Bowel Obstruction

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Objectives

Presumed background knowledge

- Able to describe the gross anatomy of the abdominal wall and intrabdominal viscera.

- Able to describe the motility, absorptive and secretory functions of the small and large bowel.

- Able to describe the gross and microscopic appearance of [a] adenocarcinoma of the colon [b]Crohns disease of the small bowel.

Knowledge to be acquired

- Able to classify causes of bowel obstruction under the subheadings of "acute onset" and " gradual onset"

- Define the terms incarceration and strangulation

- Have a knowledge of the usual history of these conditions; take a history from the patient, using direct questions where appropriate. The questions should reflect an awareness of other possible diagnoses.

- Examine a patient with a possible bowel obstruction, identifying the signs volume depletion when present. Examine the abdomen with a focus which reflects knowledge of the possible causes of the bowel obstruction, the complications of obstruction, and the alternative diagnoses.

- Be able to write orders for the management of a patient with recent onset obstruction.

- Describe, in general terms, how you would approach apatient with the following problems.[include a basic description of the operation or procedure] Use proper names for the operative procedure eg. "Right Hemicolectomy" not "take out the right colon.

a. complete sbo due to adhesions
b. complete sbo due to incarcerated groin hernia.
c. advanced Crohns stricture of the ileum, with malnutrition and anemia.
d. a sigmoid volvulus, with marked abdominal distention, pain, and repiratory distress.
e. complete rectosigmoid obstruction by a carcinoma

Introduction – Bowel Obstruction

This presentation is confined to the topic of intestinal obstruction in adults. It reviews the etiology and management of obstruction arising between the duodenal-jejunal flexure (ligament of Trietz) and the rectum. Obstructions in the duodenum or more proximal are not addressed.

From the standpoint of etiology and management strategies small bowel obstruction and large bowel obstruction require quite distinctive and separate approaches in most instances. It is therefore useful to distinguish if the obstruction is in the small bowel or large bowel when approaching a patient who appears on clinical grounds to possibly have a bowel obstruction.

Background Information – Bowel Obstruction

I. Introduction to Small and Large Bowel Obstruction

Small bowel obstruction (SBO) is more common than obstruction in the large bowel largely because of the great frequency of obstruction caused by postoperative adhesions and external hernias. The latter are rarely a cause of obstruction in the large bowel. Most reviews would indicate SBO makes up about 80% of the cases of intestinal obstruction between the ligament of Trietz and the rectum. The most common cause of SBO in the industrialized world is post operative adhesions. All patients undergoing open abdominal surgery will develop some degree of an adhesive process early in the post operative period. The extensiveness of this process is related to the degree of peritoneal contamination, extent of dissection and other factors. Peritoneal adhesions develop quickly following surgery and become very intense in the following few weeks. Gradually over a period of 2 to 3 months the process softens and reverses to some extent as the adhesions are remodeled.

SBO is a challenging clinical problem. Herniation and strangulation of intestine is often involved in the obstructive process. Strangulation is usually the result of either internal hernia through a defect in the peritoneal cavity or external herniation through one of many common sites. External herniation with incarceration of viscera is usually readily identified. Internal herniation, however, is much less easily detected. Delay in interventions with eventual infarction of the involved bowel necessitating resection forms the basis for most mortalities related to SBO. If an operative intervention with SBO occurs early enough to avoid resection, morality rates are less than 5%.

Large bowel obstruction (LBO) is less common than SBO. Adhesive bands and external hernias rarely capture the colon. The colon, in a significant portion of its course is retroperitoneal and therefore seldom accessible to external hernia or any internal orifice created by adhesive bands. The transverse colon is suspended by a mesentery fused to the greater curve of the stomach by the gastrocolic omentum and is not likely to be captured by adhesive bands. Rarely, the sigmoid colon or transverse colon maybe caught in an inguinal or umbilical hernia.

Mortality due to LBO is often related to intra-abdominal and wound sepsis. Carcinoma of the colon is the commonest cause of LBO and the lesions causing this usually arise in the sigmoid or rectosigmoid area. In this area of the colon tumors are sclerotic and stricturing. The increased consistency of the fecal stream and the narrower lumen makes this site the most common point for colonic obstruction.

Although strangulation is a great risk in complete SBO, it is seldom a feature of colonic obstruction except for rare cases of cecal and sigmoidal volvulus.

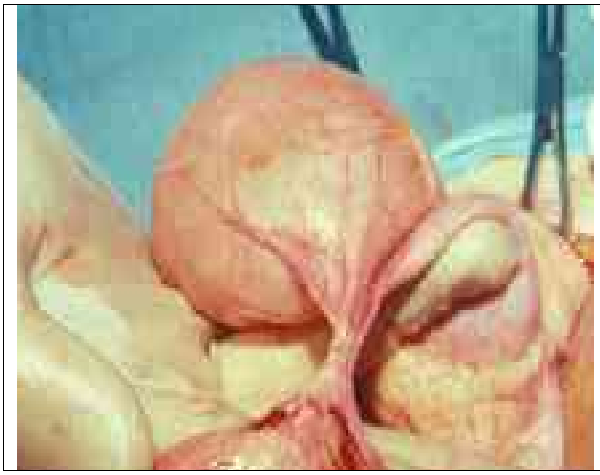
Fluid and electrolyte disorder with sequestration of significant components of the extracellular fluid is not usually a feature of LBO. Gaseous distention of the colon with marked colonic distention and risk of cecal rupture is the usual clinical concern . Septic complications may follow operative interventions with attempts at anastomosis, stoma formation or occasionally the preoperative occurrence of colonic rupture due to distention.
In contrast to the surgical approach to the small bowel it is seldom acceptable to resect obstructing lesions or segments which have undergone volvulus and do a primary anastomosis. This is particularly true when the lesion is encountered in the left side of the colon. Many patients who develop LBO are elderly and suffer from comorbid illness. Surgical approaches that feature a staged approach may have a better outcome.

II. Acute onset SBO

Adhesive Bands

An acute onset SBO is one of the most common reasons for emergency admissions for abdominal pain. Many of these obstructions are of sudden onset and most are on the basis of previous operative interventions and residual adhesive bands. Adhesive bands that are in the lower abdomen, in the infracolic compartment, and are solitary pose the greatest risk for SBO. Passages between loops of bowel or a loop of bowel and the omentum form sites for potential internal hernias. Obstruction

usually occurs suddenly due to the internal herniation of a loop of intestine under an adhesive band.

	Adhesions between peritoneal surfaces begin to evolve in the first few days after laparotomy. Initially they tend to be diffuse and denser close to the operative field. Over the next 2 to 3 months many adhesions soften and even disappear, however dense areas may persist and sometimes develop into an isolated cord-like structure. At laparotomy this band was found incidentally which would allow for an internal hernia to occur. This is the usually mechanism for an acute onset SBO.

Individuals, after a major laparotomy in the lower abdomen, may carry a 10% risk through the balance of their lifetime for an episode of SBO. In some patients these obstructions are multiple, occur at frequent intervals, are usually incomplete and often resolve on conservative measures. In some, however, the obstruction is immediately complete and often associated with strangulation. The distinction of the two above problems is a great challenge.

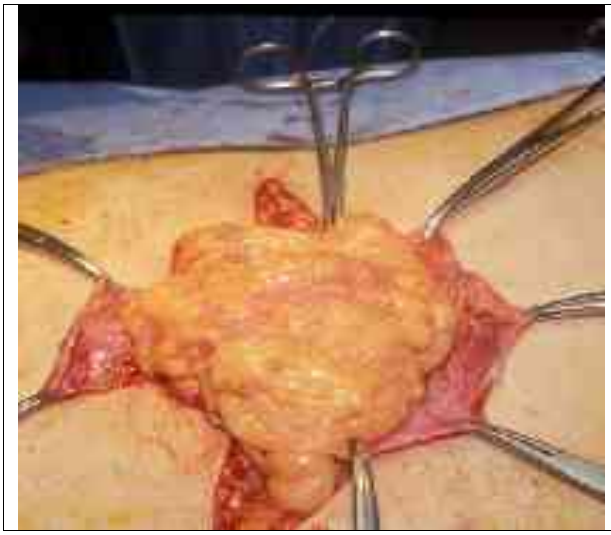
	
An isolated, dense adhesion has trapped a loop of small intestine causing a sudden onset of a complete SBO. Strangulation is in its very early stages but would evolve.	A dense band compresses the mesentery of an internally herniated loop of small bowel. This has caused strangulation of the bowel and infarction of even the adjacent mesenteric tissues.

External Hernias

An external hernia causing acute SBO often provides a great opportunity for a prompt diagnosis of a complete obstruction, strangulation and an early operative intervention. Unlike internal herniation due to adhesions in the abdomen, the external hernia is usually quite evident on the physical examination. Sometimes an incarcerated external hernia maybe quite small and careful examination of the umbilical, femoral or inguinal areas are required to detect it. This is especially true in obese individuals.

In this patient with a history of recent onset of abdominal cramps and vomiting, a tender mass appeared in the right groin area. On examination the mass is very tense, wide based and fixated. On gentle pressure there is no indication that it will reduce. It can be demonstrated that the mass in fact below and lateral to the right pubic tubercle suggesting that this is in fact an incarcerated right femoral hernia.

If a hernia is trapped in an orifice and cannot be easily reduced into the abdominal cavity on recumbency and analgesia then it is **incarcerated**. Most incarcerated hernias involving the intestinal tract contain the small intestine and in most instances a degree of strangulation is involved. The strangulation will begin to evolve and pursue an unpredictable course to infarction. It is rare for a loop of intestine to be incarcerated in an external hernia and not exhibit some degree of ischemia. This would be particularly true when the incarceration is of recent onset.



In this incarcerated hernia, which was operated on electively, there was a mass of tissue, which was tender and caused periumbilical pain. It could not be reduced but had been present for a lengthy period of time. When a hernia is incarcerated and cannot be reduced and there are no symptoms or indications of bowel obstruction, the incarcerated tissue is usually greater omentum.
The sac has been opened and viable omentum is caught in the hernia effectively plugging the opening and preventing access to the sac by any of the hollow viscera. Because of the cosmetic issues and localized pain,repair of this incarcerated umbilical hernia was indicated.

Inguinal hernias are probably the most common external hernia to trap intestine. This is partly because inguinal hernias are the most common hernia, by some margin. Umbilical hernias are probably second in frequency as a site of incarceration and femoral hernias the least common site. The femoral orifice features rigid margins such as the lacunar ligament, Cooper's ligament and the inguinal ligament. Incarceration here is commonly associated with strangulation.

Obturation by food, stones, foreign objects, etc.

Obstruction of the bowel lumen by a swallowed object, food material or a gallstone should be suspected in patients with acute SBO and no history previous of abdominal surgery or identifiable external hernias. In these patients there is almost never strangulation since the process involves a simple internal plugging of the bowel lumen.

When an acute onset SBO develops and there is no history of pervious surgery or external hernia unusual causes of SBO should be expected. Obturation by swallowed or other foreign bodies such as gallstones are one of the diagnosis that should be considered under these circumstances. In this patient there was an idiopathic stricture of the small intestine which was previously asymptomatic. Unfortunately the patient ingested a large amount of vegetable matter with high roughage content, which was poorly masticated and digested. This food bolus was held up at the previous stricture point causing complete SBO.

Occasionally these obstructions may resolve if the obstructing material is digestible. In many instances there is such a considerable mass of fibrous vegetable matter or the object is inorganic and too large to pass through the distal small bowel. Many of these obstructions occur in the distal ileum where the caliber of the small bowel narrows.

This mentally handicapped individual unfortunately swallowed a small rubber ball; know popularly as a "squeeze ball". He was not seen doing this and his abdominal pain and repeated vomiting was ascribed to other causes. Eventually he aspirated and developed pneumonia and renal failure. Even though operation was performed and the impacted ball removed, the patient subsequently succumbed to the aspiration pneumonia.
Aspiration pneumonia is a constant hazard in patients with bowel obstruction and they are particularly vulnerable during the perioperative period.

In elderly patients, who are known to have gallstone disease, a stone obstructing the intestine should be considered. The finding of air in the biliary tree on plain abdominal films or the demonstration of an opaque gallstone usually in the right iliac fossa near the terminal ileum usually gives the diagnosis.

Obstruction of the small intestine due to swallowed food material is more likely to occur in the elderly, the edentulous and patients with previous gastric surgery. In this elderly man, who was edentulous, complete bowel obstruction evolved for which there was no apparent cause. It would not resolve and at operation a mass off impacted food material was found in the mid small intestine. This could not be dislodged and the bowel was opened as seen in the lower picture. The obstruction was to due to the swallowing of an intact shitake mushroom.
Foreign bodies in the intestine should be dislodged form the site of impaction and moved, if possible, more proximally, where the intestine is more resilient with higher circulation, allowing for safer enterotomy.

Small Bowel Volvulus

A volvulus occurs in the small bowel when the mesentery is long and attenuated. It is actually a rare and uncommon cause of SBO in adults. Strangulation usually evolves very quickly and the bowel will be irreversibly infarcted soon after onset. Large sections of the intestine may be lost in the process.

This patient was receiving tube feedings for the greater portion of his life. Long and attenuated mesenteries had evolved since the intestine was chronically filled with liquid food supplements. Eventually a volvulus occurred involving almost 1/3 of the small intestine. The intestine was strangulated and the patient presented in shock with an acute abdomen.
Premorbid factors are usually essential for a volvulus to occur, these include narrow mesenteric attachments with long, attenuated mesenteries, which gives the bowel unusual mobility.

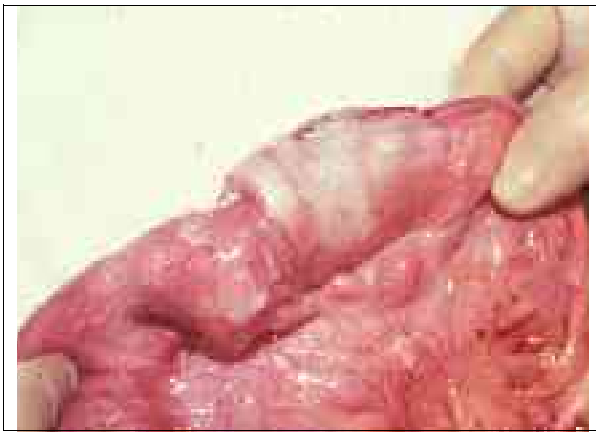
Clinical features are those of a sudden onset of complete SBO, with rapid progression and evidence of hypovolemia and toxemia. Tenderness and even an abdominal mass maybe evident. X-rays of the abdomen demonstrate evidence of a complete SBO. CT scanning, if done, may demonstrate the thickened wall of the twisted intestinal segment.

Intussusception of the Small Bowel

An intussusception describes the invagination of one gastrointestinal tract segment into its adjacent segment. Intussusception occurs idiopathically in small children, usually in males close to the 18 to 24 months age range. When intussusception occurs in adults there is usually a provoking cause such as an intestinal polyp or tumor.

In this patient who had AIDS and was known to have a lymphoma, an acute SBO evolved. Ultrasound examination revealed a characteristic double walled structure suggestive of intussusception. This was indeed found during operation. Strangulation can occur during intussusception due to the dragging of the mesentery into the distal bowel

The outer layer of an intussusception is described as the **intussuscipiens** and the bowel to which it is passing in to it is described as the **intussusceptum**. Often the intussuscepting intestine with its accompanying mesentery becomes ischemic and will eventually infarct if it is not reduced. An intussusception can occur in adults at almost any level of the intestinal tract and in some instances it can be occurring at multiple levels simultaneously.



In this unusual case the patient had had a laparotomy and surgery for an in injury to the liver due to blunt trauma. A bowel obstruction evolved postoperatively that was thought to be due to adhesions. It became complete requiring re-operation at which time intussusception was found. It is rare for an adult to develop intussusception without a precipitating tumor or other reason. The intussusception was difficult to reduce due to thickening and scarring of the adjacent bowel. A short resection was required.

A tumor of the small bowel that has a polypoid structure and grows into the lumen of the bowel is most likely to cause intussusception. Carcinoid tumors because of their inflammatory reaction and stiffening of the surrounding bowel will seldom cause an intussusception. Adenomatous polyps however, whether benign or malignant, will readily cause intussusception. Metastatic melanoma and metastatic cancer from undifferentiated lung lesions may also provoke intussusceptions.

Unlike children, a underlying intestinal polyp or tumor almost always provokes intussusception in adults. In the patient with AIDS, shown above, the provoking factor was a localized lymphoma in the small bowel that acted as the head of the intussusception. In this case strangulation did not occur. Although the patient was receiving chemotherapy, this segment of small bowel was resected to avoid early recurrence of the intussusception.

III. Gradual Onset SBO

Crohn's disease

Patients with gradual onset SBO are usually encountered in a different setting than the recent onset obstruction patient. Often they give histories, going back for weeks or months and present in ambulatory care areas. There is often an opportunity for considerable investigation in order to sort out the diagnoses.

The most common cause of gradual onset obstruction of the small bowel is Crohn's disease. Although multiple levels of the intestinal tract may be involved, its propensity for involvement of the terminal ileum usually leads to obstructive symptoms at this level. Symptoms of gradual SBO are very slow and progressive resulting in gradual weight loss, intermittent episodes of crampy abdominal pain, occasional vomiting and episodes of diarrhea. When the disease involves the terminal ileum an inflammatory mass may be palpable in right iliac fossa.

Crohn's disease is the commonest cause of gradual onset SBO. It would be suspected in a young patient with a long history of weight loss, abdominal cramps, intermittent diarrhea, occasional distention and vomiting. In this patient a laparotomy revealed a dense strictured area near the terminal ileum. Fat and inflammatory changes can be seen under the serosa. The bowel is rubbery and firm, much like a garden hose. In the upper right corner of the picture, normal proximal small intestine is evident.

The stricturing lesion of Crohn's disease seldom ever progresses to completion and most episodes of high-grade obstruction can be managed conservatively at least for a short period of time.

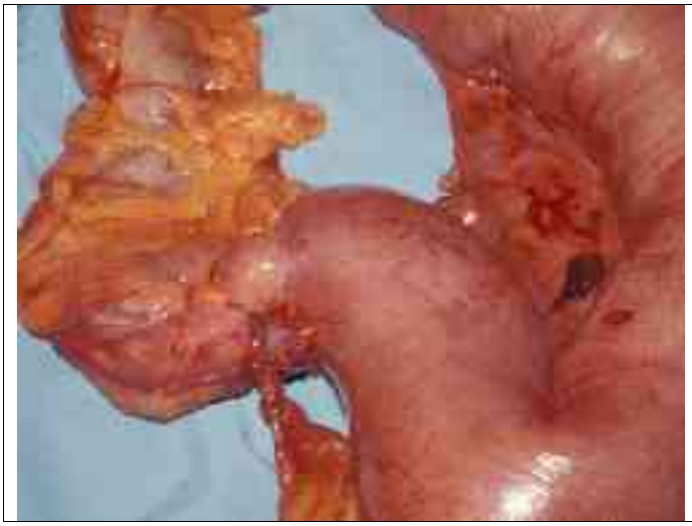
Crohn's disease almost never causes a complete SBO and although the lumen may be severely strictured there is always a passage. Conservative measures with intravenous therapy and occasionally nasogastric decompression will usually result in resolution of Crohn's obstructions. Impaction with food material and even medications may occasionally provoke complete obstruction that resolves on conservative management.

Frequently, contrast studies, small bowel follow through, will show a narrowed segment in the ileum (*"string sign"*). Occasionally skip lesions may be seen with obstruction at a variety of levels.

Neoplasms of the Small Bowel

Tumors are increasing as an explanation for gradual onset SBO.

Primary tumors of the small bowel causing obstruction are quite rare. However, metastatic cancer in the peritoneal cavity spreading from lesions in other levels of the intestinal tract or from the ovaries is commonly encountered.



In the older patient group, slowly evolving small bowel obstruction suggests the possibility of a neoplastic etiology. Primary neoplasms of the small bowel are quite rare. Metastatic neoplasm to the small bowel; hematogenously are also rare. Secondary spread of neoplasm in the peritoneal cavity is common however. In this picture another common reason for a distal SBO of gradual onset is shown. A carcinoma of the cecum has occurred right near the ileocecal valve causing massive distention and hypertrophy of the immediate proximal ileum. The tumor is tethered into the ileocecal valve; the descending colon is collapsed and empty.

Transperitoneal metastases may implant on the serosa of the small bowel and cause an obstructing, contracting, tumor mass that eventually results in obstruction. Occasionally pelvic tumor masses, as in ovarian cancer, may completely engulf the small bowel and cause obstruction by extrinsic pressure.

Patients presenting with episodes of cramping abdominal pain, abdominal distention, loud borborygmi, weight loss and who are unlikely to have inflammatory bowel disease should be suspected to have a small bowel tumor causing there obstructive symptoms. . Anemia and occult blood in the stool may be present in these patients. Occasionally a palpable abdominal mass is found, but tumors of the small bowel are extremely mobile and particularly difficult to identify consistently on physical examination. If there is extensive metastatic disease in the abdomen, ascites may develop and a pelvic masses may be palpable on digital rectal examination.

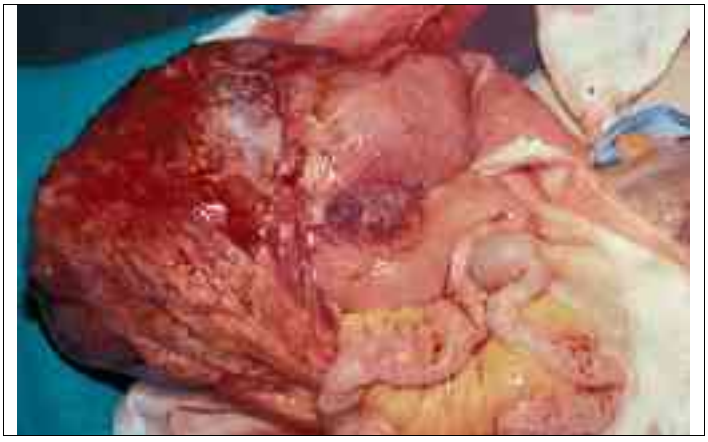
Contrast studies and follow through of the small bowel may demonstrate an obstructing lesion. CT scanning may identify an intra-abdominal mass.

Tumors of the small bowel are more likely to bleed or perforate than they are to obstruct. The bowel content is extremely fluid and many

of the lesions grow extrinsically outside the intestine rather than compromising the lumen. Occasionally tumors of extraordinary size may arise in the small bowel and simply displace the intestinal tract into the corners of the peritoneal cavity.

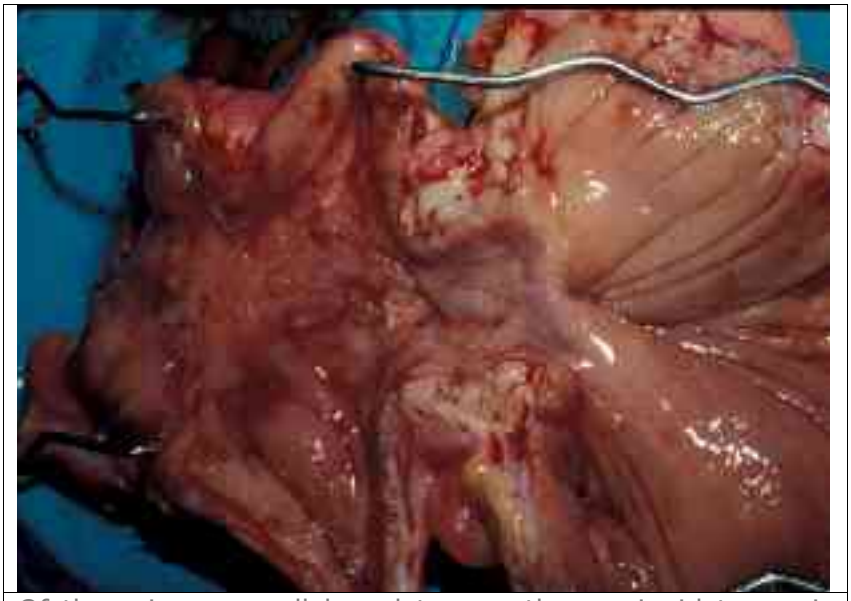
Smooth muscle tumors and hematogenous metastases to the small bowel frequently will not cause obstruction even though they reach very significant size. They tend to grow in the bowel wall, extending in a dumbbell fashion into peritoneum without encroaching significantly on the small bowel lumen. Very large masses can evolve without bowel obstruction. In this patient a metastatic lesion to the small bowel can be seen, the bowel is collapsed and there is no bowel obstruction. The lesion has been causing a GI bleed.
A closer view of the tumor shows how the lumen of the bowel is preserved. The tumor has ulcerated into the lumen of the bowel causing the lower GI bleed. A limited resection was required to stop the continued loss of blood.

Of the primary tumors of the small bowel, **adenocarcinomas** are the most likely to cause an obstructive pattern. If the lesion is polypoid, intussusception may occur. Perforation and bleeding are also more likely and commonly are features of metastases to the small bowel from lung cancer or melanoma.



This massive malignant tumor of the small bowel displaced the intestine but did not cause obstruction.

Carcinoid tumors, when they are malignant, incite a surrounding inflammatory response with desmoplasia that may result in an obstructing lesion.



Of the primary small bowel tumors the carcinoid tumor is most likely to cause obstruction due to encroachment on the lumen. As seen in this picture they cause a fibrous reaction somewhat similar to an adenocarcinoma of the colon. Carcinoid tumors cause a localized stricturing of the bowel wall. GI bleeding from these lesions is uncommon.

Very rarely other benign and malignant lesions are located either in the small bowel mesenteries or arise within the small bowel. Although obstruction may rarely occur, the vast majority of these tumors are rapidly expanding and simply displace the bowel without causing obstruction.

Hematogenous metastases to the small bowel are quite rare but are occasionally encountered in patients with undifferentiated lung cancer and melanomas. These lesions may cause intussusception, perforation, bleed or may obstruct. Unfortunately they are sometimes found at multiple levels. This picture demonstrates a metastatic lesion on the small bowel in a patient with lung cancer.

Radiation enteritis

The treatment of pelvic and abdominal tumors may lead to inflammatory changes in the small bowel. Efforts are usually made to displace or protect the small intestine when curative radiation is given to the pelvis but this is not always completely successful. Initially the process is acute and there may be anemia and diarrhea but after a period of time a more slowly progressive lesion of the exposed intestine occurs. This is mediated largely through the obliteration of the vascular lumen. {endarteritis} The condition is self-perpetuating and does not tend to resolve or slow with the passage of time.

The obstructions are seldom complete but cause recurrent low-grade obstruction with subsequent gradual weight loss and nutritional deterioration. Attempts to intervene surgically by dissecting out the affected segment may be followed by the formation of anastomotic leaks, fistula and intra-abdominal abscess. Leaving the affected bowel undisturbed and creating a proximal bypass may often be a better option.

Endometriosis

Although endometriosis more commonly involves the rectum and sigmoid colon, the deposits can affect the distal ileum. The inflammatory reaction and subsequent stricturing of the bowel where the deposits are located are more intense at the time of the menstrual period. The cyclical nature of these symptoms may be recognized raising suspicions of this relatively uncommon condition.

If the lesion is encountered during laparotomy the deposits and puckered and stricture bowel around it simulate a malignancy.

Female patients with symptoms of SBO obstruction that seem to occur in a cyclical manner should be considered to have endometriosis if they are in the proper age group. In this patient there were recurring episodes of abdominal pain and partial obstruction thought to be an intraperitoneal malignancy. At laparotomy these small hemorrhagic deposits surrounded by inflammatory reaction and scarring, puckering the intestine were found. The obstruction resolved after the conservative treatment for endometriosis.

III. Large Bowel Obstruction (LBO)

Volvulus (sigmoid, cecal)

The colon is very rarely involved in internal herniation through adhesions or external entrapment in hernial orifices. Most acute onset LBO is secondary to volvulus. Sigmoid is the most common site for volvulus followed by cecal.

In this operative photograph there is a cecal volvulus. The bowel is dusky in coloration due to venous obstruction but is likely viable. This cecum can be easily and completely delivered from the abdomen due to its poor peritoneal attachment. Poor attachments are the basis for volvulus formation. It is not possible to decompress a cecal volvulus non-operatively. Operation is indicated due to the high incidence of cecal necrosis and perforation. A right hemicolectomy is the best management.

In many third world countries volvulus of the colon is the commonest cause of obstruction. This is thought to be due to the intake of a high fiber diets causing the colon and mesentery to become redundant and attenuated. As a cause of obstruction, in North America and Western European countries, volvulus of the colon is a distant third in frequency to cancer of colon and diverticular disease.

Patients suffering form colonic volvulus are frequently very elderly and many have longstanding problems with constipation. These individuals are often institutionalized and at times on chronic psychiatric medications. They are frequently prohibitive candidates for major surgical intervention. In some cases, sigmoid volvulus may be managed by endoscopy and decompression, on a recurring basis. Occasionally a sigmoid colon volvulus will relentlessly recur or will not be decompressed by endoscopy. Distention, to the point of interfering with ventilation, may necessitate surgical intervention.

This is a massive sigmoid volvulus that was impossible to decompress despite several attempts. The patient was in respiratory distress due to the marked abdominal distention. A rectal tube was placed and the abdomen opened. The massively distended colon was delivered from the abdomen and then decompressed out of the operative field through the rectal tube. It was then possible to carry out a resection of the twisted sigmoid colon and form a temporary colostomy. The patient was eventually re-anastomosed.

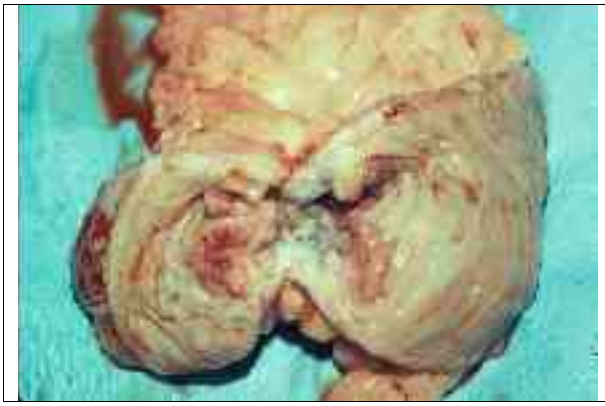
External Hernias

Obstruction of the colon by adhesive bands is extremely rare. Similarly the colon is rarely trapped in external hernias. Occasionally the ileocecal area or sigmoid may enter a groin hernia sac becoming obstructed. The transverse colon may also become trapped in an umbilical or incisional hernia.

Carcinoma of Colon

55% of colonic obstruction is due to carcinoma. Anywhere from 6% to 26% of patients with colorectal cancer develop obstruction. Of this acute obstruction occurs approximately 10% of the time.

Tumor incidence by site; rectum (50%), sigmoid (20%), left colon (15%), transverse (10%) and descending (5%). Rectal tumors rarely progress to obstruction due to the considerable capacity of the rectum. Large tumors evolving in the rectum will usually cause tenesmus and rectal bleeding and be addressed long before obstruction occurs.



Carcinoma of the colon usually causes obstruction in the sigmoid and rectosigmoid areas although obstruction may occur more proximally. The growth pattern of these tumors is annular and constricting. The pathological term is "napkin-ring".

Obstruction in the colon of gradual onset is most frequently due to carcinoma. Tumors in the rectosigmoid area commonly have an annular growth pattern that is constricting. Their maybe preliminary symptoms with altered bowel habits and crampy abdominal pains. Infrequently the onset of obstruction may seem to be fairly sudden and likely is the result of fecal impaction in a narrowed lumen.

This photograph shows a resected carcinoma of the sigmoid colon that to this point was non-obstructing but the same annular growth pattern is seen. If a patient can be diagnosed and the bowel prepared before obstruction intervenes then a single stage resection can be carried out.

Diverticular Disease

Diverticular disease is extremely common in the elderly population. It most frequently presents with episodes of diverticulitis and localized perforation or occasional abscess formation. Obstruction of the colon is probably the least common complication. Occasionally the inflammatory process may be intense with considerable fibrosis and constriction of the area of involvement. Fecal impaction in a narrow channel may often lead to near complete obstruction of the colon. The course may be slightly more acute but simulates the course of malignant obstruction very closely.

This patient has an inflammatory mass at the rectosigmoid junction with complete colonic obstruction. The x-rays show a markedly dilated transverse colon to splenic flexure. The contour and the location of the splenic flexure identify this segment of bowel as the transverse colon. It would be necessary to perform a hypaque enema to confirm the point of distal obstruction.

Assessment – Bowel Obstruction

I. Assessment of the Patient with SBO

Symptoms of Small Bowel Obstruction

Four major symptoms are characteristic of SBO. These are **abdominal pain, vomiting, abdominal distention** and **cessation of flatus** passed per rectum**.** These symptoms vary depending on the anatomical location of the obstruction, the degree of obstruction and the presence or absence of strangulation.

The abdominal **pain** is characteristically generalized and colicky. Patients often appear restless and uncomfortable. Features of wave-like accentuations in pain may or may not be present. Pain is seldom localized to either side of the abdomen or epigastrium. As a rule pain is generalized and periumbilical. The onset of pain is usually quite sudden and relates closely to the moment of internal

herniation. Although an adhesion may have been present in a patients abdomen for months or many years the instant of internal herniation probably requires only a few minutes. Swallowed gas and upper GI secretions quickly distend the proximal bowel and hyper-peristalsis with increasing tension in the bowel wall ensues causing the colicky pain.

The degree of **distention** may be greater if the obstruction is distal rather than proximal in the jejunum. **Vomiting**, however, is likely to be more frequent and profuse when the obstruction is proximal rather than distal. The bowel may occasionally move following the onset of a complete obstruction but soon thereafter the passage of flatus in particular comes to a complete halt. The absence of flatus being passed per rectum is a more consistent symptom relating to the completeness of bowel obstruction.

The intensity of the above symptoms is related to the completeness of the obstruction. Partial obstructions are less likely to cause repeated vomiting and marked abdominal distention. Small amounts of flatus may continue to be passed per rectum and there may be a passage of liquid stool with partial obstruction.

Physical Signs of Acute Onset Small Bowel Obstruction

General physical signs are related to the degree of third spacing and subsequent intravascular fluid losses. Theses signs may not be evident early in the obstruction. A postural drop in blood pressure, detecting a diminished quality in the pulse and noting a collapse in peripheral veins and poor filling in the jugular veins are all consistent with decreased intravascular volume.

On **inspection** a degree of abdominal distention, usually symmetrical, maybe appreciated. Diffuse tenderness of a mild to moderate degree is usually evident but true rigidity and guarding is unusual. Occasionally in thin patients dilated loops of small bowel can be visualized and seen in a peristaltic motion. Hernia orifices should be searched carefully for evidence of incarceration. In patients who have had previous surgery, abdominal scars will be evident. These scars should be palpated looking for signs of incarceration. In obese patients detecting small incarcerated incisional hernias is not easily demonstrated on palpation.

Abdominal mass may be occasionally felt with acute onset obstructions where there is a volvulus or an internal herniation. The loops of strangulated bowel are usually quite turgid and filled with fluid under considerable tension giving rise to a significant abdominal mass.

The abdomen is usually tympanic to **percussion** due to the significant amount of gas retained in the intestine proximal to the obstruction. Loud bowel sounds are sometimes present in incomplete obstructions but soon disappear in complete obstructions and the abdomen may be silent by the time the patient presents.

Digital rectal examination (DRE) should always be performed. Peritoneal metastases may be evident by the finding of a rectal shelf. Hemoccult positive testing of the stool may indicate Intraluminal tumors.

Identifying patients with complete SBO

Skilled clinicians have great difficulty in distinguishing patients with complete bowel obstruction and strangulation for those with incomplete obstruction. In approximately one third of patients the diagnosis of incomplete obstruction is readily made on the basis of the, rare or occasional vomiting, lesser degree of pain, passage of small amounts of flatus continuing, and a degree of softness and lack of serious distention to the abdomen.

Some of patients have a history of repeated presentation to hospital with partial obstructions that are resolved on many occasions in the past with conservative measures. Some of the patients have had multiple surgeries and are known to have extensive intra-abdominal adhesions.

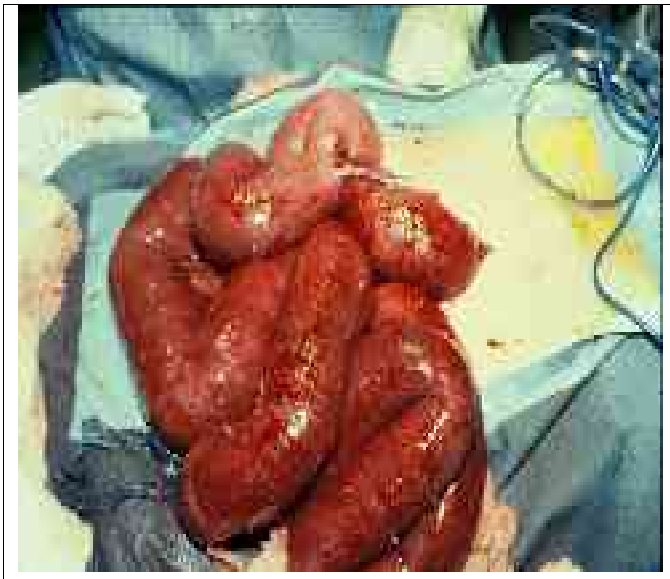
Another third of patients present with a degree of acuteness and demonstrate physical signs that strongly suggest **complete obstruction** that is easily confirmed by plain x-rays. These patients have a sudden and abrupt onset of severe generalized colic, vomit repeatedly and the abdomen becomes very distended and tense quickly. No flatus is passed per rectum. On physical examination signs of hypovolemia evolve early. The patient's abdomen is tense,

tender and silent.

There are a significant number of individuals however who present with a spectrum of symptoms and physical signs in a mid zone between complete and incomplete obstruction. The decision on whether this is an early complete obstruction or partial obstruction may be extremely difficult on clinical grounds alone. X-rays of the abdomen are not always definitive in these cases.

Identifying Patients with Strangulating SBO

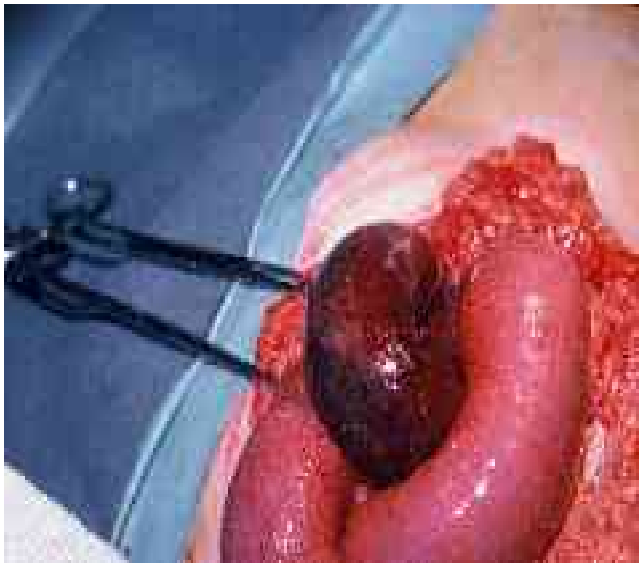
The best way identify patients with a strangulating obstruction is to identify patients with complete obstruction. In doubtful cases where a decision to treat conservatively (IV fluids and NG suction) seems to be the option then CT scanning should be attempted to detect those patients who are presenting with early complete obstruction. If a CT scan indicates a complete obstruction, operation should be undertaken without pursuing conservative measures. Examples of CT scans in difficult cases are shown below.

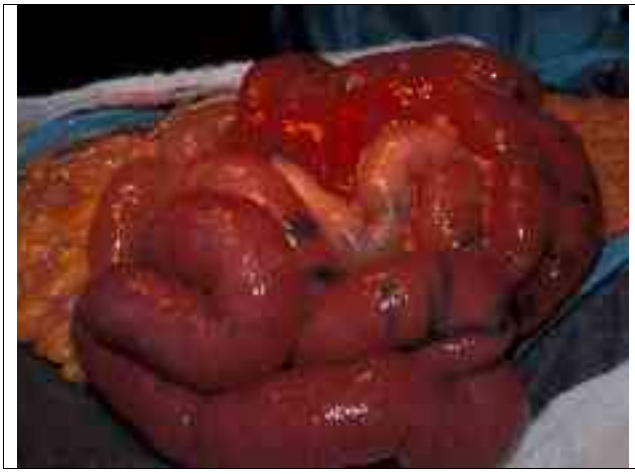


A single dense band caused an internal hernia which captured almost the entire small bowel. Fortunately, the strangulated bowel is viable and no resection was required.

	In this case a short segment of the small bowel was strangulated and unfortunately will not survive. A short resection and anastomosis will be required.
	Again, operation is too late. If the patient delayed coming to hospital and the operation was immediate then that is not your fault. However, if the patient was treated conservatively for 24hours or longer and then operated upon with these findings, you should get a substandard grade.

	Sometimes there may be great difficulty in deciding intra-operatively if the bowel is viable or not. The bowel may be replaced in the abdomen and re-inspected after 15 minutes. If doubt remains a resection should be carried out.
	This long segment of strangulated bowel contains both obviously viable sections and areas of patchy necrosis on the antimesenteric border. If left these patchy areas may perforate post operatively causing an overwhelming peritonitis.

	An internal hernia of a short segment of small bowel resulted in strangulation and necrosis. The segment has not perforated and there is not a large enough mass of dead tissue to incite a clinically identifiable inflammatory response. Lesson: Identify a complete obstruction and operate for this indication.
	In this patient there is an adhesive band causing an internal herniation of approximately 20 cm of small bowel that is in an advanced stage of strangulation.

	The length of intestine that is involved in a strangulation is variable and can occasionally involve almost the entire intestine. In this patient there was an adhesive band in the left upper quadrant that was causing an internal hernia of almost the entire small bowel. Fortunately, surgery was carried out early enough. The band was divided saving the patient from the loss of the majority of their intestine. Some patchy areas of hemorrhage and ischemia are seen but none of these where felt to require resection.

Identifying patients with acute non-obstructive abdominal conditions

This intraoperative photography demonstrates gangrene of small bowel due to a superior mesenteric artery thrombosis. These patients are vasculopaths and may have a background of myocardial infarction or arrhythmia. Generalized abdominal pain is severe. Acidosis and shock develops early. Because of the absence of peritonitis in the early stages rigidity and guarding of the abdominal wall may not be a feature. X-rays of the abdomen do not show proximal dilation and distal collapse.

This intraoperative photography demonstrates peritonitis due to colonic perforation. In these patients abdominal distention and vomiting may suggest obstruction. However, there is generalized rigidity and rebound tenderness (signs of peritonitis). X-rays may show dilated bowel, but again there is no proximal dilation or distal collapse.

A segment of intestine may become infarcted due to distal embolus or thrombosis. This may produce a partial obstruction even though there is no actual occlusion. As necrosis progresses, peritonitis will develop. Early diagnosis is difficult but operation and resection before a generalized spill of intestinal content occurs will reduce morbidity and mortality.

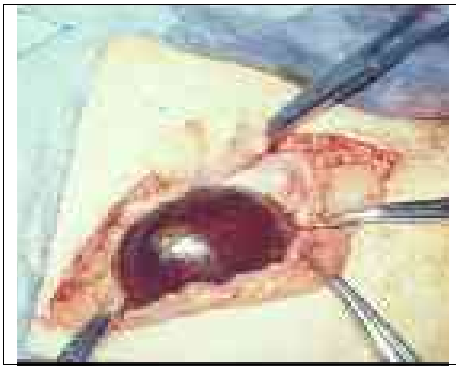
Acute appendicitis initially presents with a central abdominal pain, and may be associated with vomiting. However, pain will soon shift to the RLQ and localized tenderness will develop there. X-rays usually show only a non-specific picture.

Incarcerated External Hernias causing SBO

In third world countries and as little as a hundred years ago in industrialized western countries incarceration of the bowel in external hernias was the leading cause of SBO. Due to the widespread repair of external hernias early after their presentation the numbers of patients presenting with incarcerated external hernias and SBO has diminished significantly. This is a progressive trend because strangulation of bowel in external hernias is a significant cause of mortality.

The small bowel and the omentum are the most likely structures to become incarcerated within an external hernia, given their mobility. Once small bowel becomes entrapped in an external hernia it quickly become congested due to the obstruction of venous return. Congestion leads to edema and intramural hemorrhage and soon the strangulated loop becomes irreducible. Signs of intestinal obstruction generally appear thereafter with generalized cramping pains, vomiting and distention.

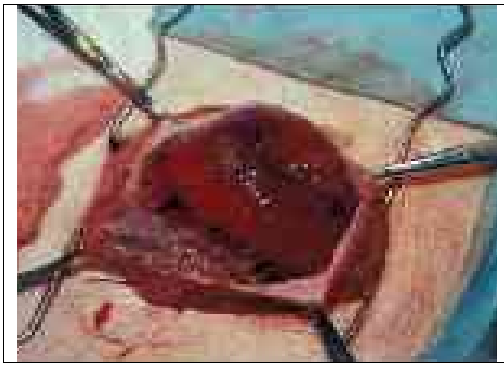
Patients presenting with the above symptoms and an identifiable mass at a hernia orifice need to be quickly evaluated and resuscitated and operated upon. If at emergency surgery the incarcerated bowel is found to be viable and can be released and reduced into the peritoneal cavity and repair of the hernia carried out then the mortality risk quite low, in the margin of 1 or 2%. If however the bowel is non-viable and a resection is required mortality rates increase significantly into the area of 5 to 10%. Needless to say every effort should be made to quickly evaluate, resuscitate and operate on these patients without unnecessary delay.



In this photo an incarcerated inguinal hernia with bowel obstruction is being explored. When the sac was exposed its contents appeared hemorrhagic. The sac was opened, bloody and foul smelling fluid aspirated and a strangulated non-viable loop of small bowel was demonstrated. The internal ring was enlarged laterally, carefully controlling the ischemic bowel. It was possible to deliver the bowel through the inguinal wound and perform a short resection. The hernia was then repaired. If appropriate mesh plugs or patches can be used.

Incarcerated hernias at the umbilicus, inguinal and femoral or previous abdominal incisions should be identified as the cause of

obstruction if at all possible. Many of the procedures in the inguinal and femoral area in particular can be carried out through a groin incision, significantly reducing the patient's morbidity. Strangulation of bowel in unusual hernia sites such as obturator and sciatic are seldom diagnosed preoperatively and is usually discovered at full laparotomy.



Umbilical defects approaching 2 cm in diameter and with a rigid margin, pose a risk of incarceration and strangulation. The patient in this picture had an umbilical protrusion recognized for many years. It was easily reducible and surgical management was not entertained. After spinal surgery, in hospital, the hernia incarcerated and a bowel obstruction developed. Emergency surgery revealed strangulated intestine and omentum. A resection was required.

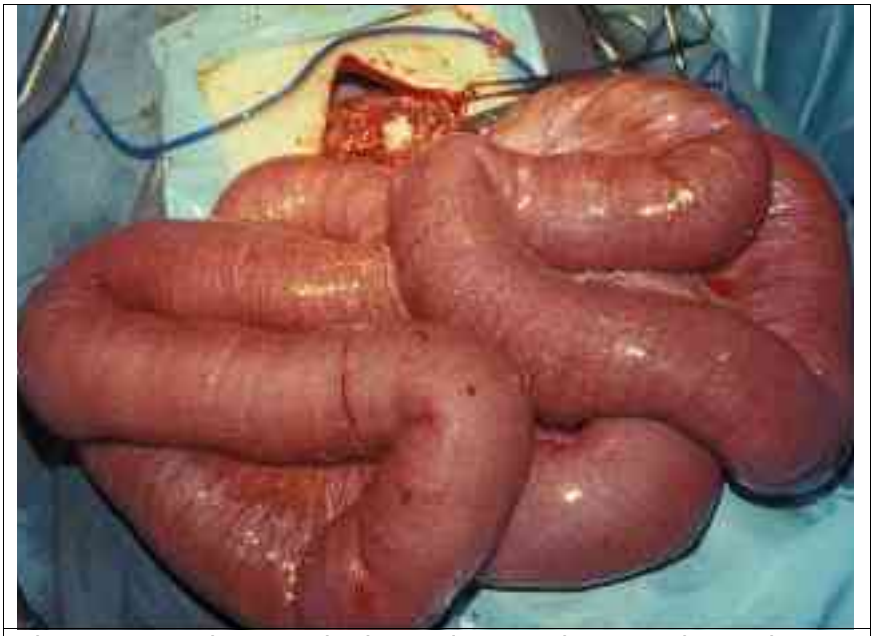
ECF deficits in Patients with Bowel Obstruction

In patients with high grade or complete SBO significant amount of extracellular fluid become sequestered into the bowel lumen and in the peritoneal cavity. This may accumulate to several liters and significantly diminish the intravascular volume giving rise to symptoms of hypovolemia. In patients who are not appropriately resuscitated the administration of analgesics or in particular anesthesia may cause them to decompensate and become "shocky".

Patients giving a history of significant duration (>24 hrs) characterized by severe pain, vomiting and absence of flatus per rectum with x-rays demonstrating significant fluid within the bowel lumen as evidenced by numerous, long, fluid levels or filling of the lumen on CT scanning should be anticipated to be hypovolemic. Often there is supportive laboratory evidence in the form of a high hemoglobin indicating a reduced intravascular volume and elevated creatinine indicating a degree of pre-renal failure. Abnormalities in sodium and potassium levels are inconsistent and should not necessarily be anticipated.

Signs of hypovolemia should be searched for early in the management of patients with SBO. If the history and physical signs indicate hypovolemia then peripheral venous access should be

established quickly. A balanced salt solution should be infused using a bolus technique. A Foley catheter should be inserted early on to monitor urine output. Repeat physical examination looking for filling of the jugular veins, reversal of the orthostatic hypotension and improvement in pulse quality are helpful in establishing adequate resuscitation.



This picture shows a high grade complete mechanical SBO. There is a large ECF deficit. The markedly dilated intestine in this obstruction has be delivered from the abdominal cavity. No strangulation is evident. The intestine does however have a dusky coloration due to venous obstruction resulting from elevated pressures in the intestinal wall. The intestinal loops are heavy and filled with displaced ECF. This fluid is partially the result of a failure to reabsorb the upper GI secretion but mainly it is due to active movement of fluid across the bowel mucosa into the lumen of the obstructed intestine. Several liters of fluid may be sequestered in an obstructed small bowel.

If resuscitation is commenced early in the patients management prior to the arrival of laboratory work, performance of x-rays or CT scanning then an adequate and almost full resuscitation may be obtained by the time the decision is made regarding surgical intervention. Only 2 to 3 hours should be necessary to achieve satisfactory resuscitation.

Strangulation of the Small Bowel

Strangulation by definition is the development of vascular compromise of the incarcerated bowel whether this be an internal hernia within the peritoneal cavity or in the sac of an external hernia. Strangulation means vascular compromise and does not necessarily infer the involved intestine is necrotic, requiring resection.

If the bowel is entrapped in an external hernia, and is obstructed, a degree of strangulation is certain to be present. The diagnosis of strangulation is relatively easily made in these circumstances which should lead to prompt surgical exploration.

When the obstruction and strangulation is within the abdominal cavity and caused by an internal hernia, the identification of strangulation becomes difficult. If the loop of intestine involved is long then fever, severe tenderness and a palpable mass may be present. If the loop of bowel involved is a short knuckle then these indicators may not be detectable even by the most astute clinician. It follows that the search for a complete obstruction should be undertaken; if found, operation should soon follow.

The evolution of strangulation in a herniated loop of intestine is unpredictable. Occlusion of venous return quickly leads to engorgement of the bowel leading to interstitial and luminal hemorrhage. The subsequent edema and venous stasis results in the elevation of vascular pressures and eventual absence of arterial flow.

If a extended length of small bowel is strangulated the subsequent hypovolemia and toxemia will likely be detected on clinical grounds. There may be a palpable mass and a considerable increase in abdominal findings. However if the intestinal loop that is internally herniated and strangulated is very short the systemic effects of this dying intestine may be minimal and impossible to detect. A complete intestinal obstruction should be evident by imaging studies. It is easier to detect the completeness of obstruction than the strangulation. Complete obstruction should be an indication for surgical intervention due to the high incidence of strangulation associated with complete obstruction.

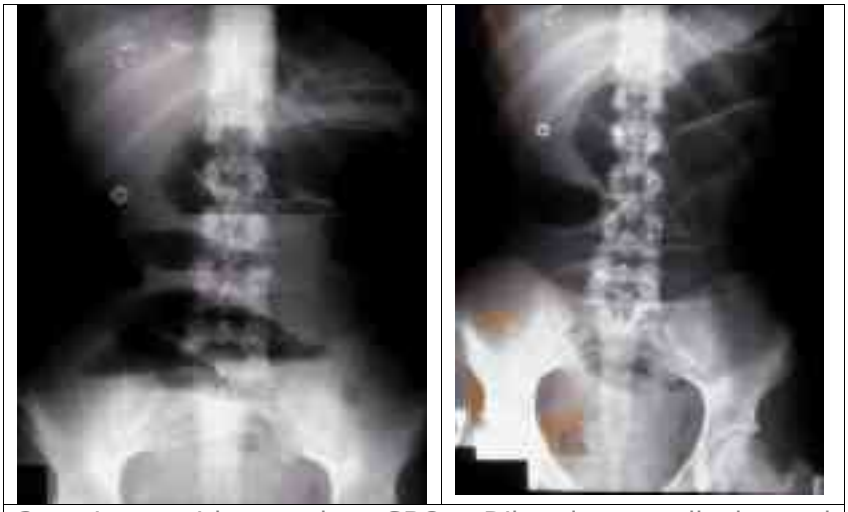
Radiographic Imaging patients with Acute SBO

Patients presenting with acute abdominal pain, as a general rule, should have supine and upright views of the abdomen and a chest x-ray performed as part of the initial assessment. The assessment of the patient should be well underway as should the resuscitation of the patient before such radiographs are sought. The patient's vital signs including their ventilatory reserves, oxygenation and circulatory status should be assessed and correct to as near normal as possible before the patient departs the emergency department for the x-ray department.

Patients with fluid volume deficits with postural hypotension and pre-renal failure tolerate transport poorly. The patient's intravenous resuscitation should be well underway and if there has been vomiting or abdominal distention a NG tube should be in position and functioning. Aspiration of vomitus is a serious complication of

intestinal obstruction. This is particularly dangerous if it occurs outside the emergency department in the darkness of a x-ray suite.

X-rays of the abdomen should first be scrutinized with a view to determine whether there is in fact an obstruction and if so, where it is located.



2 patients with complete SBO. Dilated, centrally located small bowel loops with no colonic gas identifiable. History strongly supported the conclusion that the obstruction was complete. Further imaging is unnecessary.

Acute abdomens with peritonitis, retroperitoneal trauma or bleeding and even remote injuries such as rib fractures, spinal injury and pelvic injury may cause a degree of dilatation of the intestinal tract and even fluid level formation. X-rays of patients with true mechanical obstruction should show true proximal dilation of bowel with distal collapse.

X-rays that demonstrate SBO are usually readily identified by the appearance of centrally located loops of dilated intestine often forming a "ladder-like" or clustered pattern in the central abdomen. Multiple fluid levels are often seen in the upright view. If the obstruction is in the small intestine and complete, absence of gas in the cecum and transverse colon can usually be confirmed.

In cases of colonic obstruction the cecum and transverse colon are usually readily identified. Occasionally loops of small intestine may also be distended if there is incompetence of the ileocecal valve. If colonic obstruction is suspected then the site of obstruction can be

confirmed by a contrast study given per rectum.

As a general rule, contrast given by mouth or NG tube to attempt to demonstrate points of obstruction in cases of SBO are unsuccessful as the contrast dilutes out in the intestinal fluids. It becomes very difficult to demonstrate a point of obstruction or assess the completeness of obstruction.

In any case of acute abdomen or in particular suspected SBO, x-rays of the abdomen in supine and upright positions should be obtained. Many times a plain film of the abdomen will be sufficient to distinguish between high grade complete obstructions and partial obstructions. These series of radiographs show cases of SBO which from a clinical standpoint where complete. Radiographs should be searched for evidence of gas in the cecum and other identifiable areas of the colon. In the middle radiograph (upright abdomen) the amount of dilated small bowel is difficult to appreciate. In any case where the clinical picture suggests bowel obstruction, but the radiographs are inconclusive then CT scanning is indicated.
The degree of dilation, the numbers of dilated loops or the length of their fluid levels are not necessarily an indication of the completeness or incompleteness of obstruction. In the radiograph on the right (upright abdomen) there is clear identification of complete obstruction showing only 3 short fluid levels in the small intestine. There is no gas located in colon or cecum; the obstruction is radiographically complete. An early operation revealed a strangulating obstruction.

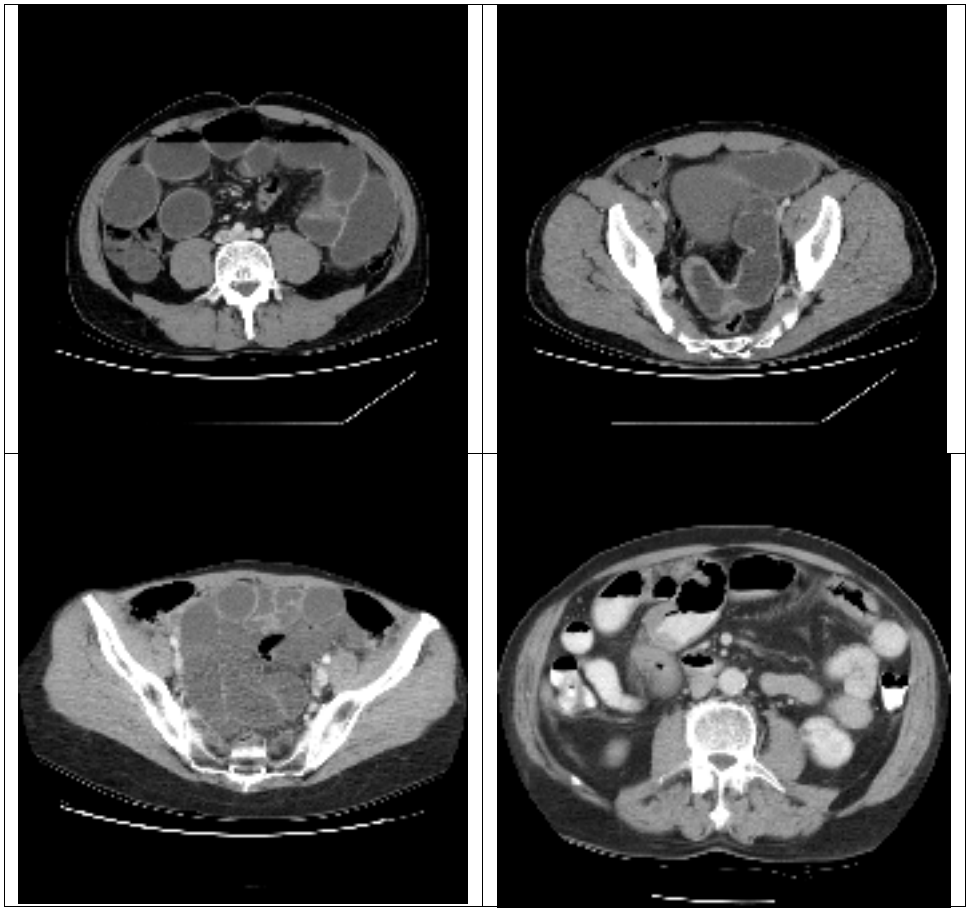
CT scanning patients with acute SBO

The CT scan may be a very useful tool in the assessment of patients with SBO. Neither intravenous nor oral contrast are absolutely necessary if the patient requires continuous NG suction or renal function is impaired. Fluid filled loops of bowel, sometimes difficult to discriminate on plain upright films of the abdomen, may be readily seen on CT. When all of the images are present they can be traced through and a point of obstruction, if there is one, can usually be discriminated. Warning signs of strangulation including free fluid within the peritoneum, thickened loops of bowel or even gas in the

bowel wall may be identified.

Patients with incomplete obstruction, where there is a compatible history and physical exam, and x-rays show nonspecific patterns without proximal dilation, may not need CT scanning.

Some other patients with a very clear history of sudden onset of complete obstruction, concerning physical signs and a set of x-rays showing dilated bowel loops and no visible colon do not require CT scanning; they should be resuscitated and proceed to operation. *A CT scan may be a very significant and discriminating test to apply to at least a third or more of patients with acute onset SBO.



CT scanning in patients with suspect SBO can be more successful in showing complete points of obstruction as well as indicating ischemic or strangulated loops of intestine. Intestinal obstruction in which there are large amounts of fluid but little gas entrapped within the obstructed loops, are identified more readily by CT scanning than plain radiographs. Some selected panels of patients with small bowel obstruction are shown. There are considerable limitations in viewing a single panel of a study.
That said, the panel in the top left corner demonstrates markedly dilated small intestine; most loops of bowel are completely filled with sequestered ECF. The descending colon is a tiny gas filled structure in the left paracolic gutter. The obstruction is very high grade and essentially complete.
In the right upper quadrant (different patient), dilated loops of intestine are seen in a pelvic panel. There is thickening of the bowel wall. The rectum is seen as a tiny collapsed gas filled structure just in front of the sacrum.
The panel in the lower left corner demonstrates many dilated loops of small bowel in the pelvis and again the rectum is a tiny structure with a small amount of gas in it just in front of the sacrum.
The panel in the lower right corner demonstrates contrast migrating through distended and obstructed loops of small bowel. A transition point is noted just the midline to the right, just deep to abdominal wall. The contrast within the lumen demonstrates intestine proximal to the obstruction. Contrast does not reach the colon The obstructed bowel is not particularly dilated, there is no free fluid, no thickened bowel wall. In this case, a period of observation would be safe, with repeat of the CT scan..

Symptoms and Physical examination of Gradual onset SBO

Patients with a gradual evolving obstruction of the small bowel usually present in an ambulatory care setting. Often their history will span many weeks and sometimes months to years. The basic complaints are similar to those of acute SBO; however, they are less sustained and less severe. The distribution of the pain is similar in the sense that it is located in the periumbilical area. The pain has a colicky nature that causes restlessness. The pain may have a wave-like character and is often accompanied by loud borborygmi. In between episodes of obstruction there may be, paradoxically, periods of diarrhea. Usually symptoms are increased with eating and the more solid and amount food the more intense the symptoms. A degree of abdominal distention is usually evident. The patient may occasionally have nausea and rarely vomiting. Because of the relationship between pain and food, patients often develop a gradual weight loss due to self imposed dietary limitations.

An enquiry should be made into the previous medical and surgical history. Previous abdominal surgery for malignancy would suggest the symptoms represent a recurrence with peritoneal metastases. Radiation therapy to the pelvis may induce radiation enteritis and obstruction may develop years after treatment is completed.

Younger patients with weight loss, intermittent diarrhea, crampy abdominal pain and anemia should be suspected of having inflammatory bowel disease. Older patients with serious vascular disease should be assessed for mesenteric vascular occlusion and intestinal ischemia. The symptoms of this condition may closely mimic those of gradual onset SBO.{intestinal angina}

On physical examination a careful search of the abdomen for a palpable mass should be made. Tumor masses on the small bowel or omentum are frequently mobile. Any previous incisions and the umbilicus should be carefully searched for tumor implantation. A DRE may reveal tumor implantation in the pouch of Douglas or the rectovesicalar pouch. Auscultation of the abdomen will frequently reveal loud, high pitched bowel sounds that occur in waves, if they are not audible at the bedside.

Investigations of Gradual Onset SBO

In such cases there is usually a significant time frame available to carry out investigations. Hematological studies may demonstrate anemia if there is an ulcerative lesion in the small bowel or ileocecal area. Stool may be positive for occult blood.

Plain x-rays of the abdomen may demonstrate dilated loops of small bowel, particularly during times of increased symptoms. Films taken during asymptomatic periods may fail to show any abnormalities. Most small bowel tumors are beyond the reach of conventional endoscopic studies, although a lesion at the ileocecal valve may be visualized by colonoscopy. Enteroclysis, which is the injection of barium into the duodenum by a nasoenteric tube, may be successful in demonstrating one or more points of obstruction in the small bowel. In patients whom mesenteric vascular occlusion is the suspected diagnosis angiography may be indicated.

CT scanning may be successful in demonstrating tumor masses in

the omentum, bowel or mesenteries and even the peritoneum. Retroperitoneal nodal disease and liver metastases may also be shown.

II. Assessment of the Patient with LBO

Presentation of Acute Onset LBO due to Volvulus

Volvulus of the colon occurs relatively rarely North America. In other countries, presumable on the basis of a bulky high fiber diet, the incidence of volvulus causing obstruction is much higher (Iran 33%, North India 30%, Uganda 20%). Many individuals have a pattern of multiple recurrence of volvulus.

Volvulus of the colon usually has a short history (for that particular episode), often less than 24 hours. There is rapid and progressive abdominal distention accompanied by some degree of generalized abdominal pain. At times the distention is so severe it compromises ventilation.

This photo from the operating room shows the markedly distended, tympanic abdomen that is a feature of colon obstruction.

Patients often have a long history of irregular bowel motion and laxative abuse. The patient may be using antipsychotic medications that have effects on bowel motility. Many of the individuals are frail, demented and institutionalized making them unfavorable for surgical intervention. Occasionally patients decompress intermittently resulting in the discharge of large amounts of

"mucusy" secretions. Frequently individuals become well known to emergency departments due to multiple visits.

Investigation of LBO Caused by Volvulus

In the case of sigmoid volvulus a "coffee bean sign" may be seen on plain abdominal films. The massively distended sigmoid colon is orientated form the left iliac fossa to the right upper quadrant with the intervening mesentery separating the large loop. At times the radiological picture is confusing only showing dilated loops of colon. When there is some uncertainty of cause or level of obstruction a contrast study instilled per rectum may be helpful.

When LBO is suspected on clinical grounds and plain x-rays of the abdomen appear to confirm the suspicion, water soluble contrast medium may be delivered per rectum to clarify both the nature and level of obstruction. In this patient with a confusing plain radiograph, but massively dilated loops of bowel, a hypaque enema has been performed which demonstrates the twisting at the rectosigmoid junction. The twisting produces the characteristic "beak" at the rectal end of the obstruction.

The point obstruction in this radiograph is in the right colon suggesting this is a cecal volvulus. The typical "beak-like" appearance of the water soluble contrast is shown.

Symptoms and Physical signs of LBO due to Colon Cancer

Many patients with LBO due to colonic cancer have a history of lower abdominal cramps, periodic episodes of rectal bleeding and alterations in bowel habits. These symptoms may have been in place for weeks; hopefully, if the patient seeks medical attention, appropriate investigations [barium enema, endoscopy] and an elective surgery, on prepared bowel, will follow.

The colon can squeeze stool through a 1cm neoplastic stricture for an astonishing time, but a complete occlusion will inevitably occur, usually by impaction of a fecal pellet.

Patients presenting with complete obstruction of the left colon have significant abdominal distention and tympany. A palpable mass is rarely felt because of the small and sclerotic nature of these tumors. Frequently the tumor is beyond the reach of DRE.

Identifying the Site of LBO due to Colon Cancer

Patients with suspicious symptomatology, in particular cramping lower abdominal pain with alterations in bowel habit should have endoscopic and contrast studies carried out. If a DRE is negative then at least a rigid sigmoidoscopy of 20 cm should be performed to exclude an obvious lesion within this area of the bowel. If this is negative a barium enema would be the most appropriate test in an ambulatory setting. Frequently an "apple core" or a narrowed segment of the rectosigmoid area will be demonstrated. The residual lumen is often surprisingly narrow and attempts to fill the proximal colon with contrast should be resisted by the radiologist. A colonoscopic examination to obtain a biopsy and image the lesion is appropriate, but not absolutely necessary in typical cases. A scan for metastatic disease is often performed in these patients in the form of US or CT of the abdomen.

This patient had an annular carcinoma of the rectosigmoid junction with complete colonic obstruction. Plain film identifies the dilated cecum and transverse colon. A hypaque enema was performed and confirmed complete obstruction at the rectosigmoid junction. Also seen in the plain film, are some dilated loops of small bowel in the central abdomen; the ileocecal valve is incompetent, diminishing the risk of cecal rupture.

Some patients, particularly those in a hospital setting such as ICU's or postoperative surgical patients with recent procedures to the chest, spine or retroperitoneum may develop a colonic ileus which closely simulates a mechanical LBO. Frequently the cecum is massively dilated, as is the transverse colon to the splenic flexure. At this point there appears to be an obstruction. The abdomen may appear distended and the patient may seem to be at risk for colonic perforation. Although the setting and the history is different from that of a mechanically obstructive lesion of the colon, mechanical obstruction must always be excluded. The condition goes by the name **Ogilvie's syndrome** or colonic pseudo-obstruction. A plain x-ray of the abdomen may be convincing in terms of showing continuity of the colon with gas passing from the sigmoid to rectum. If this is not a certainty a hypaque study of the rectum may be necessary to exclude a mechanical obstruction.

Further value of a water soluble construct study of a patient with suspect colonic obstruction is the ruling out of colonic ileus (**Ogilvie's syndrome**). Some patients with adynamic ileus present with a picture consistent with mechanical colonic obstruction. In this radiograph contrast has be instilled per rectum and can be seen flowing through a patent but markedly dilated colon to the cecum. A level of mechanical obstruction is ruled out.

Occasionally the degree of distention from a pseudo-obstruction may be so significant that colonoscopic decompression may be required. A significant success rate has been obtained by intravenous administration of a cholinergic stimulus in the form of Neostigme.

Besides colonic pseudo-obstruction other conditions are known to cause colonic dilatation that may simulate a mechanical obstruction. Toxic megacolon may develop in the course of ulcerative colitis. Usually this condition can be discriminated by the chronic history of ulcerative colitis, usually spanning years. The toxic megacolon usually develops during the course of a fulminating episode of colitis.

This photograph demonstrates the operative appearance of a patient with toxic megacolon due to colitis. The omentum is shown draped over the massively dilated colon. Some portions of the colon appear somewhat dusky and thin walled. Megacolon and ulcerative colitis should be readily distinguished from mechanical obstruction by the history of the patient with colitis. Often the diagnosis of toxic megacolon needs to be made on clinical grounds and contrast and endoscopic studies may be extensively risky.

C. difficile colitis often occurs on surgical wards. Although most are heralded by the onset of diarrhea, in some instances, dilation of the colon without significant diarrhea occurs..

Management – Bowel Obstruction

I. Management of Patients with SBO

Operative Strategies for Adhesive Bands

Patients coming to the operating room for complete SBO suspected to be due to adhesive bands should be fully resuscitated and have established a good hourly urine volume with no evidence of hypovolemia. A NG tube should be in place and the stomach should be empty prior to anesthetic induction.
Intravenous broad spectrum antibiotic should be given before the incision is made.

Vertical scars are often present in patients who have adhesive obstructions. Often this scar is orientated to the lower abdomen since surgery in this zone is more often complicated by adhesive obstructions.

The abdomen needs to be opened very cautiously because the distended bowel is often adhered to back of the incision. The patient should have received IV antibiotics to cover both anaerobes and aerobic coliforms. These drugs should be given just prior to surgery to assure adequate blood and tissue levels.

The vertical incision is then extended cephalad or distal in order to enter the peritoneal cavity at an area where bowel is less likely to be adherent to the back of the abdominal wall. Once a safe entry is made into the peritoneal cavity the incision should then be opened further to provide adequate exposure.

The inadvertent entry into a distended, obstructed bowel with spillage of contents into the wound and peritoneum is a significant negative event. Perforation and spillage of the bowel greatly increases the chances of post operative morbidity and mortality. Great caution is required in the initial stages to lessen the chances of such a catastrophe.

Once a free entry into the peritoneal cavity is obtained the point of obstruction should be very carefully sought out. The distended loops of bowel may be delivered from the abdomen to provide better visualization and access. This should be done without twisting or kinking of the mesentery or traction on the delicate loops of intestine. Often the obstruction is due to a single band. If the band can be identified early, the band divided and the obstruction released then the procedure may be over.. Identifying collapsed small intestine is also helpful since it may be traced proximally to identify the point of the obstruction.

The mechanism of obstruction is usually an internal herniation. Once the adhesive band creating the internal defect is divided it is often necessary to assess the viability of the loop of bowel that has been caught. At times a viable loop must be resected because the adhesion has caused a band of pressure necrosis.

Loops of bowel that have been strangulated may be observed over a period of 10 or 15 minutes after restoring the bowel to the abdomen and covering the exposed bowel with warm sponges. Sometimes quite congested intestine may clearly improve in terms of coloration obtaining a more hemorrhagic and pinker color rather than purple. Peristalsis can often be seen passing through viable areas and pulsation of small vessels close to the bowel wall may be observed. In any case if doubt remains it is usually the wiser choose to resect the involved segment of small bowel.

If resection is required, spillage from the obstructed intestine is again a risk.. Carefully blocking off the strangulated segment with sponges and controlling the proximal bowel with a non-crushing intestinal clamp is often effective.

Bowel stomas are seldom necessary in SBO except under very unusual circumstances. Once the strangulated bowel is resected a primary anastomosis is usually performed. The risk of anastomotic leak is about 2% but this is considered reasonable. Staged surgeries in small bowel obstruction are often overly morbid for the patient and fluid losses from stomas are excessive. Eventually, difficulty with late reconnection is usually encountered.

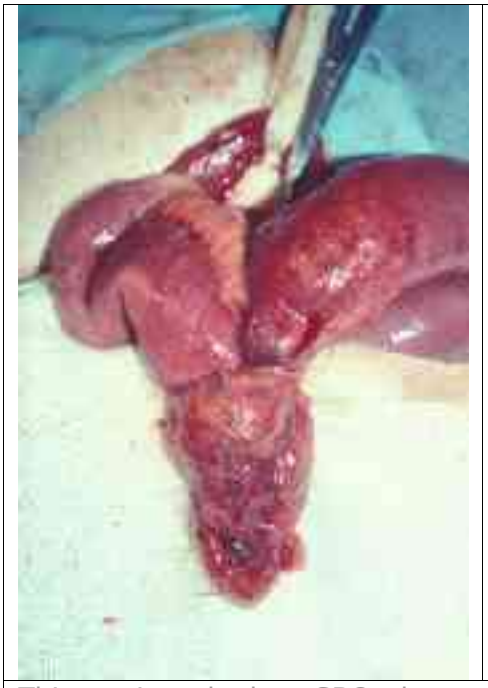
Operative Strategies for SBO caused by External Hernias

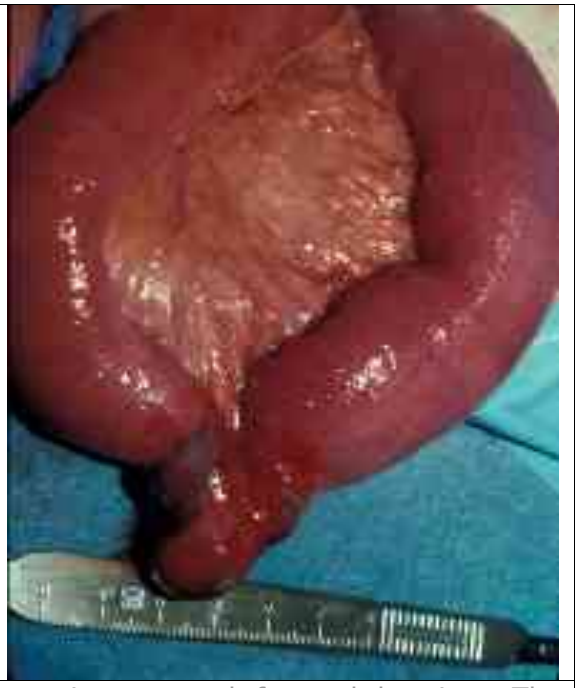
It is of great advantage for a patient to have an external hernia identified as the cause of their SBO. Occasionally in obese individuals or when the hernia is particularly small the external hernia is missed on inspection and a vertical laparotomy incision is made only to find that the bowel is incarcerated in a inguinal or femoral hernia sac. It is preferable to avoid this latter course.

A standard skin crease incision in the groin should be made in cases of an incarcerated hernia. The sac should be carefully dissected. The constricting fascia or peritoneal ring should be left in place controlling the incarcerated bowel as long as possible. If the bowel is clearly strangulated by its appearance it may be preferable to leave the sac in place and perform a resection of the sac and strangulated loop in continuity.

In cases where the viability of the bowel is in doubt the hernia sac

can be carefully surrounded with operative sponges and then opened and its contents aspirated. If the bowel is strangulated and requires resection this can usually be achieved by lengthening the hernia incision laterally through the oblique muscles of the abdominal wall and delivering further intestine into the groin. Once the anastomosis is performed it can be reduced back into the peritoneal cavity through the groin incision and followed by a standard repair of the hernial defect.





This patient had a SBO due to an incarcerated femoral hernia. The obstruction had been in place for almost two days and strangulation of the incarcerated bowel was strongly suspected. In the first operative photograph it is shown the peritoneal sac with its entrapped bowel has been delivered from under the inguinal ligament without opening the sac. In the second photography, after careful protection of the wound the sac has been opened which revealed necrosis at the point of compression. The Cooper's ligament, lancunar ligament and inguinal ligaments of femoral hernias are very rigid and unforgiving. This segment of bowel required resection because of the compression necrosis. The resection was carried out easily through the groin incision.

Operative Strategies for SBO caused by Obturation

Patients with intra-luminal obstructions are not threatened by strangulation however their courses are usually longer than those with an adhesive or hernial obstruction. Often their fluid, electrolyte and renal problems are more pronounced. If obturation is suspected

due to the absence of incisions or an identifiable external hernia or there is a clear history of swallowing a potential obstructing body the relative urgency of the surgical procedure is diminished. Full evaluation and resuscitation of the patient is possible.

If preoperative radiology reveals air in the biliary tree then a cholecystoduodenal fistula with a gallstone in the intestinal tract is likely the cause of SBO. Often a stone can be visualized in the right iliac fossa. The stone is usually solitary and large. Access to the GI tract is usually by virtue of a cholecystoduodenal fistula caused by recurrent inflammation with erosion of a large calculus.

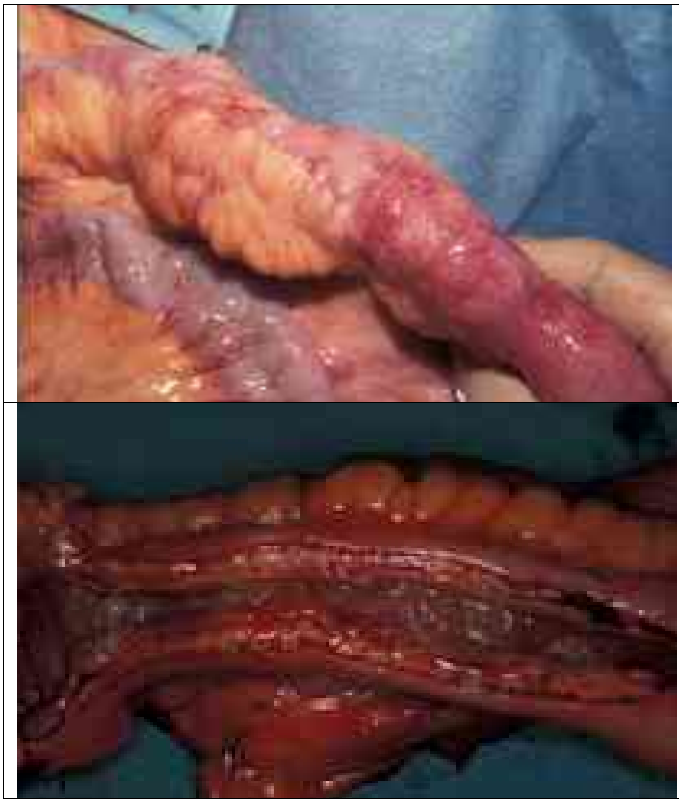
The stone can usually be dislodged form the point of impaction in the terminal ileum and gentle milked proximally up the small bowel. The stone should be reversed to the jejunum where the bowel is less distended and more resilient. A careful search of the intestinal tract should be made for other potential obstructing stones. An enterotomy can then be performed and the stone removed. As a rule no effort is made to close the cholecystoduodenal fistula or to remove the gallbladder.

The management of the other forms of obturation is similar. Although in some instances of phytobezoars causing SBO it is possible to gently breakdown the impacted material and to displace it through into the cecum to be passed uneventfully. This is preferable to enterotomy.

Indications for Surgical Intervention in Gradual Onset SBO

The approach to this group of patients is quite variable given the different time course and prognosis of the underlying conditions. Crohn's disease is a common cause of incomplete SBO. If there is progressive nutritional deficits evolving and the patient can be shown to have localized disease of a relatively short segment of the intestinal tract (frequently ileocecal) then a resection is likely indicated. The outcome in the case will likely be satisfactory over time allowing for a return of nutritional vigor and the withdrawal from debilitating medications. Close cooperation between surgeon

and gastroenterologist is clearly a favorable scenario.



Patients with gradual onset SBO can usually be operated on electively. This would be particularly true in patients with Crohn's disease. In these photographs their rigid, rubbery texture and the creeping fat growing around the bowel readily identify the involved segments. The involved segment is sharply demarcated from the normal bowel just below the involve bowel in the first photograph. Favorable cases for resection would be those with a single level of involvement with sharply demarcated margins. Wide margins of excision are not required, although a short margin of grossly normal intestine should be obtained.

In patients where metastatic malignancy in the peritoneal cavity is likely the cause obstruction careful evaluation to determine the extent of there disease is required. Multiple levels of obstruction are difficult to sort out intraoperatively if they are not identified preoperatively. Some patient's disease is beyond the point where a useful palliative procedure can be performed. If possible, these patients should be identified and a last ditch operation avoided. If a tumor is solitary and the obstruction is only at one level resection is preferred to bypass. However, if multiple levels are involved with extensive peritoneal disease then a bypass surgery is more appropriate than a risky and difficult resection.

Surgery should be approached cautiously in patients who have significant involvement of the intestine by radiation enteritis. Leaving the radiated bowel in situ is often a better strategy than attempting dissection and resection. Bypass from a healthy proximal jejunum to the colon is a better choice even though the intestinal length may be sacrificed to some extent.

Management Strategies for LBO caused by Volvulus

As mentioned above many of these individuals are chronically ill and debilitated making surgical intervention unpalatable. Unfortunately their condition is often relentless and recurrence becomes so frequent that intervention must be considered. Occasionally an operative intervention is forced in the acute situation because of the inability to endoscopically decompress a sigmoid volvulus and at times out of concern for the patient's ventilatory status.

Volvulus of the cecum is at higher risk for ischemia and eventual infarction or perforation of the massively distended cecum. An operative intervention may be indicated in the first instant for the problem. Endoscopic decompression of cecal volvulus is probably not neither safe nor possible.

If an operative intervention for sigmoid volvulus is required then a rectal tube should be positioned prior to preparing and draping the abdomen. The twisted sigmoid may then be immediately decompressed intraoperatively and exteriorized. A sigmoid colostomy and closure of the rectal stump is likely the best option. In the majority of patients re-anastomosis will not be attempted.

When the indication for surgery is a cecal volvulus then the best procedure is a right hemicolectomy with a primary anastomosis, if the patient remains stable. Attempts to pexy the cecum to the parietal peritoneum or to drain the cecum (cecostomy) are usually ill-fated.

Approach To The Patient With Colon Obstruction Likely Due To Carcinoma

Obstructing colon cancers usually occur in the sigmoid colon. More proximal lesions may also cause obstruction however, and the management may be different.

X-rays of the abdomen will usually show dilation of the cecum if the obstruction is in the colon, and then variable lengths of more distal colon dilation. The precise point of obstruction may be uncertain. Contrast studies from "below" are indicated to confirm obstruction

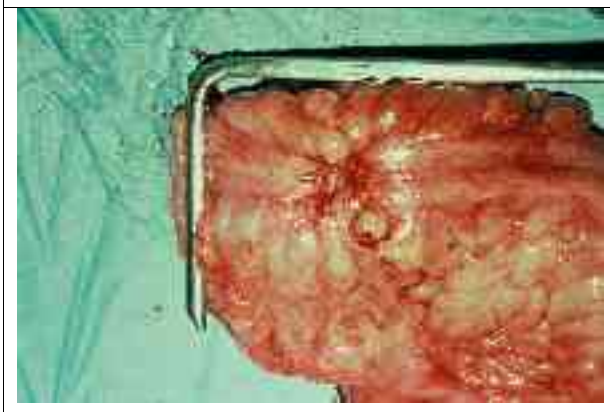
and show the level.

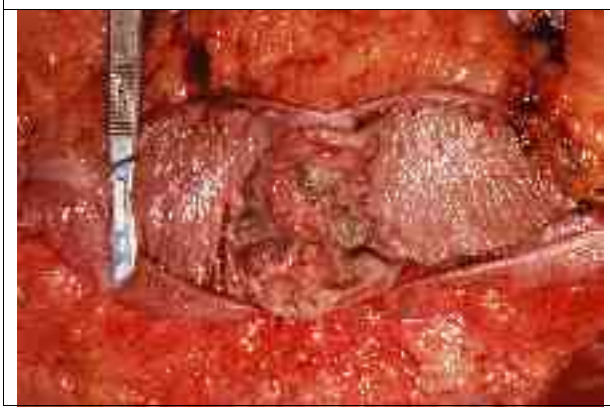
Obstruction is confirmed. It is total. There is no need to make a tissue diagnosis. This can be established later.

There are several approaches to a completely obstructing left colon lesion. In the presence of a massively dilated colon, loaded with feces, with attenuated and fragile wall, attempts to resect the lesion should be resisted (in the author's opinion)

The colon will be very distended. It can be decompressed with a 18 gauge needle and gently lifted out on the abdominal wall. A plastic rod is through the mesentery and prevents retraction. The bowel is opened on the antemesenteric side.

A proximal diverting colostomy (loop, with transverse colon) is the safest approach, to be followed in about 2 weeks by resection of the identified lesion. The colostomy should be left to protect this anastomosis, and then closed several months later.

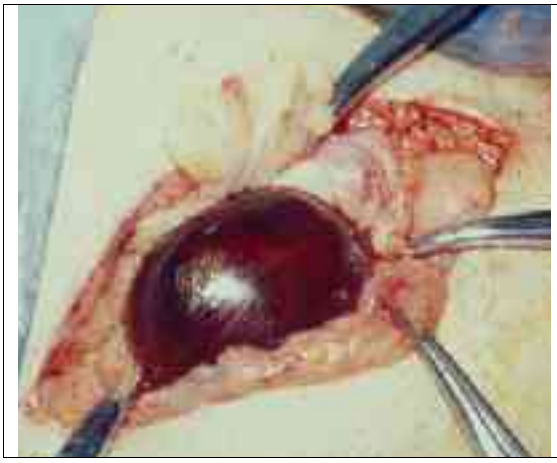
	Diverticulitis may closely mimic carcinoma. A tight stricture may be formed which will not resolve, and will still need resection.
	This completely obstructing cancer was resected 2 weeks after an emergency loop colostomy. The bowel is collapsed and empty, very easy to dissect and handle without risk.

	This man presented with a mass in the RLQ. The mass was an accumulation of dessicated vegetable matter. The problem was caused by a small, stenosing carcinoma in the ascending colon. Not all R colon lesions are bulky. A right hemicolectomy was performed.
	Carcinoma in transverse colon. It is circumferential but did not obstruct.

If the obstructive tumor is in the R colon, some "leeway" is given, as healthy, well vascularized small bowel can be anastomsed to a relatively empty L colon with an acceptable morbidity.

Short Cases with Questions for You

1.



A inguinal hernia was incarcerated. The sac was exposed and contained bloody fluid. The sac was opened and bowel of questionable viability was seen. During dissection, the bowel slipped into the abdominal cavity and could not be retrieved.

- What would you do?

2.

A tender mass appeared in the right inguinal area. It was painful and the patient presented two days later. Temperature and vital signs were normal. The abdomen was soft with no localized tenderness. An operation was undertaken.

- Strangulated bowel was found. Why was there no obstruction?
- What would have happened if surgery was further delayed?

3.

This massive incarcerated right inguinal hernia was found to contain a large segment of the greater omentum. It could not be reduced into the peritoneal cavity.

- What would you do?

4.

In this unusual case, the patient had many obstructive episodes. Eventually, an operation was performed. This dense band, compressing adjacent small bowel was discovered.

- From the appearances in the photo, in basic terms, what do you think should be done [operatively] in this case?

5.

This patient acutely developed abdominal pain, severe distention, and respiratory failure. He was too unstable to permit Xray evaluation. At operation, a sigmoid volvulus was found. The entire proximal small and large bowel was distended with gas. Distended gut has burst from the abd after the incision was made.

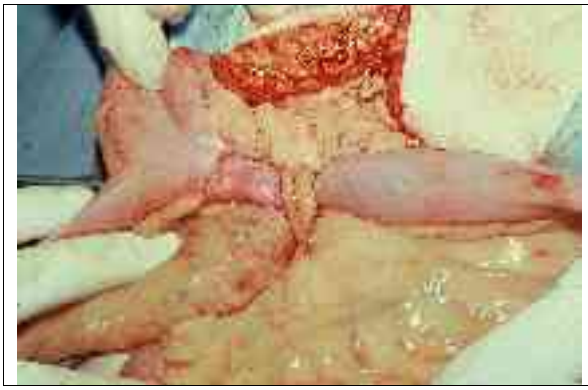
- Now what??

6.

Xrays demonstrated acomplete rectosigmoid obstruction. The colon was massively distended. The patient had bone marrow transplant previously, for AML. He is on immunosuppressive drugs. He is in the OR, ready for prep and drape.

- What procedure do you think would be the best option in this situation?

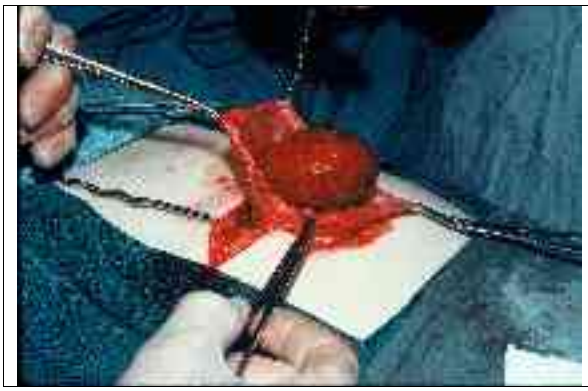
7.



The operative photo shows a fatty band compressing the terminal ileum. The patient gave a history of several months duration.

- Develop what you think would have been the History of Present Illness.

8.



This patient had a large, reducible umbilical hernia for many years. There were few symptoms. He was advised, by MDs, to leave it be. Finally, it suddenly became incarcerated. At operation, the sac was opened, revealing a congested, hemorrhagic loop of bowel. It will not reduce.

- What to do??

For feedback on your answers to the above problems look below the section on references.

References – Bowel Obstruction

Lawrence, Bell and Dayton, Essentials of General Surgery Third Edition

- Chapter 14: Small Intestine and Appendix (pp. 255-259)
- Chapter 15: Colon, Rectum, and Anus (pp. 284286)
- Chapter 11: Abdominal Wall, Including Hernia

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Oregon Health Sciences University: Radiology on Call (CT SBO)
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Emedicine: Small Bowel Obstruction
http://www.emedicine.com/EMERG/topic66.htm

homeearthlink.net: CT images and case of closed loop bowel obstruction
http://www.emedicine.com/EMERG/topic66.htm

University Hospitals of Cleveland: case of radiation enteritis with CT

scans
http://www.uhrad.com/ctarc/ct176.htm

Feedback on short questions

1. Unfortunately, this adverse event will make it necessary to open the abdomen through a lower midline incision. This may increase the elderly patients morbidity, but the strangulated section of bowel absolutely must be located and its viability assessed.

2. This strangulated femoral hernia was not obstructing, as only the antemesenteric portion of the bowel was involved [Richters hernia] If the strangulated bowel became necrotic a fasciitis of the proximal thigh and lower abdomen would commence-likely to a fatal conclusion.

3. No amount of pushing, poking and prodding will reduce this mass of edematous and congested omentum, Resect it, being careful to ligate all vessels securely; do not take too much tissue in each tie.

4. Of course, divide the band. The bowel has been compressed by it for so long it is very scarred and strictured. The symptoms of obstruction may not be relieved unless a resection is performed.

5. There is patchy gangrene of the sigmoid; a sigmoid resection and end colostomy, with closure of the rectal stump [Hartman procedure] is the procedure. Closure of the incision will be a struggle. Opening the bowel in the operative field to ”suck it out” may cause disastrous soilage; having had the forsight to place a rectal tube would allow some decompression of the colon before resecting the sigmoid.

6. Loop colostomy in the tranverse colon!

7. Long history of repeated episodes of cramping pain, nausea, distention; loud borborygmi. Maybe gradual weight loss or multiple ER visits? X-rays not helpful unless done during an acute episode.

8. Hernias with large sacs and small, rigid abdominal defects are “high risk”; the patient received poor advice. To free the bowel, carefully slip the end of a curved forcep [Lauer]under the edge of the defect and incise the linea inferiorally. Once the defect is large enough, the mesentery and gut should be decompressed-check the bowel wall where it caught in the fascial ring-necrosis due to direct pressure can occur.