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MEDICAL GRAND ROUNDS

INTESTINAL PSEUDO-OBSTRUCTION

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Case Report

T.H. is a 7-1/2 y/o BF who has suffered from severe constipation since birth. During the first year of life, milk of magnesia was added to each bottle of milk for constipation. Subsequently she improved somewhat and apparently did well until 1974 when she was 4 years old.

In 1974 she developed chronic urinary tract infection and workup revealed dilated urinary bladder with some dilatation of both ureters. She was dilated but recurrent attacks of urinary infection persisted.

In February 1975, she developed acute abdominal pain, distention and vomiting. At surgery she was reported to have malrotation and a small bowel volvulus. In addition she also had unexplained dilation of both large and small bowel. A Ladd's procedure was done. Post-operatively she did very poorly and continued to have massive abdominal distention with NG drainage of over 1500 ml/day.

Two weeks later she was transferred to Children's Medical Center at Dallas. At that time adhesions and partial obstruction of the third portion of the duodenum were diagnosed and she had a second operation. Gastrostomy was performed for NG drainage and a jejunal tube was placed for feeding. She continued to drain large volumes of gastric contents, but in 3 weeks was able to tolerate clear liquids by mouth and tubes were pulled out and she was discharged.

In the next 2 years she had approximately five admissions to the Corsicana hospital for abdominal distention, vomiting and dehydration. Each time the acute episode responded to 5-7 days of nasogastric suction, I.V. fluids and other supportive therapy.

In January 1977 she was readmitted again to CMC at Dallas with severe volume loss (BUN of 78) hypokalemia (K - 2.1) and carpopedal spasm (Ca - 5.2; alb.- 3.0). Gastric losses ranged between 1500-3500 ml per day. X-rays were consistent with a colon volvulus and a third operation was performed. At laparotomy the entire small bowel and colon were described as massively dilated and thin. The colon had herniated around the gastrostomy site but was not obstructed. A full thickness biopsy of the bowel was performed and it was reported as normal. A diagnosis of intestinal pseudo-obstruction was now quite obvious. She was placed on central HAF feeding for 3 weeks. She survived the many complications of the central HAF and began to tolerate fluids. She was put on Mestinon 4 mg/k/day and was discharged after 1½ months of hospitalization.

She continued to have problems with intermittent abdominal distention and vomiting. She was usually handled at home, but required 5 more hospitalizations for severe problems with dehydration. One of her hospitalizations was for two months.

Her total hospital bills so far have exceeded $250,000.

She continues to have problems with abdominal distention with discomfort and vomiting. She is very intolerant to milk and milk products. Tracy discovered that beans do not agree with her. She has a bowel movement every 3-4 days, but the stools are never hard. They are usually mushy, malodorous and sometimes loose. She has no dysphagia. Her growth is retarded (bone age is 2 years retarded). She denies Raynaud's phenomenon.

On physical exam, she is intelligent. Her abdomen is large and her limbs are thin. She has no abdominal tenderness. Bowel sounds are audible and low pitched, except during acute episodes.

Her family history is remarkable in that her mother has occasional constipation and her maternal aunt has difficulty in swallowing.

Lab:

Abdominal X-rays: Hugely distended small bowel, stomach and colon, frequently with air fluid levels. Severity of distention of different parts of gut differ at different times.

Barium studies: UGI shows dilated stomach with poor gastric emptying, dilated duodenum - mostly second and third parts,with apparent narrowing of the distal transverse duodenum. Dilation of jejunal and ileal loops. The mucosa is not edematous and the transit time from stomach to cecum is markedly prolonged (>24 hours). Barium enema showed massively dilated colon with lack of haustral markings.

Esophageal motility: Lack of peristaltic wave. Normal LES pressure and relaxation.

Small bowel motility:

Duodenal cultures revealed 10^4 aerobes: Anaerobe cultures were not done.

Flatoanalysis has not yet been done. Thyroid functions are normal. Prostaglandin E levels are within normal limits.

Other lab studies show fluctuating levels of nutritional deficiency states which are now reasonably well controlled with nutritional supplements.

She is on milk-free, carbohydrate-restricted diet, multiple vitamins, iron and other supplements. She is also on Mestinon 4 mg/kg/day and Tracy exercises for abdominal gas.

The purpose of my presentation is to share with you the frustrations and the feeling of helplessness that we had - (and still have) and the lessons that we have learned in understanding the disease processes and the management of Tracy's disease.

WHAT IS A PSEUDO-OBSTRUCTION SYNDROME?

As the ingested food is digested and absorbed, it is also transported aborally and finally the residue is expelled out as feces. A mechanical occlusion of the lumen of the gut naturally hinders the aboral propulsion and the condition is called mechanical obstruction. Furthermore, since aboral propulsion requires very complex motor activities or the propulsive force proximal and the inhibition of activity distally, derangement of motor activity can also lead to impaired propulsion. These motility disorders could be classified as pseudo-obstructions. Thus achalasia of the esophagus and scleroderma of the esophagus would be types of pseudo-obstruction. Similar pseudo-obstructions occur in stomach as in gastroparesis or gastric atony. A variety of lesions that produce constipation and megacolon could also be classified as pseudo-obstruction.

The term pseudo-obstruction, however, is more frequently used in relation to small intestines, where it is called intestinal pseudo-obstruction syndrome. Furthermore, acute and transient motor disorders of the small bowel such as paralytic ileus more appropriately called inhibition ileus, are forms of pseudo-obstruction, but the term pseudo-obstruction syndrome when used without qualification refers to the chronic forms of the syndrome.

Chronic Intestinal Pseudo-obstruction Syndrome (CIPS) is thus a syndrome of chronic or intermittent episodes of symptoms and signs simulating either complete or partial small bowel obstruction in the absence of actual organic obstruction of the intestinal lumen.

It should also be emphasized that chronic intestinal pseudo-obstruction syndromes are usually generalized disorders involving other parts of the gut such as esophagus, stomach and colon. Sometimes involvement of these organs may predominate the clinical picture.

CONSEQUENCES OF INTESTINAL PSEUDO-OBSTRUCTION

Any condition, true obstruction or pseudo-obstruction, that impairs the transport of the luminal contents produces similar consequences. The events are dependent upon the duration of the disease, degree of pseudo-obstruction or obstruction, and the level of the intestine that is involved.

The main consequences are:

1. Collection of gas and fluid
2. Bacterial overgrowth
3. Changes in the bowel wall (mucosal atrophy, ischema and edema)
4. Malabsorption and malnutrition

1. Collection of gas and fluid:

Collection of gas

Under normal circumstances, the gastrointestinal tract of man, in the fasting state, contains a small amount (∿ 150 ml) of gas. ∿ 50 ml of gas is normally present in the stomach. The location of this gas varies with posture; in the upright position it collects in the fundus; in supine position it may outline the whole stomach; and in the left lateral decubitus film gas moves to pylorus and antrum.

Duodenal bulb also may contain gas normally as seen in upright position. It is also well seen in left lateral decubitus film as the gas from stomach may enter it and in this position gas may stay in descending duodenum. Small air fluid level is a normal finding in duodenal bulb. Small bowel usually contains no gas, except during its transit. Only temporarily, then gas is present in small bowel. Terminal ileum may temporarily contain some gas and fluid and small fluid level may be seen. If there is no gas at all in small bowel, loops are not be visible. Colon and rectum contain ∿ 100 ml of gas.

The "residual" (150 ml) gas in the gut in the fasting steady state is the balance of the input and output of liters of gas in the gut under normal circumstances. Intestinal gas is derived from:

1) Swallowing of atmospheric air. It is estimated that with each swallow 2-3 ml of air is ingested. In 24 hours this amounts to several(∿ 2-3) liters of air. The swallowed air contains N and O . N is not absorbed in the gut. It is eliminated by eructation or passed out as flatus. It is estimated that under normal circumstances around 50% of the gas in the bowel is derived from swallowing.

Most of the swallowed air is collected in the stomach, trapped in the fundus and is belched out. In the supine position or in left lateral decubitus the swallowed air is expelled into the small bowel. The N in the swallowed air is not absorbed in the gut and is transported to the colon and finally expelled as flatus.

2) CO_2 is produced by the action of acid gastric juice with bicarbonate in the pancreatic secretion. It is estimated that around 6 liters of CO_2 may be produced per day by this process. After a meal, however, additional fatty acids produced during digestion may generate even more CO_2. Fortunately, however, CO_2 is very rapidly diffused into the blood. Normally, no CO_2 from this source reaches the colon.

3) Fermentation of food material by bacteria: Normally this occurs only in the colon, but in the presence of bacterial overgrowth in the small bowel, considerable amounts of gases may also be produced. Carbon dioxide, H and methane are produced. Schwartz noted that decomposition of 100 gm to cellulose produced 19.5 liters of CO_2, 7.5 liters of methane and 4 liters of H . Fermentation of carbohydrates in causing excessive gas is well known. Similarly, lactose deficient patients produce large volumes of intestinal gas. In one

lactose intolerant subject rectal gas output was 1380 ml/hr.

4) Diffusion of gases between lumen and blood: gases passively diffuse between lumen and mucosal blood. H and CH_4 always diffuse from lumen to blood. Addition of other gases to swallowed air reduces the partial pressure of nitrogen in the gut. Consequently, nitrogen diffuses from blood into gas phase in the gut. $\sim$ 500 to 1000 ml of N may be added to bowel lumen in this way.

Normal subjects pass 400-1600 cc gas per rectum per day, and 12-60% of this is constituted by nitrogen.

In patients with small bowel obstruction, almost 72% of the gas is derived from swallowing. Nitrogen is the main constituent (70%). It is important to reemphasize that N is not properly absorbed, and therefore it stays in the lumen unless aspirated by suction.

Collection of Fluid

Under normal cicrumstances, 5 to 10 liters of fluid derived from food and drink and from salivary, gastric, pancreatic, biliary and intestinal secretion enter the small intestine. Most of this fluid is absorbed, and roughly 1 liter reaches the cecum. In the presence of obstruction, depending upon the site, the absorptive surface is reduced and fluid accumulates. Accumulation of fluid and gas further enhance secretion of gastrointestinal secretions, causing further collection of fluid in the lumen. Distention of the bowel also impairs mucosal circulation leading to edema and large losses of fluid in edema of the gastrointestinal wall.

In high obstruction, vomiting is a prominent feature. Losses of gastric juice lead to hypochloremic alkalosis. If the stasis is below the entrance of the biliary and pancreatic secretions, electrolyte content of the vomitus would be similar to that of plasma.

When the pseudo-obstruction is in the lower part of the small bowel, it is not possible to empty the small intestine without artificial help. The continuous distention has deleterious effects on the bowel wall. Moreover, the massive quantities of fluid that may be sequestered in the lumen and the wall of the bowel produced severe alterations in fluid and electrolyte balance in the body.

2. Bacterial Overgrowth:

Normal motor activity of the small bowel is essential to keep it essentially free of bacteria. Normally, total bacterial counts are $0\text{-}10^3$ in the stomach, $0\text{-}10^4$ in the jejunum, $10^5\text{-}10^8$ in the ileum and $10^9\text{-}10^{12}$ in the cecum. Anaerobes are not normally present in the jejunum. Bacterial overgrowth in the bowel occurs in all types of mechanical (both complete and incomplete) obstructions,

as well as stasis due to motor disorders. In these patients, jejunal bacteria resemble that found in the colon or feces.

Bacterial overgrowth is more marked when the functional obstruction is in the distal segments of the small bowel. In the complete mechanical obstruction, bacterial overgrowth is responsible for the feculent vomiting. In partial small bowel obstruction (due to adhesions, tuberculous stricture or Crohn's disease), bacterial overgrowth contributes to steatorrhea and anemia.

Patients with stasis syndrome also have marked bacterial overgrowth, and this undoubtedly contributes to and may be largely responsible for steatorrhea, anemia and diarrhea.

3. Changes in the Bowel Wall:

Distention due to accumulation of gases and fluid causes an increase in intraluminal pressure, as well as an increase in the diameter of the bowel lumen. These changes have the effect of magnifying the tension in the bowel wall. These changes are also associated with reflex vasoconstriction and bowel ischemia, which in turn may lead to bowel wall edema. Moreover, bacterial overgrowth may produce mucosal changes of atrophy.

4. Malabsorption:

Malabsorption results from the following causes: a) bacterial overgrowth; b) unstirred water layers; c) mucosal atrophy; and d) ischemia of the bowel. Malabsorption may contribute to diarrhea that these patients have. Malabsorption also causes nutritional deficiencies.

PATHOGENESIS OF INTESTINAL PSEUDO-OBSTRUCTION

The central problem in this syndrome is ineffective motor activity, causing impaired propulsion of food in the aboral direction. However, an understanding of the reasons for impaired propulsion has been limited because of ignorance of normal mechanisms involved in normal propulsion.

1. Law of peristalsis (peristaltic reflex): Starling performed studies in vitro with segments of small bowel and showed that distention of the lumen with a balloon caused a wave of contraction proximal to the balloon and inhibition distal to the balloon. He also showed that this sequence traveled aborally, transporting the balloon distally with it. This is called the peristaltic reflex. The wiring diagram of the neurons that execute this reflex are complex and still unresolved. A simple version is shown on the next page.

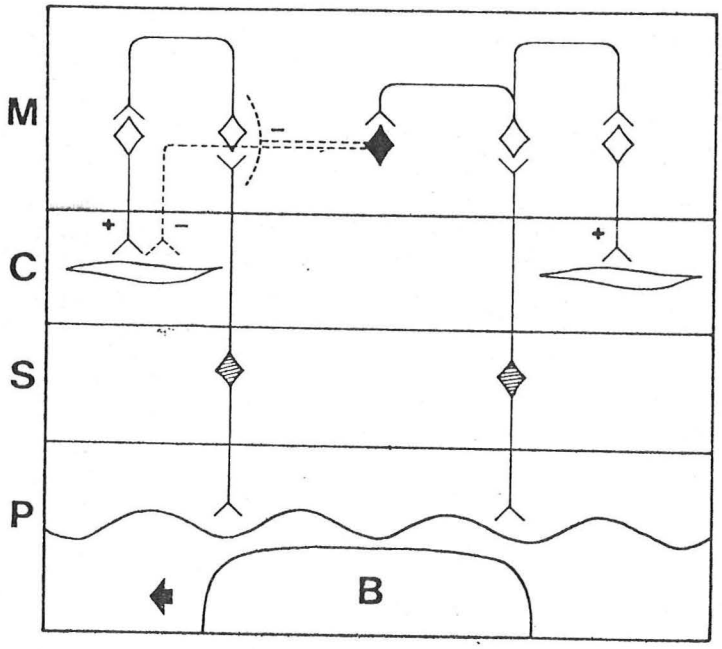


Fig. A very simple scheme of the neurons involved in peristaltic reflex.

Peristalsis clearly occurs in the esophagus. It was assumed that food bolus in the small bowel is also transported by peristaltic wave. But this was not found to be so at all. If it were so, separate boluses of a meal delivered in the small bowel will be transported to the cecum, like a non-stop train of well separated, independent boluses. Such a process in the small bowel would be unsuitable for its digestive and absorptive function, and this simply does not occur.

Moreover, peristaltic reflex is impossible to demonstrate in vivo. If a balloon is distended in the small bowel, it causes no peristaltic reflex, but instead it causes marked inhibition of existing intestinal activity. This intestino-intestinal inhibitory reflex is mediated by the sympathetic nerves.

2. In order to investigate propulsive small bowel activity, several investigators performed intraluminal manometric studies just like we do for the esophagus. These studies showed completely irregular and chaotic pattern of contraction in the fasting and fed state.

3. In more recent years, prolonged continuous electrical or mechanical recording of small bowel have been done. These studies have revealed very interesting temporal or spacial patterns of activity. Distinct patterns of activity are seen during fasting state and after ingestion of a meal.

4. The migrating myoelectric complex: This complex is a continuous burst of rhythmic contractions (lasting $\sim$ 10 min) at a single point in the gut. This starts in the stomach or duodenum and migrates aborally and ends at the terminal ileum. This complex cycles itself every 1-1/2 hours. This complex

is propulsive, and if barium is placed, during manometric studies, in front of the complex, the barium is swept by the complex down the small bowel. This complex has been called the interdigestive housekeeper of the small bowel. It provides a cyclic cleansing or propulsive mechanism in the small bowel.

Feeding causes an abrupt disruption of this complex. After feeding, migrating complex may not appear for 4-6 hours. In the fed state, the small bowel shows irregular isolated contractions that represent segmental contractions of the gut. These contractions mix and spill the bolus both forwards and backwards. Sometimes short propulsive forms occur that transport the bolus for short distances. Thus, during the digestive period food moves aborally by mere spillage by the segmenting contractions. This mechanism allows the food to stay in the small bowel for an extended period of time to allow for absorption.

Does your bowel have a complex? Yes. Migrating myoelectric complexes have recently been shown to be present in human small bowel.

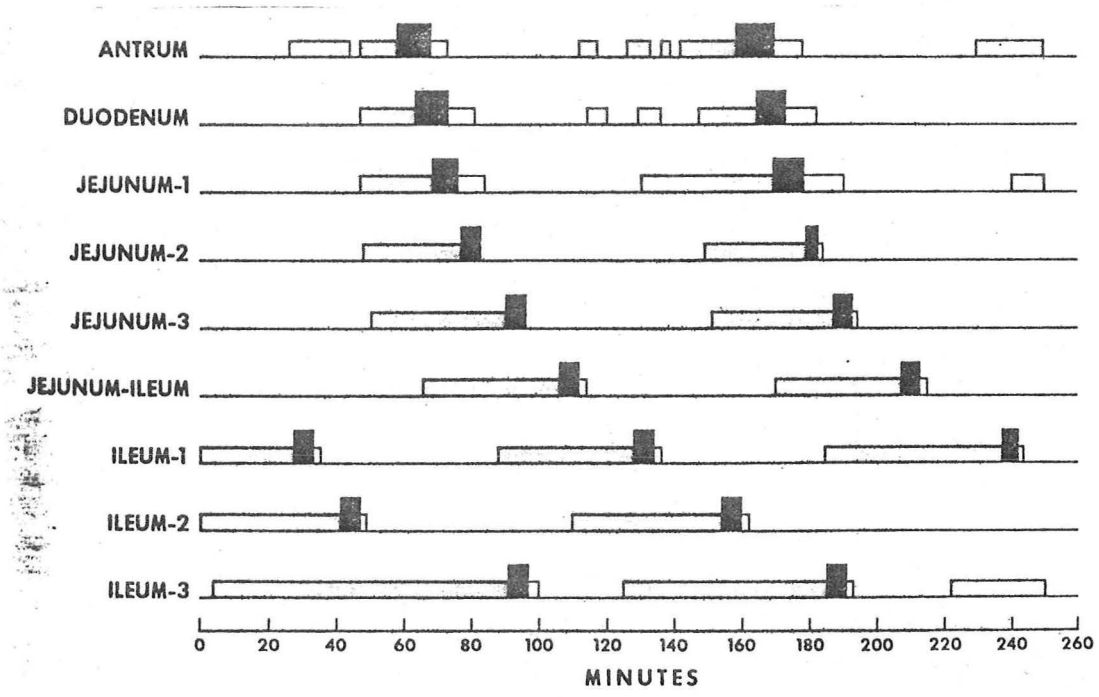


Fig. Migrating myoelectric complex in a fasting dog. Solid bars show the complex as it migrates down the bowel. New complex starts as the previous one reaches the end of its journey to the terminal ileum. (Code: Am. J. Physiol. 246:289, 1975)

5. Neural control of gut activity: The enteric nervous system is a distinct minibrain of the gut, and the neurons in myenteric plexus are not mere postganglionic neurons in the parasympathetic (vagal) pathway. This system has complex circuitary with many different types of neurons: a) Some are excitatory, and others are inhibitory. Some are sensory, and yet others are integrative. b) They release many different types of transmitters, including polypeptides (such as VIP), and they all are not cholinergic as is usually implied.

   The function of this system is to organize a meaningful activity of the gut. However, rhythmic localized contractions can go on in their complete absence. The ability of rhythmic contractions resides directly in the smooth muscle of the gut. This is like cardiac muscle and unlike skeletal muscle.

   The overall influence of the nerves on the small bowel is excitatory and on the colon it is inhibitory.

6. Pseudo-obstruction will result if: a) muscle contraction is weakened because of a disorder of muscles or if it is inhibited by nerves or circulating hormones or drugs. These patients will show poor contractions in the small bowel.

   b) Absent or abnormal or interrupted migrating myoelectrical complexes: This may result from dysfunction of myenteric neurons due to the disease or secondary to the influence of hormones or drugs. These patients may show good amplitude of contractions (indicating good muscle strength), but abnormalities in migrating myoelectric complexes. It is interesting that recently abnormal migrating complexes in the gut have been reported in some patients who had bacterial overgrowth in their gut.

   c) These abnormalities may be generalized or even localized to a small segment. However, clinical consequences may be similar, i.e., pseudo-obstruction. The localized defect type of cases may have several features suggesting mechanical obstruction.

   d) In the final analysis, we would need to find the specific neurons in the complex circuitry that are diseased and also the step of the neurohumurol transmission at which the disruption in function has occurred.

   Remember Murphy's Law: "Anything that can go wrong will go wrong."

   In summary, it is clear that the concepts that may help decipher the pathophysiology of pseudo-obstruction syndrome have been born, but they are only in their postnatal period. And there is a long way to go!

CLINICAL FEATURES OF INTESTINAL PSEUDO-OBSTRUCTION

1. Distribution of organ involvement is variable in different types of pseudo-obstruction syndromes. In a full-blown case, the esophagus, stomach, small bowel and colon are all involved.

   Esophageal involvement produces dilation, lack of peristaltic contractions and weak contraction in the lower part of the esophagus. The lower esophageal sphincter may be hypotonic, or it may show failure of relaxation as in achalasia. These patients may complain of dysphagia. In certain pseudo-obstruction syndromes, esophageal involvement is early and frequent.

   Gastric involvement causes gastric atony, dilation and stasis. These patients have to be distinguished from pyloric obstruction. They present with epigastric fullness and discomfort, nausea and vomiting. Sometimes they receive a diagnosis of psychogenic vomiting.

   Small bowel involvement is most frequently manifested as megaduodenum with dilation of descending and transverse duodenum with an abrupt cutoff of barium at the level of the spine in a supine x-ray. These cases are misdiagnosed as superior mesenteric artery syndrome or other types of mechanical obstruction.

   Colon involvement is very common. Sometimes the colon is involved extensively even in the absence of the small bowel involvement. These cases have been called megacolon in the past. Recently, there is a tendency by some investigators to call these cases colonic pseudo-obstructions.

2. The course of the syndrome is variable. Acute transient syndromes with short duration occur in adynamic ileus. In these cases, the secondary cause of ileus is usually obvious. The chronic and recurrent types present with evidences of mild,continuous symptomatic involvement with episodes resembling acute obstruction or acute adynamic ileus.

3. The clinical features and laboratory findings vary with the severity of small bowel involvement:

   a) Mild involvement: It may be completely asymptomatic, and abnormalities are detected on barium studies or on other investigations. Sometimes these patients have bacterial overgrowth in the bowel, and they may present with anemia, steatorrhea, diarrhea and other features of malabsorption syndrome. With colon involvement, they have chronic constipation. Frequently they have alternating constipation and diarrhea and steatorrhea.

   b) Moderate involvement: These cases have clinical features that resemble low grade obstruction. They complain of added distention, discomfort after eating, nausea and vomiting, and constipation and/or diarrhea. They usually show megaduodenum, and they may be diagnosed as superior

mesenteric artery syndrome or partial duodenal obstruction.

c) Severe forms of the syndrome present with a picture resembling acute intestinal obstruction or adynamic ileus. During such presentation, surgery may be done because of fear of acute obstruction or acute abdomen. Usually the severe episodes occur on the background of history or other features of mild or moderate symptoms.

Symptoms and signs of a severe case: These patients complain of abdominal distention and discomfort. Frequently there is no real pain. The presence of excessive pain and intestinal colic is more suggestive of actual mechanical obstruction. They also have nausea and vomiting.

These patients are usually constipated, but the stools are seldom hard. Instead, they are usually mushy or even loose, but they are passed infrequently. They are usually malodorous, and they may contain excessive amounts of fat (steatorrhea). Frequently episodes of diarrhea alternate with those of constipation. They usually pass large amounts of flatus, although infrequently. These features are of great help in distinguishing these patients from those with bowel obstruction.

Nutritional deficiencies and electrolyte imbalances may be severe in these patients because of losses and malabsorption.

Physical exam usually reveals marked distention, but rebound tenderness is usually absent. Bowel sounds are absent, reduced, or they may sometimes be increased and simulate mechanical obstruction. Great attention should be applied to the clinical examination if unnecessary surgery is to be avoided in these patients.

RADIOGRAPHIC FINDINGS

Abdominal X-rays:

Plain films of the abdomen are of great value in the diagnosis of these patients. Radiographic features of an acute episode of chronic pseudo-obstruction or of acute transient ileus are similar, and they cannot be distinguished from each other. The major task is to distinguish pseudo-obstruction from true mechanical obstruction.

The following points should be considered:

i) Demonstration of air fluid levels

ii) Distribution of distended loops

iii) Character of the dilated loops

iv) Edema of bowel wall

i) Air Fluid Levels:

a) Marked gaseous distention, but without any air fluid levels are seen in:

1. Children
2. Aerophagia, following endoscopy
3. Lactose intolerance
4. Megacolon
5. X-rays in supine position in obstruction or ileus

b) Fluid levels can be detected only if the x-ray beam passes horizontal to the bowel loops, e.g., in an upright position or in right or left decubitus films. Such films must be obtained for proper evaluation in suspected cases.

c) Air fluid levels of no clinical importance occur in the following:

1. Gastroenteritis and severe diarrheas
2. Ingestion of magnesium sulphate and irritant cathartics
3. Administration of an enema
4. Normally in: stomach, duodenal bulb and rarely in terminal ileum

d) Frimann Dahl suggests that fluid levels at the same height in a loop indicated ileus, whereas levels at different heights indicated mechanical obstruction. This is not so, as different heights of levels are also seen in adynamic ileus.

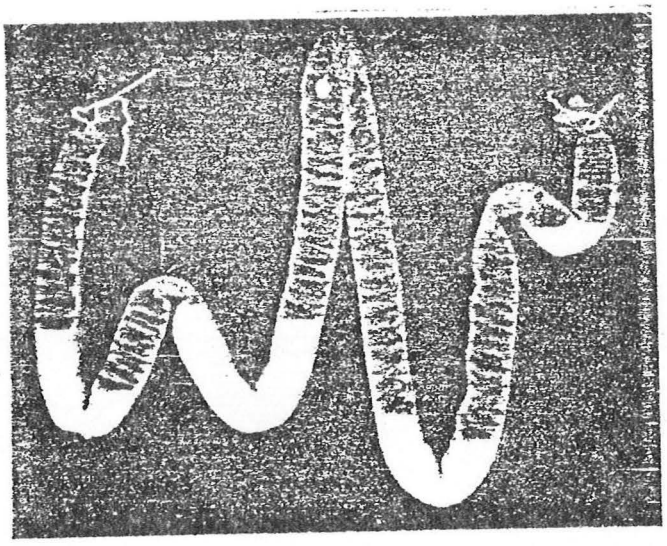


Fig. Fluid (barium) level at different heights in bowel loops in atonic small bowel removed at autopsy. (Lasser, 1967)

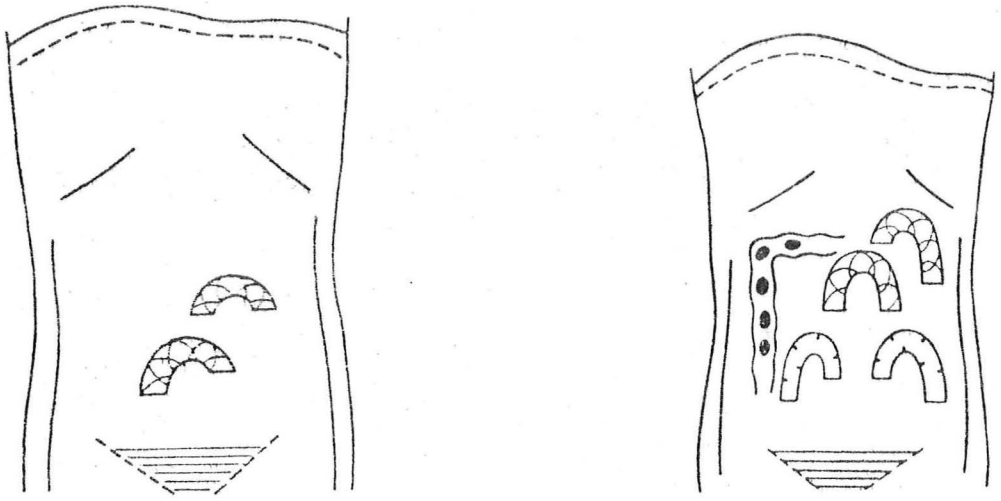
ii) Distribution of Distended Loops:

a) Identification of different bowel loops: The small bowel loops are usually multiple and small and are usually located in the central part of the abdomen. The jejunal loops may show a feathery pattern, and ileal loops show uniformly placed circular shadows that encircle the entire bowel wall. When the distention is marked, however, and the calibre reaches 3 to 5 cm, the wall becomes parallel and contourless.

The colon loops are characterized by haustrations which are irregular and incomplete constrictions of the bowel wall. The haustra are easily identified on gas filled colon. Haustra also disappear when the colon is massively dilated for a long time. However, in contrast to the small bowel, colon dilation of 3 to 5 cm still reveals haustral markings. Sometimes plica semilunaris are visible as small bands nearly reaching each other from the other side of the colon wall. When this happens, the appearance may simulate small bowel. Sometimes a longitudinal density corresponding to teniae coli may be seen.

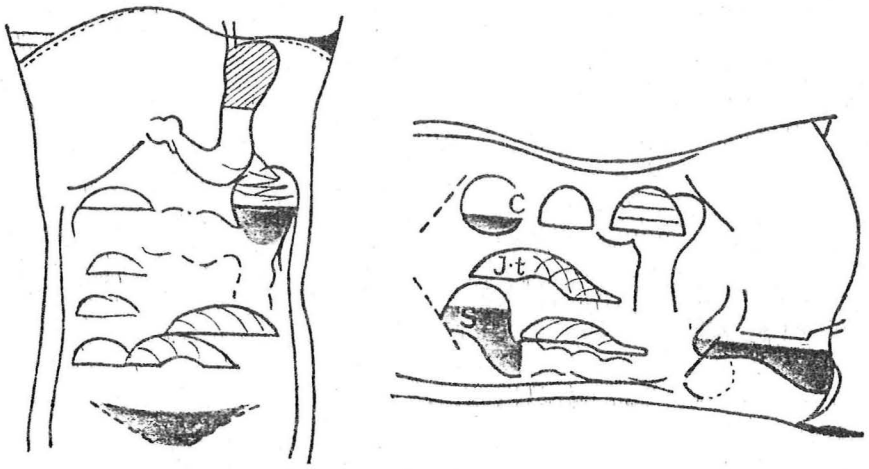
b) Distribution of distention and air fluid levels:

Distention and/or Air Fluid in	Pseudo-obstruction or Ileus	Mechanical Obstruction
Esophagus, stomach small bowel, colon and rectum	Diagnostic	Essentially excluded
Stomach, small bowel, colon and rectum	Most likely	If mechanical obstruction, there must be associated ileus
Small bowel, colon and rectum	Most likely	"
Small bowel and colon	May be	Distal colon obstruction with incompetent ileocecal valve
Colon only	Megacolon	Distal colon obstruction
Small bowel only	Unlikely, except 1) localized ileus 2) megaduodenum	Small bowel obstruction most likely



A B

Fig. Mechanical obstruction: air fluid levels in small bowel only. (A) no gas or air fluid levels in colon. (B) small amount of gas and feces in colon.



A B

Fig. Pseudo-obstruction or ileus: Air fluid levels in the stomach, small bowel and colon. (A) upright. (B) lateral decubitus. (From Frimann-Dahl)

iii) Character of Dilated Loops:

Hoop-shaped loops of small bowel with hairpin turns and short fluid level generally suggest mechanical obstruction, whereas atonic flaccid flattened loops with long fluid levels that tend to come confluent suggest adynamic ileus. In

some patients with overlapping loops that are hugely dilated, the x-ray appearance may simulate volvulus. Several patients with pseudo-obstruction were operated because of diagnosis of volvulus.

iv) Edema of the Bowel Wall:

Edema of the bowel wall is suggestive of associated vascular ischemia or inflammation. In pseudo-obstruction the bowel wall is thin, In fact, such dilated thin-walled loops can be mistaken for free intraperitoneal air.

v) Pneumatosis Cystoides Intestinalis and Air in the Bowel Wall:

Air in the bowel wall is suggestive of necrosis of the bowel wall associated with ischemic bowel disease. Air in the bowel wall may also be a benign condition, as in some patients with intestinal scleroderma. Generally, small segments of air in the wall is more serious, as it is usualy associated with bowel necrosis.

vi) Free Air in the Peritoneum:

Free air in the peritoneum is an ominous sign and suggests bowel perforation. Proper films must be obtained (i.e., using horizontal beam and proper centering to show free air. In the supine films, free air should be suspected when the outside of the bowel loop is clearly demonstrated.

In massive dilations with thin-walled bowel as in pseudo-obstruction, a mistaken diagnosis of free air under the diaphragm may be made.

RADIOPAQUE MARKER TRANSIT STUDY

Radiopaque markers (1-2 mm thick circles cut from a radiopaque Levin tube) can be used to study the transit through the gut. The patient ingests 20 such markers, and the progress of these markers is followed by a daily film of the abdomen. In obstruction, the marker will accumulate at the site of obstruction, but in pseudo-obstruction they may be widely distributed in the gut and progress slowly.

BARIUM STUDIES

1. Barium Swallow and Uppper GI with Small Bowel Follow-Through:

   Esophagus may be dilated and show poor peristalsis. The stomach may show dilation and gastric stasis. The duodenum, particularly the descending and part of the transverse duodenum, is dilated, and there is apparent cutoff of barium at the level of the spine. These patients are diagnosed as duodenal obstruction due to superior mesenteric artery - the so-called superior

mesenteric artery syndrome.

Jejunal loops may also be dilated. The mucosal folds are usually thin but may be thickened. Small bowel loops over 3 cm can be considered as dilated.

Small bowel transit time: In normal persons, the small bowel transit time, i.e., the time taken by a bolus of barium from the stomach to reach the cecum, varies from 15 minutes to 5 hours. It is also highly variable in the same person from one day to the next. In order to determine the transit time, x-rays are taken at one-half hour intervals. What is interesting is that the progress of the barium through the small bowel is not uniform and steady. Instead, it is found that barium will move very little for some time, and then all of a sudden it is swept down the small bowel. This transport of barium is most likely related to migrating myoelectric complex in the small bowel.

In any event, transit time is considered to be abnormal only when it is delayed over 5 hours. Moreover, many frequently used medications such as anticholinergics, narcotics and antihypertensive drugs tend to prolong the transit time. However, under these circumstances, the small bowel is usually not dilated. Delayed transit time with dilated small bowel is seen in pseudo-obstruction syndrome.

2. Consideration of Contrast Studies in Evaluation of Intestinal Pseudo-Obstruction:

If colon, particularly the right side and transverse colon, is dilated, barium enema is usually necessary to exclude large bowel obstruction.

If, however, there is no colon dilation and small bowel obstruction is to be excluded, it may be best to instill barium ($\sim$ 200 ml) through the nasogastric tube or a Miller-Abbott tube that may already be in position. This technique avoids problems with prolonged stasis of barium in the stomach.

The contrast agent of choice is suspension of barium sulphate. There is no evidence that barium suspension would inspissate and convert partial small obstruction into a complete one. Water soluble, iodinated contrast materials are not useful because of their dilution. Indeed, use of water soluble contrast materials may be hazardous, because these agents are hyperosmolar, and they draw further fluid in the lumen. These agents should not be used in evaluation of small bowel pseudo-obstruction.

The major problem with barium is that because of slow transit time it may stay in the abdomen for a long time. Such a stasis interferes with other investigations such as an angiography if it is necessary for ischemic bowel disease or any other lesion. Moreover, some fear the problem arising for leak of barium in the peritoneal cavity due to bowel perforation, or at the time of surgery should the surgery become necessary. Therefore, barium studies in these patients, during the acute episode, should be done only

after careful consideration.

In contrast to mechanical obstruction, which should not show dilated bowel loops distal to the presumed obstruction, the most characteristic finding of pseudo-obstruction is generalized dilation with dilated bowel loops even distal to the presumed obstruction.

FINDINGS AT SURGERY

At surgery, bowel is found to be dilated and thin-walled. The dilation is most marked in the upper small bowel and distally the bowel assumes normal calibre. Stomach may also be dilated, but colon is frequently dilated and thin-walled. In some cases, volvulus is noted to be present, but it appears to be nonobstructive, and there is no luminal occlusion.

MEGACOLON: COLONIC PSEUDO-OBSTRUCTION

Some observers have used the term pseudo-obstruction to describe what was called megacolon in the past. Although there is nothing conceptually wrong with the usage of the term pseudo-obstruction, it has caused unnecessary confusion. The term intestinal pseudo-obstruction should not be used to describe cases of isolated megacolon.

The causes of megacolon include:

1) Associated with other systemic diseases: These diseases are essentially the same as those that cause intestinal psuedo-obstruction. Particularly: laxatives, clonidine, thorazine, and other drugs; neurological disorders.
2) Toxic megacolon: Associated with inflammatory bowel disease.
3) Hirschsprung's disease and related disorders: Aganglionosis, hypoganglionosis, hyperganglionosis.
4) Ganglioneuromatosis
5) Spinal cord lesions, paraplegia, cauda equina lesions
6) Primary megacolon: Psychogenic; as a part of primary intestinal pseudo-obstruction syndrome.

Ogilvie reported two patients with abdominal symptoms that mimicked mechanical obstruction who had encasement of sympathetic plexus by a carcinoma. He thought colonic obstruction was due to sympathetic denervation. These findings have not been substantiated.

DISEASES ASSOCIATED WITH TRANSIENT, INEFFECTIVE PROPULSION (ADYNAMIC ILEUS; INHIBITION ILEUS; PARALYTIC ILEUS; TRANSIENT PSEUDO-OBSTRUCTION)

1. Peritonitis and intra-abdominal inflammations such as cholecystitis, pancreatitis, appendicitis and intra-abdominal abscess
2. Post-surgery
3. Gram positive sepsis
4. Abdominal trauma, retroperitoneal hemorrhage
5. Spinal injury
6. Severe inflammatory bowel disease, viz, ulcerative colitis, granulomatous colitis, pseudomembranous colitis, amebic colitis
7. Bowel ischemia: CHF, shock, hypoxia
8. Electrolyte imbalance: hypokalemia, hypochloremia, calcium and magnesium abnormalities
9. Renal failure
10. Drugs: anticholinergics, ganglionic blocking agents, anti-Parkinsons drugs and narcotics
11. Unrelieved mechanical obstruction

DISEASES AND CONDITIONS ASSOCIATED WITH CHRONIC OR RECURRENT INEFFECTIVE PROPULSION AND PSEUDO-OBSTRUCTION SYNDROME

A. <u>Secondary</u>:

1. Collagen Vascular Disease:
   - Scleroderma
   - Systemic lupus erythematosus
   - Dermatomyositis
   - Polymyositis
2. Myopathies:
   - Myotonic dystrophy
   - Progressive muscular dystrophy
3. Neurological diseases:
   - Dysautonomic disorders
   - Parkinson's disease
   - Chaga's disease

4. Endocrine and Metabolic Disorders:

   Hypothyroidism
   Pheochromacytoma
   Hypoparathyroidism
   Diabetes mellitus
   Acute porphyria

5. Infiltrative diseases:

   Amyloidosis

6. Drugs and Poisons:

   Phenothiazines
   Tricyclic antidepressants
   Anti-Parkinsonian medication
   Antihypertensives: Clonidine, ganglionic blocking agents
   Vincristine
   Laxative abuse
   Lead
   Narcotics

7. Miscellaneous:

   Non-tropical sprue
   Brown bowel syndrome (ceroidosis)
   Jejunoileal bypass
   Jejunal diverticulosis
   Psychosis

COLLAGEN VASCULAR DISEASE

Scleroderma:

1. Scleroderma is a frequent cause of intestinal stasis, causing a variety of symptoms. Out of the collagen vascular disorders, this is the most frequent cause of gastrointestinal involvement.
2. Abnormal findings on radiographic studies may be found in as many as 40% of the patients lacking symptoms.
3. Any or all parts of the gastrointestinal tract that are composed of smooth muscle fibers from the esophagus to the anal canal may be involved in scleroderma.
4. The lower part of the esophagus is most commonly involved. Second and third portions of duodenum are frequently involved. The stomach, jejunum and ileum and colon may also be involved.
5. The involvement may be diffuse or patchy, and the involved areas are hypotonic, dilated and thin-walled. Increased collagen deposits and fibrosis in the bowel wall can occur, but it is frequently patchy. Most often, however, the involved gut is thinner and its muscle atrophic without obvious evidence of fibrosis. On electron microscopy, collagen may be shown to be deposited between smooth muscle cells, leading to their atrophy.

6. Symptoms of gastrointestinal disease may be the initial manifestation of the disease, and may precede the usual signs and symptoms of arthritis, scleroderma, sclerodactyly and Raynaud's phenomenon for several months to years. For example, in Poirier and Rankin's cases, gastrointestinal symptoms developed in the 12-month period preceding the diagnosis of progressive systemic sclerosis.

   Rodnan and Fennell described 4 patients who developed progressive and fatal gastrointestinal involvement with no manifestation of scleroderma except for minimal skin involvement.

   Also consider that: 1) There are no distinctive diagnostic findings of scleroderma in the pathology of the bowel. 2) Laboratory tests for diagnosis of scleroderma are not entirely definitive.

   Therefore, it may become impossible to exclude a diagnosis of scleroderma in patients with apparent "idiopathic" pseudo-obstruction.

7. The spectrum of the disorder varies from completely asymptomatic subjects with motor abnormalities in small bowel or manometric or radiographic studies to constipation, to syndrome of bacterial overgrowth with steatorrhea, diarrhea and anemia, to chronic partial obstruction, to recurrent acute episodes resembling acute obstruction.

   Severe atony may lead to ulceration or frank perforation. Sometimes these patients may develop pneumatosis cystoides intestinalis and subsequently may also develop pneumoperitoneum.

8. Small bowel involvement without esophageal involvement or Raynaud's phenomenon is rare but can occur.

9. Bacterial overgrowth with malabsorption state that responds to antibiotics has been demonstrated to occur in scleroderma. Several patients with an acute episode simulating obstruction with unneccessary laparotomy have been described.

10. Colon may show sacculations or pseudo-diverticula; they are infrequent (9%) but are diagnostic when present.

Systemic Lupus Erythematosus:

Brown et al. reported intestinal pseudo-obstruction-type syndrome in 5 out of 87 patients with SLE. One patient had jejunal involvement, and he apparently responded to jejunostomy. One of the patients died and autopsy showed focal submucosal hemorrhage. Arteritis of the mesenteric vessels, that has been reported, also suggests that chronic ischemia may be the cause of abnormal motility in these patients.

Polymyositis and Dermatomyositis:

Polymyositis, particularly that associated with other overlap syndromes (mixed connective tissue disease), may produce intestinal pseudo-obstruction.

Dermatomyositis is also associated with intestinal pseudo-obstruction syndrome, but this is rare.

MYOPATHIES

Myotonia Dystrophia:

Myotonia dystrophia is a familial disease transmitted by an autosomal dominant gene. Affected subjects usually are young adults who have testicular atrophy, baldness and lenticular cataracts in addition to the involvement of skeletal and smooth muscles. Skeletal muscles show evidence of atrophy and weakness along with myotonia. Myotonia is responsible for inability of these patients to release their grip after a hand shake.

Abnormalities in smooth muscles have been found in the gut, respiratory and genitourinary systems. Dysfunction of the gastrointestinal tract is most frequently manifested in the esophagus. Prolonged dilation and atony of the stomach, small bowel and colon may occur. Rarely megacolon and pseudo-obstruction may occur without esophageal or gastric involvement. Intestinal atony and stasis may lead to steatorrhea, bacterial overgrowth and malabsorption syndrome, closely resembling sprue.

Involvement of skeletal muscles usually precedes the clinical symptoms of gastrointestinal involvement. In some patients, gastrointestinal manifestations may be the first presenting symptoms.

These patients have fatty infiltration in between the muscle bundles and the smooth muscle cells. The myofibrils are atrophic and hypereosinophilic. Muscle nuclei are smaller and vacuolated. The nerve plexuses are intact.

Progressive Muscular Dystrophy:

These patients may also have involvement of smooth muscle of the gastrointestinal tract and motility disturbances.

Pathological changes are diffuse and consist of edema, causing separation of muscle fibers and atropy of myofibrils without fibrous tissue replacement. The myenteric plexus shows fatty infiltration.

NEUROLOGICAL DISORDERS

Familial Dysautonomic Syndromes:

Intestinal pseudo-obstruction or stasis syndrome has been described in association with a variety of neurological disorders.

1. Cockel described four siblings who had: 1) steatorrhea; 2) intestinal pseudo-obstruction; 3) mental retardation; and 4) cerebral calcifications. The myenteric plexus of one sibling showed degeneration of argyrophobe neurons.

2. Hirschowitz reported three sisters with deafness, progressive peripheral sensory neuropathy associated with dilation of the duodenum with diverticulitis of the ileum and lower jejunum and abnormal antral motility.

3. Riley-Day dysautonomia is associated with autonomic dysfunction and gastrointestinal dysfunction. This disorder begins in infancy and is almost always confined to Jews.

4. Other idiopathic dysautonomic syndromes associated with dysphagia, ileus and constipation have been described. These patients usually have an acute onset and spontaneous recovery.

5. Schuffler described two siblings with late dementia, atoxia, hypotonia, absent deep tendon reflexes and reduced vibration and position sense. They also had autonomic dysfunction: a) absent sweating to heat, intradermal nicotine (1:100,000) or intradermal acetylcholine (1:10,000); b) small irregular pupils, decreased constriction to light, exaggerated constriction to 0.1% pilocarpine and absent dilation to 4% cocaine; c) inappropriate blood pressure responses to phenylephrine, Valsalva maneuver and upright posture.

   These patients had a 40-year history of abdominal pain, distention and vomiting. One of them had dysphagia. One of the patients also had gastrojejunostomy for diagnosis of superior mesenteric artery syndrome. Because of the awareness of the diagnosis of pseudo-obstruction syndrome, these patients did not have exploratory laporotomies, but they were treated by medical means

   At autopsy esophagus was normal, duodenum and upper jejunum were dilated, and the bowel assumed normal caliber in the mid-jejunum. The colon had multiple diverticulae. The thickness of wall was normal. Although mucosa was autolyzed, H and E stain sections of muscular wall showed no obvious abnormality, either in the muscle thickness or the neurons in the myenteric plexus, as compared to controls.

   Further detailed histological studies have shown: 1) Marked diminution

in neuronal score; 2) silver stains showed reduction in number of

NEURON SCORES

	Controls Mean ± SD	Case 1	Case 2
Esophagus	12.7 ± 3.4	0.46	0.86
Duodenum	22.4 ± 4.1	1.4	0.57
Jejunum	18.0 ± 6.8	1.7	3.0
Ileum	23.8 ± 6.7	4.0	2.9
Colon	27.8 ± 5.1	5.2	4.5

neurons in each ganglia (2 or less); abnormally shaped neurons; reduced number of processes; marked diminution in number of nerve fibers in nerve tracts; 3) axons were vacuolated; nerve terminals containing neurotransmitter not found; 5) intestinal smooth muscle was normal.

Parkinson's Disease:

Chronic intestinal pseudo-obstruction has been reported in Parkinson's disease. However, because all these patients were on medication, particularly anticholinergics, the pathogenesis of motility disorder in these patients is not clear.

Chagas' Disease:

Chagas' disease, caused by Trypanosoma cruzi, produces destruction of ganglia in the myenteric plexus. Rectum and sigmoid colon are more usually involved and dilated than the ascending or transverse colon. Esophageal involvement resembles achalasia, and small bowel involvement produces dilation and pseudo-obstruction syndrome. In a review of 556 autopsied cases, Ferreira Santos found frequency of gut involvement as follows: megacolon (69), megaesophagus (62), megagastrium (5), megaduodenum and megajejunum (3).

ENDOCRINE AND METABOLIC DISORDERS

Hypothyroidism:

Patients with myxedema are well known to have gastrointestinal hypomotility. These patients frequently complain of constipation and abdominal distention. Diarrhea, alternating with constipation, may also occur. Vomiting is rare but can occur. Barium studies may show dilation of esophagus, stomach, duodenum, small bowel and colon. Gallbladder and urinary bladder may also be atonic. However, colon distention is usually most prominent.

Sometimes these patients may present with acute abdomen simulating acute ileus and peritonitis or acute mechanical obstruction. Since the mortality and morbidity are so much increased in these patients, unnecessary surgery should be vigorously avoided. It is important to note the following:

1) Although acute severe ileus or pseudo-obstruction usually occurs in patients who are frankly myxedematous, rarely hypothyroidism may remain unappreciated, particularly if this condition is not kept in mind.

2) Intestinal atony may persist despite good treatment of hypothyroidism, although it usually responds to conservative, supportive therapy and treatment of hypothyroidism over a period of 7-10 days.

3) Myxedema ileus is frequently associated with myxedema coma. Bowel sounds are markedly hypoactive and barium transit is markedly prolonged.

4) At surgery or at autopsy, the bowel is found to be hypoactive with thickening of its wall. Microscopically, mucosal atrophy and mucopolysaccharide infiltration is found. It should be noted that mucopolysaccharide infiltration responds rapidly to thyroid hormone.

5) Possible pathogenetic mechanisms for pseudo-obstruction include: a) altered myoneural impulse transmission because of deposits; b) neuropathy with abnormal axons of myenteric plexuses; c) bowel ischemia due to low flow state; and d) associated electrolyte abnormality.

Hypoparathyroidism, Pheochromocytoma and Adrenal Insufficiency:

All these disorders have rarely been responsible for pseudo-obstruction syndrome.

Diabetes Mellitus:

Constipation is the most frequent symptom in diabetics. Some of these patients develop diarrhea with or without steatorrhea that may alternate with episodes of constipation. These patients may have large megacolon

but dilation of small bowel is unusual. On the other hand, gastric dilation and stasis can occur frequently. Acute ileus can occur in diabetic ketoacidosis, but this may be related to electrolyte disturbances.

Acute Intermittent Porphyria:

1) Massive dilation of small and large bowel may occur during an acute attack, and this subsides with remission of the attack.

2) Vomiting, abdominal distention and discomfort may erroneously suggest mechanical obstruction.

INFILTRATIVE DISEASES

Systemic Amyloidosis

1) Systemic amyloidosis may involve any part of the gut. However, gastric antrum and pyloric region of the stomach are most frequently involved. Small bowel and colon are less frequently involved.

2) Several patients with gastrointestinal amyloidosis, who have clinical picture resembling intestinal pseudo-obstruction, with some receiving unnecessary surgery have been described.

3) Amyloidosis involving blood vessels may also produce ischemic bowel disease.

4) Histology shows amyloid deposits and muscular atrophy in circular and longitudinal muscle layers.

DRUGS

Phenothiazines:

Chlorpromazine (Thorazine®), trifluperazine (Stelazine®) and thioridazine have been reported to cause intestinal pseudo-obstruction. Milner has suggested that alcoholism may enhance the inhibitory effect of these agents on the propulsive activity of the gut.

The mechanism of action of these agents is not known, but it may be related to their anticholinergic or antiserotonergic action, or due to their calcium antagonism causing impairment of electromechanical coupling in smooth muscles.

Antidepressants:

Iminodibenzyl derivatives such as imipramine (Tofranil®), amitriptyline and nortriptyline (Aventyl®) all have been reported to cause a syndrome resembling pseudo-obstruction.

Drugs Used in Parkinson's Syndrome

Benztropine and trihexylphenidyl (Artane ®) produce severe constipation and sometimes syndrome resembling pseudo-obstruction.

Antihypertensives:

Ganglionic blocking agents such as hexamethonium or pentolinium frequently produce constipation. Occasionally they produce severe symptoms suggesting intestinal obstruction. Dilation is usually limited to small bowel and colon, but at times gastric dilation occurs as well. Becker and Sutnik pointed out that abdominal distention produced by ganglionic blocking agents is typically accompanied by severe cramping abdominal pain. Bowel sounds are increased and high pitched. These findings closely simulate intestinal obstruction. However, on operation no mechanical obstruction is found. These effects are presumably due to blockade of synaptic transmission in the enteric nervous system.

Clonidine was the cause of "intestinal pseudo-obstruction" in two recent case reports. In both cases dilation was limited to colon, and this resolved when drug was withdrawn.

Vincristine:

Vincristine has been responsible for pseudo-obstruction syndrome and for patients receiving surgery for mistaken diagnosis of intestinal obstruction or peritonitis. We saw such cases here at Parkland when Vincristine was being used in large doses. Since Vincristine is known to cause a block of flow of neurotransmitter precursors in the microtubules, it may have an effect of neural blockade.

Laxatives:

Chronic use of laxatives, especially those containing anthroquinones cause "paradoxical" constipation, abdominal pain, abdominal distention and vomiting. Radiographic study shows dilated colon with loss of haustral marking. Typically ascending colon is more dilated than rest of the colon. Many of these patients have melanosis coli on proctoscopy. Other purgatives such as bulk purgatives do not produce these changes. It has been shown that anthroquinones cause neuronal damage in the myenteric plexus. Small bowel and stomach are not involved.

Lead:

Chronic lead ingestion may result in severe pseudo-obstruction. There is severe dilation of colon and small bowel. White flecks of lead seen in the lumen of the colon are diagnostic.

Narcotics:

Morphine and heroin may cause abdominal distention and pain and rarely syndrome simulating intestinal pseudo-obstruction. This resolves with narcotic withdrawal. These patients may also have intestinal vascular insufficiency associated with mycotic aneurysm and arteritis that may occur in these addicts.

MISCELLANEOUS

Non-tropical and Tropical Sprue:

1. Ingelfinger described a patient with non-tropical sprue who had chronic vomiting and abdominal distention and has had three operations for possible obstruction - none was found. Similar cases with tropical sprue have also been described.

2. Marshak described intussusceptions on small bowel series. These intussusceptions, however, are transient and frequently non-obstructive and do not need surgical treatment.

3. Motility abnormalities in sprue may be secondary to associated nutritional myopathy, particularly that of vitamin E which may be associated with deposition of ceroid pigment in smooth muscles. On the other hand, some patients diagnosed as sprue may indeed be cases of primary motility problems, with secondary bacterial overgrowth and mucosal changes and steatorrhea.

Brown Bowel Syndrome (Ceroidosis):

1. Some patients with chronic obstructive symptoms of the small bowel reveal a dilated brown intestine. Ceroid is a lipofuscin pigment that is found deposited in the smooth muscles.

2. Pathogenesis of ceroid pigment deposition and its relationship to disordered motility is not known. However, according to one view, it is due to vitamin E deficiency.

3. Ceroid deposits in small bowel have been described in: 1) Chronic pancreatitis, 2) scleroderma with pseudo-obstruction, and 3) sprue with pseudo-obstruction.

Jejunoileal Bypass:

1. Acute or chronic abdominal distention is frequently observed after jejunoileal bypass. Sixteen of the 28 patients with jejunoileal bypass reported by Drenick had such symptoms.

2. Air fluid levels in the colon are common; 16 of the 24 patients showed it on x-ray examination.

3. Four patients had surgery for apparent obstruction of the colon - none was found at surgery.

4. Dilation is localized to the colon that was distal to the anastomosis in patients with side to side anastomosis, whereas in patients with end to side bypass the whole colon is affected.

5. Proximal part of bypassed jejunum had bacterial overgrowth.

6. It is suggested that motor abnormality is associated with or caused by bacterial overgrowth, particularly the anaerobes. Antibiotics effective against anaerobes produce excellent response of symptoms of pseudo-obstruction, as well as of the dilation.

Jejunal Diverticulosis:

1. Symptoms of obstruction were found in 16 out of 62 patients with jejunal diverticulosis (Altemeir).

2. In three patients who eventually went to surgery for suspected obstruction, duodenal dilation without any mechanical obstruction was found.

3. Possible mechanisms of pseudo-obstruction include: a) diverticula interfere with normal peristalsis; b) associated intermittent volvulus; c) abnormal bowel motility, causing diverticulosis and pseudo-obstruction; and d) bacterial overgrowth.

Psychosis:

Watkins and Oliver described six insane persons who had chronic colon dilation and chronic constipation who were treated with colectomy. At operation, distal small bowel was also noted to be dilated. Kraft and his co-workers similarly reported 16 psychotic patients who had abdominal distention and fecal incontinence. It is not known if these cases form a spectrum of pseudo-obstruction or what the cause of pseudo-obstruction is. Coexisting neurological disorders and particularly antipsychotic drugs may play an important role in these cases.

PRIMARY INTESTINAL PSEUDO-OBSTRUCTION

1. This term should be used for cases that are not associated with other disease entities. Such cases are sometimes also called idiopathic intestinal obstruction. However, the work "idiopathic" could appropriately also be applied to many cases of secondary intestinal pseudo-obstruction, where the exact cause of pseudo-obstruction is not clear. The designation "primary" to describe cases that are not associated with other more generalized diseases also has problems. Intestinal pseudo-obstruction may at times be the sole manifestation of a more generalized disease. For example, some patients with visceral scleroderma may have intestinal pseudo-obstruction without any other evidence of scleroderma. Second, the many so-called primary intestinal pseudo-obstruction syndromes have involvement of other organs in the body.

   I believe that with proper understanding of the pathophysiology of this syndrome, a more appropriate classification of these syndromes will emerge. In the meantime, a diagnosis of primary intestinal pseudo-obstruction remains a diagnosis by exclusion of all the diseases that may be associated with this syndrome.

2. Only severe forms of this syndrome, i.e., the patients who have had multiple operations for possible mechanical obstruction, are recognized at present. In the future, less severe forms of this syndrome, which present with problems of intestinal stasis, will probably be included if similar pathophysiologic or morphologic defects are demonstrated.

3. It occurs in all age groups and both sexes.

4. Family history: Two of Maldonado's patients were siblings. Byrne et al. reported 11 affected subjects in a family. Seven were symptomatic, while 4 were asymptomatic. Siblings of a symptomatic patient showed radiographic abnormalities. An autosomal dominant pattern of inheritance with variable penetrance was suggested.

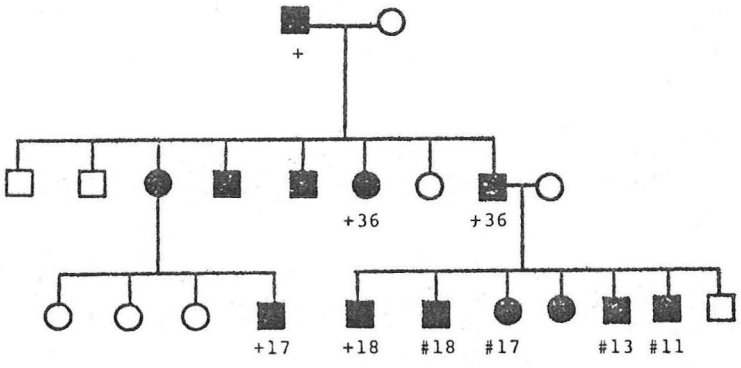


Fig. Family pedigree of a patient with chronic intestinal pseudo-obstruction. (Byrne et al, 1977)

Schuffler and Pope studied 12 relatives of a 15-year-old patient with this disease, and found esophageal motor abnormalities (observed on low amplitude contractions) in 4 maternal relatives. Two of these 4 subjects also had urinary bladder dysfunction. They also suggested that this disorder was inherited as a dominant trait with variable expressivity.

5. These patients have involvement of the esophagus, stomach, small bowel and colon. The severity and the distribution of involvement, however, varies.

6. In addition to the gut, urinary bladder is frequently involved.

7. Pathological studies reveal either normal or flat small bowel mucosa, and these changes are patchy.

   The muscular wall in some patients shows atrophy. The atrophy when present is also patchy, and involves both circular and longitudinal muscle layers. These cases are thought to have some type of visceral myopathy. Neurons and their process appear normal.

   Other patients show normal or hypertrophic muscle layers. Some of these specimens show abnormalities in myenteric neurons and their nerve processes. It should be emphasized that the changes in neural elements can be completely overlooked unless special techniques are used to stain and to study them. Electron microscopy of the neural elements in the gut and study of sections stained for neurons and nerve processes is essential for proper evaluation.

8. Small bowel motility study in our patient showed almost absent segmental contractions. The migrating myoelectric complexes were infrequent, weak and abortive. The amplitude of contration was poor.

9. Strips of tissue removed at operation showed no abnormalities upon testing with a variety of pharmacologic agents.

10. It is almost certain that the syndrome of chronic intestinal pseudo-obstruction may result from a variety of anatomic and functional abnormalities. One or more of the following may be involved in different patients with this syndrome.

    1) Muscle disorder: Structural or metabolic defect.

    2) Abnormalities of intramural plexuses and reflexes: Diseases of one or more components of intramural neurons; defective neuromuscular transmission.

    3) Abnormalities of extrinsic neurohumoral control: Adrenergic overactivity (inhibition ileus); vagus has little influence; circulating hormones or local hormone abnormalities.

MANAGEMENT

1. The first step is to make the proper diagnosis so that an unnecessary surgery for a mistaken diagnosis of mechanical obstruction or acute abdomen can be avoided. Some have suggested: "Because of the consequences of mechanical obstruction are so serious, it is better to explore too frequently than to risk generalized peritonitis." I cannot agree with this view, because the literature is full of cases that proved fatal because of surgery that was unnecessary. In a patient with known diagnosis of pseudo-obstruction, or in whom careful evaluation suggests such a diagnosis, exploratory laparotomy should be avoided unless there are otherwise features of unequivocal mechanical obstruction or bowel perforation. It should also be noted that a radiographic appearance of transverse duodenum obstruction or of volvulus may be seen in patients with pseudo-obstruction syndrome.

2. Supportive therapy includes meticulous nasogastric suction or sometimes small bowel suction, intravenous fluid replacement and other supportive measures.

3. Evaluate for causes that might be associated with pseudo-obstruction and treat them if possible.

   Pay particular attention to: drugs, electrolyte disturbances, infections and sepsis, endocrine and metabolic abnormalities.

4. Antibiotics: tetracyclines for bacterial overgrowth.

5. Nutritional supplements and correction of deficiency states.

6. Intravenous hyperalimentation.

7. Drugs: Neostigmine, Mestinon, bethanechol, Carbachol, metoclopramide and indomethacin. These drugs could be tried without any assurance of their usefulness. Cerulein has also been tried in some patients.

8. After the acute attack is resolved, they can be contined on: a) drugs; b) diet: milk-free, carbohydrate restricted, low residue diet; c) nutritional supplements; d) antibiotics; e) home hyperalimentation; and f) exercises for gas.

9. Elective surgery: A variety of operations including various types of bypass procedures, i.e., gastrojejunostomy, duodenojejunostomy, resections of parts of the gut and ileostomy, have been done. Most observers are not enthusiastic about the outcome of surgery.

   Anuras et al. reported 4 patients with megaduodenum due to familial visceral myopathy. Three patients had side to side duodenojejunostomy, and the fourth patient had gastrojejunostomy. Three of these patients developed peritonitis. Two of these patients died. Two of the patients that survived the surgery

and the postoperative period are reported to be doing well. Since both of these have side to side gastrojejunostomy, the authors recommend dudenojejunostomy as the operation of choice in these patients. They also recommend preoperative antibiotics to treat bacterial overgrowth in the duodenum in order to avoid postoperative peritonitis.

10. It is important to remember that the clinical course of this syndrome is characterized by spontaneous fluctuations. Therefore, a potential advantage of a certain mode of therapy should be evaluated with care.

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