IMAGING IN NEONATAL INTESTINAL OBSTRUCTION

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Outline

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  - *MRI*
- Common causes of obstruction
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  - ***Diagnosis***
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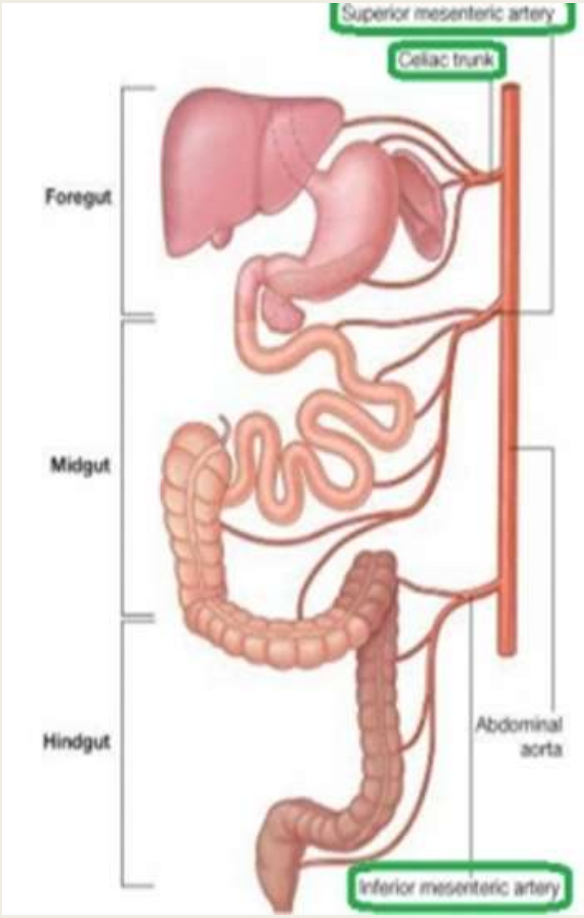
  - *Prognosis*
- Summary

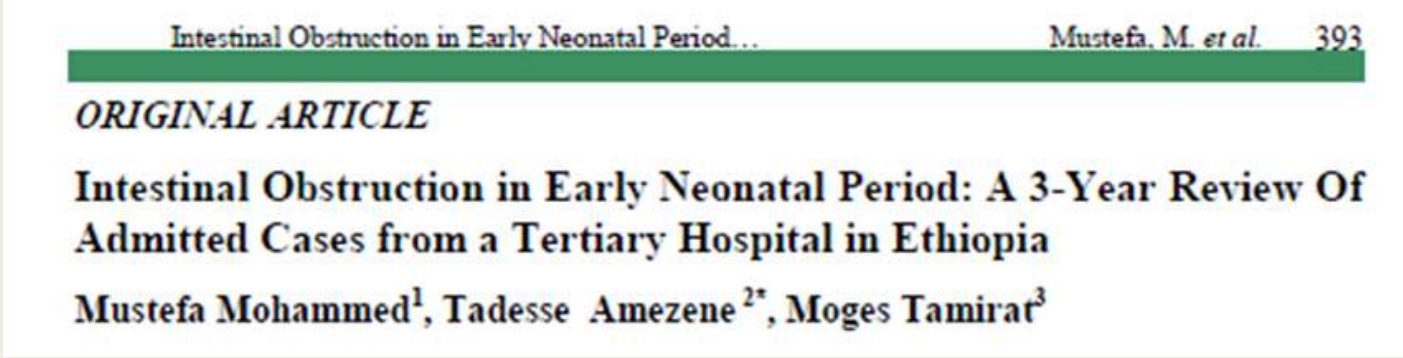


Introduction

- A common neonatal problem (1:2000 LB)
- Most are result of congenital abnormalities which can be classified high Vs low
  - *Clinical*
  - *Radiologic*
- Functional obstruction can occur in NEC, sepsis, hypothyroidism electrolyte imbalances
- Success of management depends on timely diagnosis & intervention
- Outcome is excellent

TABLE 5–1. Common Causes of Intestinal Obstruction in Neonates

High	*Low*
Midgut volvulus-malrotation	Hirschsprung disease
Duodenal atresia-stenosis	Meconium plug syndrome (small left colon syndrome)
Duodenal web	Ileal atresia
Annular pancreas	Meconium ileus
Jejunal atresia	Anal atresia-anorectal malformations



ORIGINAL ARTICLE

Intestinal Obstruction in Early Neonatal Period: A 3-Year Review Of Admitted Cases from a Tertiary Hospital in Ethiopia

Mustefa Mohammed[1], Tadesse Amezene[2*], Moges Tamirat[3]

- 51 CASES (age 0-7 days)
  - *ARM = 29 (57%)*
    - Low type (55%) and High type (45%)
  - *Intestinal Atresia = 7 (14%)*
  - *HD = 6 (12%)*
  - *Intestinal Malrotation= 3 (6%)*
  - *Meconium Plug = 2 (4%)*
  - *Other = 4 (8%)*

Part 1 – Imaging techniques

Prenatal Ultrasound

- Should be done for all pregnancies at 11-13wk and at 20 wk

- But difficult to detect GI anomalies early
  - *Esophagus and anorectum not completely seen before 3rd TM*
  - *Sufficient swallowing of amniotic fluid after end of 2nd TM (can't see double bubble)*
  - *Bowel isn't distended with meconium until 3rd TM (cant diagnose obstruction)*
- Most intestinal anomalies will escape prenatal detection
  - *77% of duodenal obstruction are detected*
  - *50% of small bowel obstruction are detected*
  - *ARM not generally amenable to prenatal detection (rarely distended rectum)*
- GI anomalies are invariably treated after birth (no change in standard obstetric management)
  - **polyhydramnios*
  - ** fetal pain*
- Plain radiographs should be performed after birth to confirm the diagnosis

Plain abdominal film

- Main diagnostic technique in children
- Natural contrast of air
  - *stomach within minutes of birth*
  - *Small bowel within 3 h the entire small bowel*
  - *After 8–9 h, sigmoid gas*
- Views = supine AP ± lateral decubitus / cross table lateral
- Site of obstruction
  - *High obst = few dilated loops, no gas in lower portion of abdomen*
  - *low obst =*

Ultrasound

- excellent imaging modality for the evaluation of the gastrointestinal tract in pediatric patients
- Initially with curved array transducer then with high resolution linear probe
- Limited by bowel gas interposition>> overcome by gentle graded compression technique to displace undesirable gas
- Signs
  - *proximal bowel loop distension (16 to 40 mm) filled with fluid, and punctuated with echodense particles of gas.*
  - *distal bowel is small in size (3–4 mm) with echodense or target-like meconial content*
  - *gas = intramural, portal, free*
  - **intraabdominal fluid, peristalsis, bowel wall thickness and bowel wall perfusion*
  - *Malrotation

Contrast study

- One of the main diagnostic techniques in children
  - *In selected patients*
  - *using the correct technique*
  - *at the lowest radiation dose possible*
- Methods
  - *continuous fluoroscopy technique*
  - *last image-capture technique*
  - *pulsed fluoroscopy with capture of the acquired series*
- Types
  - *UGI series = NPO 3-4hr, low osmolality water soluble contrast (dec aspiration)*
  - *SBFT = after 20 min*
  - *enema = barium can be used for most cases*

    = low density water soluble (avoid excessive density) if suspect meconium ileus
- To establish the specific cause of obsturction in cases where urgent intervention is not indicated (no shock, peritonitis, pneumoperitoneum)

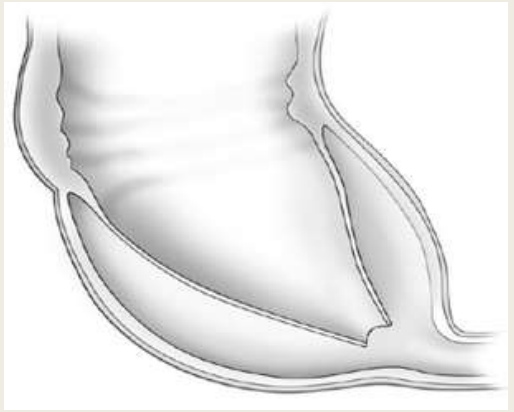
MRI

- *continuous innovations in use of this technique in children*
- *Recent application to GI study*
- **Anorectal abnormalities*

Part 2 – Common causes of obstruction

Duodenal obstruction

- Pathology
  - Intrinsic
    - Atresia or stenosis (failure of recanalization)
    - Web (obstructive membrane with pin size hole in the center)
  - Extrinsic
    - *annular pancreas (associated with stenosis)*
    - *Malrotation (Ladd's band, midgut volvulus)*
    - *Other (Preduodenal portal vein, duplication cyst)*



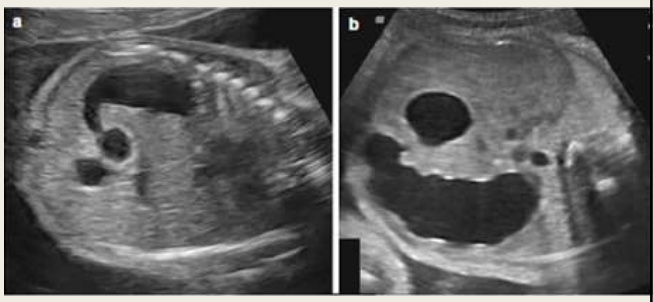
- Incidence (atresia/stenosis) = 1 in 2,500 LB

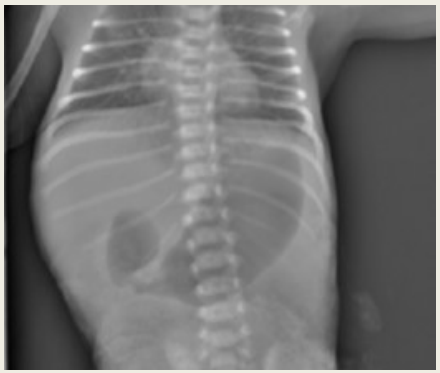
- Presentation
  - *Age = at birth or within couple of days (webs may present later)*
  - *Bilious vomiting (85%), Scaphoid abdomen*
  - *toxic and tenderness indicates malrotation*

- Associated anomalies
  - *Cardiac, down's syndrome (30%), premature (45%)*

Duodenal obstruction

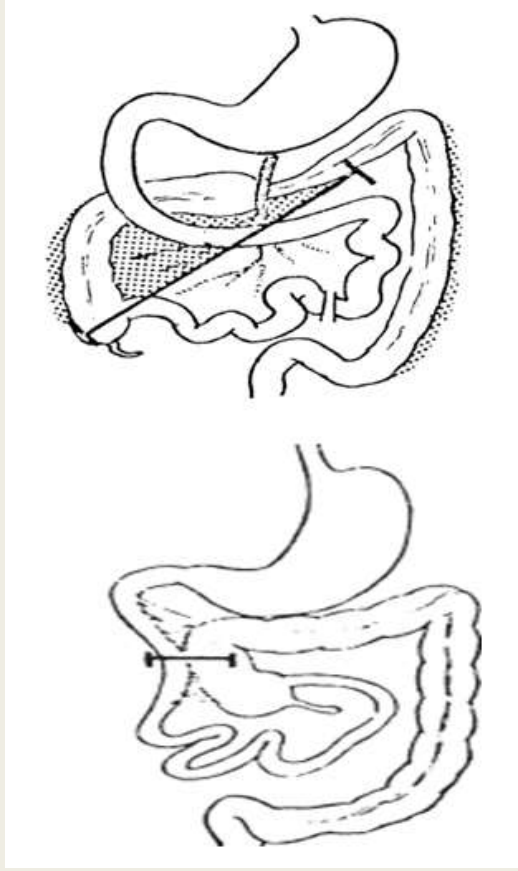
- Radiology
  - *Prenatal US*
    - Polyhydraminos, Double bubble sign
  - *Plain film*
    - Double bubble sign (may be obscured if excess fluid in stomach)
  - *Upper GI series*
    - If uncertain (partial obstruction)
- Treatment
  - *Resuscitation*
  - *Surgery (Duodeno-duodenostomy or duodenotomy-excision of web)*
- Prognosis
  - *90% survival*
  - *megaduodenum & motility disorders*
  - *alkaline reflux & PUD*





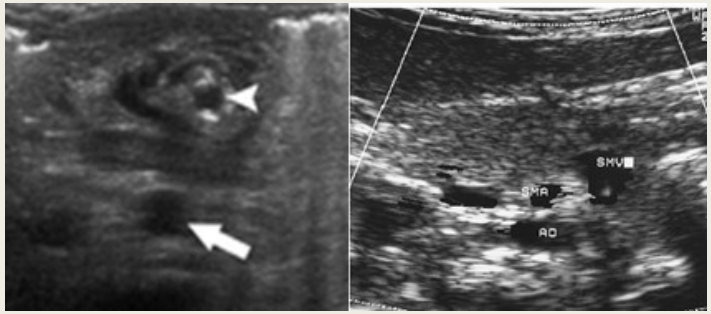
Intestinal malrotation

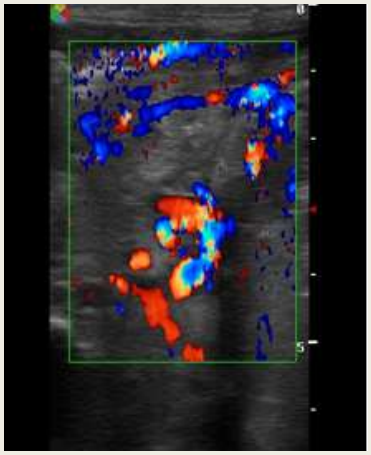
- **Pathology** - abn in intestine position or attachment (arrest of normal embryonic midgut rotation)
  - **malrotation** (*duodenojejunal non rotation and cecocolic partial rotation)*
  - **Midgut volvulus** (short mesentery)
  - **Ladd bands** (abnormal fibrous peritoneal bands)
  - **Paraduodenal hernias** (reverse rotation of DJ & normal rotation of CC)
- **Incidence** = 1 in 6,000 LB
- **Presentation**
  - *75% present during neonatal age*
    - Bilious vomiting with toxicity and tenderness
    - Hematemesis / bloody stool (infarction)
  - *Another 15% present within 1st year and the rest later*
    - intermittent duodenal obstruction, abdominal pain
- **Associated anomalies** (30-62%)
  - *CDH, abd wall defect, intestinal atresia (5-26%),*



Intestinal malrotation

- Prenatal US
  - *Dilated bowel loop, abnormal SMV positions*
- Plain film
  - *normal, mild dilatation*
  - *gasless abdomen (volvulus)*
  - *double-bubble*
  - *NG tube into abn positioned duodenum*
  - *Pneumoperitoneum (perforation)*
- Ultrasound (2-3% with normal US had malrotation on upper GI series)
  - *dilated douodenum & abn position (normally b/n SMA & aorta)*
  - *Abn position duodenojejunal junction (normally left to aorta)*
  - *Abn position of cecum*
  - *reverse position of SMV (vein anterior or to the left of artery)*
  - *Whirpool sign (Swirling pattern around SMV) indicating volvulus*



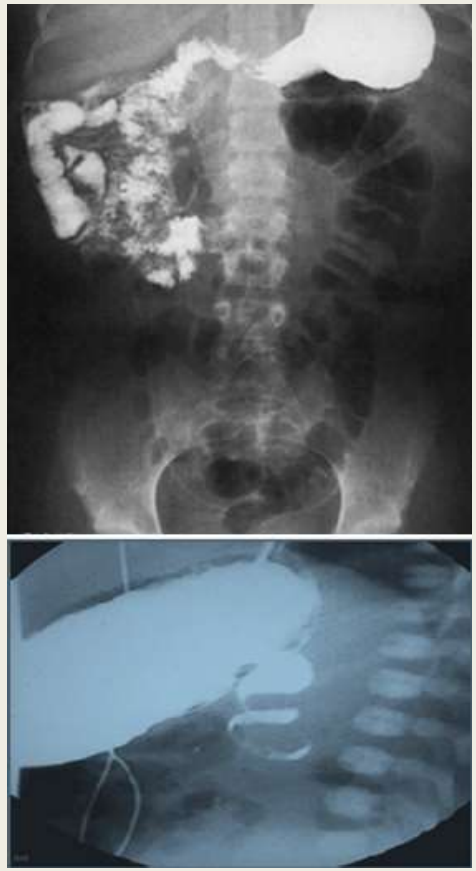


Intestinal malrotation

- **Upper GI series** (false –ve in 6-4%, false +ve in 7-15%)
  - *malposition of DJ junction & jejunum and cecum*
    - Duodenum to Rt & doesn't cross spine (Normally Lt of spine)
    - DJ (normally same level or sup to duodenal bulb)
  - *corckscrew appearance of Duodenum & jejunum (Volvulus)*
  - *beak appearance (Duodenal obstruction)*

- **Barium enema** (only as an adjunct to upper GI series)
  - *Abn positioned cecum (but cecum poorly fixed in all neonates + 20% of malrotation might have normal positioned cecum)*
  - *Complete obstruction of transverse colon (vlolvulus)*

- *Urgent surgery (without any imaging) if there are signs of decompensation (hematemesis, hematochezia, abdominal distension, peritonitis, shock)*
- *normal findings do not exclude malrotation*

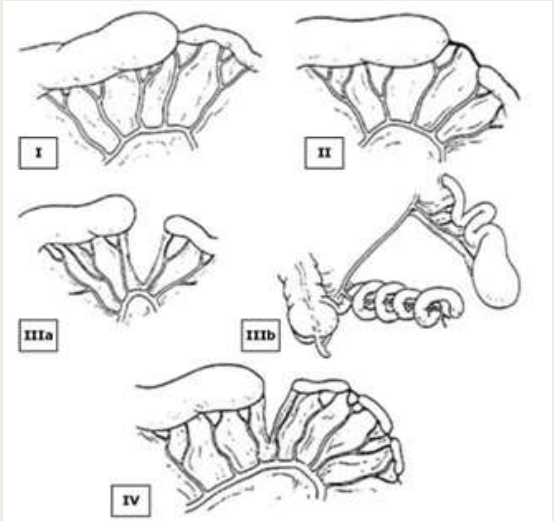


Intestinal malrotation

- **Treatment** (Top surgical emergency)
  - *Resuscitation*
  - *Surgery (Untwist-ladd procedure or 2nd look if ischemic)*
- **Prognosis**
  - *Mortality 3-9 % (more in volvulus, gangrene, premature)*
  - *volvulus in 2-8%*
  - *intussusception in 3.1%,*
  - *Adhesive SBO in up to 10%*

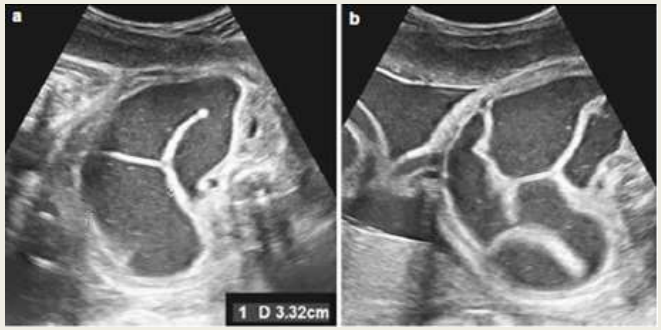
Jejuno-ileal atresia

- Pathology
  - *in utero mesenteric vascular accidents leading to a necrotic segment which is later resorbed*
- Incidence = 1 in 2,000-5,000 LB
- Presentation
  - *Age = first 48 hr*
  - *vomiting and abd distention, may pass meconium*
- Associated anomalies
  - *premature (30%)*



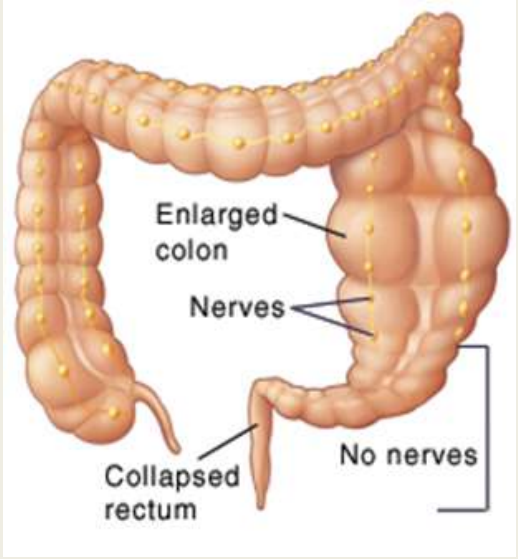
Jejuno-ileal atresia

- Prenatal ultrasound
  - *Dilated bowel loop, inc peristalis*
- X-ray
  - *dilated loop and complete absence of air downstream*
  - *air fluid levels*
- Barium enema (if uncertainty)
  - *Microcolon*
  - *Not possible to reflux contrast to dilated proximal bowel*
- Treatment
  - *Resuscitation*
  - *Surgery (resection and anastomosis)*
- Prognosis
  - *Functional obstruction at site of anastomosis*



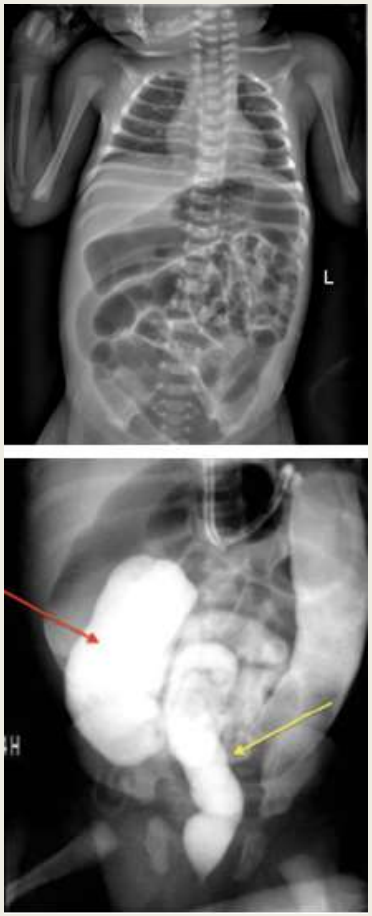
Hirschsprung disease

- Pathology
  - *deinnervated colon spasms and causes functional obst (Failure neural crest migration)*
  - *rectum affected with variable portions of colon*
    - **Ultrashort segment** (int. sphincter only)
    - **Short segment** (rectum & distal colon) = 75%
    - **Long segment** (splenic fexure & transverse colon) = 15%
    - **Total colonic aganglionosis** = 2-13%
- **Incidence** = 1 in 5,000 LB
- Presentation
  - *Age = most present in neonatal age (20% present later)*
  - *Delayed passage of first meconium (95%)*
  - *Acute obstruction (Abdominal distention, vomiting)*
  - *Enterocolitis (foul smelling diarrhea, septic)*
  - *Chronic constipation & failure to thrive*
  - *Volvulus*
- Associated anomalies
  - *Down's syndrome (5%), genetic mutations (GDNF, RET)*



Hirschsprung disease: Diagnosis

- Radiology
  - *Plain film*
    - Low obstruction (dilated bowel loops with absent/dec air in rectum)
  - ***Unprepped barium Enema*** *(only 76% sensitive)*
    - Demonstrate patency, localize transition zone & determine its length
      - *narrow rectum/colon transitioning to megacolon*
      - *reversal of recto-sigmoid index (normal ratio >1)*
      - *residual barium in delayed postevacuation film (24hr later)*
    - ** enema should be avoided in children with enterocolitis
- Anorectal manometry (83% sensitive)
  - *lack of relaxation of internal anal sphincter (no recto-anal inhibitory reflex)*
- Rectal suction Biopsy (93% sensitive)
  - *no ganglion cells, hypertrophic nerve fibers, elevated Ach. esterase activity*



Hirschsprung disease

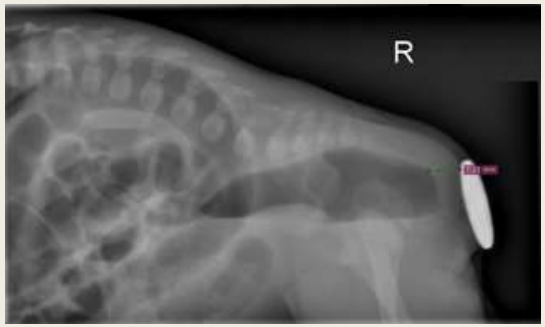
- Treatment
  - *Resuscitation*
  - *Colonic irrigation*
  - *Surgery (colostomy or pullthrough)*
- Prognosis
  - *anastomotic stricture*
  - *persistent or acquired aganglionosis*
  - *motility disorder*
  - *increased internal anal sphincter tone, sphincter dysfunction*

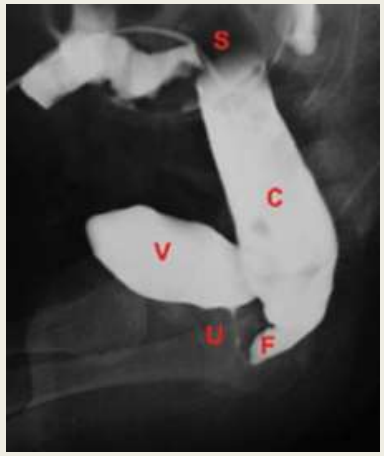
Anorectal malformation

- **Pathology** abnormal location of rectum in relation to sphincter (failure of descent of urorectal septum)
  - ***Low lesion*** *= covered anus, RPF, RVF*
  - ***High lesion*** *- imperforate anus without fistula, rectourethral/vesical*
  - ***Persistent cloaca*** *- long/short (>3cm / ≤3cm)*
  - ***Rectal atresia*** *(normal anal canal with obst 2cm above skin level)*
- **Incidence** = 1 in 5,000 LB
- **Presentation**
  - *Failure to pass meconium*
  - *Passage of meconium through abnormal opening*
- **Associated anomalies** (50-60%)
  - *Vertebral (30-50%) Cardiac (30%) TracheoEsophageal (10%) Renal (30-50%)*

Anorectal malformation

- Radiology
  - *Prenatal ultrasound*
    - Calcified meconium in bladder in case of rectovesical fistula
  - ***Prone cross-table lateral X-ray*** *(at 24 hr of life with marker on perineum)*
    - High vs low = rectal gas bubble below coccyx or <1cm from perineum
  - *MRI*
    - Distal rectum and musculature (true level of elevator sling)
  - ***Abdominal ultrasound, Echocardiography, Vertebral X-ray***
    - Look for associated anomalies (VACTERL)
- Treatment
  - *Resuscitation + Antibiotic (if suspect urinary fistula)*
  - *Surgery*
    - Low type = definitive surgery
    - High type = colostomy followed by definitive surgery
      - ****Distal colostogram*** *(to identify fistula tract before definitive surgery)*
- Prognosis
  - *depend on associated anomalies*





Meconium ileus and plug

	Meconium ileus	Meconium plug (functional immaturity of colon)
Pathology	Obstruction of the ileum by inspissated meconium usually at IC junction (pancreatic insufficiency)	Abnormal motility of left colon (immaturity of ganglion cells) => temporary unlike HSD
Presentation	Age = Within 3 days Failure to pass meconium	Failure to pass meconium
Ass. anomalies	Cystic fibrosis (80-90%) Complex MI (perforation, atresia, volvulus) in 50%	Premature, Infants of diabetic mothers, mothers taking MgSO4
X-ray	Distal obstruction, ground glass/ soap buble sign (meconium-gas), calcifications (perforation)	
Water soluble enema	Distended terminal ileum multiple filling defects (meconium pelletes) Microcolon	Multiple filling defects (meconium plugs) No microcolon (but left colon may be smaller) Rectum normal
Other	Prenatal US = polyhydramnios, peritoneal calcification	**Rectal Biopsy**
Treatment	Resuscitation Enema (diluted sodium meglumine diatrizoate, Gastrografin) monitored with fluoroscopy Surgery (for complex & unresponsive)	Enema

Summary

- Clinical scenario is very important
  - *For diagnosis*
  - *for choosing advanced imaging modality*
- Be suspicious for malrotation/volvulus
- look for associated congenital anomalies

References

- Mario Lima, **Pediatric Digestive surgery**
- Lane F. Donelly, **Fundamentals of pediatric radiology**
- *Mohamed et al. **Intestinal obstruction in the early neonatal period: A 3 year review of admitted cases in a tertiary hospital in Ethiopia***
- Uptodate 21.6

THANK YOU