Visceral volvulae and management

Daniel White
Bruce Levy

Abstract

Volvulus refers to torsion of a segment of the gastrointestinal tract, which often leads to bowel obstruction. Obstruction of the intestinal lumen and impairment of vascular perfusion occur when the degree of torsion exceeds 180 and 360 degrees, respectively. Visceral volvulus causing obstruction is a common presentation to the emergency department. Ascertaining the gastrointestinal level and grading the severity of the obstruction is paramount as each can be managed entirely differently. A spectrum from nasogastric or rectal tube decompression, to endoscopic decompression with or without fixation, and finally, surgical intervention are all at the surgeons disposal. Clinical and radiographic assessment of both the pathological process and the patient provide all the necessary detail for appropriate management of what are often a highly comorbid cohort of patients. This article will summarize current evidence for management of the most common sources of volvulus; gastric, small bowel, and colonic.

Keywords Emergency; endoscopy; general surgery; intestinal obstruction; ischaemia; laparoscopy; PEC; PEG; volvulus

Gastric volvulus

Gastric volvulus is defined by the axis along which the rotation occurs. Most commonly this is the long axis between the pylorus and the gastro-oesophageal junction (organoaxial, pictured in red in Figure 1) and the short axis, perpendicular to the greater and lesser curvatures of the stomach (mesenteroaxial, pictured in black in Figure 1). Organoaxial is the most common, comprising 60% of cases. Rarely a combination of both types is observed.

In addition to the axis, gastric volvulus can be defined by the mechanism of its aetiology, being primary or secondary. Primary gastric volvulus is rare, and occurs as a consequence of congenital malformations, or chronic anatomical variations such as kyphoscoliosis, where elongation of the gastric ligaments occurs over time, enabling malrotation. Secondary gastric volvulus is most common, occurring with synchronous pathology such as paraoesophageal hernia, diaphragmatic hernia, and phrenic nerve injury. Other than these known anatomical risk factors, the only risk is age, with 90% of patients being adult, most commonly presenting in the fifth decade of life or later.

Daniel White *MBBS MRCS is a Surgical Research Fellow at the Minimal Access Therapy Training Unit, Guildford, UK. Conflicts of interest: none declared.*

Bruce Levy *MB ChB MD is a Consultant Colorectal Surgeon at St Richards Hospital, Chichester, UK. Conflicts of interest: none declared.*

Due to the common pathology being synchronous with a paraoesophageal hernia or diaphragmatic hernia, symptoms can often be chronic with only 40% of patients presenting with true acute symptoms of gastric outflow obstruction, but they will be the primary focus of this management discussion. Symptoms of acute obstruction are abdominal pain with or without chest pain and severe vomiting with typically an inability to pass a nasogastric tube. These three symptoms are known as Borchardt's triad and are present in 70% of acute gastric volvulus cases. Haematemesis can be a later sign from ischaemic change or a Mallory Weiss tear from repeated vomiting. Clinical signs to be elicited are a dilated fluid filled stomach, dull to percussion in the upper abdomen, and a typically volume deplete patient. Bowel sounds can often be auscultated in the chest in the presence of a large hernia. There is overlap with signs of an acute coronary syndrome and all reasonable steps must be taken to rule it out as a diagnosis, without introducing potential life-threatening delays to surgery.

Upper abdominal pain and vomiting will usually prompt an erect chest radiograph to investigate for visceral perforation. This will demonstrate an air-fluid level within the thoracic cavity and a distinct bubble (hernial sac) separate from the diaphragm. This is demonstrated below in Figure 2. Once proven, an immediate attempt should be made by a suitably trained person to decompress the stomach with a nasogastric tube. Often this will derotate the stomach and resolve the acute episode, allowing surgical planning for fixation on the index admission. This will involve an anesthetic assessment as patients are often high risk and major surgery must be weighed against potential repeat nasogastric decompression, which is a safe option in the unfit patient.

If the diagnosis is not proven on plain radiograph then a CT scan is the best modality. CT scan not only confirms the diagnosis but the relationship of other organs such as transverse colon and spleen, the size and frequency of any diaphragmatic defects, and the presence of any free air or fluid.

If nasogastric decompression is not successful, endoscopy can be used to place the nasogastric tube, decompress and derotate the stomach, and has the additional benefit of mucosal visualization to assess for ischaemia or any source of bleeding. In the event of an inability to decompress via nasogastric tube or endoscopic intubation, immediate surgical management is necessary, as delays in treatment can lead to ischaemia with or without perforation and an associated mortality of up to 50%.

In a similar dilemma to patients with sigmoid volvulus, resectional surgery is not always appropriate or possible. Resection of any portion of the stomach combined with extensive hiatal dissection and repair is major surgery that not all patients are suitable for in the presence of alternatives. Evidence for and against management options is generally based on small case series as this is a rare condition not compatible with robust, large volume clinical trials. However, the management options are:

Nasogastric or endoscopic decompression and no other treatment

Recurrence rates are high at around 65% but mortality low and few require major surgery acutely. This is a perfectly reasonable option for a comorbid patient or those declining surgery or endoscopic management.

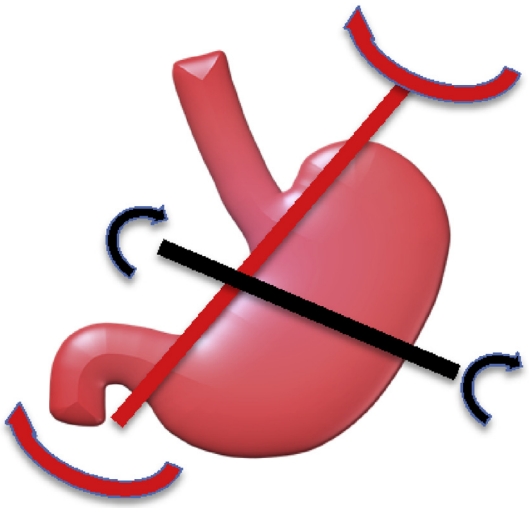

Figure 1 Diagram of stomach demonstrating rotational axis of gastric volvulus (Adapted from Flickr, Inc.).

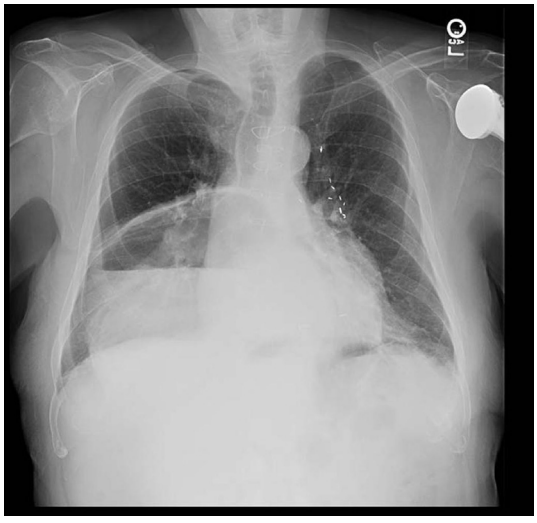

Figure 2 Plain chest radiograph demonstrating air fluid level and hernial sac (Case courtesy of Radswiki, Radiopaedia.org, rID: 11448).

Decompression and endoscopic fixation – percutaneous endoscopic gastrostomy (PEG)

Fixation to the anterior abdominal wall is achieved using at least one percutaneous endoscopic gastrostomy tube. Multiple points of fixation can be used as it is thought that a single fixation still allows rotation about a fixed axis and higher levels of recurrence though this is not supported with published data. Low-level complications such as dislodgement of tubes, leakages and pain are high at 50–80% with an associated mortality of 10%.

Decompression and surgical fixation (laparoscopic gastropexy)

This can be achieved using either sutures or commonly a gastrostomy, surgically or endoscopically placed. The number of fixation points varies in the literature, as does the fixation site (abdominal wall, crus, transverse colon) but single fixation is still thought to provide an axis for malrotation, so multiple point fixation is preferable as with endoscopic fixation.

Decompression, reduction of hernia and repair of anatomical defect with or without anti-reflux procedure

Although this is major surgery, when the correct patients are selected, the mortality is as low as 2%, with a complication rate of 16% and low recurrence rates of 9% at 4 years having been reported in a large elective series of laparoscopic repair for giant paraoesophageal hernias.[1]

Partial gastric resection, reduction of hernia and repair of anatomical defect with or without anti-reflux procedure

The stomach is a highly vascular organ and very robust, but in 10–20% of patients, gastric necrosis will be discovered and require resection. This has an associated mortality of 30–50%. The extent of resection and the clinical stability of the patient would dictate the remainder of the operative management with regard to fixation and anti-reflux surgery as these are lengthy operations for which an unstable patient may not be suitable.

Small bowel volvulus

The most common forms of small bowel obstruction are secondary to congenital or surgical adhesions, accounting for 70% of all small bowel obstruction presentations. In contrast, true primary small bowel volvulus is rare, accounting for just 1–2% of all presentations in adults in Western countries. It is often a consequence of a freely mobile small bowel, often attributable to a degree of congenital malrotation and as such presents far more commonly in children. Few risk factors are known, but there appears to be a dietary component with significantly increased incidence in high-fibre diet populations such as Africa, India and the Middle-East.[2]

Clinical suspicion is necessary for cases of small bowel obstruction in a virgin abdomen where the hernial orifices are not the clear pathology. Signs are not specific and will include abdominal pain, distension, nausea and vomiting with typical high-pitched ‘tinkling’ bowel sounds.

A plain abdominal radiograph will reveal a classical picture of small bowel dilatation but will rarely be diagnostic of volvulus. These patients are at high risk of ischaemic bowel and as such, evidence of leukocytosis, raised blood lactate, fever, tachycardia or peritonism should prompt an urgent CT scan of the abdomen and pelvis to delineate the pathology of the obstruction or a diagnostic laparoscopy with or without laparotomy. A peritonitic or unwell patient has little benefit to be gained from the delay of a CT scan if the end result is operative management irrespective of the scan result. In addition, despite the high sensitivity and specificity for mesenteric ischaemia (>95%), a normal CT scan in the presence of clinical suspicion should not negate surgery due to the consequences of a missed pathology.

Regarding surgical intervention, time is truly a factor and prompt operative management essential to reduce the morbidity and mortality. Early derotation can preserve bowel without the need for resection. This can be achieved via a small midline laparotomy or laparoscopically in cases where the patient is not tensely distended (Figure 3). Up to 50% of patients will require a small bowel resection which doubles 30-day mortality rates from

Figure 3 Small bowel findings at laparotomy. The bowel is poorly perfused, distended and has developed a serosal tear, identified by the arrow. With derotation this could still potentially be preserved (https://commons.wikimedia.org/wiki/File:Intestinal_Obstruction.JPG).

4.4% to 9.1%, underlining the value in expediting patients to the operating room.[3]

Once derotation has been performed, warm packs are applied and copious volumes of warm saline to determine the viability of the bowel and define margins of resection if necessary. Clinical signs such as peristalsis, arterial pulsation, and bowel coloration assist the surgeon in their decision making. Other intraoperative techniques such as fluorescein dye or Doppler ultrasound have been studied and have been found to be beneficial but are not routinely performed in the emergency setting. Trials are ongoing such as the INTACT trial, assessing the using of fluorescent dye (indocyanine green - ICG) to determine blood flow to proximal and distal colon in anterior resections in an attempt to reduce anastomotic leak rates.

Figure 4 Plain abdominal radiograph showing large bowel dilation and 'coffee-bean' sign (https://commons.wikimedia.org/wiki/File:Sigmoid volvulus.jpg).

Where bowel resection is necessary there is no evidence to support hand sewn or stapled anastomosis being a superior technique and the surgeon should select based on personal experience and preference.

Sigmoid volvulus

Sigmoid volvulus is the commonest of all presentations of volvulus, accounting for 60% of volvulus cases. It remains in the western world, a less common cause of colonic obstruction overall (<10%), with large bowel obstruction presentations commonly being due to colonic cancer. In contrast, in the so-called volvulus belt of Africa and the Middle East, sigmoid volvulus accounts for 50–60% of all colonic obstruction. This is hypothesized to be due to a high fibre diet causing elongation of the colon and a susceptibility to volvulus.[4]

Risk factors for sigmoid volvulus are well known but the precise pathophysiology is much less clearly understood. Factors contributing to colonic dysmotility are chronic constipation, laxative dependency, chronic opioid use and immobile or institutionalized patients. Anatomically, patients who have a long, redundant, often chronically dilated sigmoid colon and narrow mesenteric attachment are at risk. Both of these can be identified radiologically with a CT scan, or direct endoscopic visualization.

Patients most commonly present in their sixth or seventh decade with an acutely distended, tympanic abdomen, absolute constipation, with accompanying nausea or vomiting. Conversely, as we have already stated, many patients are infirm, and may only be able to provide a very limited history, so clinical suspicion must be high. A digital rectal examination can often find a capacious rectum, where pseudo obstruction should be considered, or a collapsed rectum more in keeping with a true obstructive picture.

A patient presenting with abdominal distension, constipation and nausea should prompt a plain abdominal radiograph. Sigmoid volvulus has a characteristic coffee-bean appearance (Figure 4). The radiological picture is that of paucity of rectal gas with a distended segment of colon, identified as such by colonic haustra and the apex of the sigmoid pointing towards the right upper quadrant, in contrast to a caecal volvulus which tends to have the apex pointing to the left upper quadrant.

Primary management is concerned with decompression of the colon and assessment of colonic viability and is successful in up to 95% of cases for sigmoid volvulus, in contrast to caecal volvulus which has a success rate of just 20%. Only in circumstances where perforation is confirmed or there is clinical or radiographic evidence of ischaemia should surgery be the initial course of action. Direct visualization with rigid sigmoidoscopy and placing of a flatus tube should be undertaken only when suitably trained or formal endoscopic decompression unavailable. Inexperienced use of a rigid sigmoidoscope or blind placement of a flatus tube can lead to perforation and provides minimal details of mucosal viability. The preferred method is formal decompression within an endoscopy unit or theatre. Flexible endoscopy offers optimal visualization by a skilled operator who is able to determine between true volvulus (Figure 5) and a pseudo-obstruction, together with bowel viability. A small percentage of patients (5%) will not successfully be decompressed with a sigmoidoscope and require

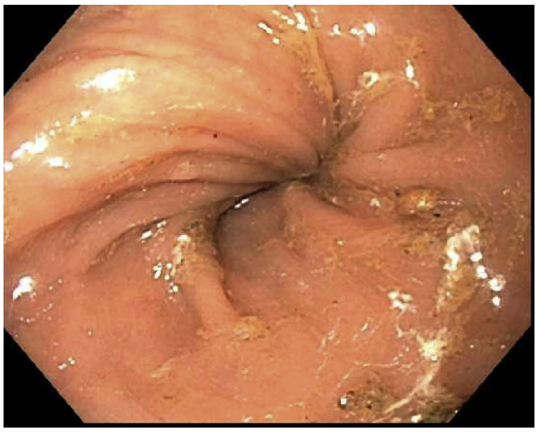

Figure 5 Endoscopic image showing characteristic blind ending loop from the true twist of a sigmoid volvulus (https://eventscribe.com/2017/wcogacg2017/ajaxcalls/PosterInfo.asp?efp=S1lVTUxLQVozODMy&PosterID=116017&rnd=9.792984E-02).

colonoscopy. This can be due to highly redundant, lengthy colon, or less common pathologies such as transverse colon volvulus. In most cases, a flatus tube will be left to allow further decompression of the colon. This can be sutured in place to prevent immediate expulsion.

The timing of definitive intervention is one that has not achieved consensus, though some series have shown acceptable results with a 24–48 hour delay with rectal tube decompression before resectional surgery, most would plan to discharge the patient and perform an elective surgery, or endoscopic fixation at the earliest available opportunity. Not acting promptly will yield a very high recurrence rate of 70% or more, commonly within 60 days.[5–7]

Definitive management options are summarized in Table 1 and described below.

When assessing figures such as these it must be remembered that patient selection is key. Although a laparoscopic sigmoid colectomy has a high success rate, not all patients will be suitable to be offered it. Equally, although sigmoidopexy appears to have a very high mortality, it again will reflect the population that this procedure was offered to. Despite being the highest risk procedure, in patients presenting with megacolon, a subtotal colectomy is the operation of choice. A tailored approach considering all of the above is vital in all cases. Many centres will discuss such elective cases in a benign multidisciplinary team meeting.

A Paul Mikulicz procedure involves making a transverse incision at the site of planned double-barreled colostomy. Upon doing so the sigmoid colon will often spontaneously deliver via this incision. A tension-free resection can be performed once the bowel is exteriorized and stoma formed with or without a stoma bridge.

A Hartmann's procedure can be successfully performed laparoscopically or open and involves resection of the sigmoid colon and creation of an end colostomy. This is a larger undertaking than the Paul Mikulicz procedure, which does not appear to attract a higher mortality. An end colostomy is far more easily managed than a double-barreled colostomy and patient factors are often a strong consideration here. An example of poor strategy selection would be a patient with no support network who cannot manage his or her own stoma, who in being given one, is committed to full residential or nursing care.

A subtotal colectomy is the largest intervention available here and only done in cases of megacolon where chronic dilated bowel has an additional volvulus. It involves resection of all colon, and preserves the rectum. An ileorectal anastomosis can be made, or patients given a temporary or permanent ileostomy. It has the lowest recurrence rate but due to the magnitude of surgery has the highest mortality rate and as such is only used in highly specific circumstances.

Advantages and disadvantages of the different management options, including mortality data for each[a]

Procedure	Advantage	Disadvantage	Recurrence	Mortality[a]
Trephine colectomy (Paul Mikulicz)	Minimally invasive No need for risk of pneumoperitoneum	General anaesthetic (GA) Major surgery Double-barreled stoma	3–20%	11%
Hartmann's procedure (laparoscopic/open)	Low risk recurrence	GA Major surgery	0–3%	7–8%
Sigmoid colectomy (laparoscopic/open)	No stoma Low risk recurrence	GA Major surgery Anastomotic leak	3–22%	1–5%
Subtotal colectomy (laparoscopic/open)	Lowest risk of recurrence	High risk cohort Highest risk surgical choice Can still have megarectum	0%	20–24%
Sigmoidopexy (laparoscopic assisted or endoscopic)	No stoma No resection/GA	Sedation or GA Higher risk of recurrence	16–36%	11–15%
Percutaneous endoscopic colostomy (PEC) (two-point fixation)	Can treat very elderly/comorbid	High risk peritonitis Need community support network	0–24%	10–50%

[a] Mortality for elective non-obstructed patients.

Table 1

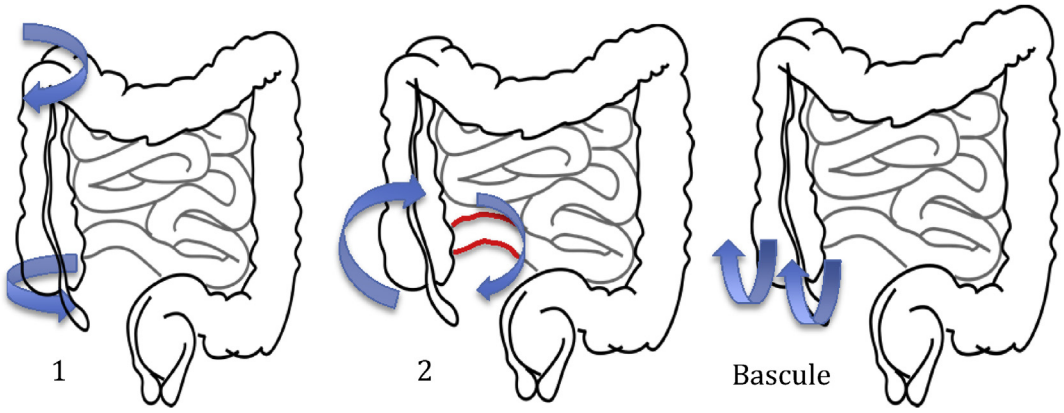

Figure 6 Types of caecal volvulus (Adapted from Flickr, Inc.).

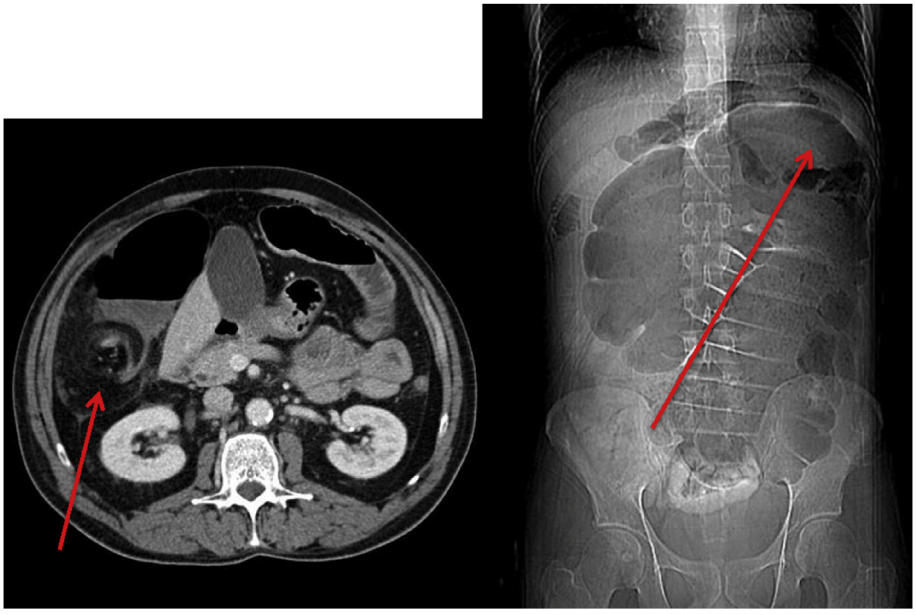

Figure 7 CT findings demonstrating (a) the characteristic 'swirl' sign of the mesentery and (b) colonic dilatation with the apex pointing toward the left upper quadrant (Image a Courtesy of Dr Paresh K Desai, Radiopaedia.org, rID: 5798; image b Courtesy of Dr Jens Christian Fischer, Radiopaedia.org, rID: 12823).

Two non-resectional strategies are available, with fixation of the sigmoid to the abdominal wall via either a percutaneous endoscopic colostomy (PEC), or surgically placed sutures (sigmoidopexy).

Unlike in gastric volvulus, evidence is sufficient for single point fixation with an endoscopically placed gastrostomy tube. PEC gained approval by NICE in 2006. If the tube is removed or inadvertently pulled out, recurrence rate is high at 37%.

A laparoscopic, sutured sigmoidopexy is far less frequently adapted than PEC and has the least evidence with only a limited selection of very small case-series. It can be used as a temporizing measure to definitive surgery but has not been proven to have a role long term in comparison to PEC. Satisfactory outcomes have been demonstrated with laparoscopic assisted procedures, placing single or multiple gastrostomy tubes rather than sutures.[6,8]

Caecal volvulus

Caecal volvulus is significantly rarer than sigmoid volvulus, accounting for just 10% of colonic volvulus and less than 1% of all large bowel obstruction. It typically presents in younger patients, in their fourth and fifth decade.

The mechanism can be very similar to sigmoid volvulus, with a long mesentery allowing mobility and torsion of the caecum in an axial plane (Type 1) or twist of part of the caecum including a portion of terminal ileum (Type 2). The third mechanism is by an upwards fold or kink in the caecum itself, named a caecal bascule (Figure 6). Despite its rarity, a cadaveric study stated that 36% of specimens examined showed the ability for this kink to occur, underlying the more complex nature of its mechanism and our lack of understanding of the true pathophysiology here.

In stark contrast to sigmoid volvulus, caecal volvulus can be very much insidious in onset with gradual symptoms for months to years. Patients may still present acutely with acute abdominal distension, with nausea and vomiting being a more prominent feature than with sigmoid volvulus. The functionality of the ileocaceal valve is important here as it can allow decompression into the small bowel if incompetent. If competent, a closed loop obstruction is created between the volved caecum and the ileocaecal valve and the patient can deteriorate quickly and is at high risk of caecal perforation.

In contrast to the reliable radiograph for sigmoid volvulus, a caecal volvulus can be missed on a plain abdominal radiograph but would typically show a dilated caecum with the apex of the colon pointing to the left upper quadrant. An abdominal CT scan will be the modality of choice here to confirm clinical suspicion (Figure 7). CT scans, however, are not 100% sensitive and 10% of cases are identified intraoperatively.[9]

Surgical decompression as we have already stated is rarely successful here and an acute surgical approach is usually adopted. Due to the often insidious nature, gangrenous bowel is much more common in caecal volvulus (20–40%) compared to sigmoid volvulus. The primary operative strategy would be a right hemicolectomy or ileocaecectomy for a patient who is fit. With the presence of gangrene and a septic, unstable patient, it is prudent to consider a defunctioning loop ileostomy. In those who are not fit or unstable, reduction of the volvulus and a caecopexy can provide an interim solution until the patient is fit for a definitive procedure. In patients found to have ischaemic or gangrenous bowel at the time of surgery, detorsion of the colon is not recommended due to the resulting septic insult to the patient. In those who are not fit for any definitive resection, caecopexy can be performed in isolation but has a high recurrence rate of up to 30% and a mortality of 10%. Recurrence rates are however much lower (10–20%) than in sigmoid volvulus and so the non-resectional approaches can be a valuable tool in the high-risk patient. The subtype of volvulus (types 1–3) should not govern the operation procedure performed.

Summary

Visceral volvulus encompasses a wide spectrum of pathological processes, across a broad range of patient demographs, with varying clinical outcomes. It is clear from this article that a large degree of overlap in symptoms and signs is present and that clinical acumen with adjunctive imaging is key to the best outcomes in this generally high-risk cohort of patients. Balancing the cautious approaches necessary in the high-risk patient with an easily reduced volvulus against those in urgent need of timely surgery is difficult. There is no single management pathway that could ever be applied here and the primary message should be to assess thoroughly and manage each case on a tailored, individual basis. ◆

REFERENCES

1 Luketich JD, Raja S, Fernando HC, et al. Laparoscopic repair of giant paraesophageal Hernia : 100 consecutive cases. *Ann Surg* 2000; **232:** 608–18.

2 Anton ROGGO. Acute small bowel volvulus in adults. *Ann Surg*, 1992; 135–41. August 1992.

3 Peacock O, Bassett MG, Kuryba A, et al. Thirty-day mortality in patients undergoing laparotomy for small bowel obstruction 2018; **1006–13**.

4 Maddah G, Kazemzadeh GH, Abdollahi A, Bahar MM. Management of sigmoid Volvulus : options and prognosis. *J Coll Physicians Surg Pak* 2014; **24:** 13–7.

5 Larkin JO, Thekiso TB, Waldron R, Barry K, Eustace PW. Recurrent sigmoid volvulus – early resection may obviate later emergency surgery and reduce mor- bidity and mortality 2009; vols. 205–9.

6 Desaint B, Bennis M, Chafai N, Tiret E. Management of acute sigmoid volvulus : short- and long-term results, 2015; 922–8.

7 Frank L, Park R. Use of percutaneous endoscopic colostomy (PEC) to treat sigmoid volvulus : a systematic review, 2016; 737–41.

8 Johansson N, Rosemar A, D EAM. Recurrence risk of sigmoid volvulus – a single center cohort study. *Color Dis* 2018; **20** (20):529–535.

9 Turner JS, Boutros MDM, Chun MDJ, Steele SR. Clinical practice guidelines for colon volvulus. 589–600.

