) as well as variations in patient SSI risk.

An additional perspective on reported SSI rates and their associated health care costs was presented in an article by Biondo in Techniques in Coloproctology, 2014. The author noted that SSIs are the most common type of hospital-acquired infection in patients undergoing colorectal surgeries. Reported SSI rates in patients undergoing colon resection range from 5% to 40%; cost data cited by the author confirm that SSIs add more than $17,000, on average, to the cost of a colon or rectal procedure.

There is also significant regional variation in reported SSI rates following colon and rectal procedures. Acin-Gandara and coauthors reported data from a single institution in Spain and observed an overall SSI rate of 10.6% for patients undergoing elective colon and rectal procedures. This rate was compared with data reported from large American databases that confirmed SSI rates of 5%–7%. The authors noted that data from the NSQUIP database disclosed a 9% SSI rate. Reports of observational studies from single centers in the United States have shown considerable variability, with some SSI rates ranging from 16% to 20% according to data cited by Acin-Gandara and colleagues. Data from a national database in Spain cited by the authors confirmed a 17.6% SSI rate for elective colon and rectal operations done in Spain from 2006 to 2008; the 2009 rate for Madrid was 16.9%.

Biondo noted that the wide range of reported SSI rates occurred because of variability in reporting the timing of SSI diagnoses (during hospital admission alone vs. the 30- to 90-day interval after operations); variability in the types of colon and/or rectal procedures included in the reported cohort; and the inclusion or exclusion of high-risk procedures, such as urgent and emergency operations. Higher SSI rates are also reported in patients who have undergone preoperative radiation and/or chemotherapy, or those with known SSI risk factors, such as diabetes, steroid use, immunosuppression, anemia, and/or perioperative blood transfusion requirements. There is also variability in compliance with perioperative maneuvers that may reduce SSI risk, such as maintenance of normothermia and normoxia, protection of wound edges, and timely administration and redosing of systemic antibiotics. Biondo noted that several clinical trials of interventions to reduce SSIs following colon and rectal resections have failed to demonstrate the benefit of evidence-based SSI reduction bundles.

Fry discussed interventions designed to reduce SSI risk and the strength of the evidence supporting each of these interventions. Preoperative cleansing of the skin is an intervention that makes intuitive sense, but aggregated data analyses of colon and rectal procedures and dataset analyses of clean elective operations, as well as available systematic literature reviews, have failed to document a significant reduction in SSI rates that are associated with this practice. Fry noted that because colon content is the source of bacterial contamination in SSI events following colon and rectal procedures, preoperative skin washing is unlikely to be helpful. Additional data were cited that support the selective removal of body hair with electric clippers prior to skin preparation. Studies of skin preparation prior to incision also support the use of chlorhexidine according to data cited by Fry; however, while the addition of 70% isopropyl alcohol to the chlorhexidine application is popular, it is associated with an increased risk of operating room fires. That said, the data supporting a significant reduction in SSI risk with the addition of isopropyl alcohol are weak. Fry concluded the discussion of non-pharmacologic measures for SSI reduction by reviewing data on the use of wound sealants and protective drapes. The only wound intervention supported by available data is the use of ring wound drapes, where a plastic ring is inserted into the wound and plastic protective drapes are brought out over the exposed subcutaneous tissue and skin. Fry noted that this practice is supported by one meta-analysis, but that additional study is warranted.

Another review article that discussed the use of non-pharmacologic methods for SSI risk reduction is by Murray and coauthors in the Journal of the American College of Surgeons, 2010. This report agreed with the analysis presented by Fry and offered additional data supporting the use enriched inspired oxygen and the maintenance of normothermia as potentially effective measures to reduce SSI risk.

Fry reviewed the rationale and data supporting the use of systemic antibiotics administered in the hour prior to the incision and redosed based on the duration of the procedure and the expected half-life of the antibiotic used. Data cited from classic older studies and more contem-
porary work support the use of antibiotic agents that are effective against the aerobic and anaerobic gram-negative organisms expected to inhabit the colon lumen. Because of the association of increased BMI with increased SSI risk, Fry suggests that weight-based dosing of systemic antibiotics is a sensible approach. The author noted that increasing concern for methicillin-resistant *S. Aureus* (MRSA) has led some investigators to suggest that vancomycin be added to the systemic antibiotic regimen for patients known to be colonized with this organism, or in hospitals with higher MRSA infection rates; however, the available data do not presently support this practice.

An article by Deierhoi and coauthors in the *Journal of the American College of Surgeons*, 2013, analyzed the impact of antimicrobial drug choice (for systemic antibiotic prophylaxis) on the risk of postoperative colon and rectal SSIs. This article is supplied as a full-text reprint accompanying some formats of SRGS. The authors analyzed data from the Veterans Affairs Surgical Quality Improvement Program (VASQIP), including information on nearly 6,000 patients who underwent colon and rectal surgical procedures. SSIs were diagnosed in 12.3% of patients during the first 30 days after their operations; data analysis showed that first-generation cephalosporin combined with metronidazole was associated with a 63% reduction in SSI risk, compared with other antibiotic combinations. There was a significant SSI risk increase associated with the use of ampicillin/subactam for systemic antibiotic prophylaxis. The data also showed that oral antibiotics, administered preoperatively, were associated with an additive benefit when combined with systemic first-generation cephalosporin plus metronidazole. The topic of mechanical bowel preparation with or without oral antibiotic administration for SSI risk reduction will be discussed at this time.

Fry cited evidence supporting the use of mechanical bowel preparation combined with oral antibiotics (neomycin/erythromycin base or neomycin tetracycline) as a means of reducing SSI rates. SSI rates of approximately 5% were reported by several investigators using these approaches; however, health care cost control measures have led to the elimination of preoperative hospitalization for the purpose of safely conducting bowel preparation and administering antibiotic agents, and thus a reduction in the use of these approaches; several studies from Europe showed no reduction in SSI rates with mechanical bowel preparation alone. In addition, survey data have confirmed that mechanical bowel preparation is used in less than half of patients undergoing colon and rectal procedures and oral antibiotics are omitted in approximately 25% of patients. Recent data, cited by Fry, have reemerged supporting the use of mechanical bowel preparation combined with oral antibiotics. Barriers to the outpatient use of oral antibiotics and mechanical bowel preparation include the risk of dehydration and reductions in intravascular volume associated with the use of laxatives (especially in elderly patients and patients with comorbid conditions). Also, there may be resistance to taking large volume laxatives; other negative effects are abdominal cramping and a sensation of bloating that may accompany the use of oral antibiotics and mechanical bowel preparation. Protocols will be needed to assure adequate compliance and maximum patient safety.

The first example of data confirming the value of oral antibiotics with or without mechanical bowel preparation was reported by Cannon and coauthors in *Diseases of the Colon and Rectum*, 2012. The authors reported outcomes on nearly 10,000 patients cared for in the Veterans Affairs Health System. Statistically significant reductions in SSI rates were observed in patients who received oral antibiotics with or without mechanical bowel preparation. SSI rates associated with left-colon or rectum resections vs. right-sided ones were not reported, so the benefit of mechanical bowel preparation in left-sided or rectal procedures is not clear.

An article that reported outcomes data from more than 5000 patients is by Moghadamyghaneh and coauthors in the *Journal of the American College of Surgeons*, 2015. Data were extracted from the NSQIP database for a single year. The analysis showed that 27% of patients had both mechanical and oral antibiotic bowel preparations; patients in this subgroup that underwent left-sided colon procedures or rectal procedures had significantly reduced SSI rates and anastomotic leakage. The authors concluded that oral and mechanical bowel preparation were beneficial for patients undergoing left-sided colon or rectal procedures.

A final article supporting the use of mechanical bowel preparation and oral antibiotic administration was reported by Keenan and coauthors in the *Journal of the
The article presented data from a single institution. Outcomes were analyzed following the sequential introduction of protocols for preoperative preparation of patients undergoing colon and rectal procedures that emphasized an enhanced recovery pathway initially, and later combined this pathway with an infection reduction bundle that included mechanical bowel preparation, oral antibiotics, and appropriate systemic antibiotic prophylaxis, as well as other measures, including maintenance of normothermia, low-volume intraoperative intravenous fluids, wound protection drapes, and separate instrument kits for wound closure. The authors risk-adjusted the groups to make them as comparable as possible. There was a significant SSI reduction rate following introduction of the infection prevention bundle; superficial wound SSIs were reduced from 16% to 6.3%. The authors concluded that a protocol-based approach improved outcomes in patients undergoing colon and rectal procedures, and that the infection prevention bundle was effective.

Major challenges to the success of efforts to reduce SSI risk are the lack of sufficient institutional resources to implement and monitor SSI prevention protocol performance, as well as the resistance of surgeons and other health care professionals to implementation and monitoring processes; thankfully, recent reports have shown that these challenges can be overcome with dedicated effort. Data supporting the use of a multidisciplinary protocol-driven approach for reduction of SSI were presented in an article by Cima and coauthors in the Journal of the American College of Surgeons, 2013. The authors reported on a single-institution study and described the process of recruiting, educating, training, and monitoring a multidisciplinary team. The team employed an infection reduction protocol that emphasized patient preoperative cleansing, appropriate administration (and redosing, if necessary) of systemic antibiotics, evidence-based skin preparation, use of separate instruments for wound closure and careful postoperative hand hygiene. The components of the program are illustrated in the article; the illustration is reproduced as Figure 3. The introduction of the protocol was associated with a significant reduction (p < 0.05) in overall and superficial wound SSIs to 4% and 1.5%, respectively. The authors concluded that a multidisciplinary team approach was feasible and effective. It was obvious from the data presented that the authors carefully assembled and educated team members, and created incentives to maximize compliance. Overall, this is a good example of a successful method for accomplishing multidisciplinary quality improvement.

A final article describing a multi-stage knowledge translation process designed to improve compliance with a mechanical bowel preparation clinical practice guideline was presented by Eskicioglu and coauthors in the
Journal of Gastrointestinal Surgery, 2015. The authors reported a multiphase education and training project that emphasized education and the use of reminder cards in phase one, followed by the recruitment of “champions” to support the effort, preprinted electronic health records, audits, and presentation of compliance data in phase two. Analysis showed that the knowledge transfer program increased compliance with the clinical practice guideline from 59% (the level prior to beginning the effort) to 81%. The authors concluded that a dedicated knowledge transfer program, supported by institutional leadership and implemented with sufficient resources to determine and maintain compliance, can be successful in developing effective means for reducing SSIs in patients undergoing colon and rectal procedures.

Surgery of the appendix

The first appendectomy was performed by Claudius Amyand, a naturalized British surgeon of French descent in the mid-eighteenth century. The patient was a child whose appendix had been pierced by a pin; Amyand hernia is a condition wherein an apparently normal appendix presents in the sac of an inguinal hernia. The pathologic features of appendicitis were documented by Reginald H. Fitz in 1886.

Appendicitis occurs because of obstruction of the lumen of the appendix leading to edema, reduction of appendiceal blood flow, and inflammation. In children, obstruction may be caused by hypertrophy of appendiceal lymphoid tissue, while fecaliths are common causes of luminal obstruction in adults. Appendiceal tumors may also cause obstruction and appendicitis, and these instances of appendicitis cluster in elderly adults. As the process progresses, necrosis of appendiceal tissue may develop along with bacterial overgrowth leading to perforation and extensive periappendiceal inflammation. Some patients will resolve symptoms spontaneously or with antibiotic therapy, indicating that development of perforation and peritonitis is not inevitable. Overall mortality for appendicitis is less than 1%, but approaches 15% in elderly patients with multiple comorbid conditions.

Appendectomy is the one of the most common emergent or urgent abdominal operations performed by general surgeons. The diagnostic process for appendicitis has been refined as ultrasound and computerized tomographic imaging has improved. Along with the increased use of CT imaging has come an understanding of the potential long-term risk of radiation exposure, especially in children and young adults. Approaches to the management of appendicitis have evolved and laparoscopic appendectomy is used with increasing frequency. Expectant management of appendiceal phlegmon and abscess using antibiotics and percutaneous drainage has decreased the frequency of urgent operations for this condition. As these changes have occurred, the role of interval appendectomy has been challenged.

Acute appendicitis

In young male patients, the diagnosis of acute appendicitis is usually straightforward based on clinical evaluation. The classic clinical presentation of periumbilical pain that migrates to the right lower quadrant (RLQ) of the abdomen, combined with nausea and vomiting as well as concomitant localized tenderness to palpation in the RLQ, is dependable for the diagnosis of appendicitis, especially when evidence of an inflammatory process (fever and leucocytosis) is present. In such patients, imaging is not necessary. In a previous discussion of the clinical diagnosis of appendicitis in children (SRGS, Volume 40, Number 4) evidence was presented supporting the accuracy of sequential physical examinations as a means of establishing the diagnosis of acute appendicitis in children and adolescents without relying on imaging.

Diagnosis of appendicitis may be challenging in young women because of other disease processes that present as pain and tenderness in the RLQ. In this patient group, consideration needs to be given to conditions such as ovarian torsion, ectopic pregnancy and complicated endometriosis. Imaging with ultrasound, and computerized tomography has improved the accuracy of diagnosis. These adjuncts may also contribute to diagnostic accuracy.
in managing special groups, such as pregnant patients, patients with a history of prior abdominal operations and/or associated intestinal disease, and elderly patients.

There is understandable concern regarding the radiation exposure that accompanies CT imaging when diagnosing appendicitis. In an effort to minimize radiation exposure, CT imaging protocols and techniques have been developed. An article discussing one such protocol is by Kim and coauthors in the *New England Journal of Medicine*, 2012. The authors conducted a single-institution non-inferiority randomized trial comparing a low-dose CT imaging protocol with standard CT imaging. Appendectomy was performed in 172 patients in the low-dose group, and in 186 patients in the standard-dose group. The primary endpoint was the rate of negative appendectomy. Data analysis showed that the negative appendectomy rates were nearly identical in the two groups. Other variables of interest, such as the rate of complicated appendicitis, did not differ when the two groups were compared. Of interest was the fact that patients in the low-dose imaging group were more likely to undergo additional imaging studies and had a longer interval between imaging and operation than patients in the standard-dose group. The authors hypothesized that this was due to the hesitancy of surgeons to base a decision for surgery on the newer imaging approach. Despite these limitations, the data support the diagnostic accuracy of the low-dose CT imaging approach.

Management of appendicitis in patient groups where operative risk may be increased, such as in elderly patients, in whom comorbid conditions may be present that will influence potential postoperative complications and outcomes. Another special situation is appendicitis in pregnant patients, where considerations of risks to the fetus, which may change with different management strategies, will need to be balanced with the need to obtain the optimum outcome for the mother.

An article that provides perspective on the diagnosis and management of appendicitis in elderly patients was reported by Segev and coauthors in the *Journal of Gastrointestinal Surgery*, 2015. The authors reported a retrospective analysis of a single-institution experience with 1,898 patients diagnosed with appendicitis over a three-year interval. The authors defined “elderly” as 68 years or older. There were 68 patients in the group that fit this definition; 28 patients were older than 80. Data cited in the article confirm that the risk of developing complicated appendicitis and postoperative complications increase in elderly patients. Reported incidences of appendiceal perforation and postoperative complications are 70% and 48%, respectively. The analysis of their data indicated that elderly patients had significantly longer intervals between onset of symptoms and hospital admission. The interval between admission and operation was longer for elderly patients compared with the younger group. Younger patients were more likely to undergo sonography for diagnosis, while CT imaging was more commonly used in elderly patients. Laparoscopy was the initial operative approach in approximately half of each group, but the conversion rate to an open approach was significantly higher in the elderly patients. Postoperative complications were observed in 34% of the elderly group, compared with 14% in the younger patients. The only complication that occurred significantly more often in the elderly group was wound infection. The numbers of superficial vs. deep wound infections were not reported, nor was the incidence of wound dehiscence. The single postoperative death occurred in an 82-year-old patient. The authors noted that the longer interval between hospital admission and surgery might be explained by the increased use of CT imaging in the older patients. They hypothesized that implementation of an early CT imaging protocol in elderly patients might reduce this delay. They also suggested that a more complete assessment of frailty preoperatively might assist in identifying groups with higher complication risks. Whether reduction in the interval between hospital admission and operation would reduce the risk of complications is uncertain. A recent cohort study and meta-analysis reported by the United Kingdom National Surgical Research Consortium in *Annals of Surgery*, 2014, presented data confirming that delays of up to 24 hours between admission and operation did not increase the risk of complications in patients with appendicitis.

Diagnosis of appendicitis in pregnant patients is possible using a combination of physical examination findings and ultrasound imaging; accurate diagnosis is important in order to minimize the risk of negative appendectomy. Data on outcomes of pregnant patients undergoing negative appendectomy were presented in an article by Ito
and coauthors\textsuperscript{18} in the \textit{American Journal of Surgery}, 2012. The authors determined fetal outcomes in 87 pregnant patients who underwent appendectomies. The negative appendectomy rate was 36\% in this patient series, and the fetal death rate was 3\% in patients who had a negative appendectomy. This rate was similar to what was observed in patients documented as having acute appendicitis at operation. The fetal demise rate was 14\% for patients who had complicated appendicitis. The authors concluded that accurate diagnosis with operation performed before development of complicated appendicitis is a desirable goal in pregnant patients suspected of having acute appendicitis; the association of complicated appendicitis with higher rates of fetal demise was confirmed in an analysis presented by Abbasi and coauthors\textsuperscript{19} in \textit{Archives of Gynecology and Obstetrics}, 2014.

Ultrasonography may be undependable in the late stages of pregnancy; in such patients, MR imaging offers an opportunity for accurate diagnosis without exposing the fetus to radiation. The accuracy and safety of MR imaging in pregnant patients suspected of having appendicitis was analyzed in a retrospective review of medical records from a single institution by Fonseca and coauthors\textsuperscript{20} in \textit{JAMA Surgery}, 2014. The authors evaluated outcomes in 79 patients seen over an 11-year interval. Thirty-one patients had MR imaging, with only one negative appendectomy. Out of the patients with MR imaging findings that did not support the diagnosis of appendicitis, there were no subsequent admissions to the study institution for appendicitis. The authors concluded that MR imaging was helpful in diagnosing appendicitis in pregnant patients when clinical and ultrasound findings were nondiagnostic.

**Open versus laparoscopic appendectomy**

Minimally invasive appendectomy has grown in popularity, riding a wave of enthusiasm fueled by the promise of shorter recovery times, improved cosmesis, and a lowered risk of wound infection.

Because a significant proportion of appendectomies are performed after hours, the availability of laparoscopic appendectomy will vary, since some surgeons are not experts in this technique; also, the issue of cost should be considered. Laparoscopic appendectomy is more expensive, especially if disposable equipment is used. In this section of the overview we will discuss the evidence supporting the use of open and laparoscopic appendectomy for uncomplicated appendicitis, as well as for complicated appendicitis and appendicitis in specific patient groups such as pregnant patients, obese patients, and the elderly.

National guidelines for the performance of laparoscopic appendectomy have been promulgated by the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES). These guidelines are described in an article by Korndorffer and coauthors\textsuperscript{21} in \textit{Surgical Endoscopy}, 2010; the guidelines document is available free at SAGES.org. The guidelines state that laparoscopic appendectomy is feasible and safe for patients with uncomplicated appendicitis. Advantages of laparoscopic appendectomy, as stated in the guidelines, are small improvements in postoperative pain and recovery time. The laparoscopic procedure requires, on average, an additional 15–20 minutes of operating time. Clinical series have suggested a reduced frequency of postoperative wound infections, but a slightly higher rate of postoperative intraabdominal abscess. Korndorffer and colleagues cited data from later clinical series suggesting that there is not an increased risk of intraabdominal abscess associated with laparoscopic appendectomy.

One of the limitations of using large databases to compare treatment approaches using outcomes of care is that adjustment for the factors influencing a clinician’s choice of procedure are most often not included in the data available for analysis. One potential method for adjusting for the bias that may be introduced, due to these factors, is to use propensity scoring. Propensity scoring is a statistical technique that helps to adjust multivariate regression analyses using clinical evidence (such as signs of peritonitis or preoperative sepsis) to adjust for the influence that these factors may have on the surgeon’s procedure choice. Two articles that employ this technique will be reviewed at this time.

The first article is by Hemmila and coauthors\textsuperscript{22} in \textit{Archives of Surgery}, 2010. The authors used 2005–2008 data from the NSQIP database and adjusted their analysis with propensity scoring. They found that mortality risks, overall complications, major complications, and rates of reoperation were not different when laparoscopic and open appendectomies were compared. As in previously
discussed articles, an increased rate of organ-space infection was confirmed in the patients undergoing laparoscopic appendectomy. As with any technique of statistical adjustment, propensity score analysis carries the risk of adjusting for one source of bias while overlooking a second one. The result in this situation would be to amplify the effects of the overlooked source of bias; this risk is highlighted by the invited critique that accompanies this article. Nevertheless, the careful analysis conducted by these authors serves to reinforce the prior discussion supporting careful risk assessment, especially the risk of postoperative organ-space infections, when choosing an operative approach for appendicitis.

A second article employing propensity scoring as a statistical adjunct in a comparison of open vs. laparoscopic appendectomy is by Ingraham and coauthors in the Journal of the American College of Surgeons, 2010. These authors also queried the NSQIP database for the interval of 2005-2008 and employed propensity scoring to adjust for potential sources of bias. They found, as was observed in the previously-reviewed article, that overall morbidity was lower in patients undergoing laparoscopic appendectomy. Serious morbidity was equivalent for both approaches, and the rate of organ-space infection was higher in patients having laparoscopic appendectomy. When academic and non-academic institutions were compared, outcomes were similar, with laparoscopic appendectomy patients having short hospital stays and short recovery times. Operative durations for both open and laparoscopic appendectomy were longer at academic institutions.

Korndorffer and coauthors noted that the SAGES guidelines for laparoscopic appendectomy state that laparoscopic appendectomy is safe and feasible in various special patient groups, including patients with complicated appendicitis, children, pregnant patients, and the elderly. Korndorffer and coauthors stated that laparoscopic appendectomy “is considered by many to be the standard of care for gravid patients with suspected appendicitis.”

Fetal outcomes for laparoscopic and open appendectomy have been reported, but these studies have been small single-institution retrospective analyses that have concluded that laparoscopic appendectomy is safe. Other analyses of large, single-institution experiences, as well as a systematic review of the literature, have suggested that fetal risks are higher in pregnant patients who undergo laparoscopic appendectomy; rates of fetal loss range from 5% to 9.6%. A recent case series from a single institution presented data suggesting that fetal outcomes were similar in patients undergoing open or laparoscopic appendectomy. An article that reported outcomes data for a national health insurance database is by Cheng and coauthors in Surgical Endoscopy, 2015. The authors examined outcomes in 859 pregnant women who were treated for appendicitis. Adverse fetal event rates were highest for patients treated nonoperatively. Fetal and maternal outcomes for patients who underwent open or laparoscopic appendectomy were similar. The available data regarding the adverse fetal event rates for pregnant patients undergoing laparoscopic appendectomy are not strong; surgeons should advise patients concerning the associated risks of open and laparoscopic appendectomy during pregnancy.

Nonoperative management of acute appendicitis

An important development in the management of acute appendicitis has been the emergence of nonoperative protocols for management of patients with acute appendicitis without signs of severe peritonitis. In such patients, successful management with systemic antibiotics has been reported, and this management approach has become increasingly common in Europe. An article that reported experience from a group of Italian centers is by Di Saverio and coauthors in Annals of Surgery, 2014. This article is supplied as a full-text reprint accompanying some formats of SRGS. The authors prospectively enrolled 159 patients in the nonoperative management study. The mean Alvarado score of patients in this group was 5.2; this level indicates a moderate risk for acute appendicitis. The Alvarado score was first described by Alvarado in Annals of Emergency Medicine, 1986. In the introduction of the article, the authors stated that the rationale for the study was the significant risk of complications in patients who had a negative appendectomy. Data cited by the authors indicated that 15%–30% of patients who undergo appendectomy do not have appendicitis confirmed. These patients would be at risk for such complications as wound infection, intraperitoneal adhesions, and even sterility, due to tubal inflammation in young women. The authors
cited additional data from observational studies and two randomized trials that confirmed the success rates of nonoperative therapies equivalent to appendectomy. Relapse rates over the first year of follow-up ranged from 10% to 14%. Approximately half the patients who relapsed could have been managed with another course of nonoperative therapy. Early failure of the nonoperative approach occurred in 11.9% of patients. All of these early failures underwent appendectomy. Over two years of follow-up, no patient was lost and the rate of recurring symptoms was 13.8%. Approximately two-thirds of the recurrences were managed with another course of antibiotics. The authors concluded that a nonoperative approach to patients with suspected appendicitis was safe and effective.

Available data comparing nonoperative protocols with the traditional “early appendectomy” approach to patients with suspected appendicitis are reviewed by Flum in the New England Journal of Medicine, 2015. This article is supplied as a full-text reprint accompanying some formats of SRGS. Several important points were made by the author, including the heterogeneity of appendicitis definitions and the “success” of nonoperative approaches reported in the “antibiotics first” trials of patients with appendicitis. In addition, most of the trials had relatively small numbers of patients and follow up was less than one year. Also, Flum emphasized the fact that open appendectomy is used most often in Europe, where most of the studies on nonoperative therapy were performed. This would suggest that the motivation of patients to avoid operation might be higher in Europe than in the United States, where relatively low-morbidity laparoscopic approaches are used in at least 50% of patients. Another important consideration is the criteria for diagnosis of appendicitis; in many of the reported trials, an appendiceal diameter of 6 mm or more on imaging has been used to diagnose appendicitis. Flum cited data that suggested that this appendiceal diameter is present in at least 20% of patients with a normal appendix. A final consideration that lends support to consideration of a nonoperative approach is that the appendix may make contributions to patient health that are not fully understood at present. For example, recurrence of C. difficile colitis is higher in patients who have undergone appendectomy. This suggests that the appendix may function to support the microbiome of the colon. Flum concluded that, on the basis of the reviewed data, most patients with suspected appendicitis should be treated with appendectomy using a laparoscopic approach if equipment and expertise are available. He encourages clinicians to offer nonoperative approaches in patients who are at an increased risk. Clinicians should also make patients aware of the European data supporting a nonoperative approach for the management of appendicitis.

Management of periappendiceal phlegmon and abscess

The approach to patients who present with a periappendiceal inflammatory mass or periappendiceal abscess would appear to have come full circle: from the suggested approach of aggressive operative management with early exploration and appendectomy for diffuse peritonitis to drainage (currently percutaneous radioguided) of established periappendiceal abscess, followed by later appendectomy, as proposed by Ochsner and coauthors in Annals of Surgery, 1930. As effective antimicrobial drugs became available, management of complicated appendicitis changed to an approach emphasizing early appendectomy with debridement of inflammatory tissue and drainage of abscesses. This approach was associated with disturbing complications, including disabling incisional infection, enterocutaneous fistula, and recurrent abscess formation. Recognition of the morbidity associated with immediate appendectomy for complicated appendicitis, the availability of powerful antimicrobial drugs, and the availability of imaging for localization and drainage of established abscesses have all contributed to the development of the current approach to complicated appendicitis. The principles of managing this condition currently include establishing the diagnosis, resuscitating the patient with intravenous fluids and antibiotics, determining the need for operation based on the presence of progressive diffuse peritonitis, and using percutaneous drainage for established abscesses. Traditionally, patients treated with abscess drainage and antibiotics for complicated appendicitis are encouraged to undergo “interval” appendectomy after they have been treated for the intraabdominal infection and have fully recovered. The need for interval appendectomy is a subject of ongoing debate. In this section of the overview we will review articles dealing with the management of complicated appendicitis.
The first article reviewed in this section is by Similis and coauthors\textsuperscript{34} in Surgery, 2010. This article presents a meta-analysis of available randomized and non-randomized trials comparing management strategies for complicated appendicitis. The authors opened the article by noting that patients with acute appendicitis fall into three clinical groups: patients with acute appendicitis, which is managed with immediate appendectomy; patients with perforated appendicitis causing diffuse, progressive peritonitis, who are resuscitated and treated with early appendectomy with debridement and drainage as necessary; and patients presenting with a localized inflammatory mass or abscess, who are frequently stable on admission and respond promptly to antimicrobial therapy and image-guided percutaneous drainage. The objective of the meta-analysis was to analyze comparative data and establish the expected outcomes of management of this third patient group, with either immediate operation or antimicrobial therapy and abscess drainage—with or without subsequent interval appendectomy. Seventeen studies of acceptable quality were identified. More than 1,500 patient records were analyzed in these studies, and a slight majority of patients were treated without immediate operation. Examination of the data from the various studies revealed that treatment failure rates (as evidenced by the need for more than one procedure during the acute hospitalization), wound infection, recurrent abscess, and intestinal obstruction were significantly fewer in patients managed without early appendectomy. These differences remained when the analyses were adjusted to examine specific treatment groups (adults vs. pediatric patients); adjustment for studies’ quality did not change the differences noted. The length of initial hospitalization and the duration of antibiotic therapy were not different when the two treatment approaches were compared. The authors concluded that this analysis suggests, but does not prove, the superiority of the nonoperative approach to appendicitis complicated by phlegmon and/or abscess formation. They suggest that a randomized prospective trial is needed to provide the necessary evidence of the superiority of one approach over the other.

A meta-analysis comparing open or laparoscopic appendectomy for complicated appendicitis is provided by Markides and coauthors\textsuperscript{35} in the World Journal of Surgery, 2010. These authors conducted a systematic review of available literature comparing the open vs. laparoscopic approach for patients with complicated appendicitis (perforation, gangrene, and/or abscess). Twelve studies were included, and the authors noted significant heterogeneity in the studies; as well as the poor design quality of all the included studies. Half of the included studies analyzed data from patients treated prior to the year 2000. Understanding the studies’ significant limitations, the authors concluded that there were no differences in overall complications when the two techniques were compared. Surgical wound infections were seen less often with the laparoscopic approach, and no difference in the rates of organ-space infections were observed when the groups were compared. Of interest is the fact that conversion rates from laparoscopic to open approaches were not reported, and there is no indication that patients were analyzed on an “intent to treat” basis, which would include converted patients in the laparoscopic groups for analysis purposes. In addition, no specific measures were taken to account for sources of bias in the included studies. All of these factors contribute to making this a suspect analysis for the purpose of supporting one approach choice over the other.

The available data support the use of antibiotics and percutaneous drainage of abscesses, when indicated, in stable patients (no sign of progressive peritonitis) with complicated appendicitis. Given the overall weakness of the available data, a decision for or against interval appendectomy following nonoperative management of patients with complicated appendicitis cannot be made with confidence. Management of patients with localized, well-tolerated appendiceal phlegmon and/or localized abscess with antibiotics and percutaneous abscess drainage followed by interval appendectomy as soon as recovery is complete is a sensible approach.

**Benign and malignant appendiceal tumors**

Common benign and malignant tumors of the appendix include carcinoids, mucoceles, and appendiceal adenocarcinomas. Carcinoids may be discovered incidentally at the time of appendectomy. When benign or malignant
tumors become symptomatic, the clinical presentation may be indistinguishable from appendicitis. If tumors grow to a sufficient size, they may present as a palpable mass; in this section of the overview we will discuss the diagnosis and management of these tumors.

The first article discussed is by Marmor and coauthors in the *Journal of Gastrointestinal Surgery*, 2015. The authors presented data on the current epidemiology of appendiceal neoplasms, using information extracted from the national Surveillance, Epidemiology, and End Results (SEER) database; they identified 4,675 patients who were treated for appendiceal cancer from 2000–2009. The data analysis showed a 54% increase in the incidence of appendiceal cancer over the interval studied (from 0.63 per 100,000 population to 0.97 per 100,000 population). The increase occurred in all types of appendiceal malignancies, and there were no distribution changes by tumor type, stage, patient age, or patient gender. The most common tumor types were mucinous adenocarcinomas, followed by carcinoid tumors, unspecified adenocarcinomas, and signet-ring cell adenocarcinomas. The authors noted that the mean age of patients developing appendiceal cancer was 58, while the mean age for developing other colon malignancies was 72. This observation implies that there are important biologic differences in appendiceal cancers, compared with other colon cancers. The reasons for the increased incidence are not clear. The authors noted that there has been an emphasis on differentiating appendiceal cancer from ovarian cancer. The incidence increase identified by the authors occurred in both males and females, so efforts to identify appendiceal and ovarian cancers probably cannot explain the increased incidences. The authors also noted a substantial increase in screening and surveillance colonoscopies over the study interval; however, the incidence of appendiceal cancers increased in age groups not generally eligible for colonoscopic screening, so the use of colonoscopy probably does not explain the increased incidence, either. CT imaging for abdominal complaints also increased significantly over the study interval—this may have contributed to the increased incidences of appendiceal cancer. The data analysis showed that patient characteristics associated with increased risk of mortality included black race, older age, and advanced tumor stage.

Appendiceal cancers can present as complicated appendicitis with perforation and abscess formation. With the increased interest in treating complicated appendicitis nonoperatively with antibiotics and percutaneous abscess drainage, the role of interval appendectomy is important, especially in older patients. Omission of interval appendectomy in patients with complicated appendicitis treated nonoperatively, who remain asymptomatic, has been increasingly practiced in adults and children. An article that presented data suggesting a significant risk of appendiceal cancer in patients treated without immediate or interval appendectomy for complicated appendicitis is by Wright and coauthors in the *American Journal of Surgery*, 2015. The authors reviewed outcomes in 6,038 patients who underwent appendectomy over a 12-year interval in two university-affiliated institutions. Appendectomy was performed during the index admission in 97% of patients. 188 patients had appendicitis treated without appendectomy—47% of these patients underwent interval appendectomy. Twelve percent of patients were diagnosed with appendiceal carcinoma at the time of interval appendectomy, compared with 0.5% of patients with appendiceal carcinoma who were diagnosed at the index appendectomy. The authors noted a 16% appendiceal cancer diagnosis rate in patients older than 40 who had interval appendectomy. This report is important, but interpretation of the data is significantly limited by the fact that long-term outcomes are unknown in the 99 patients who did not have interval appendectomy. Also unknown is the number of patients in the interval appendectomy group who had recurrent symptoms prior to interval appendectomy. The authors concluded that interval appendectomy should be considered in all patients who are treated for complicated appendicitis without appendectomy. I agree with this approach, especially for older patients, given the safety and low morbidity associated with laparoscopic appendectomy.

The next discussion article deals with appendiceal mucocele and is by Stocchi and coauthors in *Archives of Surgery*, 2003. The authors conducted a retrospective medical record review of 129 patients diagnosed with appendiceal mucocele over a 24-year interval at a single institution. The authors noted that the term appendiceal
mucocele has been used to describe three subsets of tumors: two of these are benign lesions (simple mucocele and cystadenoma) and one is malignant (cystadenocarcinoma). The authors classified their patients using the World Health Organization histological classification: this classification system considers a simple mucocele to be a dilated appendix with an accumulation of mucus due an obstructed lumen; a cystadenoma is defined as a dilated appendix filled with mucous having a benign adenomatous mucosal lining; and a cystadenocarcinoma is a dilated, mucous-filled appendix with malignant changes in the mucosal lining. The patients reviewed were mostly female and diagnosed, on average, in their 50s. Preoperative diagnosis was unusual. Most simple mucocles were diagnosed when the pathologist examined the excised appendix. The authors noted that CT imaging was not available when many of the patients were treated and that the rate of preoperative diagnosis is probably higher now. Most patients with simple mucocele were asymptomatic. The presence of symptoms, particularly abdominal pain and weight loss, was associated with a malignancy diagnosis. The authors emphasized their observation of associated neoplasia in other sites in one-third of the patients. Many of the associated tumors were ovarian or uterine in origin. This observation reflects the fact that appendiceal mucocele was diagnosed during an operation for another lesion. There was, however, the discovery of colonic neoplasm in 11% of patients. Perforation of the appendiceal mucocele with intraperitoneal mucous deposits (pseudomyxoma peritonei) was present in 29% of patients and was strongly associated with the presence of malignancy. The authors noted that patients suspected of having a malignant mucocele are best treated with right hemicolecetomy, and they recommend this operation for all patients with lesions of 2 cm or more in diameter. In the discussion that accompanies this article, the authors were questioned about the five-year survival for patients with cystadenocarcinoma. In response, they referred to a 1994 article from their institution by Nitecki and coauthors, which documented a 55% five-year survival for patients with appendiceal malignancies; survival varied by the stage of the lesions (as defined by the modified Dukes staging system). Stage A lesions had a 100% five-year survival, and survivals gradually declined with higher-stage lesions. Nitecki and colleagues noted that the majority of patients with adenocarcinoma of the appendix had the mucinous variety and 22 of the 52 patients with the mucinous tumor type had pseudomyxoma peritonei. The authors consider right hemicolecetomy the appropriate operation for patients with appendiceal malignancy.

Additional information on pseudomyxoma peritonei is found in an article by Youssef and coauthors in Diseases of the Colon and Rectum, 2011. The authors presented a retrospective single-institution case series consisting of 456 patients seen over a 15-year and 3-month interval. The common clinical presentations of these patients were with abdominal pain or signs and symptoms of gynecologic neoplasm. The involvement of the uterus and ovaries was frequent in this patient group and many of the patients were diagnosed at an operation for suspected ovarian neoplasm. The authors noted that the key elements for successful treatment of patients with pseudomyxoma peritonei were right hemicolecetomy and complete tumor debulking. In this series, 97% of patients underwent colon resection and tumor debulking. Complete tumor debulking was possible in 66% of this group. Debulking required complete omentectomy and resections of the liver capsule, diaphragmatic peritoneum, ovaries, uterus, and spleen. Some patients required gastrectomy and/or subtotal colectomy and ileostomy. After resection of the primary tumor and complete or partial debulking, hyperthermic intraperitoneal chemotherapy using mitomycin C was applied. Operative mortality was 1.6% and major morbidity was 7%. The most common major complications were perioperative bleeding and anastomotic leak. The authors emphasized that 81% of their patients had postoperative intraperitoneal chemotherapy in addition to the treatment applied at the primary operation. When complete tumor debulking was possible, the estimated 5- and 10-year survivals were 87% and 74%, respectively. For patients treated with partial debulking and chemotherapy the 5- and 10-year survivals were 34% and 23%, respectively. The authors emphasized that management of these patients was labor-intensive and required an experienced surgical team. With the approach they described, the long-term outcomes are excellent when successful debulking is possible.

Dr. Paul Sugarbaker has been a prominent contributor to the knowledge base relevant to the management of pseudomyxoma peritonei. In an editorial that ac-
compared the publication by Youssef (discussed above), Dr. Sugarbaker noted that appendiceal mucinous tumors that cause pseudomyxoma peritonei rarely metastasize to lymph nodes and liver and, because of this, the tumor progresses indolently over several years if aggressive resection and debulking is not used. The typical pattern of tumor deposition is in the pelvis, the greater omentum, and between the right hemidiaphragm and the liver. The small bowel is usually spared, except for the final portion of the terminal ileum that is often involved with the primary lesion. Sugarbaker noted that successful management of this tumor requires aggressive surgical resection of the primary tumor combined with complete debulking of mucous deposits and hyperthermic intraperitoneal chemotherapy.

The frequent involvement of the uterus and ovaries with metastases from appendiceal carcinoma was emphasized in the articles discussed above. An article describing the histologic features of ovarian metastases from appendiceal carcinoma is by Ronnett and coauthors in the American Journal of Surgical Pathology, 1997. These authors reported histologic findings from 20 patients with metastases to the ovaries from appendiceal carcinomas. Four categories were described; the most frequent pattern observed was the signet-ring type, with or without glandular or goblet cell differentiation. This category mimics the histology of gastric adenocarcinoma. The other categories included mixed signet ring and intestinal histology, pure intestinal histology, and colorectal cancer histology. The authors noted that positivity for cytokeratin C-7, a marker often used to identify primary ovarian tumors, was observed in 50% of the patients with ovarian metastases from appendiceal carcinomas. The authors recommend that appendiceal carcinoma be considered and investigated whenever these cell types are present in ovarian tumors.

Primary adenocarcinoma of the appendix is rare. Descriptions of clinical series of patients with this tumor type indicate that, for the most part, the tumors present clinically as acute appendicitis in older patients. Although right hemicolectomy is recommended as the first-line treatment for these tumors, a significant proportion of patients do not have this procedure as the initial treatment. An article confirming this fact is by Ito and coauthors in Diseases of the Colon and Rectum, 2004. In this series, data from 36 patients seen at a single institution over a 20-year interval were presented. Female patients comprised 61% of the series and the most common age range was 50 to 59 years. Only 18 patients underwent primary right hemicolecctiony. These patients had a five-year survival of 61% compared to a five-year survival of 32% in patients who did not have right hemicolecctiony. Outcomes were also related to tumor stage and tumor histology (72% five-year survival rate with colonic type vs. 47% with mucinous type). The authors emphasized that tumor stage is an important determinant of survival and that T1 tumors confined to the mucosal and submucosal layers of the appendix can probably be managed with appendectomy alone.

An article evaluating the use of right hemicolecctiony for patients with appendiceal carcinoma is by Walters and coauthors in the American Surgeon, 2008. These authors used data from the SEER database, identifying 2,511 patients accumulated over a 15-year interval. They noted, as has been mentioned previously, that survival was related to tumor stage. They also observed that appendectomy alone was the operative approach in 33.4% of patients. This group had a five-year survival of 38% and 26% for stage III and IV tumors, respectively, compared to 48% and 46% for patients with stage III and IV tumors, respectively, treated with right hemicolecctiony. The data showed that treatment of appendiceal carcinoma with appendectomy alone resulted in excellent five-year outcomes (90% and 78%, respectively) for stage I and II tumors. Outcomes for patients treated with right hemicolecctiony were similar for patients with stage I and II tumors. The authors stressed that the main disadvantage of treatment of these patients with appendectomy alone is the inferior quality of lymph node staging with the lesser procedure. The authors noted that limitations of database analysis suggest that these data should be interpreted cautiously. They also recommend prospective trials of appendectomy and right hemicolecctiony for stage I and II appendiceal adenocarcinoma, and noted that the infrequency of this disease means that multicenter trials will be necessary.
Diverticular disease of the colon

Diverticulosis of the colon is common and the proportion of patients with colonic diverticula increases with age. Only 20% of patients develop diverticulosis complications; the most common is acute inflammation (diverticulitis) that is usually located in the sigmoid colon. Diverticulitis can either be a relatively mild condition that will respond to nonoperative therapy with antibiotics, or can progress to perforation with generalized peritonitis or intraabdominal abscess. Diverticular hemorrhage may require colon resection if bleeding cannot be controlled endoscopically, or by interventional radiology. Articles pertinent to the management of patients with these two conditions will be reviewed.

Sigmoid diverticulitis

A review of current knowledge relevant to the diagnosis and management of acute sigmoid diverticulitis was presented by Morris and coauthors in JAMA, 2014. The authors noted that improvements in diagnosis, due largely to increased accuracy and use of cross-sectional CT imaging, have led to an improved understanding of the natural history of diverticulitis. Data from large patient databases with long-term follow-up information have increased understanding of the effectiveness of various medical therapies. Surgical management now emphasizes the use of minimally invasive approaches and the avoidance of diverting colostomy. This approach is supported by data confirming the reduced quality of life in patients with colostomies, as well as other data showing a relatively low rate of reversal of sigmoid colostomies performed for complications of sigmoid diverticulitis. The authors cited data confirming the role of altered colonic motility in the formation of diverticula. Causes of diverticular inflammation are unclear, but altered motility may play a role—it is now known that patients who take calcium channel blockers (which cause smooth muscle relaxation) have a reduced risk of developing diverticulitis. Improvements in medical therapies, including the use of fiber supplementation, probiotics, and mesalamine, have reduced the need for sigmoid colectomy as a means of preventing chronic pain and recurrent acute diverticulitis. Data on the management of acute uncomplicated diverticulitis have shown that oral antibiotics administered on an outpatient basis after an initial dose of intravenous antibiotics in patients with acute, uncomplicated sigmoid diverticulitis are as effective as inpatient management with intravenous antibiotics.

Practice parameters for the management of sigmoid diverticulitis were promulgated by the American Society of Colon and Rectal Surgeons (ASCRS) and published in an article by Feingold and coauthors in Diseases of the Colon and Rectum, 2014; this parameters document is available free at FASCRS.org. The guidelines propose that patients suspected of having acute sigmoid diverticulitis undergo a focused history and physical examination, including laboratory studies and imaging based on this evaluation; the parameters document recommends using CT imaging to document the location, extent, and severity of the disease. The parameters document also presented data confirming the fact that complications of diverticulitis, such as perforation and abscess, can be accurately diagnosed using CT imaging with contrast. Accuracy rates of 97%–99% have been reported from high-quality studies of CT imaging for diverticulitis; ultrasound and MR imaging can be considered for patients who have contraindications for radiation exposure.

The parameters document also recommends that patients with uncomplicated diverticulitis be managed with oral or intravenous antibiotics, and that endoscopic evaluation of the sigmoid colon be done following recovery for patients with a first episode of acute sigmoid diverticulitis. If colonoscopy has been done recently, post-recovery endoscopic evaluation can be omitted. A systematic review of the literature relevant to the value of colonoscopy after an episode of uncomplicated diverticulitis was reported by Sharma and coauthors in Annals of Surgery, 2014. This article is supplied as a full-text reprint accompanying some formats of SRGS. The review disclosed that the discovery of a colon cancer or advanced polyp disease on a colonoscopy done after an episode of uncomplicated diverticulitis was reported by Sharma and coauthors in Annals of Surgery, 2014. This article is supplied as a full-text reprint accompanying some formats of SRGS. The review disclosed that the discovery of a colon cancer or advanced polyp disease on a colonoscopy done after an episode of uncomplicated diverticulitis was similar to rates of discovery in the normal population. The data also showed that there was an increased risk of colon cancer or advanced polyp disease after an episode of complicated diverticulitis. The authors concluded that colonoscopy...
could be used selectively, but that offering a colonoscopic evaluation might be a way to influence the patient to enter a colon cancer screening program.

The practice parameters document\(^7\) advises that elective colon resection for diverticulitis be employed selectively. The document cited data that indicate a risk of recurrent disease approaching 13%–23%. The risk of needing an emergency operation was 6% and the need for an operation that included a colostomy was 1%. Additional recent studies confirm the low risk of recurrent complicated diverticulitis and/or emergency operations following an episode of acute diverticulitis.\(^9\)\(^5\) Because of these low rates of recurrence, in addition to improvements in medical therapies, the traditional recommendation that colon resection be done after the second recurrence of symptoms has changed. Available data support the recommendation that the decision to perform a colectomy should not be based solely on the number of episodes of recurrent symptoms (pain) or episodes of acute diverticulitis.\(^5\)\(^1\) Operation is indicated in patients with colonic stenosis, fistulas, or recurrent bleeding. High-risk patients who are immunosuppressed, have chronic renal disease, or collagen-vascular disorders should also be considered for elective colon resection.

The practice parameters document\(^7\) recommends that abscesses complicating diverticulitis be managed with percutaneous drainage in stable patients without diffuse peritonitis. Operation is indicated in patients with peritonitis and patients without an adequate radiologic window for percutaneous drainage. Recovery without the need for emergency operation is achieved in 52%–74% of patients according to data cited in the parameters document. Consideration of elective colectomy after percutaneous abscess drainage is recommended by the practice parameters document. A retrospective review of medical records by van de Wall and coauthors\(^2\) in the *Journal of Gastrointestinal Surgery*, 2013 compared outcomes in 59 patients with diverticular abscess with 663 patients without abscess. There was a statistically significant increase in the risk of recurrent complicated disease and the need for urgent surgery in patients with abscesses. These findings support the recommendation for elective operation in patients who are successfully treated for diverticular abscess with percutaneous drainage.

The practice parameters\(^7\) endorse sigmoid resection with diverting colostomy as the preferred approach for emergency management of complicated sigmoid diverticulitis. The parameters document goes on to discourage using surgical therapy without resection; it should be noted, however, that emerging data supports excellent outcomes for patients with perforated diverticulitis who are managed with laparoscopic peritoneal lavage, suture closure of the perforation and delayed sigmoid resection.\(^5\)\(^5\)

The desire to avoid sigmoid colostomy and to perform definitive resection with primary anastomosis on patients requiring emergency management of complicated sigmoid diverticulitis has stimulated the consideration of sigmoid resection with primary anastomosis and diverting loop ileostomy as an option for this patient group. A randomized clinical trial of primary anastomosis with diverting loop ileostomy vs. Hartmann resection and colostomy was presented in an article by Oberkofler and coauthors\(^3\) in *Annals of Surgery*, 2012. This article is supplied as a full-text reprint accompanying some formats of SRGS. The authors analyzed outcomes in 62 patients randomized to receive a Hartmann resection with diverting colostomy (n=30) or a sigmoid resection with primary anastomosis and diverting ileostomy (n=32). The data analysis showed that perioperative mortality and morbidity were equivalent in the two groups. Operating time was also similar for the two procedures. A significant difference was observed in stoma reversal rate: ileostomy was reversed in 90% of patients, compared with 54% of patients with sigmoid colostomy. The authors acknowledged that allocation of patients in the four participating centers was challenging and that some eligible patients were not enrolled because surgeons declined to participate in the trial. This could have conceivably influenced the interpretation of the data. The authors did analyze outcomes carefully, however, and the distribution of disease severity and operative risk factors was similar in the comparison groups. The data support the authors’ conclusion that resection with primary anastomosis and diverting ileostomy is a strategy for managing complicated sigmoid diverticulitis that results in a much better chance for restored bowel continuity.
Lower gastrointestinal bleeding

Diverticular hemorrhage is the most common cause of lower gastrointestinal bleeding. The etiology of the bleeding is believed to be an acquired weakness in the wall of the nutrient vessel adjacent to a colonic diverticulum. The first article reviewed in this section of the overview is by Adams and Margolin in Clinics in Colon and Rectal Surgery, 2009. The authors noted that diverticular bleeding can range in severity from occasional spotting to life-threatening massive hematochezia. Known risk factors for diverticular bleeding include older age, hypertension, hyperuricemia, three or more comorbid medical conditions, and use of nonsteroidal antiinflammatory drugs (NSAIDs). Risk factors for colonic diverticular bleeding is the focus of an article by Jansen and coauthors in the World Journal of Gastroenterology, 2009. The authors compared risk factors in 30 patients with confirmed diverticular bleeding to risk factors in patients with known diverticulosis without bleeding. Stepwise logistic regression analysis disclosed that the use of NSAIDs and medications for atherosclerotic cardiovascular disease was a distinct risk factor. The authors concluded that their findings supported the concept that a damaged atherosclerotic vessel is the source of diverticular bleeding. Risk factors for mortality from lower intestinal bleeding are discussed in an article by Strate and coauthors in Clinics in Gastroenterology and Hepatology, 2008. These authors used data from the National Inpatient Sample (NIS) to develop a multivariate analysis of risk factors associated with death caused by lower intestinal bleeding. The strongest risk factors identified included advanced age, a diagnosis of intestinal ischemia, comorbid illness, bleeding during hospitalization for another disease, male gender, and indices of bleeding severity, such as clinical evidence of hypovolemia and coagulopathy. When the analysis of risk factors associated with diverticular bleeding was conducted, only intestinal ischemia was eliminated. The authors concluded that diverticular bleeding tends to cluster in older patients with multiple comorbid conditions.

Adams and Margolin emphasized that most (80%) of the episodes of lower gastrointestinal bleeding will cease spontaneously; there is a 30% recurrence rate after an initial episode. Initial management of the patient includes obtaining intravenous access and beginning resuscitation. A directed history and physical examination is done; in addition, nasogastric intubation is performed to exclude, insofar as possible, an upper gastrointestinal source of bleeding, and digital, rectal, and proctoscopic exams are done to exclude bleeding from an anorectal source. Correction of coagulopathy and transfusion, as needed, are important components of early care.

Options for localization of the bleeding site include nuclear scintigraphy and angiography. Two forms of nuclear scintigraphy are available: one of these uses radiolabelled sulfur colloid and the other uses tagged red blood cells. Sulfur colloid requires minimal preparation and can be injected directly. The agent has a short half-life, so diagnosis will occur only in patients who are actively bleeding at the time of the scan. Tagged red blood cells, on the other hand, have a prolonged half-life and can detect intermittent bleeding up to 24 hours after injection. Scintigraphy is not a sensitive test for diagnosis of lower gastrointestinal bleeding. Average sensitivity from data cited by Adams and Margolin is less than 50%. A positive test is more likely in a patient who has been hypotensive at least once in the 24 hours prior to testing. Of interest is the fact that a positive scintigraphy examination is predictive of successful localization of a bleeding point on subsequent angiography.

Because diverticular bleeding is from an arterial source, angiographic localization is more likely to be successful for this type of lower gastrointestinal hemorrhage than for other causes of bleeding. A contrast blush is likely to be identified and this imaging finding will persist through the venous phase of the imaging study. Angiography-based techniques of vessel occlusion can be used to control bleeding as well. Vasopressin infusion is successful in temporarily stopping diverticular bleeding, but is associated with severe systemic side effects. According to data cited in their article, Adams and Margolin reported that transcatheter occlusion of the bleeding vessel was successful in more than 95% of patients where it was used.

A review of results of angiography for control of diverticular bleeding is found in an article by Strate and coauthors in Clinics in Gastroenterology and Hepatology, 2010. After successful identification of a bleeding artery, angiembolization was successful in 96% of cases and control of bleeding persisted for more than 30 days in 85% of patients. The most significant disadvantage of
angiographic control of bleeding is bowel infarction. Because diverticular bleeding tends to occur in older patients with multiple comorbid conditions, complications such as myocardial infarction, nephrotoxicity, and vascular injury are encountered. Additional data regarding the success of angiographic localization and control of diverticular bleeding using CT angiographic mapping followed by selective angiography are in a letter to the editor by Feld and coauthors. The authors described a single case where identification of a bleeding point by CT angiography permitted mapping of the vascular anatomy at the bleeding point. The identification of the vessels at risk permitted the later angiographic embolization and occlusion of the at-risk vessels, even though the patient was not bleeding at that time. The authors noted that the most common reason for failure of angiographic control is that a bleeding vessel is not identified. Using CT angiographic mapping, this problem may be remedied.

Adams and Margolin noted that colonoscopy for localization and control of diverticular bleeding was successful in nearly 75% of patients. Data cited indicated that laxative preparation of the colon may not be necessary; in additional studies they cited, successful localization and control was not related to the time-lapse between hospital admission and colonoscopy. While colonoscopic control techniques, such as epinephrine injection and coagulation, were associated with successful immediate control, recurrent bleeding occurred in 25%-40% of patients. Hemoclip control is associated with higher success rates, as well as rebleeding rates of less than 10%. A technique employing a suction device with band ligation of the bleeding point via a water-jet colonoscope is described in an article by Ishii and coauthors in Digestive Endoscopy, 2010. These authors reported five patients who had a diverticular bleeding point localized and controlled using this suction device; bleeding was controlled in all patients, and over a follow-up interval of three months, there was no recurrence of bleeding.

Adams and Margolin closed their review with a brief discussion of operative intervention for bleeding from colonic diverticula. A few patients experienced massive bleeding and hemodynamic instability. Emergency operations for these patients will usually entail subtotal colectomy after efforts to exclude a small intestine source of bleeding using palpation, transillumination, and enteroscopy. Rebleeding occurred in less than 1% of patients treated with subtotal colectomy, but mortality risk was high (27%) according to data cited in the review. More commonly, patients who have stopped bleeding, or who have had successful control of bleeding angiographically or endoscopically, experience a major re-bleed and are referred for operation; in these situations, segmental colectomy of the portion of the colon where the bleeding was identified was associated with a mortality risk of less than 10% and an average risk of rebleeding of 14%.

Colon obstruction and volvulus

Colon obstruction is encountered commonly in surgical practice. The typical patient is elderly and potentially has multiple comorbid conditions. Neoplastic obstruction accounts for approximately 50% of colon obstructions; this topic will be reviewed in the next issue of SRGS, when a discussion of the diagnosis and management of colon neoplasms will be presented. Benign conditions that can cause obstruction include diverticulitis (abscess compression or stricture causing approximately 10% of obstructions), colon volvulus (10%-17% of colon obstructions), Crohn’s disease, constipation, and chronic pseudoobstruction (Olgivie syndrome). This section will review articles that present information on the diagnosis and management of benign colon obstruction and colon volvulus.

A review article dealing with benign colon obstruction is by Yeo and Lee in the Journal of Gastrointestinal Surgery, 2013. The initial steps recommended by the authors include a focused history and physical examination; another important element of this initial evaluation is an assessment for hemodynamic stability. Late presentations of obstruction are more likely to be associated with signs of dehydration; acute obstructing processes such as colon volvulus can be associated with colonic ischemia and/or perforation. Early detection and treatment of peritonitis is important, particularly in patients with acute obstruction that is complicated by ischemia or perforation with peritonitis. Tenderness over the cecum
is common, since the cecum is the part of the colon most likely to be distended in patients with colon obstruction. The article recommended adjunctive laboratory studies to detect anemia, leucocytosis, and electrolyte and acid-base abnormalities that would need to be corrected prior to contrast-enhanced cross-sectional imaging. If initial plain radiographs of the abdomen suggest sigmoid obstruction or volvulus, flexible sigmoidoscopy may be helpful for diagnosis and treatment. CT imaging with contrast enhancement will be helpful to differentiate colonic pseudo-obstruction from mechanical obstruction. Detection of a transition point or abrupt change in the caliber of the colon on CT images suggests mechanical obstruction. CT imaging is also useful to detect distention of the cecum; cecal diameters of 12 cm or more indicate an increased risk of cecal perforation.

Data cited by Yeo and Lee confirmed the desirability of segmental colon resection with primary anastomosis and proximal diversion using loop ileostomy in patients who are stable enough to tolerate resection, and for whom primary anastomosis is feasible. Owing to frequent patient instability, resection with anastomosis is frequently not possible. Careful assessment of patient risk will be necessary to properly choose the best approach for individual patients.

Yeo and Lee cited data confirming the value of colonic stenting as a “bridge to surgery” in patients with malignant distal colon obstruction. An article that presented data on the use of stenting for benign colon obstruction is by Small and coauthors in Surgical Endoscopy, 2008. The authors presented data on 23 patients at a single institution over a seven-year interval. Complicated diverticulitis was the most common cause of obstruction (16 out of 23 patients) with anastomotic stricture and radiation-induced stricture observed in three patients. Stent placement was successful in relieving the obstruction in 22 or 23 patients, but significant complications (stent migration, re-obstruction, perforation) occurred in 38% of patients. Most of the complications occurred more than one week after stent placement. Elective, rather than emergency, operations were possible for 16 patients. Resection and primary anastomosis without a diverting stoma was possible in 42% of the 19 patients who underwent definitive operative repair for the obstruction. The authors concluded that stent placement was safe and feasible. Based on their experience with frequent complications occurring late after stent placement, they recommended that early (within one week) definitive operation be performed.

**Colonic volvulus**

Volvulus of the sigmoid colon and cecum are uncommon but important causes of colonic obstruction. Sigmoid volvulus can usually be reduced with sigmoidoscopy, but operative reduction or resection may be needed frequently for cecal volvulus. Relatively little data are available to determine the health burden and outcomes of management for colonic volvulus in the United States. Halabi and coauthors, in Annals of Surgery, 2014, reviewed NIS data (2002–2010) on the causes of bowel obstruction in more than 3 million patients. This article is included as a full-text reprint accompanying some formats of SRGS. Colonic volvulus was the cause of obstruction in 1.9% of patients. Sigmoid volvulus was more commonly observed in older men (>70 years of age), while cecal volvulus was diagnosed more commonly in younger women. Over the course of the study interval, the incidence of colonic volvulus increased by 5.53% per year; the increases were due to more frequent diagnoses of cecal volvulus. The incidence of sigmoid volvulus remained stable.

A colonic volvulus diagnosis is usually made through physical examination, supplemented by imaging. Plain radiographs can demonstrate segmental dilation of the colon in the right mid-abdomen for cecal volvulus and can demonstrate two loops of dilated sigmoid colon located above the transverse colon in patients with sigmoid volvulus. CT imaging can accurately diagnose colonic volvulus by the location of the “whirl sign,” indicating twisting and engorgement of vessels within the colon mesentery. A retrospective review of medical records comparing the accuracy of diagnosis of colonic volvulus according to the location of the whirl sign (right side for cecal volvulus and left/mid abdomen location for sigmoid volvulus) is by Macari and coauthors in Clinical Radiology, 2011. The authors presented data on 34 patients with colonic volvulus and compared CT imaging findings to a group of patients without colonic volvulus who underwent CT
imaging evaluation for renal stone disease. All patients with colonic volvulus had a whirl sign, while no patient in the renal stone group had a whirl sign. The location of the whirl sign was highly accurate for colonic volvulus diagnoses.

Nonoperative management with endoscopy was possible in 17% of patients reported by Halabi and coauthors.65 The authors noted that the high recurrence rate of sigmoid volvulus managed with endoscopic detorsion alone accounts for the fact that most patients with this condition in their series were managed with immediate surgery, or with operation performed after endoscopic detorsion. An article focusing on the recurrence rate of sigmoid volvulus after endoscopic management is by Larkin and coauthors67 in *Annals of the Royal College of Surgeons*, 2009. The article reported a retrospective outcomes analysis of 27 patients at a single institution over a 10-year interval. Of the 11 patients managed with endoscopic detorsion alone, there was a 71.4% recurrence rate and an overall mortality rate of 36.4%; the mortality rate for patients managed with endoscopic detorsion and elective operation was 6%. The authors concluded that endoscopic detorsion and elective operation is the preferable strategy for patients who do not have indications for immediate operation.

Halabi and coauthors66 also found that detorsion with fixation of the colon was rarely used (11% of patients), with resection and anastomosis or diversion performed in 89% of patients who underwent operation. The data analysis also showed that detorsion and fixation of cecal volvulus was more commonly performed in young patients. The reasons for this are not clear. Halabi and colleagues speculated that younger patients may refuse resection of the colon, especially if a temporary stoma may be necessary. Overall mortality rates for sigmoid volvulus approached 10%; the mortality rate for cecal volvulus in this series was 6.64%. The authors found that the diagnosis of bowel gangrene and the presence of coagulopathy were strong predictors of mortality. They concluded that aggressive efforts to obtain an early diagnosis with detorsion and delayed operation or immediate resection are most likely to be associated with reduced risk of mortality.

An article that reported the successful application of a protocol-driven approach for management of sigmoid volvulus is by Raveenthiran and coauthors68 in *Colorectal Diseases*, 2010. These authors produced a systematic review of the literature on sigmoid volvulus. They determined that endoscopic examination and attempted detorsion is the approach favored by most authors in patients without signs of intestinal ischemia. Flexible endoscopy is preferred because the endoscope can be passed above the site of obstruction, so that the proximal colon can be decompressed: once the endoscope has untwisted the colon and the proximal colon is decompressed, a rectal tube is placed and the patient is prepared for colon resection if they are an acceptable operative risk. Very high-risk patients may be treated with repeat endoscopy and rectal tube placement or laparoscopic colopexy. Patients who undergo elective operation can be treated with sigmoid resection and primary anastomosis under most circumstances. Resection and anastomosis is appropriate for patients undergoing emergency operation if the colon is healthy. Raveenthiran and colleagues reviewed outcomes data and concluded that the reported mortality rate for resection and primary anastomosis ranges from 8% to 13%, while colostomy formation is associated with a 25%–50% mortality rate. This difference is most likely due to patient selection rather than an influence of the procedure chosen.

### Parastomal hernia

Parastomal hernia is a frequent complication of stoma formation; it occurs in up to 48% of end colostomies and end ileostomies. Although the frequency of stoma hernia formation is high, most parastomal hernias can be managed without additional surgical procedures. A review article relevant to the topic of parastomal hernias is by O’Neill and coauthors69 in *Journal of Gastrointestinal Surgery*, 2015. This article is supplied as a full-text reprint accompanying some formats of *SRGS*. The authors opened their review by noting that the actual incidence of parastomal hernia is difficult to document because diagnostic criteria are often arbitrary and rates of hernia diagnosis based on clinical symptoms vs. CT imaging vary widely. The authors estimated that the hernia rate is probably between 30% and 40% for all stomas created.
Data cited by the authors suggest that risk factors for parastomal hernia formation include waist circumference (a possible surrogate for BMI), presence of increased intraabdominal pressure, chronic obstructive pulmonary disease, cigarette smoking, diabetes, steroid use, advanced age, and the creation of an end colostomy.

The authors noted that there is evidence supporting the use of mesh, placed at the time of stoma formation, to prevent parastomal hernias—in either an intraperitoneal sublay fashion or intraperitoneal onlay fashion. Results of the placement of intraperitoneal onlay polypropylene mesh using a laparoscopic approach was reported by Lopez-Cano and coauthors in Hernia, 2012. Mesh was used in 18 patients; no mesh was used in 16 patients. Hernia diagnosis was made at 12 months using CT imaging. The analysis showed that 50% of patients in the mesh group and more than 90% of patients in the control group had parastomal hernias diagnosed. Reoperation was necessary for hernia complications in three patients in the control group and one patient in the mesh group. Other data cited by O’Neill and coauthors indicated that symptomatic hernia rates can be reduced (12%–15%) by use of a mesh placement preventive protocol. A trial of biologic mesh placement cited by the authors confirmed no significant difference in rates of hernia formation in the mesh and control groups. O’Neill and colleagues recommended that synthetic mesh placement at the time of stoma formation be considered.

For patients with symptomatic parastomal hernia, O’Neill and associates recommended use of the laparoscopic Sugarbaker parastomal hernia repair. This repair uses a mesh patch to overlay the entire hernia defect with a 5 cm overlap. The bowel leading to the stoma is lateralized and emerges at one edge of the mesh prosthesis. Alternatives to the Sugarbaker approach include laparoscopic mesh placement with a “keyhole” created for the bowel leading to the stoma and the laparoscopic “sandwich” repair. Most available data report a lower rate of recurrence (4%–10%) for the Sugarbaker operation; although one trial cited by the authors reported a recurrence rate of 2.1% for the “sandwich” mesh repair. The authors concluded that laparoscopic intraperitoneal mesh repair of parastomal hernia is the preferred approach.

Rectal prolapse and fecal incontinence

Rectal prolapse and fecal incontinence are conditions that occur commonly in older women. These conditions also cluster in patients who have a history of colon dysmotility, constipation, and pelvic organ prolapse. Emerging data suggest that a comprehensive evaluation of patients with chronic constipation and/or pelvic organ prolapse that is associated with rectal prolapse or fecal incontinence will benefit from a comprehensive management strategy that addresses all aspects of pelvic organ prolapse and anorectal function.

The first article reviewed presented a comprehensive discussion of the clinical features and management alternative for chronic constipation and pelvic outlet obstruction. The report is by Hedrick and Friel in Gastroenterology Clinics of North America, 2013. The authors noted that constipation is a common complaint and afflicts up to 25% of patients in the United States. Diet is the primary contributing factor, but other important contributors include psychiatric and neurologic diseases, hypothyroidism, and certain medications, such as antihypertensive and antidepressant drugs. Constipation not amenable to management with dietary adjustments and laxatives is divided into three subtypes: motility disorders (partial or total colonic), irritable bowel syndrome, and pelvic outlet obstruction. Diagnosis of chronic constipation was made using the Rome III criteria. These criteria included a six-month history of symptoms, such as having fewer than three stools per week, hard stools present for at least 25% of defecations, use of digital evacuation, frequent straining, and sensation of incomplete evacuation. Loose stools did not occur unless laxatives were used. An initial trial of dietary adjustment and laxatives was recommended. If this approach failed, further testing with anorectal manometry and defecography was indicated. Surgical options for patients with severe symptoms who failed medical therapy included total abdominal colectomy with ileorectal anastomosis if gastric and small bowel motility were normal.
The authors noted that pelvic outlet obstruction manifested as a sensation of incomplete rectal emptying, rectal pain, frequent need for enemas, and frequent episodes of fecal incontinence. Rectal prolapse and pelvic organ prolapse (cystocele, rectocele) were frequently associated with these complaints. According to data cited by the authors, treatment with sacral nerve stimulation has been successful for patients with incomplete rectal emptying and patients with fecal incontinence.

The use of sacral nerve stimulation for management of fecal incontinence was reviewed in a meta-analysis by Tan and coauthors23 in the International Journal of Colorectal Disease, 2011. The authors identified 34 studies of acceptable quality including nearly 1,000 patients. Significant improvements in numbers of episodes of incontinence, incontinence scores, quality of life, and mental health were recorded in most studies. Durations of follow-up varied. An article providing data on long-term outcomes of sacral nerve stimulation was presented by Maeda and coauthors34 in Annals of Surgery, 2014. The authors provided five-year outcome results on a prospectively gathered patient group consisting of 101 patients treated over a six-year interval in a single institution. Sustained improvement in incontinence scores and quality of life scores was observed in 42.6% of patients at five years of follow-up. Factors associated with a good outcome included younger age and a good response to pre-implantation percutaneous sacral nerve stimulation, as well as good outcome scores 6 months after implantation. Of the patients with poor outcomes, 24 had to have the stimulation device explanted.

An article reviewing the clinical characteristics and management options for rectal prolapse was presented by Bordeianou and coauthors25 in the Journal of Gastrointestinal Surgery, 2014. This article is included as a full-text reprint accompanying some formats of SRGS. The authors noted that symptoms encountered in patients with rectal prolapse included protrusion of a portion of the rectum through the anal orifice. Digital reduction of the protruding mass is often possible; if the mass cannot be reduced, strangulation is a potential serious complication. Other signs included constipation symptoms (reviewed earlier), as well as fecal incontinence. As noted previously, women with rectal prolapse may have associated pelvic organ prolapse and evaluation for these associated problems is advised. Patients may also have internal rectal intussusception that will present with symptoms of abdominal and/or pelvic pain and pelvic outlet obstruction. The main anatomic abnormalities in patients with rectal prolapse include a redundant sigmoid colon, diastasis of the levator ani muscle, and loss of the vertical position of rectum with loss of function in the rectal suspensory ligaments. The anatomical and functional aspects of rectal ligaments was the focus of an article by Charran and coauthors26 in the American Surgeon, 2014. Readers are encouraged to review this information.

Bordeianou and coauthors25 noted that colonoscopy and anoscopy are valuable adjuncts to the history and physical examination of patients suspected of having rectal prolapse. Anal manometry and defecography may be useful in selected patients with symptoms of pelvic outlet obstruction or fecal incontinence, although the presence of the prolapse may make it difficult to perform these studies. An algorithm that showed the authors preferred approach to diagnosis of rectal prolapse was included in the article; it is reproduced here as Figure 4. Early surgical repair of the prolapse is indicated, especially in patients with internal intussusception and patients at risk for strangulation of the prolapsed segment. Various procedures are available for management of rectal prolapse and strong data recommending one over the others are not available.

A randomized trial comparing functional outcomes for perineal vs. abdominal procedures and rectopexy vs. no rectopexy was presented in an article by Senapati and coauthors27 in Colorectal Disease, 2013. The data analysis disclosed that recurrence rates following abdominal operations were higher than previously reported in other studies (26% for abdominal procedures, compared with 20% for perineal procedures). Functional outcomes were not superior in any of the procedures studied.

Another study that evaluated outcomes in elderly patients having perineal colorectal resection for rectal prolapse was presented by Tiengtianthum and coauthors78 in Diseases of the Colon and Rectum, 2014. The authors reported outcomes data from 16 institutions. Four hundred patients had complete data available for analysis. Overall mortality was 1% and there were no differences in morbidity or long-term outcomes in the various age groups, including patients older than 90 years; median
survival after operation was four years. The authors concluded that their data from multiple surgeons and institutions probably represented a “real world” experience that confirmed the safety of perineal proctectomy. Recurrence was observed in 22.6% of patients. Of interest is the fact that the lowest recurrence rate was seen in the group older than 90, but this could have been due to shorter follow-up times in this group. Repeat perineal rectal resection was the most common procedure performed for recurrences. The authors concluded that carefully selected elderly patients can be safely treated with perineal rectal resection for rectal prolapse, and that age alone should not be a factor for withholding operative management.

A comparison of laparoscopic rectopexy or rectal resection with open abdominal procedures and perineal procedures was presented in an article by Young and coauthors79 in Surgical Endoscopy, 2015. The authors reviewed risk-adjusted outcomes data contained in the NSQIP database for the interval of 2005–2011. Outcomes for 3,254 procedures were reviewed. Despite the fact that perineal approaches were used in higher-risk patients, the risk for morbidity was nearly twofold in patients having open abdominal approaches. The laparoscopic procedures were associated with morbidity risks similar to perineal procedures; data cited by the authors from other studies confirmed a higher operative time for laparoscopic procedures, but a lower overall morbidity and shorter recovery times, as compared with open procedures.

A retrospective review of data from a French national database comparing laparoscopic ventral rectopexy in patients older and younger than 70 was reported in an article by Gultekin and coauthors80 in Diseases of the Colon and Rectum, 2015. More than 4,000 patients had outcomes data available for review; of these, 1,263 were older than 70. After multivariate analysis, no differences in morbidity could be identified when patients were stratified by over 70, younger than 70, and over 80. The authors concluded that laparoscopic ventral rectopexy is safe and effective in elderly patients.

Bordeianou and coauthors75 provided a clear algorithm for surgical management of rectal prolapse; this is reproduced as Figure 5. They preferred to use an open or laparoscopic abdominal approach for good-risk patients and a perineal approach for patients with significant comorbid conditions that increased operative risks. For good-risk patients who had associated fecal incontinence, the authors preferred ventral or posterior rectopexy without sigmoid resection. For patients with constipation, the authors preferred ventral or posterior rectopexy with sigmoid resection. For patients with concomitant pelvic organ prolapses, ventral or posterior rectopexy with concomitant sacrocolpopexy was recommended. For patients who had redundant colons and were approached with a perineal procedure, the authors preferred the Altemeier perineal colorectal resection with levator ani reconstruction if incontinence was present. If pelvic organ dyssynergy has been diagnosed, levator ani reconstruction was omitted.

Combined repair of rectal prolapse and pelvic organ prolapse is recommended for women who have both disorders. Outcomes for combined rectopexy and sacrocolpopexy in such patients was reported in an article by
Watadani and coauthors\textsuperscript{81} in *Diseases of the Colon and Rectum*, 2013. Outcomes were assessed in 110 women, with 52 patients having long-term (median 29 months) follow-ups available. There was no mortality and significant complications (wound infection, bleeding, pulmonary embolus) occurred in 12\% of patients. Significant improvements in quality of life, fecal incontinence scores and constipation scores were observed in the patients available for long-term follow-up. The authors cite data supporting improved outcomes in patients where procedures to treat pelvic organ prolapses and anorectal disorders are combined. They cited data confirming the development of anorectal symptoms in more than 25\% of patients after repairing pelvic organ prolapses alone. The authors concluded that a combined approach to anorectal dysfunction and pelvic organ prolapse is the preferred approach in these patients.

**Hemorrhoid disease**

A review article by Jacobs\textsuperscript{82} in the *New England Journal of Medicine*, 2014, presented data and perspectives on the pathogenesis, diagnosis, and management of hemorrhoid disease. This article is supplied as a full-text reprint accompanying some formats of SRGS. Jacobs opened the report with a review of the anatomic and physiologic characteristics of hemorrhoidal tissue. He noted that the hemorrhoidal complexes are composed of arteries, veins, and connective tissue. The hemorrhoid bundles are termed internal if they are located above the dentate line of the anorectal canal and external if they are located below this line. An important fact noted in the report is that external hemorrhoid tissues are innervated by somatic nerves and, therefore, more likely to be painful if hemorrhoid disease develops. It is also important to recall this fact when office procedures for hemorrhoid disease management, such as...
rubber band ligation, are contemplated. The author noted that, while the exact physiologic purpose of hemorrhoid tissue is not known, available evidence cited in the article supports hemorrhoid complexes in sensing anorectal fullness, and thereby contributing to the defecation process.

The author next considered reasons why hemorrhoids become symptomatic. Likely precursors to symptom development include loss of connective tissue support (resulting from constipation and loss of pelvic muscle support), increased venous congestion (due to pregnancy and liver disease with ascites), and dilation of hemorrhoidal arteriovenous anastomoses. Typical symptoms of hemorrhoid disease include bleeding (60% of patients), itching (55% of patients), perianal discomfort, and fecal soiling; combinations of symptoms often occur. In the initial evaluation of patients, Jacobs recommended that information on dietary habits (intake of fiber and fluids), patterns of rectal bleeding, frequency of fecal soiling, and need for manual reduction of prolapsed hemorrhoid tissue be sought. Pain associated with hemorrhoids is usually mild in the absence of complications such as external hemorrhoid thrombosis or prolapse with ischemia; however, if the patient has severe pain, other diagnoses should be considered, such as anal fissure, anorectal ulceration, rectal carcinoma, or Crohn’s disease. Hemorrhoids are classified according to the degree of enlargement and prolapse of the hemorrhoidal complexes: grade I hemorrhoids show mild engorgement with no prolapse; grade II hemorrhoids may prolapse with straining, but spontaneously reduce to a normal position; grade III hemorrhoids require manual reduction of prolapsed tissue; grade IV hemorrhoids cannot be manually reduced. A helpful illustration of the hemorrhoid grading scale is included in Jacobs’ article; the illustration is reproduced here as Figure 6.

Because of the frequency of rectal bleeding in patients with hemorrhoids, it is important to consider indications for complete evaluation of the colon with colonoscopy or double-contrast barium enema in patients who have rectal bleeding and are found to have potentially symptomatic hemorrhoids on physical examination and anoscopy. Jacobs recommended a selective approach, with flexible sigmoidoscopy used in most patients presenting with symptomatic hemorrhoids, and full colon examination indicated in patients with anemia, a bleeding pattern inconsistent with hemorrhoid disease, a history of colonic polyps, a family history of hereditary colonic disease, and symptoms suggestive of colorectal cancer or inflammatory bowel disease. Practice parameters for the management of hemorrhoids have been promulgated by the ASCRS and published in an article by Rivadeneira and coauthors in Diseases of the Colon and Rectum, 2011. The parameters document is available free at www.FASCRS.org. The parameters document agrees with a selective approach to full colon evaluation.
Additional perspective on the decision process for full colon evaluation in a patient with rectal bleeding and hemorrhoids evident on clinical examination was presented in an article by Khalid and coauthors in *Endoscopy, 2011*. The authors reported on 348 patients with rectal bleeding and suspected hemorrhoids that underwent full colonoscopy. Patients were excluded if they had anemia, a positive family history for colon cancer or hereditary colon disease, or symptoms suggestive of malignancy or inflammatory bowel disease. Adenomatous polyps were discovered in 2.8% of patients younger than 40; all lesions were in the distal colon. Polyps or malignancy was diagnosed on colonoscopy in 7.8% of patients older than 40; one of the lesions was in the proximal colon. The authors concluded that these data suggest that young patients with suspected hemorrhoid disease and rectal bleeding could be adequately evaluated with physical examination and flexible sigmoidoscopy.

Jacobs recommended nonoperative interventions for patients with mild symptoms and no hemorrhoidal prolapse. Effective interventions include fiber supplementation and sufficient fluid intake to avoid constipation. The practice parameters document agrees with this approach and notes that relatively strong evidence supports the effectiveness of fiber supplementation as a means of reducing rectal bleeding and pain. Additional measures include educating the patient to avoid straining and long intervals of sitting on the toilet. The use of topical steroid creams and topical vasoconstrictor ointments may provide temporary relief of symptoms, but evidence supporting their use is not strong.

The available options for dealing with symptomatic hemorrhoids include office procedures, such as rubber band ligation, sclerotherapy, and infrared light cauterization. Available data cited by Jacobs and referred to in the practice parameters document support the conclusion that rubber band ligation is the most effective approach for symptomatic grades I and II hemorrhoids, as well as selected patients with grade III. Jacobs recommended incision and thrombectomy for patients presenting with thrombosis of an external hemorrhoid if the thrombosis symptoms began 72 hours or less prior to the patient being seen. Data cited in the article confirmed that healing and recovery with symptomatic interventions, including pain control, would be the most frequent outcome in patients presenting after 72 hours of symptoms.

A systematic review of the literature was presented in an article by Chan and Arthur in *Techniques in Coloproctology, 2013*. The review concluded that available evidence supports the use of early excisional hemorrhoidectomy for acute hemorrhoid thrombosis, primarily based on weak evidence of higher rapid recovery with this approach. Based on their review, the authors concluded that no strong evidence was available to support the choice of one intervention over another.

Jacobs and the practice parameters document agree that excisional hemorrhoidectomy is indicated for symptomatic grade III and IV hemorrhoids. There is no strong evidence supporting the use of dissection, ligation, and excision hemorrhoidectomy over monopolar or bipolar cautery devices. A newer approach, Doppler-guided hemorrhoidal artery ligation, may be useful for patients with symptomatic grade II and III disease. A recent article by Schuurman and coauthors in *Annals of Surgery, 2012* reported a single-blinded randomized trial comparing Doppler-guided hemorrhoidal artery ligation to hemorrhoidal artery ligation without Doppler guidance; 82 patients were involved in this trial. The authors noted that the classical approach has been to localize a feeding hemorrhoidal artery with the Doppler device and, using an especially designed proctoscope, make an ligate the artery with an absorbable suture ligature. In the non-Doppler group, ligating sutures were placed in the base of the visible hemorrhoidal tissue. Analysis showed that at a six-month follow-up, symptom relief and recurrence were similar in both groups; prolapse relief was observed more often in non-Doppler patients. The authors concluded that the use of the Doppler device was not required to achieve acceptable results of hemorrhoidal artery ligation.
Perirectal infection, anal fistula, and anal fissure

Abscess formation in the perirectal area is encountered commonly in surgical practice. Approximately 30%–40% of patients who are treated for perirectal abscess will develop an anal fistula (fistula-in-ano) as a chronic complication of the abscess. Anal fistulas are clinically manifested as draining sinuses opening onto the skin in the perianal area. The internal opening of the fistula is located just above the dentate line in most simple fistulas, and the location of the internal opening can be predicted with accuracy rates approaching 80% with the use of Goodsall’s rule, which states that external fistula openings located anterior to a transverse line drawn through the middle of the anal opening (as if the patient is in the lithotomy position) will have internal fistula openings located in the anal canal in a radial location, similar to a spoke in a wheel. Openings dorsal to the transverse line will most often have an internal fistula opening in the posterior midline of the anal canal. The implication of this rule is that external fistula openings anterior to the transverse line will follow a direct course to the internal opening, while posterior openings will follow a curving, indirect course to the posterior midline internal opening. Most of these fistulas can be managed easily if the internal and external openings can be identified.

A review article by Abcarian87 in Clinics in Colon and Rectal Surgery, 2011 provides valuable perspective on the diagnosis and management of perirectal infection and fistula-in-ano. This article is supplied as a full-text reprint accompanying some formats of SRGS. The author emphasized that the primary objective of treatment of a perirectal abscess is early and adequate drainage. The objectives of treatment of fistula-in-ano are to eliminate the fistula, while providing maximum protection against the development of fecal incontinence. In general, procedures for the management of fistula-in-ano, which involve removing the fistula and dividing the anal sphincter muscle, are associated with the lowest fistula recurrence rate; however, fecal incontinence is observed in a significant number of treated patients. In contrast, procedures that do not cut the anal sphincter muscle (anal advancement flap, LIFT procedure, anal fistula plug, fibrin glue injection) have lower rates of incontinence, but are associated with significant fistula recurrence rates. Data cited by Abcarian indicate that most perirectal abscesses and anal fistulas occur in young adults (median age 40) and that these conditions are rare in children (when they are observed, the affected patients are male). Perirectal infections begin in the cryptoglandular area of the anal canal and extend through the areas of the anal sphincter muscles to involve the perirectal tissues. Abscesses that extend between the internal and external sphincter muscles to reach the perianal skin are called perianal abscesses, while those that rupture through the sphincter muscle to reach the ischio-rectal fossa are called perirectal abscesses. Abscesses that enlarge in the intersphincteric area in a cephalad direction can become high perirectal abscesses. When the abscess cavity develops above the levator ani muscle it is called a supralelevator abscess, while a horseshoe abscess is an abscess that involves the ischiorectal fossae bilaterally. Although most abscesses can be diagnosed on clinical examination, endorectal ultrasound or CT imaging may be needed for diagnosis of supralelevator abscesses. Identifying the internal opening of a fistula-in-ano can usually be done with anoscopy, but patient discomfort may be sufficient to require an examination under anesthesia. Methylene blue or hydrogen peroxide injection of the external fistula opening may facilitate localization of the internal opening.

Clinical practice parameters for the diagnosis and management of perirectal abscess and fistula-in-ano have been promulgated by the ASCRS and published in an article by Steele and coauthors88 in Diseases of the Colon and Rectum, 2011. The practice parameters document is available free at www.FASCRS.org. Data cited in the practice parameters article confirmed excellent accuracy for magnetic resonance imaging (MRI) with or without endoanal coils for mapping the external opening, internal opening, and anatomic course of fistula-in-ano.

As mentioned earlier, Abcarian87 stressed that management of perianal and perirectal abscesses requires early and adequate drainage; he recommended using one or more small incisions in the perianal skin. Multiple small incisions may be needed for complex or horseshoe abscesses as well. It is important to drain abscesses completely and to open all loculated areas using digital exploration.
and breakdown of loculations. Selected small perianal abscesses may be amenable to drainage in the office or in the emergency department, but examination under anesthesia and drainage in the operating room will be required for most perirectal abscesses. If the external and internal openings of a fistula are obvious at the time of initial drainage, a primary fistulotomy may be performed or a draining seton (soft rubber band or plastic vessel loop) placed, but extensive search for the internal opening is not necessary at the time of initial abscess drainage. The practice parameters document agrees with early complete drainage. The parameters noted that insertion of a small drainage catheter (Pezzer catheter) is acceptable for patients with small abscesses. The practice parameters emphasized the fact that adjunctive antibiotics are usually not needed, but recommended that American Heart Association guidelines for perioperative antibiotic therapy be followed for patients with artificial heart valves, heart transplants, history of prior infectious endocarditis, or congenital heart disease.

**Management of anorectal fistula**

Abcarian recommended that anorectal fistulas be classified as intersphincteric (located between the sphincter muscles), transsphincteric (passing through the sphincter muscles and crossing the ischiorectal fossa to the external opening), suprasphincteric (circling the entire sphincter mechanism before entering the ischiorectal fossa), and extrasphincteric (originating high in the anorectal canal and traversing the entire sphincter muscle complex and the levator ani muscle). Using this system, it is obvious that most transsphincteric and intersphincteric fistulas are “simple,” while fistulas in the other two categories are more likely to be “complex.” Most fistula tracts can be completely identified on clinical examination by palpation during digital rectal examination augmented by gentle probing of the tract and/or injection of the tract with methylene blue or hydrogen peroxide.

Abcarian noted that the operative management of anorectal fistulas can be categorized according to whether or not the procedure requires division of the sphincter muscles (sphincterotomy). Procedures requiring sphincterotomy are associated with good rates of healing of the fistula and low rates of recurrence, but carry a risk of incontinence of up to 16%, according to data cited in Abcarian’s article. Sphincterotomy may be staged (initial placement of a soft, draining seton with a later procedure to open the fistula tract and divide the remaining sphincter): placement of a cutting seton results in gradual division of the skin and sphincter muscles as the seton is progressively tightened; placement of a chemical seton (coated with the alkaline compound Kshara) results in the chemical division of sphincter muscles.

Procedures for management of the fistula without division of the sphincter muscles include fibrin sealant injection, placement of a bioprosthetic plug in the internal opening of the fistula tract, creation of an endorectal advancement flap (ERAF), creation of a dermal island flap anoplasty (DIFA), and the LIFT procedure. The LIFT procedure requires an incision parallel to the anal verge, with dissection proceeding in the plane between the sphincter muscles until the fistula tract is identified. The tract is then ligated with absorbable sutures, proximally and distally, and the tract is divided. While these procedures are associated with low rates of incontinence, successfully “curing” anorectal fistulas only occurs in 40%–70% of patients. The LIFT procedure was described in detail in an article by Rojanasakul in Techniques in Coloproctoscopy, 2009. The article is illustrated with clear color photographs. Readers are encouraged to review this information.

The practice parameters document recommended all of the sphincter-sparing procedures as acceptable approaches except for the LIFT procedure, where no recommendation was given. The parameters document provided supporting data for each of the recommendations. Healing occurred in 50%–80% of patients in the reported studies with incontinence rates below 10%. Recurrence of the fistula occurred in approximately 20% of patients included in the studies reported in the parameters document.

**Anal fissure**

The symptoms of acute anal fissure are anal pain associated with defecation and anal bleeding. Visual examination of the anal area will frequently disclose the anal tear. Most of these acute lesions will heal spontaneously with therapies such as topical anesthetic creams, sitz baths,
increased water intake, and a high fiber diet. Acute fissures resistant to conservative treatment and all chronic anal fissures require pharmacologic or surgical treatment. An article summarizing recent innovations in anal fissure management was presented by Poh and coauthors in the *World Journal of Gastrointestinal Surgery*, 2010. The article noted that anal fissure accounts for 10% of ano-rectal surgical procedures in Australia and the United Kingdom. The lesion can be assumed to be chronic if healing has not occurred after four weeks of nonoperative management. Chronic fissures have indurated edges and sphincter muscle fibers can be seen in the base of the lesion. A sentinel polyp may be present at the apex and/or the distal end of the fissure. Most fissures occur in the posterior midline of the anal canal; that said, anterior fissures are diagnosed in 10% of female patients and 1% of male patients. The authors presented data on the pathogenesis of anal fissure. There is an initiating injury to the mucosa of the anal canal, often from passage of hard fecal material. Patients who are susceptible to anal fissure have increased anal sphincter tone. This abnormal sphincter tone, combined with relative ischemia of the area of injured tissue, leads to the development of the fissure. The authors supplied a useful algorithm for the management of anal fissure; this algorithm is reproduced as Figure 7.

Practice parameters for the diagnosis and management of anal fissures have been promulgated by the AS-CRS and published in an article by Perry and coauthors in *Diseases of the Colon and Rectum*, 2010. The parameters document is available free at [www.FASCRS.org](http://www.FASCRS.org). These guidelines note that the margins of superiority of topical nitrates and calcium channel blockers over conservative management with topical anesthetics, sitz baths, and added dietary fiber are small, but that the agents, particularly calcium channel blockers, have few drawbacks and are recommended as part of a stepwise approach to fissure management.

A review of the diagnosis and management of anal fissure was presented by Herzig and Lu in *Surgical Clinics of North America*, 2010. The authors opened the discussion by noting that an anal fissure is a tear in the epithelial lining of the anal canal. The posterior midline is the location of the lesion in 90% of patients; almost all remaining patients will have the lesion located in the anterior midline. Fissures in atypical locations are frequently associated with other chronic intestinal conditions, such as Crohn disease, tuberculosis, HIV infection, syphilis and malignancy. Hypertonicity of the internal anal sphincter associated with an anal epithelial tear during defecation is the main pathophysiologic feature of anal fissure. It is now appreciated, however, that anal fissures may occur without sphincter hypertonicity. The subset of anal fissures not associated with a hypertonic sphincter are resistant to treatment with agents directed toward relaxation of the sphincter, such as topical nitroglycerine, calcium channel blockers, botulinum toxin, and internal sphincterotomy. Fissures are further subdivided into acute and chronic types. Chronic fissures are characterized by persistence of the fissure for more than six weeks, the presence of an anal skin tag, and a hypertrophied anal papilla at the apex of the fissure. Chronic fissures also often have fibrotic rolled edges.
The authors reviewed several trials of pharmacologic treatment for persistent acute and chronic fissures. Pharmacologic therapies consisted of topical nitroglycerine, topical calcium channel blockers, and botulinum toxin injections. The available trials reviewed by the authors noted a healing rate with topical nitrates of 49% in an analysis of 15 trials, compared to a 37% healing rate observed in the placebo group. The main side effect of topical nitrates was headache. Because there is no available topical nitrate cream or ointment, the agent has to be obtained from a compounding pharmacy. Tachyphylaxis was also a problem with nitrate therapy; Herzig and Lu emphasized that measurements of anal pressure following topical nitrate application indicate that sphincter relaxation persists for only two hours.

Topical calcium channel blockers must also be obtained from a compounding pharmacy. These drugs as effective as topical nitrates and are associated with fewer side effects. Topical diltiazem is compounded as a 2% cream and topical nifedipine as a 0.2%-0.5% cream. A few patients may experience transient postural dizziness. With all types of topical therapies, increased water and dietary fiber intake, along with sitz baths, are advised.

Botulinum toxin injection (20-50 units) into the internal sphincter is associated with relaxation of the internal sphincter that lasts for 2–4 months. There is currently no consensus regarding the sites of injection or recommended numbers of injections. Herzig and Lu emphasized that the agent comes in 100-unit vials, and any amount remaining after choosing the dose for an individual patients must be discarded. This may contribute to the high overall cost of this treatment.

A randomized trial comparing topical diltiazem with botulinum toxin injection was reported by Samin and coauthors in Annals of Surgery, 2012. In this trial, 134 patients were randomized to receive botulinum toxin injection and placebo cream or topical diltiazem cream and placebo injection. At a three-month follow-up, fissure healing had occurred in 43% of each group and pain reduction of 50% or more had been observed in approximately 80% of each group. The authors noted that a side effect of perianal itching was observed in a larger proportion of patients treated with topical diltiazem. Another potential drawback to topical diltiazem cream is the fact that it is expensive and not readily available in many areas. If four patients can be treated with botulinum toxin during a single clinic session, discarding the residual drug is avoided and the treatment becomes cost-effective. A point in favor of topical diltiazem cream is that the headaches associated with topical nitrate compound use may be avoided. The authors concluded that when cost, availability, and side effect profiles were considered, botulinum toxin injection was superior to topical diltiazem.

Another trial of botulinum toxin vs. saline injection is by Maria and coauthors in the New England Journal of Medicine, 1998. This article described a randomized placebo controlled trial. Treated patients received injection of 20 units of botulinum A toxin into the internal anal sphincter muscle. Two months after injection, the fissures of 11 out of 15 patients in the treatment group had healed, compared to 2 out of 15 patients in the placebo group. The authors concluded that botulinum toxin is an effective means of treating chronic anal fissures.

Surgical approaches to the management of chronic anal fissure include open or closed lateral internal sphincterotomy, fissurectomy, and local or island advancement mucosal flaps to cover the open fissurectomy wound. Lateral internal sphincterotomy is the preferred surgical approach according to the practice parameters described by Perry and coauthors. The techniques of open and closed lateral internal sphincterotomy are described in the review by Herzig and Lu. Readers are encouraged to review these. Herzig and Lu stress that the procedures may be performed using local, general, or spinal anesthesia. The closed technique involves insertion of a No. 12 scalpel blade into the intersphincteric groove at the mid-lateral position. With the surgeon’s finger in the anal canal, the blade is turned and the hypertrophic muscle is divided, with the extent of division controlled by the palpating finger. In the open technique, a radial incision is made and the internal sphincter is visualized. The muscle is divided up to the dentate line. The authors noted that recent reports have suggested division of the internal sphincter up to the apex of the fissure or restricting the division only to the hypertrophic area of the muscle. Incontinence rates are reported to be equivalent with complete healing and recurrence rates lower in the patients with division of the sphincter up to the dentate line. Herzig and Lu
stress that most of the studies are underpowered to detect a difference in rates of incontinence, and that most of the studies suggest higher incontinence scores in patients who have sphincter division up to the dentate line. In the two studies reported by Herzig and Lu\textsuperscript{95,96} that compared lateral internal sphincterotomy to treatment with botulinum toxin injection, treatment failures were noted in 4% and 13%, respectively, of patients having sphincterotomy to the fissure apex, compared with no failures in the patients who had sphincterotomy to the dentate line. In both studies, symptomatic improvement and fissure healing rates were significantly better in the sphincterotomy patients. With up to six years of trial follow-ups, incontinence rates were equivalent and patient satisfaction favored lateral internal sphincterotomy.

Procedures that avoid division of the internal anal sphincter are attractive, especially for patients with hypotonic anal sphincters, and/or a history of fecal incontinence. Procedures that avoid division of the sphincter muscle are also attractive in patients where the risk of incontinence is increased, particularly elderly patients. Excellent healing rates for chronic anal fissure have been reported with two procedures: total subcutaneous fissurectomy and fissurectomy with anal mucosal advancement flap. A discussion of total subcutaneous fissurectomy is included in the review by Herzig and Lu (discussed previously). Readers are encouraged to review this information. An article dealing with the mucosal advancement flap is by Oualissi and coauthors\textsuperscript{97} in the World Journal of Surgery, 2011. The authors reported a series of 26 patients treated with fissure excision and mucosal advancement flap. One postoperative complication occurred (flap abscess). At 24 months, all patients had fissure healing and were free of pain. There was no worsening of incontinence after the procedure. As noted in the article describing practice parameters for anal fissure\textsuperscript{91}, clinicians should monitor future reports of these procedures, as the outcomes and appropriate patient groups who will benefit from these approaches become more clearly defined.

Anal fissure can accompany other diseases, especially Crohn disease. Herzig and Lu stress that these fissures are located in non-typical areas of the anal canal and are usually deeper and more extensive than typical anal fissures. The treatment of these patients should be cautious and tailored to the severity of symptoms. Aggressive surgical therapy is frequently associated with fissure recurrence and fecal incontinence.

Pilonidal disease

Clinical practice parameters for the diagnosis and management of pilonidal disease have been promulgated by the ASCRS and published in an article by Steele and coauthors\textsuperscript{98} in Diseases of the Colon and Rectum, 2013. The guidelines document is available free at FASCRS.org. The parameters document provides statistics that provide insight into the frequency and health burden of pilonidal disease and its complications, which afflict approximately 70,000 people annually in the United States. The disease was originally thought to be a congenital abnormality, but the current understanding is that the presence of hair in the natal cleft creates a foreign body reaction that leads to the formation of midline pits that can become inflamed and/or infected; symptoms for this condition include itching, sinus drainage, and infection. The parameters document recommended that clinical evaluation begin with a focused, disease-specific history and physical examination; the examination should seek evidence for the presence of acute infection. The differential diagnosis includes conditions such as hidradenitis suppurativa, infected furuncles, perianal Crohn disease, perianal fistula, and infections such as tuberculosis, actinomycosis, and syphilis. Physical examination will usually disclose the typical midline natal cleft sinuses often with protruding hair. Acute infection is manifest by purulent drainage and, occasionally, abscess formation. A digital rectal examination is indicated in the clinical evaluation; imaging and adjunctive laboratory studies are usually not needed.

The parameters document recommended a trial of gluteal cleft shaving as an initial nonoperative management option for pilonidal disease. This approach is best suited for patients who do not have acute infection, although small abscesses might be successfully treated with drainage at the time of shaving. Shaving has also been used as a postoperative adjunct for patients with surgically treated pilonidal disease. Postoperative shaving was the
focus of an article by Petersen and coauthors\textsuperscript{99} in *Diseases of the Colon and Rectum*, 2009. A telephone survey provided outcomes data for 504 patients who were followed out to 11 years; analysis of the presented data showed that razor hair removal did not lower the recurrence frequency, compared with no hair removal. The authors recognized that this finding was not expected, since the presence of natal cleft hair is thought to be the main cause of recurrent pilonidal disease. They hypothesized that other forms of hair removal, such as laser epilation, might be more effective than razor hair removal.

Injection of phenol or fibrin glue into the sinus tracts to obliterate these can be considered and is offered as a weak recommendation in the parameters document. Protection of the surrounding normal skin is necessary during phenol injection. Adjunctive antibiotic therapy can be considered in patients with significant cellulitis and in immunosuppressed patients. Available data have not confirmed improved healing with adjunctive antibiotics.

Operative management of pilonidal disease has traditionally included a variety of approaches. Abscess drainage is recommended by the parameters document when an acute abscess is present. Available data cited in the parameters document confirm more rapid healing when hair and chronically inflamed tissue are removed using curettage of the abscess cavity. Excision of the entire system of sinuses down to the level of the presacral fascia with secondary healing, marsupialization of the tissue defect, midline closure, and off-midline closure with obliteration of the natal cleft are all acceptable approaches according to the practice parameters. Available data cited in the parameters document confirm the improved rates of healing with off-midline closure techniques. Use of postoperative suction drains following excision and midline closure is also an acceptable practice and can be used according to the preferences of the operating surgeon.

An article by Lorant and coauthors\textsuperscript{100} in *Diseases of the Colon and Rectum*, 2011 reported a prospective, randomized comparison study of primary closure vs. secondary healing for patients undergoing surgical repair of pilonidal disease. All patients had complete excision of the pilonidal sinus complex and curettage to remove all chronically inflamed tissue and residual hair. Methylene blue injection was used to identify the sinuses within the complex. Patients in the closure group had layered midline closure done with sutures tied over gauze bolsters to obliterate dead space. Patients in the open group were treated with sequential dressing changes until adequate healing occurred. Analysis of healing and recurrence rates at monthly intervals, out to one year of follow-up, showed that complete healing occurred earlier in the closure group. One- and three-month healing rates were 50% and 93%, respectively, in the closure group vs. 20% and 50%, respectively, in the open group. Long-term follow-up showed that disease recurrence rates were 5% in both groups. The authors concluded that midline closure was associated with more rapid wound healing than secondary healing.

Flap closure is used for primary surgical management of pilonidal disease, but is particularly well suited for managing its recurrence; obliteration of the natal cleft may be accomplished with a flap closure technique. Each of the flap closure techniques are designed to rotate healthy tissue into the midline defect, created by complete excision of the pilonidal cyst complex with skin closure off the midline. Each of the three most popular flap closure techniques are illustrated in a review article by Humphries and Duncan\textsuperscript{101} in *Surgical Clinics of North America*, 2010. Readers are encouraged to review these illustrations and the accompanying technical details of each procedure. Short- and long-term results of the various flap closures have shown healing rates >90% at one month, with wound-complication rates of 8%–10%. Wound complications are observed mostly in patients who have had recent acute inflammation of the pilonidal complex. Data from one prospective study\textsuperscript{102} and from data cited in the practice parameters document\textsuperscript{98} confirmed long-term healing rates of 98% with no marked differences in outcomes for each of the techniques.
The next two issues of SRGS will continue our review of articles on surgeries of the colon, rectum, and anus. I hope that you found the information in this first issue helpful and relevant to your practice, and I invite you to return for the upcoming reviews. Thanks for reading SRGS.

Lewis Flint, MD, FACS
Editor in Chief


References | COLON, RECTUM & ANUS, PART I


1. A gram of fecal content within the colon lumen may contain which amount of bacteria?
   a) 2,000 bacteria
   b) 100,000 bacteria
   c) 1 million bacteria
   d) $10^{12}$ bacteria
   e) 4 million bacteria

2. All of the following conditions increase the risk of postoperative SSI except which of the following?
   a) Diabetes mellitus
   b) Gastroesophageal reflux
   c) Congestive heart failure
   d) Cirrhosis
   e) Chronic renal insufficiency

3. According to the report by Hedrick and coauthors, which of the following factors is associated with a reduced risk of superficial surgical wound infection?
   a) Increased BMI
   b) Open operative procedure
   c) Preoperative anemia
   d) Alcohol use
   e) Age >75 years

4. SSIs increase the cost of an elective colon procedure by which of the following amounts?
   a) $250
   b) $1,500
   c) $17,000
   d) $250,000
   e) $55,000

5. Which of the following antimicrobial agents used for SSI prophylaxis is associated with an increased risk of SSI?
   a) First generation cephalosporin
   b) Metronidazole
   c) Tetracycline
   d) Ampicillin/sulbactam
   e) Cefoxitin

6. According to the article by Cima and coauthors, the implementation of a multidisciplinary, protocol-driven initiative for the reduction of incidences of surgical site infection was associated with a reduction of risk of superficial SSI to which of the following percentages?
   a) 4%
   b) 1.5%
   c) 6.2%
   d) 8%
   e) 11.5%
7. Data from the report by Segev and coauthors indicate that the incidence of perforated appendicitis in their cohort of elderly patients was which of the following?
   a) 48%
   b) 14%
   c) 8%
   d) 70%
   e) 29%

8. According to the article by Ito and coauthors, the fetal death rate in pregnant patients with complicated appendicitis was which of the following?
   a) 2%
   b) 5.5%
   c) 14%
   d) 8%
   e) 0.5%

9. Laparoscopic appendectomy was associated with an increased risk of which of the following complications in the clinical series reported by Hemilla and coauthors?
   a) Wound dehiscence
   b) Prolonged postoperative ileus
   c) Pneumonia
   d) Organ space infection
   e) Urinary tract infection

10. In reported trials of nonoperative therapy for suspected appendicitis, an appendiceal diameter of 6 mm or more observed on imaging is used to confirm a diagnosis of acute appendicitis. This diameter is observed in which proportion of patients who do not have clinical evidence of appendicitis?
    a) 20%
    b) 50%
    c) 0.25%
    d) 2.5%
    e) 11%

11. According to the report by Marmor and coauthors, which of the following is the most common type of appendiceal malignancy?
    a) Gastrointestinal stromal tumor
    b) Squamous cell carcinoma
    c) Lymphoma
    d) Signet-ring cell carcinoma
    e) Mucinous adenocarcinoma

12. According to the World Health Organization’s definition, a simple mucocele of the appendix is defined as an appendix with an obstructed lumen that is filled distally with mucous. The mucosal lining of the appendix in such cases is which of the following?
    a) Normal
    b) Adenomatous
    c) Thickened with lymphatic hypertrophy
    d) Necrotic
    e) Ulcerated

13. When complete resection of the primary tumor, complete debulking of mucous deposits and use of hyperthermic intraperitoneal chemotherapy is possible, a five-year survival of patients with pseudomyxoma peritonei is which of the following?
    a) 14%
    b) 36%
    c) 98%
    d) 87%
    e) 74%

14. According to data reported in the practice parameters document of the American Society of Colon and Rectal Surgeons, the risk of an operation for recurrent diverticulitis that includes a colostomy following nonoperative management of uncomplicated diverticulitis is which of the following?
    a) 15%
    b) 1%
    c) 23%
    d) 34%
    e) 8%
15. The rate of successful reversal of diverting ileostomy performed with resection and primary anastomosis of the sigmoid colon for acute, complicated sigmoid diverticulitis is which of the following?
   a) 43%
   b) 54%
   c) 90%
   d) 18%
   e) 67%

16. The main advantage of using tagged red blood cells for the localization of the bleeding site in patients with colonic diverticular bleeding is which of the following?
   a) A low incidence of allergic reaction
   b) Low cost
   c) Low rates of pain on injection
   d) No need for rewarming before injection
   e) Ability to diagnose bleeding sites after active bleeding has stopped

17. The Rome III criteria for diagnosis of chronic constipation include all of the following except which one?
   a) Need for digital evacuation of feces
   b) Fewer than three defecations per week
   c) Sensation of incomplete evacuation
   d) Diarrhea at least once a week
   e) Hard stool present in 25% or more of defecations

18. According to the review by Jacobs, bleeding is the initial symptom of hemorrhoid disease in which percentage of patients?
   a) 24%
   b) 11%
   c) 60%
   d) 88%
   e) 4%

19. Endoscopic evaluation with colonoscopy is indicated in patients with suspected hemorrhoid bleeding in all of the following situations except which one?
   a) Presence of anemia
   b) Hemorrhoid disease in a primary relative
   c) History of colonic polyps or colon malignancy
   d) Symptoms suggestive of Crohn disease
   e) History of Lynch syndrome

20. According to data cited in the review article by Abcarian, fecal incontinence occurs in which percentage of patients undergoing procedures for fistula-in-ano that include division of the anal sphincter muscle?
   a) 16%
   b) 4%
   c) 38%
   d) 0.25%
   e) 9%

The following four questions are required by the American College of Surgeons for accreditation purposes. You must complete these four questions before submitting your answers.

21. This issue met the stated learning objectives.
   a) Strongly agree
   b) Agree
   c) Neutral
   d) Disagree
   e) Strongly disagree

22. The content was relevant to my educational needs and practice environment.
   a) Strongly agree
   b) Agree
   c) Neutral
   d) Disagree
   e) Strongly disagree
23. There are potential barriers to incorporating what I have learned from this issue into my practice.
   a) Strongly agree
   b) Agree
   c) Neutral
   d) Disagree
   e) Strongly disagree

24. The content was fair, objective, and unbiased.
   a) Strongly agree
   b) Agree
   c) Neutral
   d) Disagree
   e) Strongly disagree
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Recommended Reading | COLON, RECTUM & ANUS, PART I
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The full-text reprints of articles cited in the literature review are included in some formats of Selected Reading in General Surgery (SRGS). The articles appear in order of overview citation. All of the articles reviewed in this issue also appear in the reference list at the end of the literature review (35–39).

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1. An evaluation of differences in risk factors for individual types of surgical site infections after colon surgery. (46–53)
   Segal CG, Waller DK, Tilley B, et al.
   Segal and coauthors provide data supporting the risk factor patterns for SSI following colon and rectal procedures.

2. Choice of intravenous antibiotic prophylaxis for colorectal surgery does matter. (54–60)
   Deierhoi RJ, Dawes LG, Vick C, et al.
   This article presents data supporting the use of prophylactic antibiotic agents for patients undergoing colon and rectal procedures. The drugs should target aerobic and anaerobic bacteria.

3. The NOTA Study (Non Operative Treatment for Acute Appendicitis): prospective study on the efficacy and safety of antibiotics (amoxicillin and clavulanic acid) for treating patients with right lower quadrant abdominal pain and long-term follow-up of conservatively treated suspected appendicitis. (61–69)
   This article presents a review of experience from Italian medical centers supporting the use of antibiotic therapy without operation for selected patients with suspected acute appendicitis.

4. Acute appendicitis—appendectomy or the “antibiotics first” strategy. (70–76)
   Flum DR.
   Flum reviews available evidence relevant to the choice of approaches for patients with suspected uncomplicated appendicitis. The use of an “antibiotics first” approach is acceptable for carefully selected patients.

5. Systematic review and meta-analysis of the role of routine colonic evaluation after radiologically confirmed acute diverticulitis. (77–86)
   Sharma PV, Eglinton T, Hider P, et al.
   Sharma and coauthors provide evidence in support of a selective approach to colonic endoscopic evaluation in patients with acute sigmoid diverticulitis.

6. A multicenter randomized clinical trial of primary anastomosis or Hartmann’s procedure for perforated left colonic diverticulitis with purulent or fecal peritonitis. (87–95)
   Oberkofler CE, Rickenbacher A, Raptis DA, et al.
   This article provides evidence supporting the usefulness of sigmoid resection, primary anastomosis and diverting ileostomy.

   This article is a useful update on data relevant to the epidemiology of colonic volvulus.

   O’Neill CH, Borrazzo EC, Hyman NH.
   This article is a useful review of the topic of parastomal hernia.

   Bordeianou L, Hicks CW, Kaiser AM, et al.
   Bordeianou and coauthors provide evidence in support of the various interventions for management of rectal prolapse.

    Jacobs D.
    Jacobs provides a comprehensive and clear review of the topic of hemorrhoid disease.

    Abcarian H.
    This is a valuable review article that is comprehensive and clear.
The American College of Surgeons offers a variety of surgical patient education products for your colon and rectal practice.

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