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Gangrene of Large Bowel due to Volvulus- Etiopathogenesis, Management and Outcome

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1. Introduction

Large bowel volvulus accounts for 10-30% of all large bowel obstruction and occurs most commonly in the sigmoid colon (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989). It is more common in the region of Africa, South America, Middle East and Southern Asia. The most common site of volvulus include sigmoid colon (80%), caecum (15%), transverse colon (3%), splenic flexure (2%) and ileosigmoid knotting (<1%) (Bhatnagar 2004, Oren 2007, Halliday 1993, Majeski 2005, Lord 1996). Delay in presentation and diagnosis increases the risk of gangrene particularly so among the uncommon variety because of its atypical presentation and sometimes quite scarce manifestations (Bhatnagar 2004, Halliday 1993, Majeski 2005, Lord 1996). The outcome depends on intensive and adequate resuscitation with fluids and broad spectrum antibiotics and prompt resection of the gangrenous loop of gut (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Halliday 1993, Majeski 2005, Lord 1996). The mortality rate even though has improved significantly in recent years due to better perioperative management of these patients, continues to remain high when gangrene sets in. The various factors that influence the outcome include general factors like advanced age of the patient, associated comorbid conditions and local factors including perforation, peritonitis and presence of shock (Bhatnagar 2004, Halliday 1993, Majeski 2005, Lord 1996, Halliday KE 1993, Feldman D 2000). This chapter intends to discuss the etiopathogenesis, presentation, investigation and management of both common and uncommon volvulus of the colon with emphasis on those volvulus being complicated with gangrene.

2. Sigmoid volvulus

2.1 Introduction

Sigmoid volvulus is a leading cause of strangulation of large bowel the world over (Bhatnagar 2004, Halliday 1993, Majeski 2005, Lord 1996). It is common in Asia, Africa, Scandinavia, South America, Middle East and Eastern Europe (Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Halliday KE 1993, Feldman D 2000). The incidence of gangrenous volvulus is sketchy in the world literature but the major concern is the high mortality associated with it (17 to 100%) as compared to 3-30% in non gangrenous volvulus (Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989). Anatomic features predisposing to sigmoid volvulus include redundant sigmoid colon that has a narrow mesenteric

attachment. Sigmoid volvulus is seen in elderly patients, often in institutionalized and debilitated patients with neurological and psychiatric conditions such as Parkinson's disease and schizophrenia. The association of sigmoid volvulus with advancing age is more likely due to dysmotility rather than lengthening of the sigmoid colon and its mesentery. Other less common predisposing factors include pregnancy, post operative adhesions, internal herniations, intussusceptions, omphalomesenteric abnormalities, intestinal malrotation, appendicitis and carcinoma. (Bhatnagar 2004, Oren 2007, Pahlman 1989, Halliday KE 1993, Feldman D 2000)

2.2 Presentation

The predominant symptom of gangrenous sigmoid volvulus is abdominal pain and progressive abdominal distension (92 to 95%), constipation (92%), muscle guarding / rigidity (75%) and vomiting in 60% of the cases (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989). A visible sigmoid loop is noted in 42% and rectal examination may reveal blood in the examination finger. The median duration of symptom on admission is 3 days (3.7 ± 2.8 range 1-15) (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989). A previous attack of volvulus is recorded in 23.5% while 72.5% may develop gangrene in the first attack (Bhatnagar 2004). The incidence of preoperative shock did not differ in patients with differing pattern of gangrene but the incidence of shock is significantly higher in patient who died (Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Halliday KE 1993).

2.3 Pattern of gangrene

Gangrene of the colon may be extensive and well defined (figure 1) or at times may be patchy with ill defined limits. The pattern of gangrene can be divided into 3 groups (Bhatnagar 2004): (a) those with gangrene confined to sigmoid colon. In 73% of the cases the gangrene is confined classically to the area of constriction. (b) the gangrenous area may extend beyond the confines of the area under constriction on one or both sides (26% of the cases)(Bhatnagar 2004). More often it extends well down into the rectum lying in the hallow

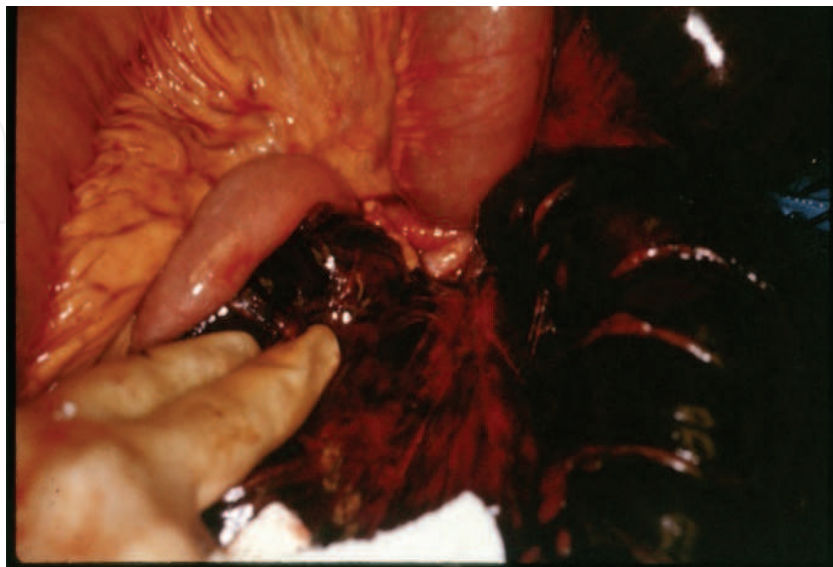


Fig. 1. Gangrenous sigmoid volvulus-Extensive and well defined

of the sacrum(c) those with gangrene of the sigmoid with ileal knotting. In 15%, the gangrenous sigmoid may be involved in knotting with ileum. The gangrene of rectum distal to the twist is uncommon as the main vascular supply to the rectum lies proximally running in the medial limb of the sigmoid mesocolon and hence is generally not involved in the twist. However it could be involved if the vessels take a slightly aberrant lateral course in the mesocolon which is narrowed and hence can become incorporated in the twist. If the gangrene in rectum distal to the twist is not recognized, it can lead to an error in judgment of performing an anastomosis to the gut of questionable viability and with disastrous consequences (Asbun 1992, Bhatnagar 2004)

2.4 Investigations

The diagnosis could be established in approximately 60% of the cases with a plain x-ray abdomen (Bhatnagar 2004, Oren 2007, Pahlman 1989, Halliday KE 1993, Feldman D 2000). The distended sigmoid colon appears as a haustral collection of gas (sometimes referred as "bent inner tube" sign or "coffee bean" sign) that extends from the pelvis to the right upper quadrant as high as the diaphragm(Feldman D 2000). Distended large bowel proximal to the sigmoid colon and air fluid levels in the small bowel are often present (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Ballantyne GH 1982). Presence of air in the bowel wall (pneumatosis intestinalis), free air in peritoneal cavity or in the portal vein would strongly indicate the presence of gangrenous gut. A barium enema with water soluble contrast is contraindicated when gangrene is suspected(Mellor MF 1994). A CT scan would show the typical finding of a whirl sign at the site of the twist caused by dilated sigmoid colon around its mesocolon and vessels and bird beak appearance of the afferent and efferent colonic segment (Catalano O 1996).

2.5 Management

It is of utmost importance to be aware that a gangrenous volvulus is an acute surgical emergency and has to be dealt expeditiously and aggressively to achieve better outcome. The management of sigmoid volvulus involves adequate and prompt fluid resuscitation, decompression of proximal bowel and urgent resection of the gangrenous segment (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Ballantyne GH 1982, Kuzu MA 2002). While in the absence mucosal ischemia it would seem reasonable to attempt detorsion and decompression via sigmoidoscopic placement of soft rectal tube or occasionally barium enema(Mellor MF 1994), the presence of gangrene of colon warrants immediate laparotomy after intensive resuscitation(Bhatnagar 2004, Ballantyne GH 1982, Kuzu MA 2002). In gangrenous sigmoid volvulus, resection and primary anastomosis may be performed with acceptable mortality and morbidity rates provided that the patients is haemodynamically stable and a tension free anastomosis of well vascularised segments of the bowel is feasible. This technique when employed has a reported mortality rate of 16 to 33%(Oren 2007, Pahlman 1989,Bhatnagar 2004, Ballantyne GH 1982, Kuzu MA 2002). On table cleaning of the proximal bowel may be added to perform the primary anastomosis with reasonable safety. When condition for primary anastomosis is not ideal then Hartmann's operation or Mickulicz procedure with resection of gangrenous loop may be life saving particularly in unstable patients with severe fecal peritonitis((Bhatnagar 2004, Kuzu MA 2002). The drawback of adding a stoma however is that it carries the mortality and morbidity risks associated with stoma and that it requires a second operation.

2.6 Outcome

The mortality following surgery in these patients range from 19 to 66% (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Ballantyne GH 1982, Kuzu MA 2002). Experienced surgeons however could perform both primary anastomosis and stoma successfully by laparoscopic approach; the concern however is that of rupture of gangrenous loop while doing so. Exteriorisation of the gangrenous gut is another option although it is difficult to fully exteriorize a gangrenous loop and the associated mortality could be higher (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Ballantyne GH 1982, Kuzu MA 2002). While the overall mortality in nongangrenous sigmoid volvulus is 6 to 24%, in gangrenous SV it ranges from 11 to 80% (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Kuzu MA 2002). The factors that influence the adverse outcome include delay in presentation or diagnosis, advanced age, fecal peritonitis due to perforation of gangrenous loop, previous episodes of volvulus, associated comorbidities including diabetes mellitus, and renal, cardiac and pulmonary insufficiency (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989, Ballantyne GH 1982, Kuzu MA 2002). The most important cause of death however is septicemic shock. The morbidity rate is approximately 6 to 26% and includes wound infection, intra-abdominal abscess, evisceration, anastomotic leakage, stomal complications, intestinal obstruction, respiratory complications and DVT (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989). The mean hospitalization period ranges from 8 to 13 days (Bhatnagar 2004). Since gangrenous SV invariably requires resection of sigmoid colon, recurrence of volvulus is unlikely (Asbun 1992, Bagarani 1993, Bhatnagar 2004, Oren 2007, Pahlman 1989).

2.7 Summary

Gangrenous sigmoid volvulus invariably occurs due to delay in presentation or diagnosis. The occurrence of gangrene beyond the confines of twist is likely and awareness of this is necessary to avoid insecure anastomosis. The management includes aggressive resuscitation followed by resection of the gangrenous loop with primary anastomosis or stoma. The mortality is significantly higher than in patients with nongangrenous sigmoid volvulus. Various factors that would influence the outcome adversely is older age group, associated comorbidities, presence of shock at admission, fecal peritonitis and previous episode of volvulus.

3. Cecal volvulus

3.1 Introduction

Cecal volvulus (CV) is an axial twist of the cecum ascending colon and terminal ileum around a mesenteric pedicle. CV is relatively uncommon with an incidence of 2.8 to 7.1 per million people per year (Tejler G 1988). Cecal volvulus occurs in patients who have increased cecal motility as a result of anomalous fixation of the right colon. Acquired anatomical abnormalities such as surgical adhesions can also contribute. Other conditions that have been associated with cecal volvulus include pregnancy, congenital malformations, colonoscopy, Hirschprung's disease and mobile cecal syndrome (Tejler G 1988, Bystrom J 1972, Madiba TE 2002). The majority of the patients with cecal volvulus have full axial rotation causing twisting of the mesentery and blood vessels (Majeski J 2005, Tejler G 1988, Bystrom J 1972). In approximately 10% of cases the cecum and ascending colon fold in the anterior cephalad direction (known as cecal bascule) (Tejler G 1988, Bystrom J 1972).

Although cecal bascule does not cause torsion of the mesentery and blood vessels it can lead to intestinal gangrene due to distension and bowel wall ischemia (Tejler G 1988, Bystrom J 1972).

3.2 Presentation

The majority of patients with cecal volvulus have similar presentation to those with small bowel obstruction (Majeski J 2005, Tejler G 1988, Bystrom J 1972, Madiba TE 2002). The major symptoms are abdominal pain, nausea, vomiting and obstipation. The pain is usually steady with superimposed colicky component associated with peristalsis. The abdomen is often diffusely distended representing the dilated right colon and small bowel. Fever, peritonitis or hypotension may indicate the presence of intestinal gangrene (Majeski J 2005, Tejler G 1988, Bystrom J 1972, Madiba TE 2002).

3.3 Investigations

The diagnosis can be established by a barium or water soluble contrast enema or CT scan (Majeski J 2005, Tejler G 1988, Bystrom J 1972, Madiba TE 2002). On plain radiography the cecum appears as a kidney shaped mass extending into the left upper quadrant. Distended loop of small bowel are common. The abdominal plain film is suggestive of diagnosis in 46% but diagnostic only in 17% of the cases (Majeski J 2005, Tejler G 1988, Bystrom J 1972). While barium study is diagnostic in 88% of the cases it is contraindicated when diagnosis is not clear or gangrene is suspected (Tejler G 1988, Bystrom J 1972). CT scan has become the preferred radiological test for establishing the diagnosis of cecal volvulus and in recognizing its variant. It can also show the signs of strangulation and or perforation (Tejler G 1988, Bystrom J 1972).

3.4 Management

While the goal of nongangrenous cecal volvulus is to prevent the development of gangrene and address the anatomic abnormality, in gangrenous volvulus the need of the hour is resection of gangrenous loop immediately after adequate resuscitation (Majeski J 2005, Tejler G 1988, Bystrom J 1972, Madiba TE 2002). While several techniques may be used in dealing with nongangrenous cecal volvulus including cecopexy and cecostomy, in the presence of gangrene the surgical approach warrants resection of gangrenous gut and primary anastomosis (Madiba TE 2002). Colopexy of the remainder right colon would be required as in most instances the right colon is mobile due to failure of fusion of the cecum and ascending colon to posterior pericolic peritoneum (Madiba TE 2002). The tinea of remainder of the right colon holds sutures very well because this segment of the colon is not involved in cecal volvulus. The remainder of the distal colon must always be carefully examined intra-operatively for colonic obstruction. A proximal ileocolic anastomosis in the presence of a distal obstruction may lead to a lethal postoperative outcome (Majeski J 2005, Madiba TE 2002).

3.5 Outcome

The outcome of resection of gangrenous cecal volvulus depends on the overall fitness of the patient including the age and associated comorbid conditions. The overall mortality in gangrenous cecal volvulus range from 23 to 48% (Majeski J 2005, Tejler G 1988, Bystrom J 1972, Madiba TE 2002). The presence of preoperative shock and fecal peritonitis have adverse outcome.

4. Splenic flexure volvulus

4.1 Introduction

The splenic flexure volvulus is rare with an incidence of less than 2% of all colonic volvulus with approximately 32 cases being reported in the literature so far (Ballantyne GH 1985). The rarity of the splenic flexure volvulus is due to the fact that this part of large bowel has limited mobility due to its attachment to phrenocolic, gastrocolic and splenocolic ligament and intraperitoneal position of the descending colon (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006). For splenic flexure volvulus to occur some or all of these anatomical factors should be congenitally absent or altered by surgery thus rendering the flexure unusually mobile. The splenic flexure volvulus has also been reported with other congenital anomalies including wandering spleen causing volvulus of the splenic flexure; this causes partial obstruction of the large intestine by the splenic pedicle (Ballantyne GH 1985, Mittal R 2007). Congenital bands and acquired adhesions due to previous surgeries could be other etiological factors (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006).

4.2 Presentation

Though there are reported cases of splenic flexure volvulus in children (Osuka A 2006) the median age of these patients is 53 years with a female preponderance (Ballantyne GH 1985, Mittal R 2007). The usual presentation of these patients is non acute and nonspecific and include recurrent episodes of abdominal pain, distension and vomiting and is usually not suspected because of the rarity of this condition. Acute presentation with features of gangrene is rare (figure 2) and such patients could present with severe tenderness, guarding, rigidity and shock invariably due to delay in presentation or diagnosis (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006).

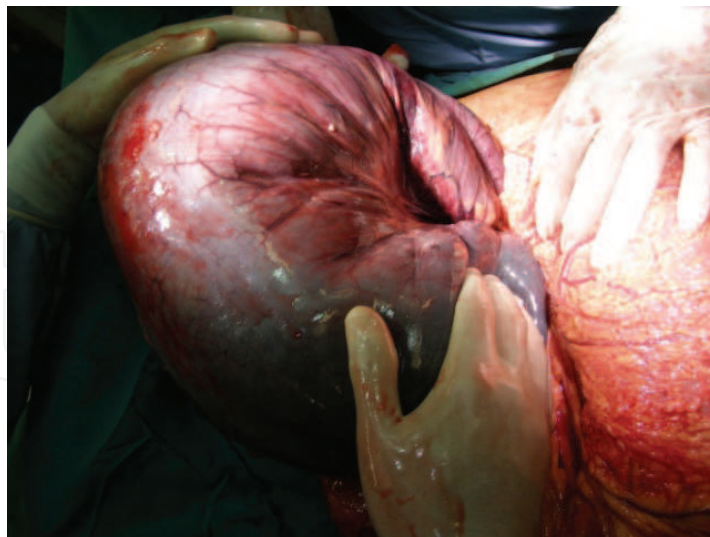


Fig. 2. Splenic flexure volvulus- grossly distended gangrenous loop

4.3 Investigations

Diagnosis of this rare condition is facilitated by radiological investigation including plain X-ray abdomen and CT scan (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006). The characteristic findings include the following: 1) two widely separated air fluid levels one in

the distended splenic flexure and the other in the cecum (figure 3); 2) markedly dilated air filled colon with abrupt termination at the anatomic splenic flexure; 3) an empty descending and sigmoid colon; 4) a characteristic beak at the anatomic splenic flexure on barium enema examination if performed; 5) a coffee bean appearance of the dilated splenic flexure is seen

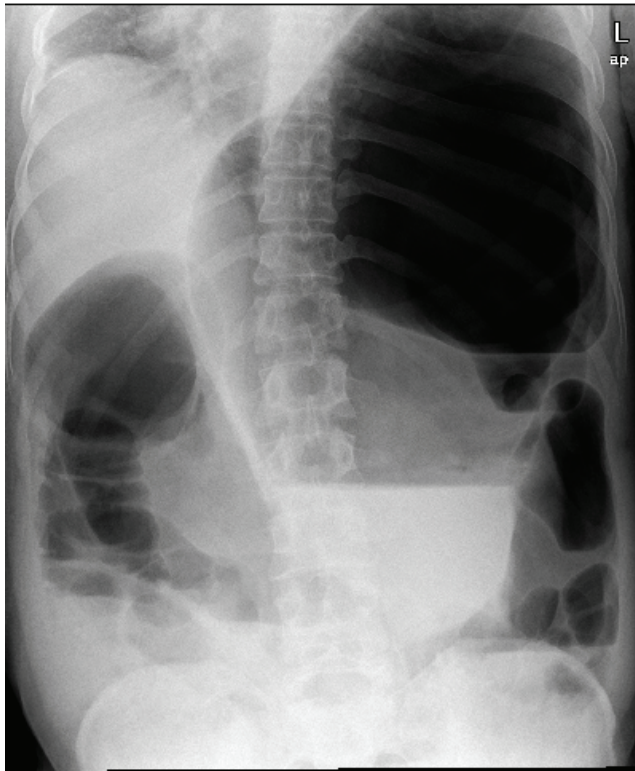


Fig. 3. Plain x-ray showing two widely separated air fluid levels in splenic flexure and cecum



Fig. 4. CT scout film revealing dilated splenic flexure loop with concavity facing upwards and laterally

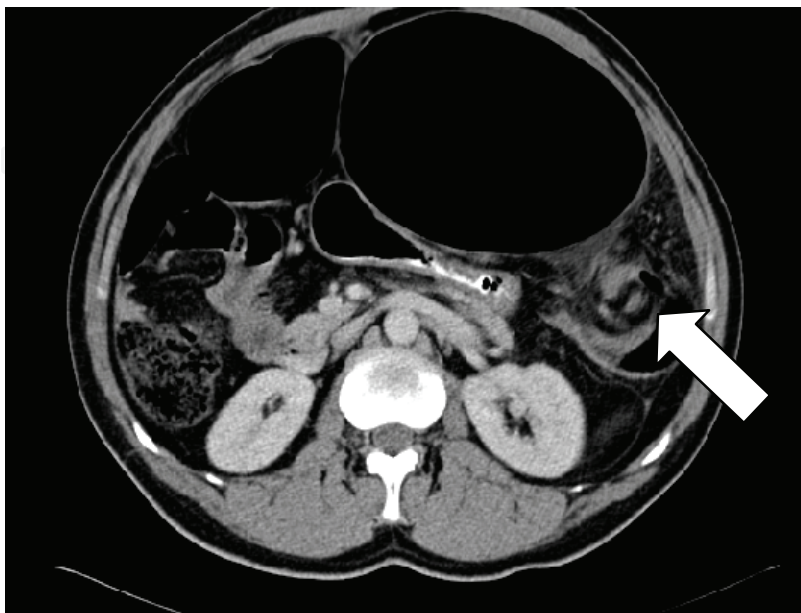


Fig. 5. CT image showing dilated splenic flexure with whirl sign (arrow)

and in splenic flexure volvulus unlike sigmoid volvulus the concavity of the bean is facing upwards and laterally (figure4). The CT scan will reveal dilated splenic flexure with a characteristic whirl sign at the site of the twist of the mesentery⁶ (figure 5). The presence of gangrene is suspected when there is air in the wall of the bowel (pneumatosis intestinalis), air in portal vein or in the presence of peritonitis⁶.

4.4 Management

Like in the case of sigmoid volvulus the immediate priority is aggressive resuscitation with IV fluids and appropriate antibiotics to optimize the patient for an urgent surgery (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006). The broad principle of management would include resection and primary anastomosis or creation of stoma. A primary anastomosis is avoided in the presence of perforation and peritoneal soiling, preoperative shock and in the presence of dilated edematous loops of gut to be anastomosed (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006).

4.5 Outcome

The overall mortality ranges from 16 to 33% and depends significantly in delay in diagnosis, presence of shock, fecal peritonitis and associated comorbidities (Ballantyne GH 1985, Mittal R 2007, Osuka A 2006).

4.6 Summary

Splenic flexure volvulus is a rare cause of intestinal obstruction. Gangrene is usually associated with the acute form of presentation. Rarity of the condition and protean manifestation may lead to delay in the diagnosis. Radiological investigations could however guide to a prompt surgical treatment after adequate resuscitation. Resection and primary anastomosis is often feasible failing which the patient may require resection with colostomy. As the manifestation of transverse colon volvulus is to a large extent similar to splenic flexure volvulus it would not be further discussed.

5. Ileosigmoid knotting

5.1 Introduction

Ileosigmoid knotting is a rare cause of intestinal obstruction that rapidly progresses to gangrene of ileum as well as the sigmoid colon (Shepherd JJ 1967, Puthu D 1991, Alver O 1993). Preoperative diagnosis is difficult because of its infrequency and atypical radiographic findings (Shepherd JJ 1967). It is essential to differentiate it from sigmoid volvulus because endoscopic reduction is a contraindication in ISK (Raveenthiran V 2001). In recent years CT has been useful in making a preoperative diagnosis (Raveenthiran V 2001). Generalized peritonitis and sepsis are the main cause of poor outcome (Shepherd JJ 1967, Puthu D 1991, Alver O 1993). After hemodynamic stabilization, immediate surgical intervention is need of the hour. Three factors are responsible for ileosigmoid knotting (Shepherd JJ 1967): 1) a long small bowel mesentery and freely mobile small bowel 2) a long sigmoid colon on a narrow pedicle and 3) ingestion of high bulk diet in the presence of empty small bowel as would happen during the fasting month of Ramadan among Muslims. When a semi liquid bulk meal progresses into the proximal jejunum it increases the mobility of the intestine and the heavier segments of the proximal jejunum fall into the left lower quadrant (Shepherd JJ 1967). The empty loop of ileum

and distal jejunum twist in a clockwise rotation around the base of the narrow sigmoid colon. Further peristalsis form an ileosigmoid knot with 2 closed loop obstruction; one in the small bowel and the other in the sigmoid colon. Ileo sigmoid knotting is categorized into 3 types (Shepherd JJ 1967). In type 1, the ileum (active component) wraps itself around the sigmoid colon (passive component) in a clockwise or anticlockwise direction. In type 2 the sigmoid colon (active component) wraps itself around a loop of ileum (passive component) in a clockwise or anticlockwise direction and in type3 the ileocecal segment (active component) wraps itself around the sigmoid colon (passive component)

5.2 Presentation

Ileosigmoid knot rapidly progresses to gangrene of ileum as well as the sigmoid colon. (Figure 6). Generalized peritonitis ,sepsis and dehydration are the principal complications (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). The predominant symptom and signs of presentation include abdominal pain and tenderness (100%), abdominal distension (94 to 100%), nausea and vomiting (87 to 100%), rebound tenderness (69%) and shock (0 to 60%)(Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). Despite the critical condition the preoperative diagnosis is not easy. The diagnostic difficulty is partly caused by the unfamiliarity of this rare entity and the confusing and self contradicting feature of the disease. While the clinical feature of vomiting suggests small bowel obstruction the radiographic findings are that of colonic distension which is uncommon in small bowel obstruction. In 73 to 79.5% of cases the bowel is gangrenous (Shepherd JJ 1967,Puthu D 1991, Alver O 1993, Raveenthiran V 2001). Both sigmoid colon and small bowel are involved in 52 to 60% of the cases. Paradoxically the incidence of bowel gangrene was 90% in those who presented early within 24 hours of their symptoms, presumably reflecting the fulminating clinical deterioration of patients due to early and extensive infarction of the bowel involved in a tight knot(Horgan PG 1992). In patients who present after 24 hours of the initial symptoms the bowel gangrene was noted in 57% of the cases.(Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001).

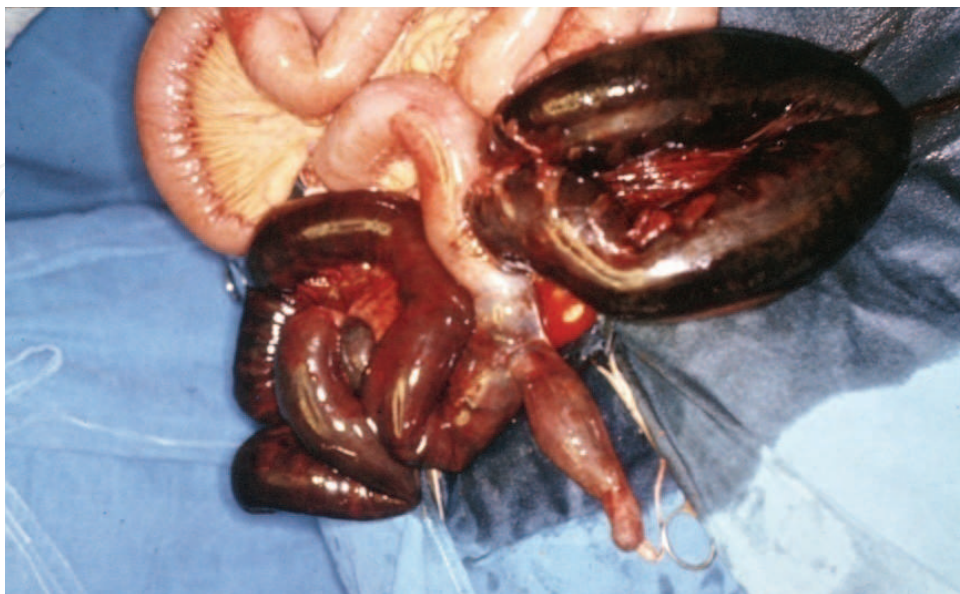


Fig. 6. Ileosigmoid knot- Gangrenous ileum and sigmoid colon seen along with the Meckel's diverticulum

5.3 Investigations

The diagnosis could be achieved following radiological investigations. The plain X-ray findings include a double loop of dilated sigmoid colon and multiple air fluid levels in the small intestine (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). The CT scan findings suggestive of Ileo sigmoid knot include the whirl sign created by the twisted intestine and sigmoid mesocolon in the ileosigmoid knot, medial deviation of cecum and ascending colon (Alver O 1993, Raveenthiran V 2001).

5.4 Management

The initial management would involve aggressive resuscitation with fluid, appropriate antibiotics and correction of acid base imbalance if any (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). After hemodynamic stabilization, laparotomy is performed without any delay. The outcome would depend significantly in early and adequate resuscitation and prompt resection of the gangrenous loop. Various surgical procedures have been employed in these patients. The initial attempt to untie the knot may be feasible when both sigmoid and ileum are viable or sigmoid colon alone is viable (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). When both sigmoid and ileum are gangrenous there is difficulty in untying the knot with the potential risk of rupture of the gangrenous loop in doing so leading to peritoneal spillage of the toxic bowel contents (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001). Intestinal clamps hence should be applied before dissection or resection of the knot and the loops.

Primary anastomosis of the small bowel loop after resection is preferable (Raveenthiran V 2001). When the terminal ileum is gangrenous within 10 cms of the ileocecal valve an end to end anastomosis is avoided (Raveenthiran V 2001). The distal stump is then closed and end to side ileocecostomy is performed. Resection of the sigmoid colon is often advised even when it is viable to prevent recurrent volvulus and recurrent knotting (Alver O 1993, Raveenthiran V 2001). Primary anastomosis following colonic resection could be carried out safely particularly when the history is short and the remaining bowel is clean, well vascularised and undistended and a tension free anastomosis is feasible. In the absence of an ideal situation and significant preoperative shock or peritoneal contamination a Hartmann procedure or covering colostomy may be advocated to avoid the risk of fecal leak from colonic anastomosis (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001).

5.5 Outcome

The operative mortality from ileo sigmoid knot varies from 0 to 48% (mean 35.5%). The mortality figures are generally related to duration of the symptom, preoperative shock, the presence or absence of gangrene and the general status of the patient (Shepherd JJ 1967, Puthu D 1991, Alver O 1993, Raveenthiran V 2001).

5.6 Summary

Ileo sigmoid knot is a rare cause of intestinal obstruction. Unfamiliarity and diagnostic difficulties have contributed to the mortality and morbidity of this condition in the past. Better understanding of the problem and increased possibility of preoperative diagnosis following CT scan have facilitated early diagnosis and intervention. Aggressive fluid resuscitation, preoperative antibiotics, prompt laparotomy and effective surgery including

resection of gangrenous loop and primary anastomosis and better perioperative care of the shocked patient have optimized the survival of these patients

6. General considerations in management of ischemic gut

While an obviously gangrenous bowel is easy to detect, operative evaluation to determine the viability of borderline ischemia may not be precise (Horgan PG 1992). The use of intraoperative doppler examination and use of intravenous administration of fluorescein with visual examination using ultraviolet light are standard methods to determine bowel viability (Horgan PG 1992). These intraoperative tests are not absolutely accurate. Moreover both tests require detorsion of the bowel and reperfusion of the bowel. Reperfusion of ischemic or gangrenous bowel can produce metabolic acidosis, intestinal bacterial and toxin translocation and possible irreversible septic shock (Patel A 1992, Zimmerman BJ 1992). Reperfusion of ischemic intestine results in extensive microvascular and parenchymal cell injury by release of proteases and physical disruption of the endothelial barrier resulting in eventual cell death (Zimmerman BJ 1992). To avoid reperfusion of the ischemic volvulus and reperfusion injury the gangrenous bowel loop should be resected without detorsion (Alver O 1993, Raveenthiran V 2001)

7. Summary

Gangrene is a potential complication of colonic volvulus. It is of utmost importance that a clinician avoids this complication in a patient with a colonic volvulus by an early diagnosis, adequate resuscitation and prompt surgical intervention. Once gangrene has set in the outcome is adversely effected. The surgical intervention would involve resection with primary anastomosis or creation of stoma. Primary anastomosis is generally avoided in the presence of shock, significant peritonitis, and inability to create anastomosis between two well vascularised loops in a tension free manner. The factors that seriously affect the outcome include general factors including advanced age and associated comorbid conditions and local factors including fecal peritonitis and shock

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Gangrene is the term used to describe the necrosis or death of soft tissue due to obstructed circulation, usually followed by decomposition and putrefaction, a serious, potentially fatal complication. The presented book discusses different aspects of this condition, such as etiology, predisposing factors, demography, pathologic anatomy and mechanisms of development, molecular biology, immunology, microbiology and more. A variety of management strategies, including pharmacological treatment options, surgical and non-surgical solutions and auxiliary methods, are also extensively discussed in the book's chapters. The purpose of the book is not only to provide a reader with an updated information on the discussed problem, but also to give an opportunity for expert opinions exchange and experience sharing. The book contains a collection of 13 articles, contributed by experts, who have conducted a research in the selected area, and also possesses a vast experience in practical management of gangrene and necrosis of different locations.

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