Volvulus of the Small Bowel and Colon

Muneera R. Kapadia, MD, MME¹

¹ Department of Surgery, University of Iowa Hospitals and Clinics, Iowa City, Iowa

Clin Colon Rectal Surg 2017;30:40–45.

Address for correspondence Muneera R. Kapadia, MD, MME, Department of Surgery, University of Iowa, 200 Hawkins Drive, Room 1530 JCP, Iowa City, IA 52242 (e-mail: muneera-kapadia@uiowa.edu).

Abstract

Keywords

- ▶ volvulus
- ▶ sigmoid volvulus
- ▶ cecal volvulus
- ▶ colectomy

Volvulus of the intestines may involve either the small bowel or colon. In the pediatric population, small bowel volvulus is more common, while in the adult population, colonic volvulus is more often seen. The two most common types of colonic volvulus include sigmoid and cecal volvulus. Prompt diagnosis and treatment is imperative, otherwise bowel ischemia may ensue. Treatment often involves emergent surgical exploration and bowel resection.

Volvulus of the intestines involves twisting around a fixed point. It may occur anywhere along the gastrointestinal tract where there is a long, mobile intestinal segment with a narrow mesenteric attachment. Volvulus leads to luminal obstruction and can compromise intestinal blood flow. For this reason, it tends to be a surgical emergency which requires prompt attention. Failure to recognize the signs and symptoms of intestinal volvulus may lead to bowel ischemia and perforation.

Small Bowel Volvulus

Volvulus of the midgut involves twisting of the small bowel around its mesenteric axis. It is much more common in the pediatric population than in adults due to the increased incidence of malrotation that can occur during fetal development. Normally, during fetal development the intestines expand, undergo a 270-degree counterclockwise rotation, and later return to the abdomen and become fixed. Malrotation occurs in 1 out of 500 births and is present when the intestines do not rotate, incompletely rotate, or reverse rotate.¹ The small intestine in these cases has narrow mesenteric attachments which make it prone to volvulus. Most cases present during the neonatal period,² although they can present in childhood or even in adulthood.³ While small bowel volvulus is frequently associated with malrotation in children, it can also be attributed to duplication cysts, meconium ileus, jejunal atresia, tumors, or Meckel diverticula.

Newborns often present with acute symptoms from midgut volvulus which include bilious vomiting and abdominal distention. Toddlers and older children may have more vari-

able symptoms which may include irritability and chronic or recurrent abdominal pain.⁴ Some cases of malrotation may not result in small bowel volvulus, and therefore may be asymptomatic.⁵

If patients present with peritonitis or are acutely ill, resuscitation and laparotomy should be performed emergently. In children who are stable, upper gastrointestinal series is recommended and will demonstrate abnormal position of the duodenum, with a “bird’s beak” obstruction.⁴ The treatment for small bowel volvulus secondary to malrotation was first described by William Ladd: detorsion of the volvulus with resection of any nonviable bowel, division of the fibrous bands overlying the duodenum termed *Ladd’s bands*, appendectomy, and placement of the cecum in the left upper quadrant. More recently, this procedure has been performed laparoscopically.^{6–10} If volvulus is secondary to an etiology other than malrotation, the specific underlying cause must be addressed.

Adults, while less commonly, may also present with small bowel volvulus. This may be due to intestinal malrotation or secondary to adhesions, tumors, or Meckel diverticula. The estimated annual incidence in Western countries is 1.7 to 5.7 per 100,000 adults, as compared with 24 to 60 per 100,000 in parts of Africa and Asia.^{11,12} This trend is similarly noted in other forms of volvulus in that it is more common in areas where fiber-rich diets are consumed. In a recent large database study of patients from across the United States, 1% of small bowel obstructions were attributed to small bowel volvulus.¹³ There was a slight female predominance and the mean age at presentation was in the seventh decade. Adhesive disease was the most common cause and was

responsible in approximately one-third of patients. Of presenting patients, 89% presented emergently, 19% had an acute abdomen, and 65% were treated with surgical intervention. The overall mortality rate in this cohort was 8%. Diagnostic evaluation typically involves computed tomography, and treatment involves surgical detorsion of the intestine, resection of gangrenous bowel, and appropriate treatment depending on the underlying etiology.

Colonic Volvulus

The most common forms of colonic volvulus include sigmoid followed by cecal volvulus (►Fig. 1).¹⁴ Depending on the form of volvulus, demographics and incidence vary. In contradistinction to small bowel volvulus, it is rare in children. Pregnant patients are a group that warrants special consideration, as they have an increased rate of colonic volvulus, such that it accounts for one-quarter of colonic obstruction in these patients. This is possibly secondary to the gravid uterus pushing upward on the colon and making it more prone to torsion. In pregnant patients with obstipation, this diagnosis must be considered.

Clinical presentation may be somewhat variable. Patients tend to have abdominal distention, and constipation or obstipation. Patients may also have associated nausea and vomiting. Some patients will have recurring episodes which spontaneously resolve. If there is ischemia of the volvulized segment, patients may also have severe abdominal pain, peritonitis, and evidence of shock.

Sigmoid Volvulus

The incidence of sigmoid volvulus is highly variable, and is much more common in areas where high-fiber diets are consumed, such as regions of Asia, Africa, and South America.¹⁵ These diets, as well as other cultural factors, are thought to contribute to sigmoid colon elongation, thereby predisposing to sigmoid volvulus. In these regions, sigmoid volvulus accounts for 20 to 54% of intestinal obstructions. In the United States, Western Europe, and Australia, sigmoid volvulus accounts for only 3 to 5% of intestinal obstructions. Worldwide, the incidence in men is much higher than in women, and this may be explained by the mesenteric shape, which tends to be longer and have a narrower base in men.¹⁶ In western regions,

patients tend to be elderly, institutionalized, constipated, and have neuropsychiatric disorders.^{14,17}

Abdominal radiographs may be useful if they demonstrate a large sigmoid loop in the shape of a “bent inner tube” or “omega loop” (►Fig. 2). A recent Turkish retrospective review of 938 patients with sigmoid volvulus reported that of patients who underwent plain films, 67% demonstrated findings of sigmoid volvulus.¹⁸ However, if plain films are equivocal, abdominal computed tomography should be attained and is almost always diagnostic.^{18,19} A mesenteric whirl sign is typical, in addition to colonic dilatation.

In a patient without signs of sigmoid ischemia, the initial step in management should be urgent endoscopic detorsion. This is performed using a flexible colonoscope, which allows for visualization of the colonic mucosa. If the mucosa is noted to be gangrenous, detorsion should be aborted due to the risk of perforation. Once detorsion has been achieved, a rectal tube should be placed to facilitate further colonic decompression. Plain films should be attained at the completion of the procedure, to confirm no free air or bowel perforation. Endoscopic detorsion is successful in 60 to 80% of patients,^{20–23} and prevents the need for emergent surgical intervention.

However, the risk of recurrence following endoscopic detorsion alone is as high as 90% and carries a high risk of mortality up to 35%^{22,24–30}; therefore, definitive elective sigmoid resection is recommended. This is usually performed within the same hospitalization. If the patient has not had a recent complete colonoscopy, this should be performed prior to sigmoid resection. Sigmoid resection may be performed laparoscopically or in an open fashion (►Fig. 3).

The risk of recurrent volvulus following sigmoid resection is low. Atamanalp reported on 166 patients who underwent sigmoid resection over a 46-year period with no recurrences.²³ Other studies similarly have demonstrated a low recurrence rate following sigmoid resection.^{25,31,32} In patients found to have sigmoid volvulus in the setting of megacolon, total abdominal colectomy is recommended due to the high recurrence rate with sigmoid resection alone.^{26,33,34} Several surgical alternatives to sigmoid resection have been described, including surgical detorsion alone, or coupled with sigmoid or mesenteric fixation.³⁵ These techniques generally have high recurrence rates or associated morbidity and are generally not recommended.^{28,36,37}

In patients with suspected ischemia or unsuccessful endoscopic detorsion, emergent surgical exploration is indicated and sigmoid resection should be performed. Whether to proceed with anastomosis versus colostomy creation depends on several factors including the patient's hemodynamic stability, nutritional status, presence of gross contamination, and degree of bowel dilation. Grossman et al reported a higher mortality in patients undergoing emergent versus elective surgical intervention for sigmoid volvulus (24 vs. 6%, $p < 0.01$). Atamanalp reported similar results with 35.3% morbidity and 16.1% mortality for emergency procedures versus 12.5 and 0% for elective procedures, respectively.²³ In a recent analysis of the National Inpatient Sample, the mortality rate for sigmoid volvulus was 9%, and gangrene was noted to be a strong predictor of mortality.¹⁴

Fig. 1 Cecal and sigmoid volvulus: (A) axial cecal volvulus; (B) cecal bascule; (C) sigmoid volvulus.

Fig. 2 Sigmoid volvulus CT image. (Image courtesy of Dr. Jason S. Mizell, MD, FACS, FASCRS.)

Cecal Volvulus

Cecal volvulus is the second most frequent type of colonic volvulus, following sigmoid volvulus.^{28,38–40} There are two forms of cecal volvulus. The more common form involves an axial twist of the ileum, cecum, and proximal ascending colon around the mesentery.^{39,41} The other involves folding of the cecum upward toward the hepatic flexure, termed *cecal bascule*, and accounts for 10% of cecal volvulus cases.

Patients with cecal volvulus tend to be younger than patients with sigmoid volvulus and it is more common in women than in men.^{20,42} As many as 10% of patients with cecal volvulus are pregnant at presentation. To develop cecal volvulus, the cecum must be mobile with little fixation of the ascending colon to the retroperitoneum; however, this alone is likely inadequate. Other contributing risk factors include high-fiber intake, chronic constipation, acute medical illnesses, mental disorders, and previous abdominal surgery.^{39,42}

Fig. 3 Laparotomy for sigmoid volvulus. Note the large dilated colon with long mesentery. (Image courtesy of Dr. Jason S. Mizell, MD, FACS, FASCRS.)

In patients with cecal volvulus, plain radiographs are diagnostic less than 20% of the time.⁴² Classically, there is a “coffee bean” sign in the left upper quadrant. However, in less clear cases, there may be evidence of cecal and small bowel dilatation, and absence of colonic gas, which should prompt further imaging. Computed tomography imaging is highly diagnostic and usually demonstrates the “coffee bean” and mesenteric whirl. The location of the mesenteric whirl can help distinguish between sigmoid and cecal volvulus, as well as the type of cecal volvulus.^{19,43}

Unlike sigmoid volvulus, endoscopic detorsion is generally not recommended as initial management for cecal volvulus because of lower success rates and higher rates of ischemia in the volvulized segment.^{22,44} Therefore, once cecal volvulus is diagnosed, surgical exploration is the appropriate course of action.

The first step in surgical management is assessing the volvulized segment. If it is gangrenous, resection is mandated. A primary anastomosis even in the setting of gangrene is acceptable; however, depending on the patient's nutritional status, comorbid conditions, or other factors negatively influencing healing, ileostomy creation may be preferred.⁴⁵ Several options have been described for treatment including detorsion alone, cecopexy, cecostomy placement, and resection usually in the form of a right hemicolectomy. Cecopexy involves suturing the right colon to the right paracolic gutter using sutures. Cecostomy placement involves placing a tube through the abdominal wall and into the cecum, which affixes the colon and prevents volvulus. Rabinovici et al reviewed 561 cases in the literature with cecal volvulus and found that detorsion, cecopexy, and cecostomy had recurrence rates between 12 and 14% compared with resection which had no recurrences.⁴² Additionally, the morbidity and mortality for cecostomy creation is 52 and 32%, respectively, compared with resection which is 29 and 22%, respectively. More recent studies have

demonstrated lower morbidity and mortality for resection, and because of the lower recurrence rates, this is the preferred treatment of choice for cecal volvulus.²⁰

Ileosigmoid Knotting

Ileosigmoid knotting is more common in Africa, Asia, and the Middle East. It is rare in the West, although few cases overall have been described in the literature.^{46,47} Patients tend to be younger than those with sigmoid volvulus alone, and there is male predominance.^{46,48–50} Ileosigmoid knotting involves volvulus and obstruction of both the sigmoid and ileum. Four general types of ileosigmoid knotting are known to occur. More often, the ileum wraps around the sigmoid colon, either clockwise or counterclockwise. The sigmoid colon may wrap around the ileum, either clockwise or counterclockwise. A fifth and least common type is sometimes described and involves the ileocolic segment wrapping around the sigmoid colon.⁵¹

Similar to sigmoid volvulus, patients have a long sigmoid colon with a narrow-based mesentery. In addition, the ileum tends to be mobile with a long mesentery. Contributing factors include high-fiber diets and large volume fluid consumption.^{51,52} Patients present with abdominal pain, distention, obstipation, nausea, and vomiting. They tend to be more acutely ill than patients with other types of colonic volvulus, and can often present with sepsis, hypotension, and acidosis.⁴⁸

Plain radiographs may demonstrate signs of a small bowel obstruction in combination with a large sigmoid loop. However, in a series of 76 patients, only 6% were correctly diagnosed when considering clinical findings and plain films.⁴⁸ Computed tomography imaging will demonstrate dilated sigmoid and ileal loops with whirl signs in the ileal and sigmoid mesenteries, and is generally recommended for aiding in the diagnosis, provided the patient is stable.⁴⁸

Endoscopic detorsion will not be successful and these patients should undergo emergent surgical exploration. Options for management depend heavily on the viability of the involved intestinal segments. Atamanalp et al published a series of 74 patients in which only 19% of patients had viable intestine.⁴⁸ Obvious gangrenous segments should be resected without attempting detorsion. Depending on the viability of sigmoid colon, hemodynamic stability, and overall health status of the patient, colorectal anastomosis versus Hartmann procedure may be performed.^{48,53} If the ileum must be resected due to ischemia, in most cases continuity may be reestablished. If the intestine is viable, it is reasonable to detorse and preserve the intestine. Several authors have suggested that sigmoidectomy should be performed regardless, because it may lessen the risk of recurrent volvulus.

Mortality for ileosigmoid knotting ranges generally between 20 and 30% overall; however, this depends greatly on bowel viability at the time of exploration.^{46,48,50,51,54} Prompt recognition and surgical intervention is critical in the management of ileosigmoid knotting.

Transverse Colon and Splenic Flexure Volvulus

Both transverse colon and splenic flexure volvulus are rare. Ballantyne et al reviewed 137 patients with colonic volvulus that

presented to Mayo Clinic and found that 3% of patients were of the transverse colon and 2% were of the splenic flexure.³⁹ Similar to sigmoid and cecal volvulus, patients may present with an acute form or a chronic form with intermittent symptoms.

Generally, the transverse colon is fixed by the hepatic and splenic flexures and has a short mesentery, making it less likely to volvulize⁵⁵; however, when the colon elongates, it is more prone to volvulus. Predisposing factors for transverse colon volvulus include distal obstruction, pregnancy, malrotation of the intestines, and chronic constipation.^{55,56} In addition, Chilaiditi syndrome, which is characterized by a loop of colon between the liver and the right hemidiaphragm, has been cited as a risk factor for volvulus.^{57,58} The splenic flexure has several attachments and is typically immobile. Volvulus of the splenic flexure occurs more commonly in the setting of chronic constipation, similar to transverse colon volvulus, and previous abdominal surgery.⁵⁹

Preoperative diagnosis for both transverse colon and splenic flexure volvulus may not be clear. Plain radiographs may demonstrate a “bent inner tube” sign in the upper abdomen for transverse colon volvulus, with two dilated loops of colon and a decompressed distal colon.^{55,60} Splenic flexure volvulus has the classic appearance of a “coffee bean” sign in the left upper quadrant.⁶¹ However, plain films are often not enough to make the diagnosis. In these cases, computed tomography may be helpful and, as in other forms of volvulus, may demonstrate a swirl sign.⁵⁹ Often the diagnosis is made at the time of surgical exploration.

Endoscopic decompression is generally not recommended for either transverse colon or splenic flexure volvulus because of the high risk of gangrene and recurrence.⁵⁵ Instead, patients should undergo surgical exploration. As with all types of volvulus, gangrenous segments must be resected. If the intestine is viable, detorsion followed by resection with either primary anastomosis or a proximal stoma is recommended to prevent further episodes of volvulus.⁶²

Conclusion

Intestinal volvulus is an important cause of bowel obstructions. There is geographic variability, and volvulus tends to be less common in Western regions. Small bowel volvulus is more common in infants and children, while colonic volvulus is more common in adults. Prompt diagnosis is critical and volvulus often represents a surgical emergency.

References

- 1 Welch GH, Azmy AF, Ziervogel MA. The surgery of malrotation and midgut volvulus: a nine year experience in neonates. *Ann R Coll Surg Engl* 1983;65(4):244–247
- 2 Filston HC, Kirks DR. Malrotation - the ubiquitous anomaly. *J Pediatr Surg* 1981;16(4, Suppl 1):614–620
- 3 Dietz DW, Walsh RM, Grundfest-Broniatowski S, Lavery IC, Fazio VW, Vogt DP. Intestinal malrotation: a rare but important cause of bowel obstruction in adults. *Dis Colon Rectum* 2002;45(10):1381–1386
- 4 Millar AJ, Rode H, Cywes S. Malrotation and volvulus in infancy and childhood. *Semin Pediatr Surg* 2003;12(4):229–236

- 5 Graziano K, Islam S, Dasgupta R, et al. Asymptomatic malrotation: diagnosis and surgical management: an American Pediatric Surgical Association outcomes and evidence based practice committee systematic review. *J Pediatr Surg* 2015;50(10):1783–1790
- 6 Hagendoorn J, Vieira-Travassos D, van der Zee D. Laparoscopic treatment of intestinal malrotation in neonates and infants: retrospective study. *Surg Endosc* 2011;25(1):217–220
- 7 Stanfill AB, Pearl RH, Kalvakuri K, Wallace LJ, Vegunta RK. Laparoscopic Ladd's procedure: treatment of choice for midgut malrotation in infants and children. *J Laparoendosc Adv Surg Tech A* 2010;20(4):369–372
- 8 Fraser JD, Aguayo P, Sharp SW, Ostlie DJ, St Peter SD. The role of laparoscopy in the management of malrotation. *J Surg Res* 2009;156(1):80–82
- 9 Yamashita H, Kato H, Uyama S, et al. Laparoscopic repair of intestinal malrotation complicated by midgut volvulus. *Surg Endosc* 1999;13(11):1160–1162
- 10 Mazziotti MV, Strasberg SM, Langer JC. Intestinal rotation abnormalities without volvulus: the role of laparoscopy. *J Am Coll Surg* 1997;185(2):172–176
- 11 Iwuagwu O, Deans GT. Small bowel volvulus: a review. *J R Coll Surg Edinb* 1999;44(3):150–155
- 12 Gulati SM, Grover NK, Tagore NK, Taneja OP. Volvulus of the small intestine in India. *Am J Surg* 1973;126(5):661–664
- 13 Coe TM, Chang DC, Sicklick JK. Small bowel volvulus in the adult populace of the United States: results from a population-based study. *Am J Surg* 2015;210(2):201–210.e2
- 14 Halabi WJ, Jafari MD, Kang CY, et al. Colonic volvulus in the United States: trends, outcomes, and predictors of mortality. *Ann Surg* 2014;259(2):293–301
- 15 Raveenthiran V, Madiba TE, Atamanalp SS, De U. Volvulus of the sigmoid colon. *Colorectal Dis* 2010;12(7 Online):e1–e17
- 16 Bhatnagar BN, Sharma CL, Gupta SN, Mathur MM, Reddy DC. Study on the anatomical dimensions of the human sigmoid colon. *Clin Anat* 2004;17(3):236–243
- 17 Ballantyne GH. Sigmoid volvulus: high mortality in county hospital patients. *Dis Colon Rectum* 1981;24(7):515–520
- 18 Atamanalp SS. Sigmoid volvulus: diagnosis in 938 patients over 45.5 years. *Tech Coloproctol* 2013;17(4):419–424
- 19 Macari M, Spieler B, Babb J, Pachter HL. Can the location of the CT whirl sign assist in differentiating sigmoid from caecal volvulus? *Clin Radiol* 2011;66(2):112–117
- 20 Swenson BR, Kwaan MR, Burkart NE, et al. Colonic volvulus: presentation and management in metropolitan Minnesota, United States. *Dis Colon Rectum* 2012;55(4):444–449
- 21 Turan M, Sen M, Karadayi K, et al. Our sigmoid colon volvulus experience and benefits of colonoscopy in detortion process. *Rev Esp Enferm Dig* 2004;96(1):32–35
- 22 Lau KC, Miller BJ, Schache DJ, Cohen JR. A study of large-bowel volvulus in urban Australia. *Can J Surg* 2006;49(3):203–207
- 23 Atamanalp SS. Treatment of sigmoid volvulus: a single-center experience of 952 patients over 46.5 years. *Tech Coloproctol* 2013;17(5):561–569
- 24 Tan KK, Chong CS, Sim R. Management of acute sigmoid volvulus: an institution's experience over 9 years. *World J Surg* 2010;34(8):1943–1948
- 25 Grossmann EM, Longo WE, Stratton MD, Virgo KS, Johnson FE. Sigmoid volvulus in Department of Veterans Affairs Medical Centers. *Dis Colon Rectum* 2000;43(3):414–418
- 26 Chung YF, Eu KW, Nyam DC, Leong AF, Ho YH, Seow-Choen F. Minimizing recurrence after sigmoid volvulus. *Br J Surg* 1999;86(2):231–233
- 27 Alam MK, Fahim F, Al-Akeely MH, Qazi SA, Al-Dossary NF. Surgical management of colonic volvulus during same hospital admission. *Saudi Med J* 2008;29(10):1438–1442
- 28 Hiltunen KM, Syrjä H, Matikainen M. Colonic volvulus. Diagnosis and results of treatment in 82 patients. *Eur J Surg* 1992;158(11–12):607–611
- 29 Safioleas M, Chatziconstantinou C, Felekouras E, et al. Clinical considerations and therapeutic strategy for sigmoid volvulus in the elderly: a study of 33 cases. *World J Gastroenterol* 2007;13(6):921–924
- 30 Larkin JO, Thekiso TB, Waldron R, Barry K, Eustace PW. Recurrent sigmoid volvulus - early resection may obviate later emergency surgery and reduce morbidity and mortality. *Ann R Coll Surg Engl* 2009;91(3):205–209
- 31 Morrissey TB, Deitch EA. Recurrence of sigmoid volvulus after surgical intervention. *Am Surg* 1994;60(5):329–331
- 32 Heis HA, Bani-Hani KE, Rabadi DK, et al. Sigmoid volvulus in the Middle East. *World J Surg* 2008;32(3):459–464
- 33 Strom PR, Stone HH, Fabian TC. Colonic atony in association with sigmoid volvulus: its role in recurrence of obstructive symptoms. *South Med J* 1982;75(8):933–936
- 34 Ryan P. Sigmoid volvulus with and without megacolon. *Dis Colon Rectum* 1982;25(7):673–679
- 35 Osiro SB, Cunningham D, Shoja MM, Tubbs RS, Gielecki J, Loukas M. The twisted colon: a review of sigmoid volvulus. *Am Surg* 2012;78(3):271–279
- 36 Oren D, Atamanalp SS, Aydinli B, et al. An algorithm for the management of sigmoid colon volvulus and the safety of primary resection: experience with 827 cases. *Dis Colon Rectum* 2007;50(4):489–497
- 37 Khanna AK, Kumar P, Khanna R. Sigmoid volvulus: study from a north Indian hospital. *Dis Colon Rectum* 1999;42(8):1081–1084
- 38 Mulas C, Bruna M, García-Armengol J, Roig JV. Management of colonic volvulus. Experience in 75 patients. *Rev Esp Enferm Dig* 2010;102(4):239–248
- 39 Ballantyne GH, Brandner MD, Beart RW Jr, Ilstrup DM. Volvulus of the colon. Incidence and mortality. *Ann Surg* 1985;202(1):83–92
- 40 Jones IT, Fazio VW. Colonic volvulus. Etiology and management. *Dig Dis* 1989;7(4):203–209
- 41 Madiba TE, Thomson SR. The management of cecal volvulus. *Dis Colon Rectum* 2002;45(2):264–267
- 42 Rabinovici R, Simansky DA, Kaplan O, Mavor E, Manny J. Cecal volvulus. *Dis Colon Rectum* 1990;33(9):765–769
- 43 Delabrousse E, Sarliève P, Saille N, Aubry S, Kastler BA. Cecal volvulus: CT findings and correlation with pathophysiology. *Emerg Radiol* 2007;14(6):411–415
- 44 Friedman JD, Odland MD, Bubrick MP. Experience with colonic volvulus. *Dis Colon Rectum* 1989;32(5):409–416
- 45 Tuech JJ, Pessaux P, Regenet N, Derouet N, Bergamaschi R, Arnaud JP. Results of resection for volvulus of the right colon. *Tech Coloproctol* 2002;6(2):97–99
- 46 Machado NO. Ileosigmoid knot: a case report and literature review of 280 cases. *Ann Saudi Med* 2009;29(5):402–406
- 47 Sangwan M, Sangwan V, Garg MK, Mutreja J, Singla D, Gautam D. Ileosigmoid knotting: a rare case report with review of literature. *J Surg Case Rep* 2015;2015(5):1–3
- 48 Atamanalp SS, Kantarci A, Aydinli B, et al. The diagnostic efficiency of CT and MRI in ileosigmoid knotting. *Turk J Med Sci* 2014;44(6):1134–1135
- 49 Akgun Y. Management of ileosigmoid knotting. *Br J Surg* 1997;84(5):672–673
- 50 Kotisso B, Bekele A. Ilio-sigmoid knotting in Addis Ababa: a three-year comprehensive retrospective analysis. *Ethiop Med J* 2006;44(4):377–383
- 51 Alver O, Oren D, Tireli M, Kayabaşı B, Akdemir D. Ileosigmoid knotting in Turkey. Review of 68 cases. *Dis Colon Rectum* 1993;36(12):1139–1147
- 52 Shepherd JJ. The epidemiology and clinical presentation of sigmoid volvulus. *Br J Surg* 1969;56(5):353–359
- 53 Bawa D, Ikenna EC, Ugwu BT. Ileosigmoid knotting—a case for primary anastomosis. *Niger J Med* 2008;17(1):115–117
- 54 Puthu D, Rajan N, Shenoy GM, Pai SU. The ileosigmoid knot. *Dis Colon Rectum* 1991;34(2):161–166

- 55 Zinkin LD, Katz LD, Rosin JD. Volvulus of the transverse colon: report of case and review of the literature. *Dis Colon Rectum* 1979; 22(7):492–496
- 56 Loke KL, Chan CS. Case report: transverse colon volvulus: unusual appearance on barium enema and review of the literature. *Clin Radiol* 1995;50(5):342–344
- 57 Orangio GR, Fazio VW, Winkelman E, McGonagle BA. The Chilaiditi syndrome and associated volvulus of the transverse colon. An indication for surgical therapy. *Dis Colon Rectum* 1986;29(10): 653–656
- 58 Nofuentes C, Mella M, Soliveres E, Pérez-Bru S, García-Marín A, García-García S. Transverse colon volvulus and Chilaiditi syndrome: an exceptional association. *Am Surg* 2011;77(11): E244–E245
- 59 Koh SZ, Low AS, Quah HM. Multidetector computed tomography diagnosis of splenic flexure volvulus: usefulness of multiplanar reformats. *Singapore Med J* 2013;54(4):e79–e82
- 60 Mortensen NJ, Hoffman G. Volvulus of the transverse colon. *Postgrad Med J* 1979;55(639):54–57
- 61 Saavedra-Perez D, Valentini M, Benarroch G, Garcia-Valdecasas JC. Volvulus of the splenic flexure of colon: the coffee bean and whirl signs. *Surgery* 2015;157(5):957–958
- 62 Ballantyne GH. Volvulus of the splenic flexure: report of a case and review of the literature. *Dis Colon Rectum* 1981;24(8):630–632