Clinical Practice Guidelines for Colon Volvulus and Acute Colonic Pseudo-Obstruction

Jon D. Vogel, M.D. • Daniel L. Feingold, M.D. • David B. Stewart, M.D.
Jacquelyn S. Turner, M.D. • Marylise Boutros, M.D. • Jonathan Chun, M.D.
Scott R. Steele, M.D.

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It should be recognized that these guidelines should not be deemed inclusive of all proper methods of care or exclusive of methods of care reasonably directed toward obtaining the same results. The ultimate judgment regarding the propriety of any specific procedure must be made by the physician in light of all of the circumstances presented by the individual patient.

STATEMENT OF THE PROBLEM

Large-bowel obstruction in adults is most often caused by colon or rectal cancer, diverticular disease, or volvulus of the colon.[2,3] Obstruction from colonic volvulus results from twisting of a redundant segment of colon on its mesentery.[4–6] The worldwide incidence of colonic volvulus is variable, with historical evidence indicating higher rates in parts of India, Africa, and Middle Eastern countries, and a relatively lower incidence in the United States, Australia, New Zealand, and Western European countries.[5,7–11] Volvulus occurs in the sigmoid colon or cecum in >95% of cases, with the remainder involving either the transverse colon or the splenic flexure of the colon.[7,9,12,13] In the United States and other Westernized countries, patients with volvulus typically present in their 6th to 8th decade of life and frequently experience chronic medical conditions, neuropsychological impairment, or constipation.[4,5,7,10,12,14] In general, sigmoid volvulus affects patients who are older, with more comorbid medical and neuropsychological conditions, compared with those with cecal volvulus.[4,5,9–12,14–19] Earlier reports, along with recent evidence from 2 large studies from the United States, 1 from France, and 1 from New Zealand, indicate an ≈2:1 predominance of sigmoid volvulus in men and 3:1 predominance of cecal volvulus in women.[4,10,11,14,15,17,20,21] The evaluation and management of colon volvulus include endoscopic and/or operative assessment of the viability of the volvulized colon segment, relief of the colon obstruction, and measures aimed at preventing recurrence of the problem. Without definitive operative treatment, colonic volvulus tends to recur, with each episode presenting a risk of ischemia and perforation.[7,10,18,22,23]

Acute colonic pseudo-obstruction (ACPO), or Ogilvie syndrome, is hypothesized to result from dysregulation of autonomic impulses in the enteric nervous system of the colon, creating a clinical picture consistent with large-bowel obstruction, although no mechanical blockage is present.[24–29] ACPO typically occurs in patients of advanced age who are hospitalized for medical conditions, traumatic injury, or a surgical procedure.[28,30–34] Untreated ACPO may progress to ischemic perforation of the colon, and, thus, timely recognition and therapeutic intervention are essential.[30,35,36] Therapeutic interventions in ACPO are focused on decompression of the colon and include supportive measures, pharmacologic therapy with neostigmine, colonoscopic decompression, and, occasionally, operative intervention. This parameter will focus on the evaluation and treatment of cecal and sigmoid volvulus and ACPO.

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METHODOLOGY

An organized search of relevant literature was performed using the following databases from inception: Ovid MEDLINE (1946 to current), EMBASE (1980 to May 2015), the Cochrane Database of Systematic Reviews (Wiley interface), the Cochrane Central Register of Controlled Trials (Wiley interface), and the National Guidelines Clearinghouse (www.guideline.gov). Retrieved literature was limited to the English language, but no year limits were applied. The searches are complete through May 2015. The search strategies were based on the concepts of *volvulus*, *pseudo-obstruction*, and various surgical and diagnostic procedures using multiple subject headings and text word terms to describe each concept. For example, the concept of *volvulus* is described by terms such as *malrotation*, *torsion*, *bascule*, and *intestinal volvulus*, whereas surgical and diagnostic concepts are described by terms like *decompression*, *colectomy*, *resection*, *imaging*, and *radiography*, among many others. Directed searches of the embedded references from the primary articles were also performed in selected circumstances. Although not exclusionary, primary authors focused on all English language articles and studies of adults. Prospective, randomized controlled trials and meta-analyses were given preference in developing these guidelines. Recommendations were formulated by the primary authors and reviewed by the entire Clinical Practice Guidelines Committee. The final grade of recommendation was performed using the Grades of Recommendation, Assessment, Development, and Evaluation system.[1] (Table 1)

Colon Volvulus

1. Initial evaluation should include a focused history and physical examination, complete blood cell count, serum electrolytes, and renal function assessment. Grade of Recommendation: Strong recommendation, based on low- or very-low-quality evidence, 1C.

Common presentation of symptoms of both sigmoid and cecal volvulus includes abdominal cramping, pain, nausea, vomiting, and obstipation.[5,7–9,17,37,38] On physical examination, there is typically abdominal distension, varying degrees of tenderness, diminished or increased bowel sounds, and often an empty rectum on digital examination.[7,9,16,17,38] The duration of symptoms before presentation ranges from a few hours to several days, with acute presentations more common with cecal volvulus and indolent presentations more common with sigmoid volvulus.[5,9,10,14,15,17,20] The frequent presence of comorbid conditions in patients with colon volvulus, along with the possibility of electrolyte derangement and acute renal insufficiency secondary to vomiting and dehydration, warrants the inclusion of routine blood testing during the initial evaluation of patients with suspected colonic volvulus. Emergency presentations, with clinical signs of peritonitis or shock related to colon ischemia or perforation, have been noted to occur in <25% and 35% of patients with sigmoid and cecal volvulus.[9,15,37,38] In general, the history and physical examination, laboratory blood work, and radiological evaluation are occurring in parallel to avoid delays.

2. Diagnostic imaging for colonic volvulus is initially based on plain abdominal radiographs and often includes confirmatory imaging with a contrast enema or CT imaging. Grade of recommendation: Strong recommendation, based on low- or very-low-quality evidence, 1C.

Plain abdominal radiographs are often useful in the initial diagnostic evaluation of patients with suspected colon volvulus. As above, imaging should occur early in the course of suspected volvulus because they may rapidly lead to a diagnosis. Radiographic images typically reveal a distended loop of colon that may resemble a coffee bean or bent inner tube projecting toward the upper abdomen, sometimes above the transverse colon, which has been described as the "northern exposure sign."[5,16,39–43] Plain abdominal radiographs may also show distention of the small bowel with air-fluid levels and decompressed colon distal to the point of volvulus. In a recently published study, abdominal radiographs were considered suggestive of diagnosis or diagnostic of cecal volvulus in 27% and 15% of patients and in 31% and 51% of those with sigmoid volvulus.[10] In another recent review, Lau et al[16] reported that plain abdominal radiographs were diagnostic of sigmoid and cecal and sigmoid volvulus in 26% and 66% patients. Plain abdominal radiographs may also reveal other conditions that are included in the differential diagnosis of colon volvulus, as well as complicating factors, such as pneumoperitoneum or pneumatosis.

In cases in which clinical assessment and plain adnominal radiographs are insufficient to confirm the diagnosis of colon volvulus, contrast enema or CT imaging may be helpful. A water-soluble contrast enema may help confirm the diagnosis of cecal or sigmoid volvulus by demonstrating a smooth, tapered point of obstruction known as a "bird's beak" at the point of colon torsion.[5,17,23,39,43,44] In the recent report by Swenson et al,[10] contrast enema was suggestive of diagnosis or diagnostic for cecal volvulus in 44% and 33% of patients and for sigmoid volvulus in 13% and 78% of patients. In the review by Lau et al,[16] the combination of plain abdominal radiographs and contrast enema images was diagnostic for sigmoid and cecal volvulus in 90% and 42% of patients. Older studies also supported the use of a contrast enema in cases of suspected cecal or sigmoid volvulus and have shown that the point of colonic torsion could be identified in ≈70% of cases.[17,43,44] In general, water-soluble contrast medium is preferable to barium contrast, because the latter could cause a chemical peritonitis in the setting of a perforated colon.

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TABLE 1. The GRADE system: grading recommendations

Grade	*Description*	*Benefit vs risk and burdens*	*Methodologic quality of supporting evidence*	*Implications*
1A	Strong recommendation; high-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	RCTs without important limitations or overwhelming evidence from observational studies	Strong recommendation, can apply to most patients in most circumstances without reservation
1B	Strong recommendation; moderate-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	RCTs with important limitations (inconsistent results, methodologic flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies	Strong recommendation, can apply to most patients in most circumstances without reservation
1C	Strong recommendation; low- or very-low-quality evidence	Benefits clearly outweigh risk and burdens or vice versa	Observational studies or case series	Strong recommendation but may change when higher-quality evidence becomes available
2A	Weak recommendation; high-quality evidence	Benefits closely balanced with risks and burdens	RCTs without important limitations or overwhelming evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patient or societal values
2B	Weak recommendation; moderate-quality evidence	Benefits closely balanced with risks and burdens	RCTs with important limitations (inconsistent results, methodologic flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies	Weak recommendation, best action may differ depending on circumstances or patient or societal values
2C	Weak recommendation; low- or very-low-quality evidence	Uncertainty in the estimates of benefits, risks, and burden; benefits, risk and burden may be closely balanced	Observational studies or case series	Very weak recommendations; other alternatives may be equally reasonable

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GRADE = Grades of Recommendation, Assessment, Development, and Evaluation; RCT = randomized controlled trial.

Contrast-enhanced CT imaging is currently the preferred confirmatory diagnostic study for both cecal and sigmoid volvulus because it is noninvasive, easily obtainable, accurate for both cecal and sigmoid volvulus, and has the advantage of identification of incidental pathology that may be missed with plain radiographs or fluoroscopic contrast studies. In addition, abdominal CT has proven useful to distinguish organoaxial cecal volvulus from cecal bascule and may facilitate the diagnosis of colonic ischemia.[41,42,45–47] In the study by Swenson et al,[10] the positive diagnostic yield of CT for cecal and sigmoid volvulus was 71% and 89%. Other diagnoses that can mimic the presentation of colonic volvulus, such as obstruction because of a neoplasm or pseudo-obstruction, can also be evaluated with the above modalities.

Sigmoid Volvulus

1. Rigid or flexible endoscopy should be performed to assess sigmoid colon viability and to allow initial detorsion and decompression of the colon. Grade of Recommendation: Strong recommendation, based on low- or very-low-quality evidence, 1C.

In the absence of colonic ischemia or perforation, the initial treatment of sigmoid volvulus is endoscopic detorsion, which is effective in 60% to 95% of patien ts.[7,9,14,18,33,48,49] Detorsion may be performed by rigid or flexible sigmoidoscopy or colonoscopy in unusual cases in which the transition point is beyond the reach of a shorter scope.[7,18,50–52] After successful detorsion of the sigmoid colon, a decompression tube should, in general, be left in place for a period of 1 to 3 days to maintain the reduction, allow for continued colonic decompression, and facilitate mechanical bowel preparation, as needed.[7,11,14,18,48–50,53–57] In patients with sigmoid volvulus who undergo successful endoscopic detorsion without subsequent intervention, index admission and long-term recurrent volvulus have been observed in 3% to 5% and 43% to 75% of patients.[10,11,14,18,50,57,58] With this high risk of recurrent volvulus and the attendant risks associated with each episode, operative intervention should be strongly considered in appropriate patients during the index admission or soon thereafter.[10,14,18,50,57,59]

In a recent study by Yassaie et al,[11] 31 patients with sigmoid volvulus who underwent successful endoscopic detorsion and no further interventions before discharge were evaluated. Recurrent sigmoid volvulus was diagnosed in 19 (61%) of these patients at a median of 31 days. Of these 19 patients, 7 underwent colectomy and 12 had repeat endoscopic detorsion alone, of whom 5 (48%) were diagnosed with a third episode of volvulus at a median interval of 5 months and 3 (25%) required emergent sigmoid colectomy.[11] In the study by Swenson et al,[10] 10 (48%) of 21 of patients with sigmoid volvulus treated nonoperatively returned with

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recurrent volvulus at a median of 106 days (range, 8–374 days) after discharge. Similarly, Tan et al[54] observed recurrent sigmoid volvulus in 28 (61%) of 46 patients who were discharged after endoscopic reduction alone.

Care should be taken in the selection of patients for endoscopic detorsion, and those with signs and symptoms of bowel ischemia or perforation should not be considered for endoscopic intervention. In cases in which advanced mucosal ischemia, peroration, or impending perforation of the colon is discovered during endoscopy, the procedure should be aborted in favor of emergent operative intervention.

2. Urgent sigmoid resection is generally indicated when endoscopic detorsion of the sigmoid colon is not possible and in cases of nonviable or perforated colon. Strong recommendation, based on low- or very-low-quality evidence, 1C.

Urgent operative intervention for sigmoid volvulus is required in the 5% to 22% of patients in whom endoscopic detorsion is not possible and in the 5% to 25% of patients in whom colonic ischemia, perforation, peritonitis, or septic shock complicate the initial presentation.[7,9,10,14,18,33,50,54,60–65] In general, resection of infarcted bowel should be performed without detorsion and with minimal manipulation to prevent release of endotoxin, potassium, and bacteria into the general circulation and to avoid perforation of the colon.[23,56,66–68] Once the volvulized segment of colon has been removed, the decision to perform primary colorectal anastomosis, defunctioned colorectal anastomosis, or end-descending colostomy should be individualized, with consideration of both the overall condition of the patient and the colon. This approach was exemplified in a consecutive series of patients reported by Kuzu et al in 2002.[64] In their retrospective study of 106 sigmoid volvulus cases accumulated over 8 years, sigmoid resection with end colostomy (Hartmann procedure, n = 49) or sigmoid resection with colorectal anastomosis without diverting ostomy (n = 57) was performed at the discretion of the operating surgeon. A Hartmann procedure was used more often in patients with a nonviable colon or peritonitis and resulted in increased postoperative complications and mortality (8% vs 5%), whereas anastomotic leak occurred in 7% of patients in the anastomosis group.[64] In the largest reported series of patients with sigmoid volvulus, a Hartmann procedure was the most commonly performed emergency operation, with overall morbidity of 42% and mortality of 20%.[50] Although this study included 952 patients accumulated over 4 decades, the most recent 10-year period was notable for more selective use of the Hartmann procedure in the setting of a nonviable colon (mortality = 7%) and resection with anastomosis when the colon was viable (mortality = 1%). Another nonrandomized study of sigmoid resection with nondiverted or diverted (blow-hole colostomy) colorectal anastomosis was notable for 12% and 0% anastomotic leaks and mortality in 8% and 10%.[63] Although there are insufficient data to support one technique over another in emergent cases for sigmoid volvulus, more robust studies performed in patients with sigmoid diverticular disease have compared urgent Hartmann procedure with colorectal anastomosis, both with and without proximal diversion. These studies demonstrated no difference in mortality or overall surgical postoperative complications among the various approaches.[60,62,63,69,70] Notwithstanding this limited evidence, end colostomy creation is often the most appropriate choice for hemodynamically unstable patients or when concomitant factors, such as increased ASA or Acute Physiology and Chronic Health Evaluation II score, hemodynamic instability, coagulopathy, acidosis, or hypothermia, add prohibitive risk to the integrity of a colorectal anastomosis.[18,62,64,71–73]

The role of laparoscopic surgery for emergent colorectal operations is still being defined, and there is a paucity of data specific to emergent laparoscopic sigmoid volvulus surgery. One recent comparison of open and laparoscopic cases demonstrated a 2-fold increase in anastomotic leak in the latter group and similar overall postoperative morbidity.[74] Additional published results indicate that the laparoscopic approach is a suitable alternative to laparotomy in select cases by surgeons who are competent with this technique.[50,74–76]

3. Sigmoid colectomy should be considered after resolution of the acute phase of sigmoid volvulus to prevent recurrent volvulus. Grade of Recommendation: Strong recommendation based on low-quality evidence, 1C.

Of the variety of elective operative interventions that have been described for sigmoid volvulus, sigmoid colectomy with colorectal anastomosis is the intervention that is most consistently effective at preventing recurrent episodes of volvulus.[7,11,14,15,18,50,55,74,77] The entire length of the redundant colon should be removed so as to reduce the risk of postresection recurrent volvulus. Stoma creation in the nonemergency setting is not usually required and should be considered on a case-by-case basis depending on the operative findings and unique circumstances of the patients. In patients with sigmoid volvulus and concurrent megacolon, subtotal colectomy has been shown to more effectively prevent recurrent volvulus when compared with sigmoid colectomy alone.[78–80] In patients with sigmoid volvulus and viable, nonperforated bowel, sigmoid resection with colorectal anastomosis results in low morbidity and mortality in the range of 0% to 12%.[7,9,11,14,50,57] Given the redundancy and mobility of the colon encountered in patients with sigmoid volvulus, resection can be performed via minilaparotomy or laparoscopically, although the potential benefits of a laparoscopic approach in this setting are not clear.[50,74,75]

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4. Nonresectional operative procedures, including detorsion alone, sigmoidoplasty, and mesosigmoidoplasty, are inferior to sigmoid colectomy for the prevention of recurrent volvulus. Weak recommendation based on low-quality evidence, 2C.

Operative detorsion alone, detorsion with intraperitoneal or extraperitoneal fixation (sigmoidopexy), and tailoring of the sigmoid mesentery to broaden its base and prevent torsion (mesosigmoidopexy) are nonresectional techniques that have been described for the definitive treatment of sigmoid volvulus in patients with a viable colon. Although recurrent volvulus after sigmoid resection is generally a rare event, recurrence after the nonresectional techniques is more variable.[5,7,18,50] Bhatnagar and Sharma[81] performed detorsion and extraperitoneal sigmoid colon fixation in a consecutive series of 84 patients in whom no recurrences were observed. In smaller series, recurrence after sigmoidopexy has been reported in the range of 29% to 36%.[14,55,61] For mesosigmoidoplasty, Subrahmanyam[82] achieved excellent results in a series of 126 patients, with recurrent volvulus observed in only 2 patients. Similarly, in a series of 15 cases reported by Akgun,[83] there were no episodes of recurrent volvulus after mesosigmoidoplasty. However, in the large series reported by Oren et al[18] and Atamanalp,[50] mesosigmoidoplasty resulted in recurrent sigmoid volvulus in 21% and 16%. Although there are only limited data on operative detorsion alone, with most evidence coming from older retrospective studies, the associated morbidity is in the range of 30% to 35%, with mortality at 11% to 15%, and recurrent sigmoid volvulus at 18% to 48%, which had led many authors to discourage the use of this intervention.[18,50,56,57,84]

5. Endoscopic fixation of the sigmoid colon may be considered in select patients in whom operative interventions present a prohibitive risk. Grade of Recommendation: Weak recommendation based on low-quality evidence, 2C.

Sigmoid volvulus is often encountered in older patients, some of whom may be unfit for abdominal operations. For this subset of patients, a number of small case series have investigated advanced endoscopic techniques as a less invasive means to prevent recurrent sigmoid volvulus. The percutaneous endoscopic colostomy (PEC) technique is performed to fix the sigmoid colon to the anterior abdominal wall, restricting its mobility, with the aim of preventing recurrent volvulus. Fixation of the colon has been performed using T fasteners or by percutaneous tube colostomy placement with or without laparoscopic assistance.[14,85–90] Although the literature includes a few reports of small case series, 1 relatively large study included 19 elderly patients with recurrent sigmoid volvulus who were judged unfit for definitive surgical treatment.[85] In that study, the PEC procedure was successfully performed in all of the patients, whereas major complications (including peritonitis, tube migration, and death) occurred in 2 patients (10%) and minor complications (eg, abdominal wall bleeding or infection) occurred in 7 patients (37%). There were 8 deaths from unrelated causes. Of the 6 patients who underwent removal of the PEC tube(s), after 6 to 26 months of fixation, none experienced recurrent volvulus at a median follow-up of 35 months. In another series of 14 patients, PEC maintained reduction of the volvulus in each of the 5 patients in whom it was left in place but in only 3 of 6 in whom the PEC was subsequently removed.[86] At present, it appears that PEC may be a useful tool for the treatment of sigmoid volvulus, but more studies are needed to assess its durability. For the time being, it should generally be reserved for patients in whom established operative interventions are judged to pose a prohibitive degree of risk.

Cecal Volvulus

1. Attempts at endoscopic reduction of cecal volvulus are generally not recommended. Grade of Recommendation: Strong recommendation base on low-quality evidence, 1C.

Several retrospective studies include patients in whom endoscopic reduction of cecal volvulus was attempted. Pooled results from of studies published between 1978 and 2012, including 34 patients in whom endoscopic reduction of cecal volvulus was attempted, demonstrated successful detorsion in 4 patients (12%).[10,15,19,48,91] In the most recent studies, by Renzulli et al in 2002[48] and Swenson et al in 2012,[10] endoscopic decompression was successful in 2 of 6 patients and 0 of 10 patients. In contradistinction to the management of sigmoid volvulus, in which endoscopic decompression is an effective means of temporarily detorsing the colon, this technique is of limited value in cases of cecal volvulus.[10,15,33] With its low likelihood of success and its potential for causing injury to the volvulized colon, attempts at endoscopic reduction of cecal volvulus are generally not recommended.[17,23,33,45]

2. In patients with cecal volvulus, resection is required in patients with nonviable or perforated bowel. Resection is also an appropriate first-line intervention for patients with viable bowel who are good operative candidates. Grade of Recommendation: Strong recommendation based on low-quality evidence, 1C.

Nonviable or gangrenous cecum is present in 18% to 44% of patients with cecal volvulus and has an associated mortality rate of 31% to 44%; a range that is 3- to 4-fold higher compared with those patients with viable bowel.[7,13,16,17,20,21,91,92] The bulk of the published literature on operative treatment of cecal volvulus that includes analysis of cases with viable and nonviable bowel comes from retrospective studies that were published

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in the 1970s and 1980s.[7,17,91,92] In the study by O'Mara et al[17] with 9 patients with cecal volvulus and gangrenous cecum, 7 underwent segmental resection with primary anastomosis, of which 2 (28%) died of septic complications. In contrast, the 7 patients with viable cecum who were treated with resection and primary anastomosis experienced postoperative morbidity at a rate equal to the nonviable cases (43%) but experienced no mortalities. In a study by Ballantyne et al,[7] there were 15 patients with cecal volvulus and gangrenous bowel, of whom 4 (27%) underwent resection with ileostomy and 11 (73%) had resection with primary anastomosis. Although the specific outcomes for the primary anastomosis group and the ostomy group were not reported, overall mortality rates in patients with nonviable and viable cecum were 33% and 12%.[7] Anderson and Welch[37] reported on 69 patients with cecal volvulus, including 19 (27%) with a gangrenous cecum, of whom 12 underwent resection with primary anastomosis and 7 had resection with ileostomy and mucus fistula. In the 12 patients with a nonviable cecum, anastomotic leak and postoperative mortality occurred in 2 (17%) and 5 patients (42%). In comparison, 2 (29%) of 7 patients who underwent resection and ileostomy died after surgery.[37] In the 14 patients with viable cecum who underwent resection with primary anastomosis, 1 patient developed an anastomotic leak and 3 (21%) died. In a closer look at the patients with gangrenous cecum, Anderson and Welch[37] noted that death after resection and primary anastomosis occurred only in patients with extensive gangrene or perforation, whereas there were no deaths after resection and primary anastomosis in patients with "patchy gangrene." In the most recent retrospective study, by Swenson et al,[10] of 53 patients with cecal volvulus, operative treatment was performed in 52, including resection in 44 patients (85%), with overall postoperative morbidity in 17% and no mortality.

To summarize, the data presented here come largely from retrospective studies of cecal volvulus published >20 years ago. The results of these studies indicate the following: 1) cecal resection is the most consistently effective means of preventing recurrent volvulus[7,17,20,21,23,45]; 2) nonviable bowel is a meaningful predictor of mortality in patients with cecal volvulus and resection is required in these patients.[7,17,20,21,23,57,92]; and 3) whether resection with primary anastomosis or resection with ileostomy, with or without mucus fistula, should be performed in cases with nonviable bowel is a delicate point. The data from Anderson and Welch,[37] O'Mara et al,[17] and Ballantyne et al[7] support the use of resection and anastomosis in select patients with cecal volvulus and nonviable bowel. Alternatively, in patients with cecal perforation, extensive gangrene, or peritonitis, resection with ileostomy (and occasionally mucus fistula) may be preferable.[17,37]

3. For cecal volvulus with viable bowel, nonresectional operative procedures may be a suitable alternative to resection. Grade of Recommendation: Weak recommendation based on low-quality evidence, 2C.

In cases of cecal volvulus with viable bowel, the options for operative treatment include detorsion alone, detorsion with suture fixation to the abdominal wall (cecopexy), cecostomy, and segmental resection of the cecum. For each intervention, the risks of postoperative morbidity and mortality should be weighed against the risk of recurrent cecal volvulus. In the review by Rabinovici et al,[20] there were 561 patients with cecal volvulus for whom cecopexy, detorsion alone, resection, or cecostomy was performed in 32%, 25%, 25%, and 16%. Patients who underwent cecopexy or detorsion alone had the low rates of abdominal and wound complications (15% and 15%), mortality (10% and 13%), and recurrent volvulus (13% and 12%).[20] Alternatively, resection resulted in abdominal or wound morbidity in 29% and mortality in 22% but no episodes of recurrent volvulus. The worst outcomes were associated with cecostomy, which resulted in morbidity, mortality, and recurrence in 52%, 32%, and 14%.[20] In the review of case series published between 1972 and 1986 by Tejler and Jiborn,[21] detorsion alone, cecopexy, cecostomy, and resection resulted in death in 13%, 5%, 10%, and 8% and recurrent volvulus in 13% 13%, 1%, and 0% of patients.

Single-center studies in which patients with nonviable bowel were distinguished from those with viable bowel indicated a low rate of mortality, with 0 or near-0 incidence of recurrent volvulus after resection of viable bowel, but were more variable in terms of morbidity, mortality, and recurrence after the nonresectional procedures.[7,10,13,15,17,37] O'Mara et al[17] reported on 41 patients with cecal volvulus and viable bowel, for whom cecostomy, resection, operative detorsion only, or cecopexy was performed in 4, 7, 12, and 18 patients and for whom postoperative complications occurred in 3 (75%), 3 (43%), 5 (52%), and 3 patients (17%). In the patients who underwent cecostomy, resection, operative detorsion only, or cecopexy, postoperative mortality occurred in25%, 0%, 17%, and 0% (7% total). With long-term follow-up, none of the 44 surviving patients in the series by O'Mara et al[17] were diagnosed with recurrent volvulus. Without separating cases with viable and nonviable bowels, Ballantyne et al[7] noted mortality for detorsion, cecostomy, cecopexy, resection with primary anastomosis, and resection with ileostomy of 27%, 0, 8%, 14%, and 25% and overall mortality with viable and nonviable bowel of 11% and 33%. Similar to O'Mara et al[17], Ballantyne et al[7] also noted 0 recurrences after cecostomy and cecopexy and only 1 recurrence in 11 patients treated with detorsion alone. Anderson and Welch[37] reported on 18 cecopexy and 14 cecostomy cases, of which there was 1 death in each group and recurrent volvulus in 3 of 18 and 0 of 14. The 1 patient who had detorsion alone developed recurrent volvulus.[37]

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Although it is clear that resection is required for nonviable or perforated bowel, limitations in the available data make it impossible to advocate the best operation for patients with cecal volvulus and viable bowel. Resection of viable bowel has the advantage of effectively preventing recurrent volvulus with 0 or near-0 mortality but the disadvantage of increased postoperative morbidity compared with the nonresectional procedures.[13,15,17,20,21,23] The effectiveness of cecopexy is more variable than that of resection but may result in a lower rate of procedure-related morbidity compared with resection.[7,17,20,21,37] Cecostomy is another effective operative intervention, with low rates of recurrent volvulus, but it has a relatively high incidence of morbidity and adds potential new challenges that relate to the ostomy.[15,17,20,21,23] Reports on the use of operative detorsion alone for cecal volvulus indicate a low incidence of recurrent volvulus (0%–13%) but a high rate of mortality (13%–33%) that, when coupled with concerns about the failure of detorsion alone to correct the underlying pathology of cecal volvulus, has led some authors to suggest that this procedure should be abandoned.[7,17,20,21] Ultimately, with more than 1 appropriate operative intervention for cecal volvulus with viable bowel, a decision on the most appropriate intervention should be individualized, with consideration of both the condition of the patient and the bowel.[45] Laparoscopic techniques to achieve reduction, fixation, or resection of the cecum are an acceptable alternative to laparotomy for hemodynamically stable patients under the care of surgeons with suitable experience.[74,76,93] The treatment recommendations for patients with cecal bascule are similar to those discussed for patients with the more common form of organoaxial cecal volvulus.[20]

Acute Colonic Pseudo-Obstruction

1. Initial evaluation should include a focused history and physical examination, complete blood count, serum electrolytes, renal function assessment, and diagnostic imaging. Grade of recommendation: Strong recommendation, based on low- or very-low-quality evidence, 1C.

ACPO is a condition that most often affects older, hospitalized, or institutionalized patients with severe comorbid conditions or infection or those recovering from surgery or traumatic injury.[28,30–34] Abdominal pain, nausea and vomiting, abdominal distension, and dilation of the ascending and transverse colons on abdominal radiographs are typical findings but are nonspecific for ACPO.[26,28,94] The frequent presence of comorbid conditions in patients with ACPO, along with the possibility of electrolyte derangement and acute renal insufficiency secondary to dehydration, warrants the inclusion of routine blood testing during the initial evaluation of patients with suspected colonic ACPO. To accurately diagnose ACPO, clinicians should exclude the presence of a mechanical large-bowel obstruction and should consider other conditions that result in colon dilation. Abdominal CT or water-soluble contrast enema can reliably distinguish ACPO from a mechanical large-bowel obstruction.[95–98] Endoscopic evaluation of the colon may also be effective in distinguishing ACPO from large-bowel obstruction but is generally not recommended for diagnostic purposes in this setting because of its invasive nature and associated risks.[24,33,99] Although most patients with ACPO have a nonemergent presentation, ischemia or perforation of the colon is reported in 3% to 15% of cases with associated mortality in <50%.[26,30,100–102] Fever, leukocytosis, abdominal tenderness, and cecum dilation >12 cm, are factors that may be indicative of colon ischemia or perforation in ACPO.[28,30,100]

2. Initial treatment of ACPO is supportive and focused on the elimination or correction of conditions that predispose to ACPO or prolong its course. Grade of Recommendation: Strong recommendation based on low-quality evidence, 1C.

First-line therapy for patients with ACPO without clinical or radiologic evidence of colon ischemia or perforation and cecal diameter <12 cm is noninvasive and typically includes correction of serum electrolyte abnormalities, fluid resuscitation, avoidance or minimization of narcotics and anticholinergic medications, identification and treatment of concomitant infection, bowel rest, ambulation, knee-chest or prone positioning to promote flatus, and the insertion of nasogastric and rectal tubes to facilitate intestinal decompression.[26,28,33,103–105] Oral osmotic and stimulant laxatives should be avoided in patients with ACPO because they may worsen dilation of the colon via gas production and propulsion of gas into an already dilated colon.[26,28] With nonoperative treatment, serial physical examinations and repeat abdominal radiographs facilitate continuous reassessment. Clinical signs of ischemia include increased pain, fever, abdominal tenderness, and leukocytosis.[30] In a series of 400 patients with ACPO, including 221 patients with documented radiographic cecal diameter, ischemia or perforation occurred in 0%, 7%, and 23% of patients with cecal diameters <12 cm, 12 to 14 cm, and >14 cm.[30] If serial examinations and abdominal radiographs do not suggest colon ischemia, perforation, or impending perforation, a nonoperative or "conservative course" of therapy should generally be continued for up to a few days, with the expectation that it will lead to resolution of ACPO in 70% to 90% of patients.[30,33,102–105]

3. Pharmacologic treatment with neostigmine is an appropriate next step for ACPO that does not resolve with supportive therapy. Grade of Recommendation: Strong recommendation based on moderate-quality evidence, 1B.

Neostigmine is an antiacetylcholinesterase drug that transiently and reversibly increases acetylcholine levels in the synapse of muscarinic receptors of the parasympathetic

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nervous system.[25] In the colon, acetylcholine promotes contractility and accelerates colon transit.[25,106] In patients with ACPO, placebo-controlled, randomized prospective trials of intravenous administration of neostigmine have shown that this drug leads to resolution of colon dilation in ≈90% of cases.[32,34,107] In the landmark study by Ponec et al,[32] patients with ACPO who received 2 mg of neostigmine intravenously over a period of 2 to 5 minutes experienced a clinical response, defined as the passage of flatus or stool and decreased abdominal distension in 10 (91%) of 11 cases at a median interval of 4 minutes (range, 3–30 minutes). In addition, serial abdominal radiographs revealed a greater median decrease in cecal diameter compared with the placebo group (5- vs 2-cm decrease). Although the authors considered neostigmine to have failed in 3 (27%) of 11 cases, 1 of the 3 initial nonresponders subsequently responded to a second dose of neostigmine, whereas the other 2 required colonoscopic decompression. In 7 of the 10 patients who received open-label neostigmine after failure of placebo, a clinical and radiographic response occurred in 100%, and there were no recurrences. A subsequent and similarly designed trial performed by Amaro and Rogers[108] included a total of 18 patients treated with neostigmine, of which 17 (94%) had immediate clinical response and 16 (89%) had sustained colon decompression. A recent review of the randomized and nonrandomized trials of neostigmine for ACPO reported that a single intravenous dose of 2 to 5 mg administered over 1 to 5 minutes was successful in 60% to 94%, with a recurrence rate of 0% to 31% and overall long-term response in 69% to 100%.[34] In initial nonresponders or partial responders to neostigmine, a second dose has proven effective in 40% to 100% of patients and therefore may be considered after an interval that exceeds the normal 80-minute elimination half-life of the drug.[28,33,36,109,110] As an alternative to rapid intravenous administration of neostigmine, a single, randomized prospective trial of 24-hour neostigmine infusion for patients with ileus rather than ACPO has led to successful resolution of the condition in 85%, with no acute harmful adverse effects.[107] In patients with ACPO who respond to neostigmine, a small, randomized, placebo-controlled trial demonstrated that the oral administration of polyethylene glycol resulted in no recurrence of colonic dilation, whereas placebo resulted in recurrence in 33%.[111]

Adverse events associated with the use of neostigmine for ACPO are attributed to excess acetylcholine and include transient abdominal pain (50%–73%), sialorrhea (23%–38%), vomiting (10%–20%), and bradycardia (5%–9%).[34] Neostigmine therapy should be administered in a setting that allows for continuous monitoring of heart rate, oxygen saturation, and frequent blood pressure measurements and that has glycopyrrolate or atropine readily available for rapid use in cases of bronchospasm or bradycardia.[26,28,32,112] Neostigmine should not be used in ACPO that is complicated by colon ischemia or perforation or in the setting of pregnancy, uncontrolled cardiac arrhythmias, or severe active bronchospasm.[28] It may be used with caution in patients with bradycardia, asthma, chronic obstructive pulmonary disease, renal insufficiency, or recent myocardial infarction.[26,112]

4. Endoscopic decompression of the colon should be considered in patients with ACPO in whom neostigmine therapy is contraindicated or ineffective. Grade of Recommendation: Strong recommendation based on moderate-quality evidence, 1B.

In patients with ACPO who have not been treated with neostigmine, endoscopic decompression of the colon has been shown to result in initial colon decompression in 61% to 95% of cases and sustained decompression in the 70% to 90% range.[30,31,33,36,103,113] To prevent the recurrence of colon dilation, more than 1 endoscopic decompression procedure and/or endoscopic placement of a decompression tube is often required. In a study of 50 patients with ACPO, 41 (82%) had 1 colonoscopic decompression with clinical success in 39 (95%), and 9 (18%) required multiple (2–4) procedures with clinical success in 5 (56%).[31] In the 8 patients (16%) in which a decompression tube was not placed, clinical success was achieved in only 2 (25%). The overall clinical success of colonoscopic decompression was 88% (44 of 50), a percentage similar to the 82% success rate for the 125 patients who underwent colonoscopy in the large review by Vanek and Al-Salti.[30,31] Additional support for the use of a decompression tube in this setting comes from a nonrandomized study in which there were no recurrences of colon dilation in the 11 patients who underwent decompression tube placement and a 36% (4 of 11) recurrence in those patient in whom a decompression tube was not used.[114] Similar results were noted in a review in which recurrence of colon dilation occurred in 40% of those who underwent colonoscopic decompression without placement of a decompression tube.[101] Commercially available, through-the-scope colonoscopic decompression kits that include guide wires are available. Ideally, the decompression tube is placed in the proximal ascending colon.

Colonoscopy in ACPO has a reported perforation rate of 1% to 3%.[28,33,36,103,115] It is performed without mechanical bowel preparation of the colon using carbon dioxide or minimal air insufflation while avoiding or minimizing the use of narcotics. The goal of the colonoscopy in this setting is to intubate the right colon rather than the cecum and to place a suitable decompression tube while removing as much gas as possible from the colon.[28,33] If mucosal ischemia is identified during colonoscopy, the safety of decompression is unclear, although a single small case series provided evidence to support this practice.[33,116] In patients with ACPO who have failed supportive, pharmacologic, and standard endoscopic therapies and have no evidence of colon perforation or ischemia, percutaneous

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endoscopic colostomy may be considered as a last step before surgical therapy. Although this procedure has been performed safely, its overall success and role in the management of ACPO remain to be determined.[28,117,118]

5. Operative treatment is recommended for ACPO complicated by colon ischemia or perforation or ACPO refractory to pharmacologic and endoscopic therapies. Grade of Recommendation: Strong recommendation based on low-quality evidence, 1C.

The effectiveness of nonoperative, pharmacologic, and endoscopic therapy for ACPO has reduced the need for surgery to cases complicated by colon ischemia or perforation or dilation refractory to nonoperative management.[26,28,31,33,112] Colon ischemia or perforation occurs in 3% to 10% of patients with ACPO who have risk factors including cecal diameter >12 cm and duration of dilation >6 days.[30,36,101] Persistent colon dilation refractory to nonoperative measures can be estimated to occur in ≈10% of patients.[30–32] A study of 400 patients with ACPO from the "preneostigmine era" included 179 patients who underwent operative intervention.[30] Of these patients, 129 (72%) received an ostomy, 25 (14%) had a resection, and 25 (14%) had other operations performed, with an overall mortality rate of 30%. Among the 129 patients treated with tube cecostomy (n = 34), cecostomy (n = 61), and ileostomy or colostomy (n = 34), successful decompression was achieved in 100%, 95%, and 73%, with mortality of 15%, 21%, and 41%, and morbidity of 9%, 3%, and 3%.[30] Surgical mortality rates with viable, ischemic, and perforated bowel were 26%, 44%, and 36%. For comparison, the mortality rates for patients treated with supportive therapy alone and endoscopically treated patients were 14% and 13%. Additional risk factors for death in ACPO were advanced patient age, cecal diameter >14 cm, prolonged periods (>4 days) of unrelieved colonic distension, and the requirement for operative intervention.[30,102] Intraoperative decisions in ACPO should be guided by the condition of the colon and the condition of the patient. With viable, dilated colon, tube cecostomy or cecostomy is successful in 95% to 100% of patients with no comparative data available to guide the preferred type of ostomy creation.[26,30] For ischemic or perforated colon, the choice of resection with end ostomy or resection with anastomosis with or without proximal diversion is determined on a case-by-case basis and follows the general principles applicable to all bowel surgeries.[100,112]

APPENDIX A: CONTRIBUTING MEMBERS OF THE ASCRS CLINICAL PRACTICE GUIDELINES COMMITTEE

Janice Rafferty, M.D.; Ian Paquette, M.D.; Daniel Herzig, M.D.; Fergal Fleming, M.B.B.Ch.

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