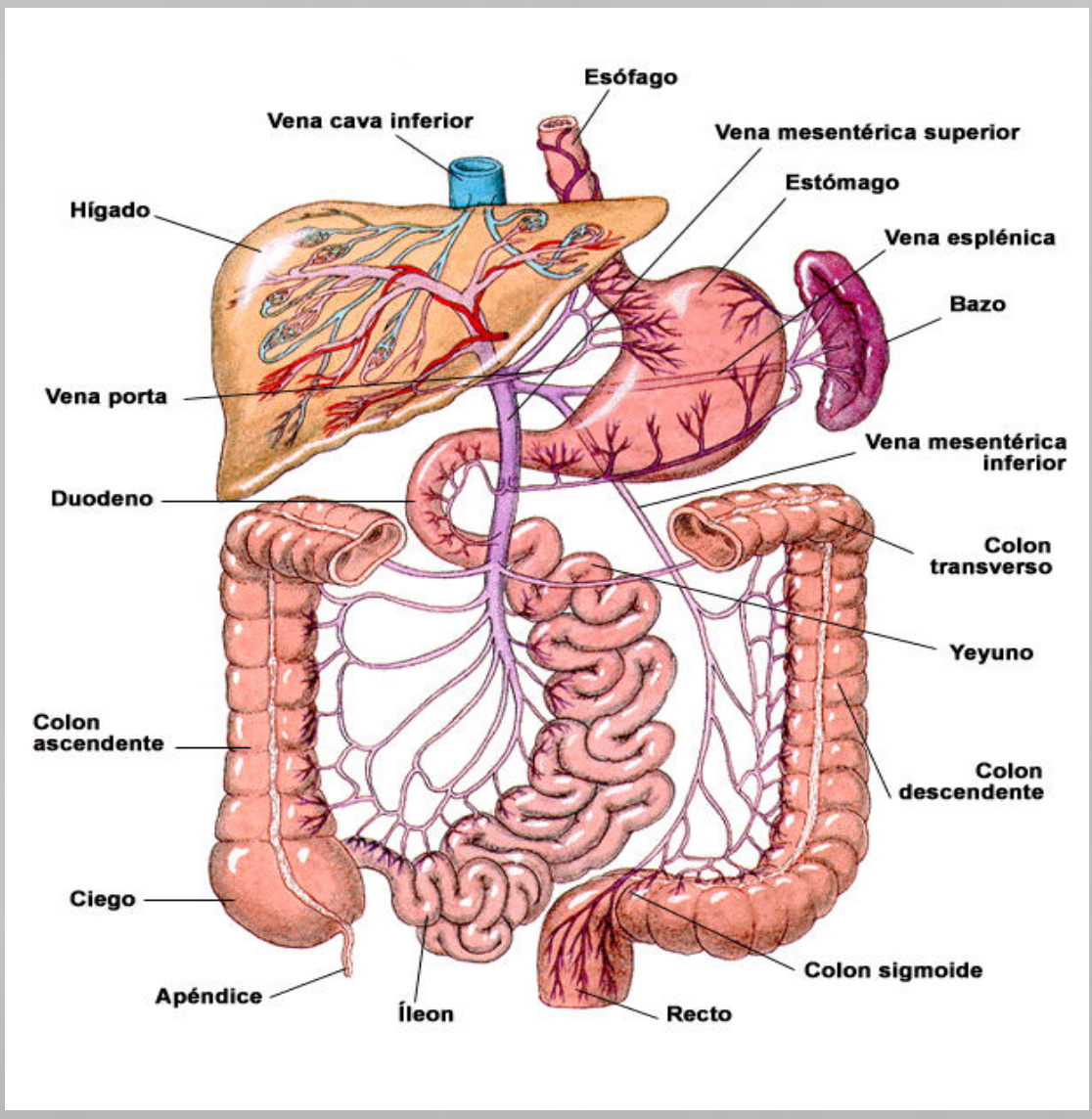
Bowel

Anatomy

Atresia, Volvulus, Meckel's diverticulum

Anatomy

- *Small intestine*: 6 meters
- Large intestine: 1.5 meters.
- The first 25 cm of the small intestine (duodenum) is retroperitoneal
- Jejunum marks the entry of the small intestine into the peritoneal cavity, terminates where the ileum enters the colon at the ileocecal valve
- Large intestine is subdivided into cecum, ascending, transverse, & descending colon.
- Sigmoid colon begins at the pelvic brim and loops within the peritoneal cavity
- Rectum begins at about the level of the third sacral vertebra.
- Reflection of the peritoneum from the rectum over the pelvic floor creates a cul de sac known as the *pouch of douglas*



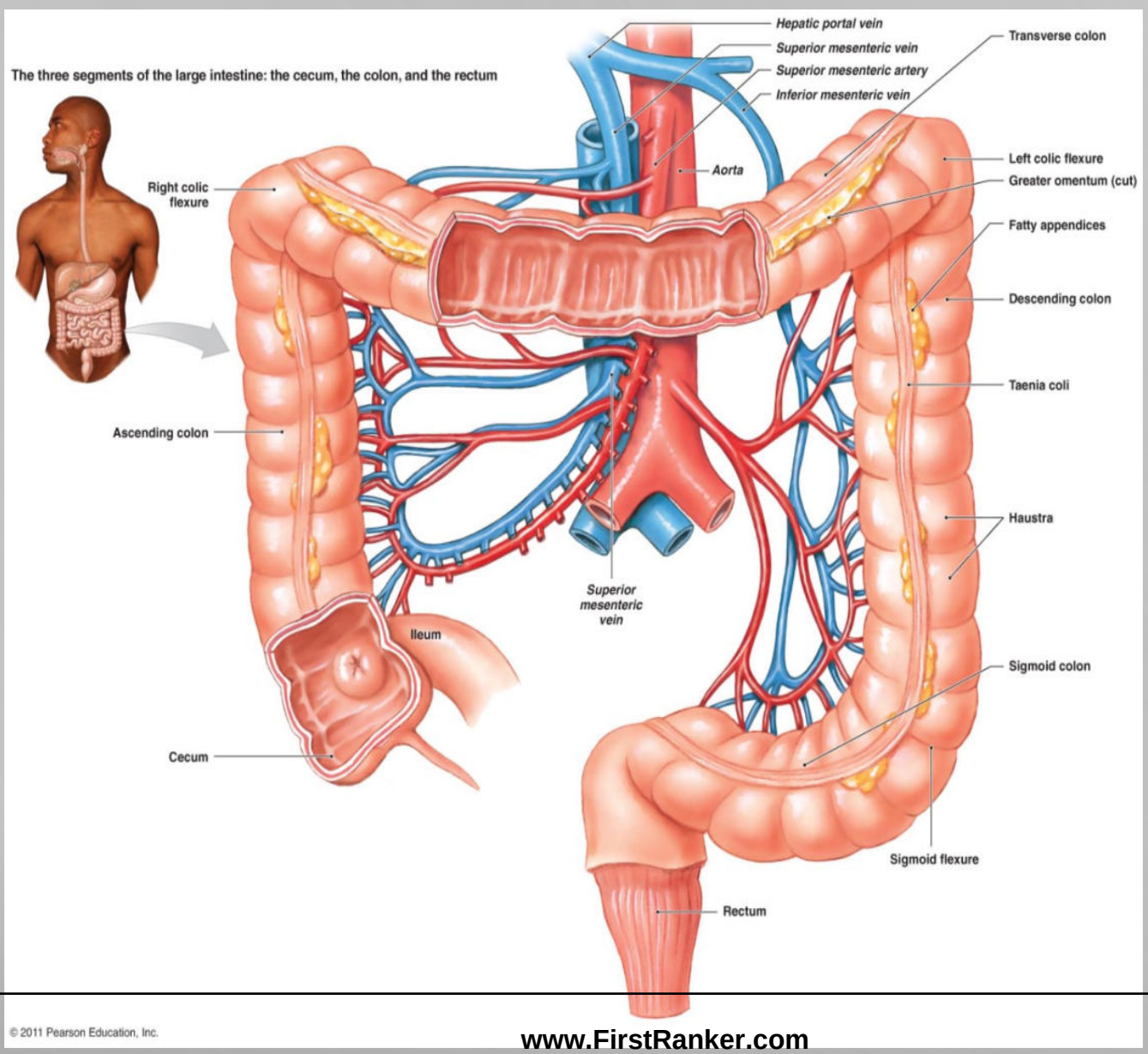
Vasculature

- **Superior mesenteric artery:** proximal jejunum to hepatic flexure of colon
- **Inferior mesenteric artery:** remainder of colon to the level of rectum
- **Superior hemorrhoidal branch of the inferior mesenteric artery:** upper rectum
- **Hemorrhoidal branches of the internal iliac or internal pudendal artery:** lower rectum

- **venous drainage** follows essentially the same distribution

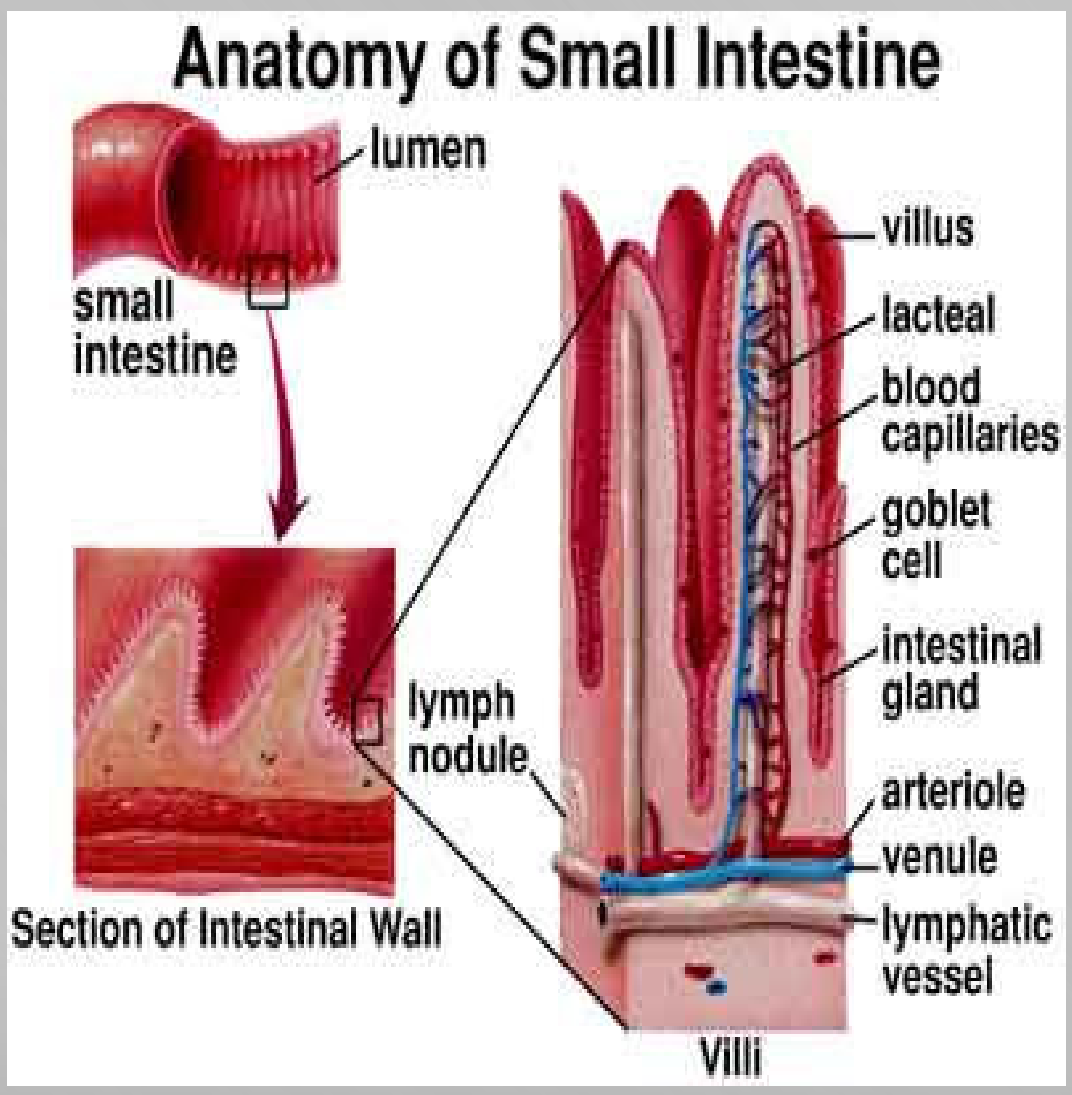
- connected by an anastomotic capillary bed between the superior and inferior hemorrhoidal veins, providing a connection between the portal and systemic venous systems.

- Since the colon is a retroperitoneal organ in the ascending and descending portions, it derives considerable accessory arterial blood supply and lymphatic drainage from a wide area of the posterior abdominal wall.



Small Intestinal Mucosa

- The most distinctive feature of the small intestine is its mucosal lining, which is studded with innumerable **villi**
- **Villi:** site for terminal digestion and absorption of foodstuffs
- Between the bases of the villi are the pit like **crypts of Lieberkühn**
- **Crypts of Lieberkühn**: contain stem cells that replenish and regenerate the epithelium
- In normal individuals, the villus-to-crypt height ratio is about **4 to 5:1.**
- Within the duodenum are abundant submucosal mucous glands, termed ***Brunner glands*.**
- ***Brunner glands*:** secrete bicarbonate ions, glycoproteins, and pepsinogen II and are virtually indistinguishable from the pyloric mucous glands.



Colonic Mucosa

- The function of the colon is to reclaim luminal water and electrolytes.
- Colonic mucosa has no villi and is flat.
- Mucosa is punctuated by numerous straight tubular crypts
- Crypts contain abundant goblet cells, endocrine cells, and stem cells.
- Paneth cells are occasionally present at base of crypts in the cecum& ascending colon
- The regenerative capacity of the intestinal epithelium is remarkable.
- Cellular proliferation is confined to the crypts
- Turnover of the colonic surface epithelium takes 3 to 8 days

Atresia

Incidence of Atresia

- Duodenum : 35%
- Jejunum : 15%
- Ileum : 25%
- Colon : 10%
- Multiple sites : 15%

Duodenal Atresia

- Failure of vacuolization of duodenum from it's solid cord stage at 8-10th week gestation
- Types :
  - Duodenal stenosis
  - Mucosal web
  - Gap separated by fibrous cord
  - Complete gap

Associated anomalies

- Down Syndrome (30%)
- Malrotation
- Annular pancreas
- Biliary atresia
- Congenital heart disease
- Anorectal malformations

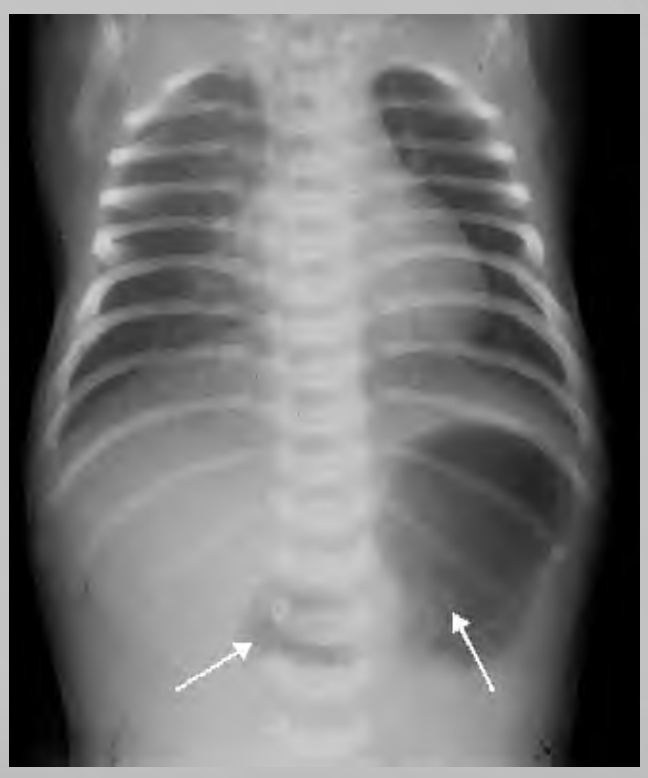
Clinical features

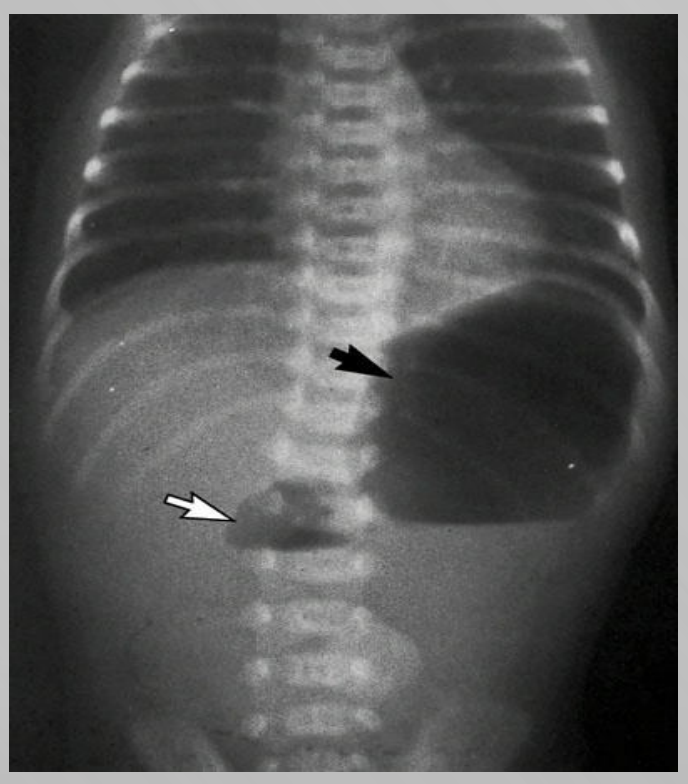
- Presents in first 24hrs of life.
- 85% distal to ampulla of vater
- Characterized by bilious emesis
- Abdominal distension is absent
- Visible gastric peristalsis

Imaging

- Check for patent anus/anorectal anomalies
- Abdominal x-ray: **Double Bubble** sign:
  - Air in the stomach, and 1st and 2nd portions of duodenum.
  - If there is no distal air, the diagnosis is secure.
  - If there is distal air, and urgent UGI contrast study is needed to rule out midgut volvulus.

"Double Bubble" Sign

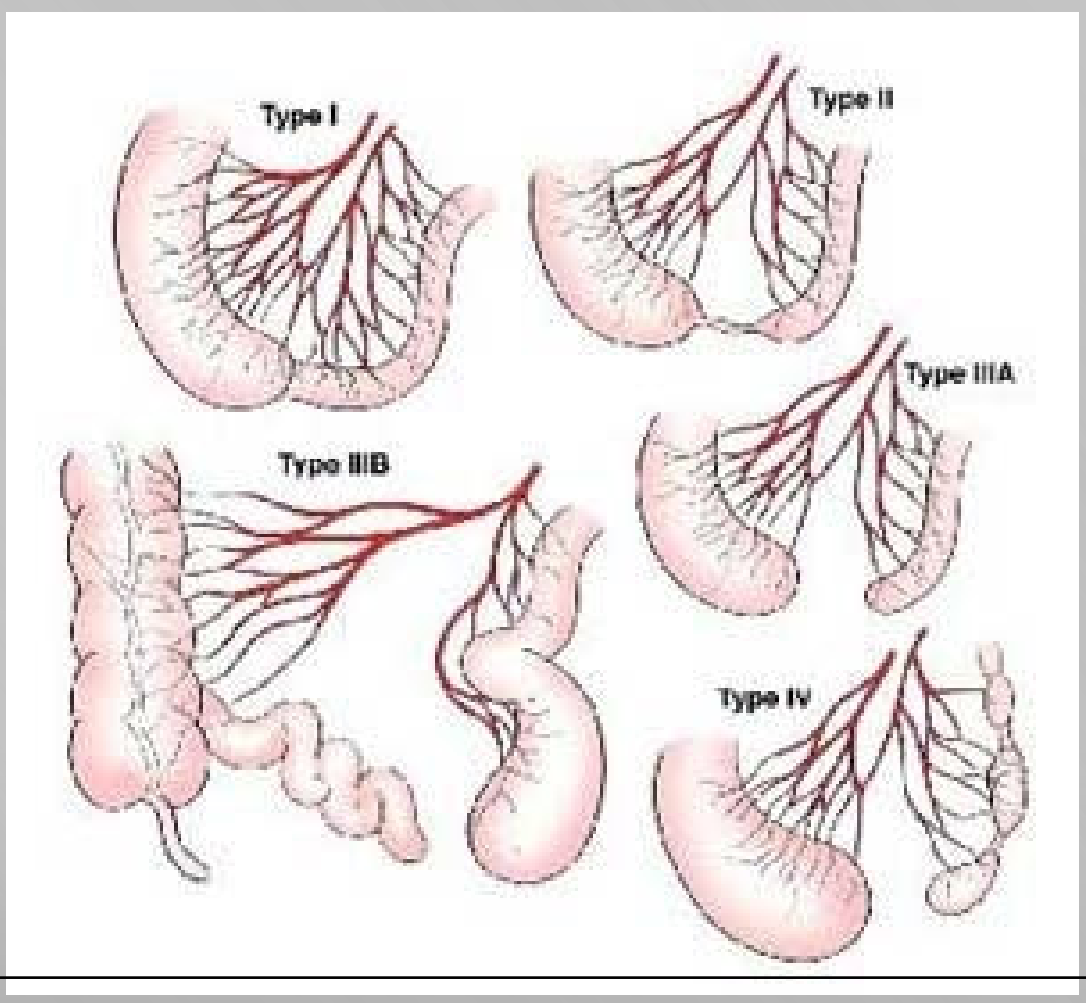




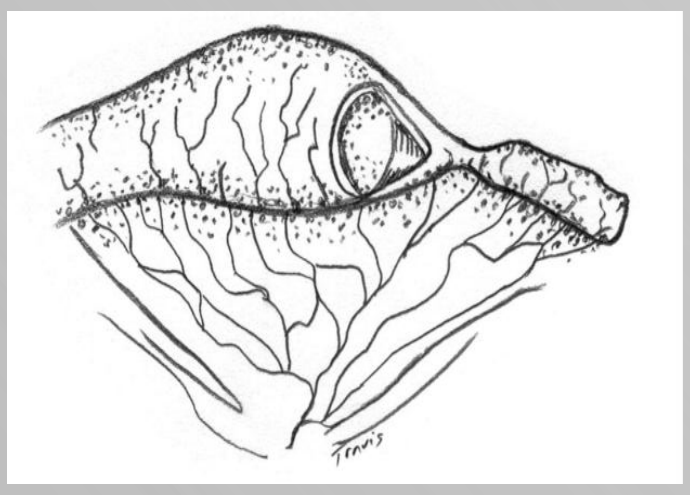
Management

- Nasogastric decompression
- Duodenoduodenostomy
- Duodenojejunostomy

Types of jejunoileal atresia



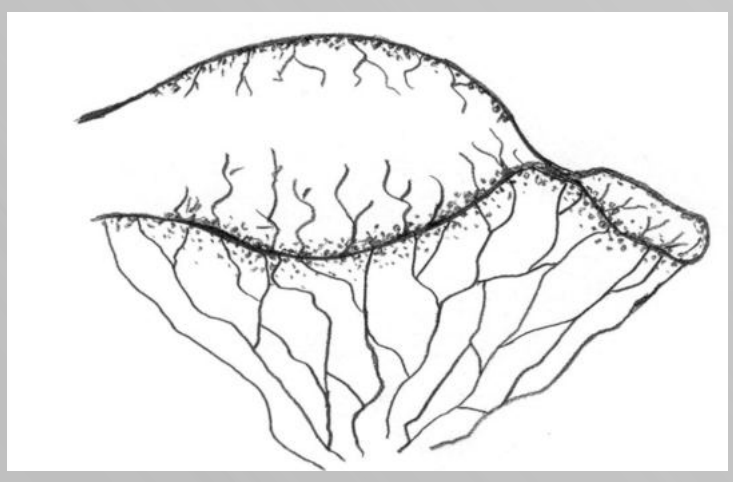
Jejuno-ileal atresia



- Type I:
  - Mesenteric development and intestinal length are normal
  - Mucosa and submucosa forms a web or membrane within the intestinal lumen
  - Windsock Effect

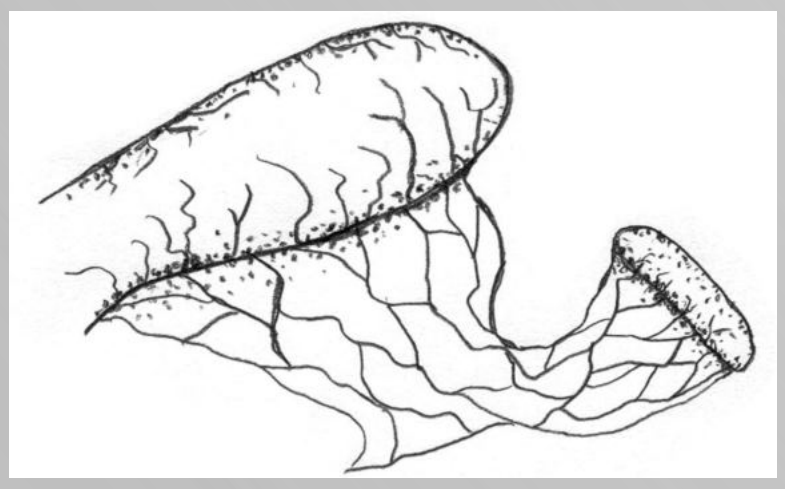
    Increased pressure proximal to the obstruction causes the web to prolapse, pushing the web through the bowel distally

Jejuno-ileal atresia



- Type II:
  - Mesenteric development and overall intestinal length is normal
  - Small bowel lumen is not continuous
  - Proximal small bowel ends in bulbous blind pouch
  - Distal small bowel is flattened
  - Proximal and distal small bowel connected by fibrous cord.

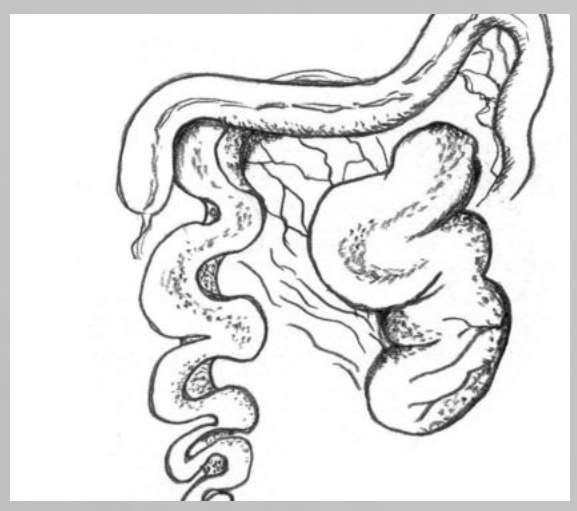
Jejuno-ileal atresia



- Type IIIa:
  - Similar to Type II
  - Small V-shaped mesenteric defect

    is present, bowel length is shortened
  - Proximal blind end is markedly dilated & aperistaltic
  - No fibrous cord connects the proximal & distal small bowel

Jejuno-ileal atresia



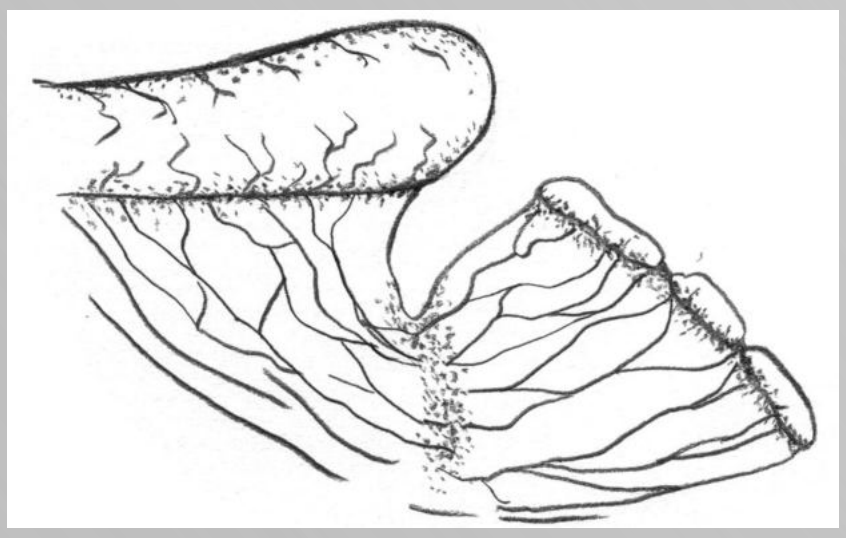
- Type IIIb:
  - Similar to Type IIIa
  - Significant mesenteric defect is present

    Superior mesenteric artery is largely absent

    Small bowel supplied by a single ileocolic or right colic artery
  - Known as **Christmas tree or apple peel deformity**

    Bowel wraps around a single perfusing artery

Jejuno-ileal atresia



- Type IV:
  - Multiple JIAs of any combination Types I – III

    Appears as a string of sausages due to multiple lesions
  - Likely result of multiple ischemic insults or inflammatory process

Pathophysiology

JIA is usually a vascular insult versus failure to recanalization of Duodenal Atresia

Intrauterine vascular accident → Necrosis of bowel segment in a sterile environment → Resorption and disappearnce of tissue

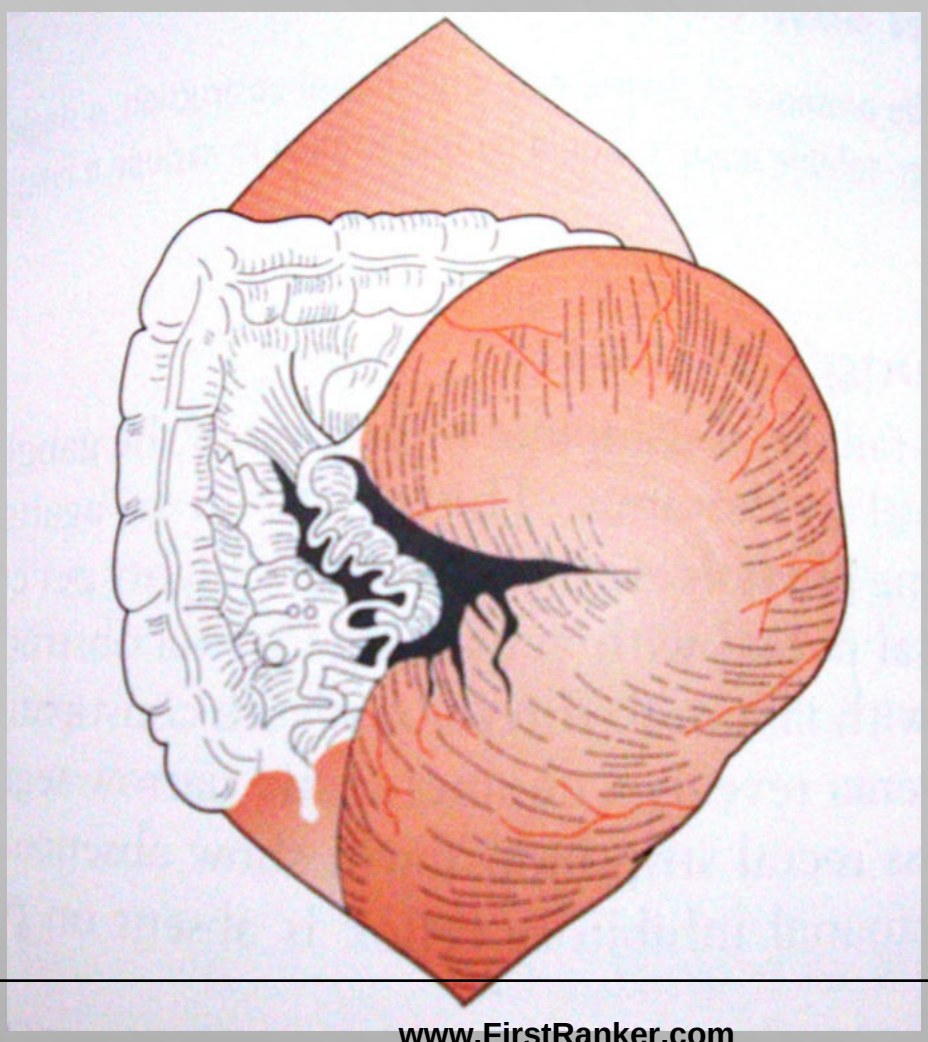
Malrotation, Volvulus (abnormal twisting of SMA), Gastroschisis, Omphalocele

All result in blood supply / gut segment separation

symptoms, physical exam findings.

- Within the first day of life
  - Depends on level of obstruction
    - Proximal
    - Distal
  - Vomiting green bile
  - Bowel sounds absent in distal small intestine
  - No meconium
  - Abdominal distention

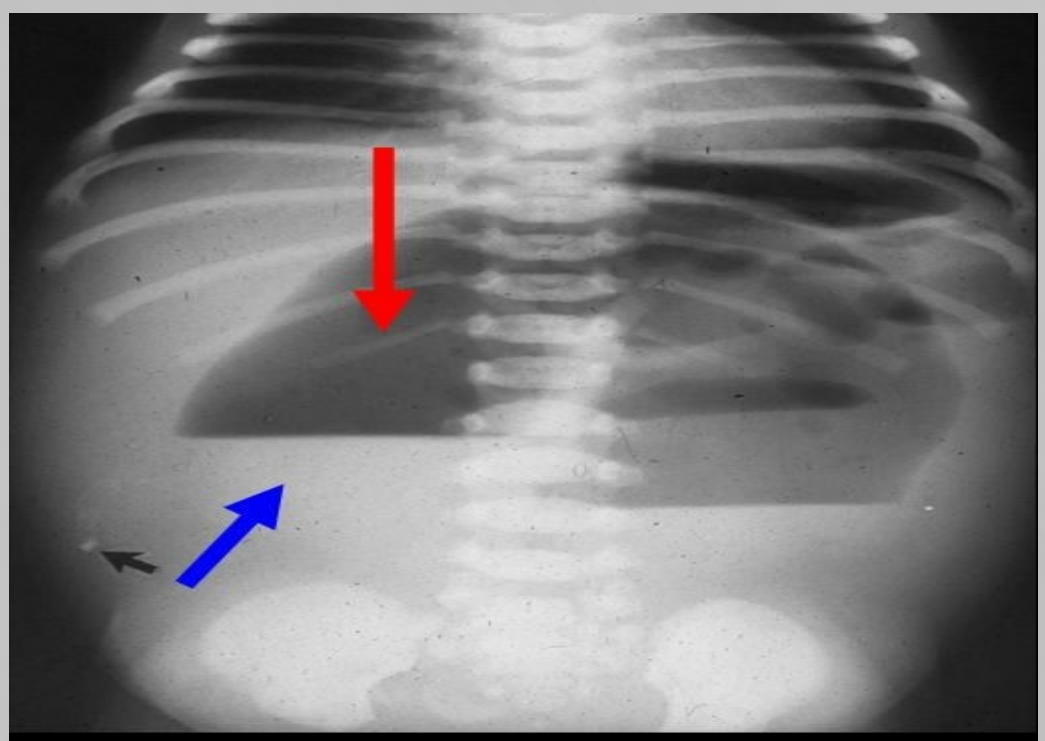
Proximal gut dilatation



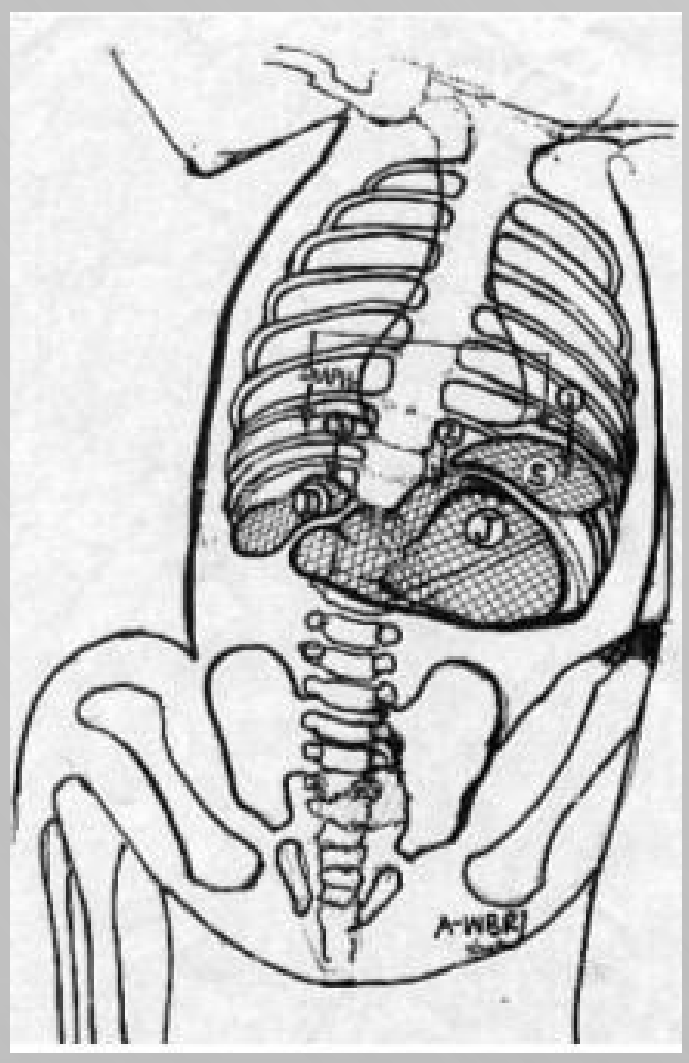
Imaging

- **Prenatally**
  - Ultrasonography will likely show excess amniotic fluid (polyhydramnios)

- **First day of life**
  - Abdominal X-ray: Air Fluid level, Dilated proximal gut
  - Water soluble contrast enema: exclude multiple strictures, Flattened distal gut, Micro colon



X-ray of a newborn with jejunoileal atresia. Note the huge portion of the intestines with air (red arrow) and fluid (blue arrow).



Triple Bubble Presentation

Initial treatment

- Immediately a tube is placed orally into the stomach to evacuate excess fluid and gasses
  - Prevents vomiting and aspiration
  - Relieves GI discomfort
- IV Fluids and Nutrients are provided until surgery is available
- Surgical intervention is necessary to repair the bowel obstruction and blood supply

Surgical management

- **Aim: Preserve as much bowel length as possible**

- Dilated proximal part
  - Resection and anastomosis
  - Tapering enteroplasty if remaining bowel is short

- Multiple strictures:
  - Multiple anastomosis over an endoluminal tube

Prognosis

- Types I, II, and IIIa have good prognosis
  - Fairly normal small bowel length results in almost normal bowel function

- Types IIIb, IV is associated with complications
  - Shortened small bowel is associated with short gut syndrome and malabsorption

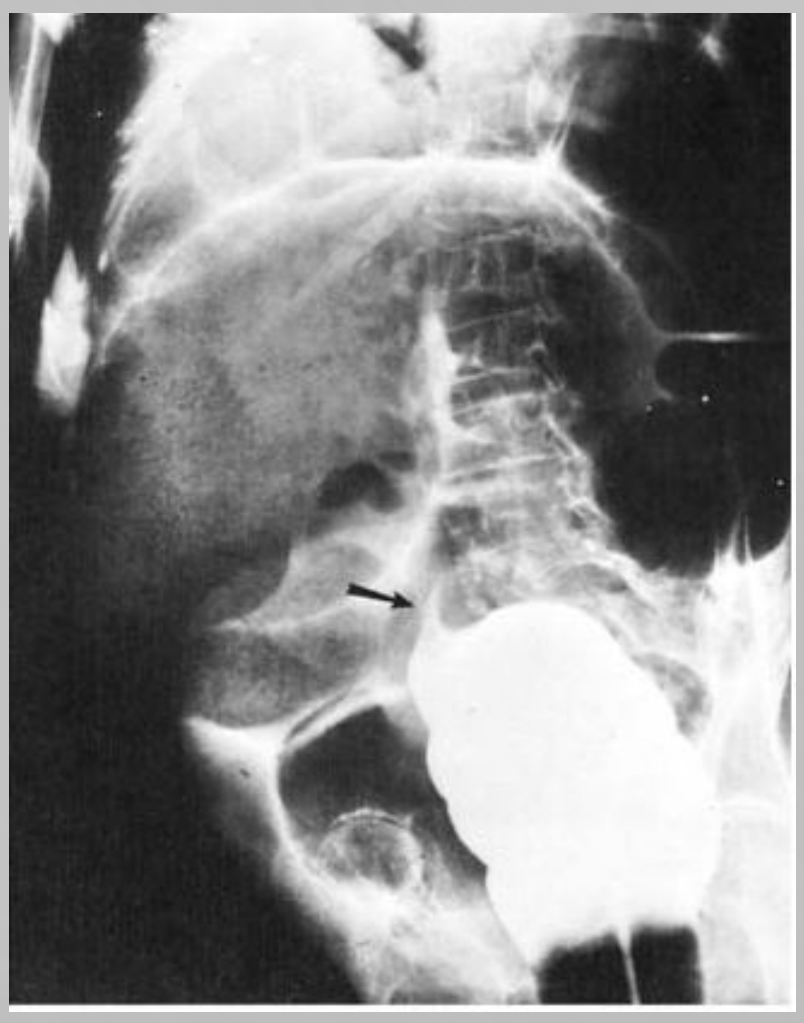
Volvulus

- Volvulus occurs when an air-filled segment of the colon twists about its mesentery.
- **Sigmoid colon** is involved in up to 90% of cases, but volvulus can involve the cecum (<20%) or transverse colon.
- Volvulus may reduce spontaneously, but more commonly produces bowel obstruction
- Chronic constipation may produce a large, redundant colon (*chronic megacolon*) that predisposes to volvulus
- Symptoms: abdominal distention, nausea, and vomiting.
- Symptoms rapidly progress to generalized abdominal pain and tenderness.
- ~~Fever and leucocytosis are heralds of gangrene and/or perforation.~~

Sigmoid volvulus

- Can often be differentiated from cecal or transverse colon volvulus by the appearance of plain x-rays of the abdomen.
- Sigmoid volvulus produces a characteristic **bent inner tube or coffee bean** appearance
- Gastrografin enema shows a narrowing at the site of the volvulus and a pathognomonic **bird's beak**

Plain X ray showing coffee bean appearance



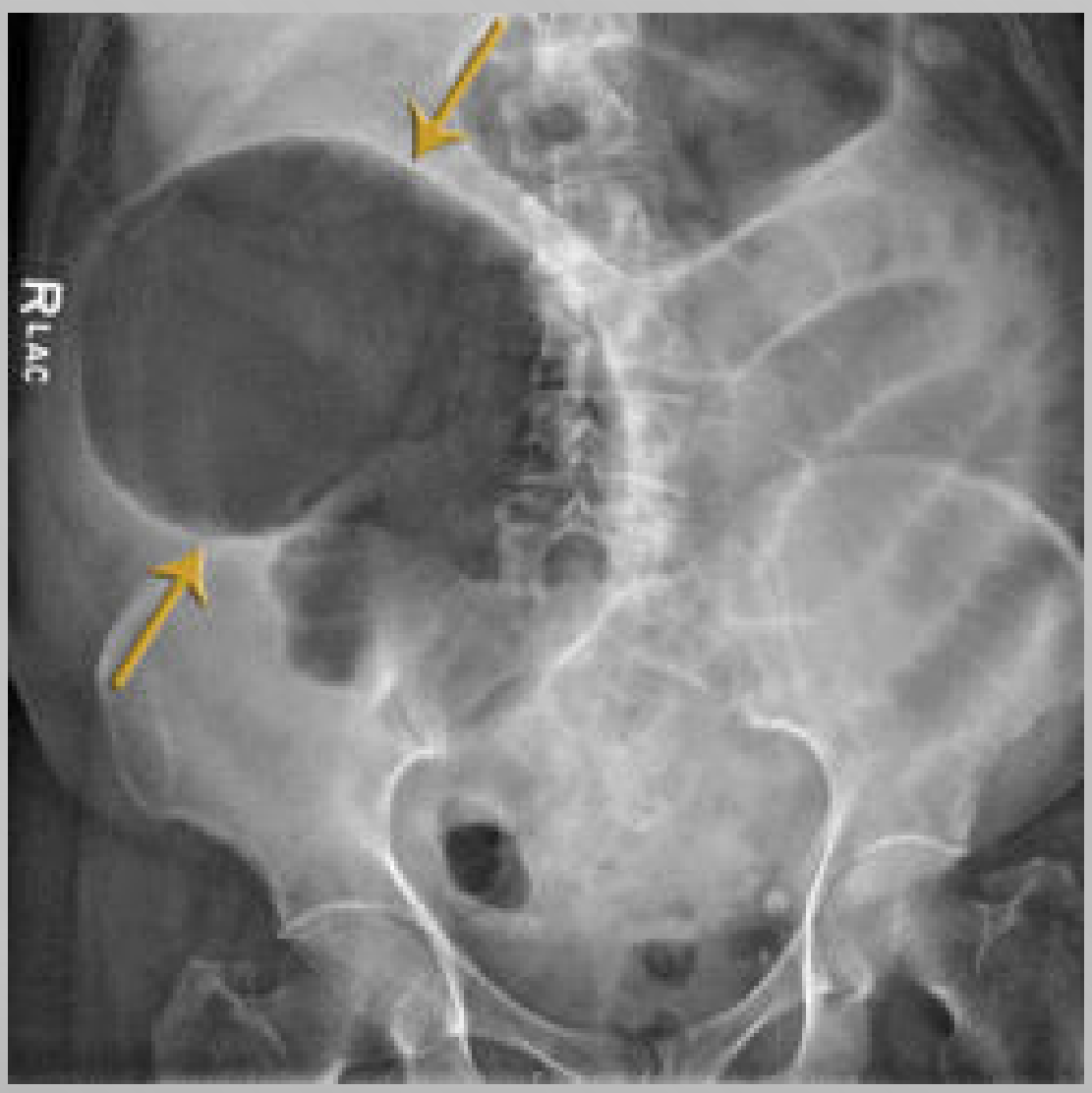
Gastrografin enema showing "bird-beak" sign (*arrow*)

Management

- Initial management: resuscitation followed by endoscopic detorsion
- Detorsion: by rigid proctoscope, but a flexible sigmoidoscope or colonoscope might also be effective.
- Elective sigmoid colectomy should be performed after the patient has been stabilized
- Surgical exploration: evidence of gangrene or perforation, presence of necrotic mucosa, ulceration, or dark blood noted on endoscopy examination
- If dead bowel is present at laparotomy, a sigmoid colectomy with end colostomy (Hartmann procedure) may be the safest operation to perform.

Cecal Volvulus

- Nonfixation of the right colon.
- Rotation occurs around the ileocolic blood vessels and vascular impairment occurs early.
- Plain x-rays of the abdomen show a characteristic **kidney-shaped**, air-filled structure in the left upper quadrant (opposite the site of obstruction), and a gastrografin enema confirms obstruction at the level of the volvulus.
- Cecal volvulus can almost never be detorsed endoscopically.
- Surgical exploration is necessary when the diagnosis is made.
- Right hemicolectomy with a primary ileocolic anastomosis can usually be performed safely and prevents recurrence



Meckel's Diverticulum

- Failure of involution of the vitelline duct, which connects the lumen of the developing gut to the yolk sac, produces a Meckel diverticulum.

- True diverticulum: contains **all three layers** of the normal bowel wall: mucosa, submucosa, and muscularis propria.

- It may be a small pouch or a blind segment having a lumen greater in diameter than that of the ileum and a length of up to 6 cm.

Rule of 2's

- 2% of the population have one
- 1/2 of symptomatic lesions usually present before the age of 2 years old, others most commonly in the first 2 decades of life
- Diveriticuli in adult patients only become symptomatic in about 2%
- 2 times more common in males than females
- Usually found within 2 feet of the ileocecal valve
- Usually are about 2 inches in length
- 1/2 contain heterotrophic mucosa (usually gastric, occasionally pancreatic)

Clinical Features:

- Lower GI bleeding
- Intestinal obstruction
- Local inflammation with or without perforation
- Rare presentations: Neoplasms

Diagnosis:

- Most accurate test, especially in children, is "Meckel's scan"- sodium 99-tc-pertechinetate, taken up by gastric mucosa
- Abdominal CT scan
- If CT is negative barium studies should be done
- If bleeding with a negative scan, angiography may be helpful

Treatment

- If symptomatic: prompt surgical intervention to resect the diverticulum or segment of ileum containing the diverticulum.

- If not symptomatic: and found incidentally at surgery in children under 2 y/o, resection is recommended.

- In asymptomatic adults, resection is controversial since only about 2% of these patient's will become symptomatic and there is about a 2% incidence of short or long term complications