

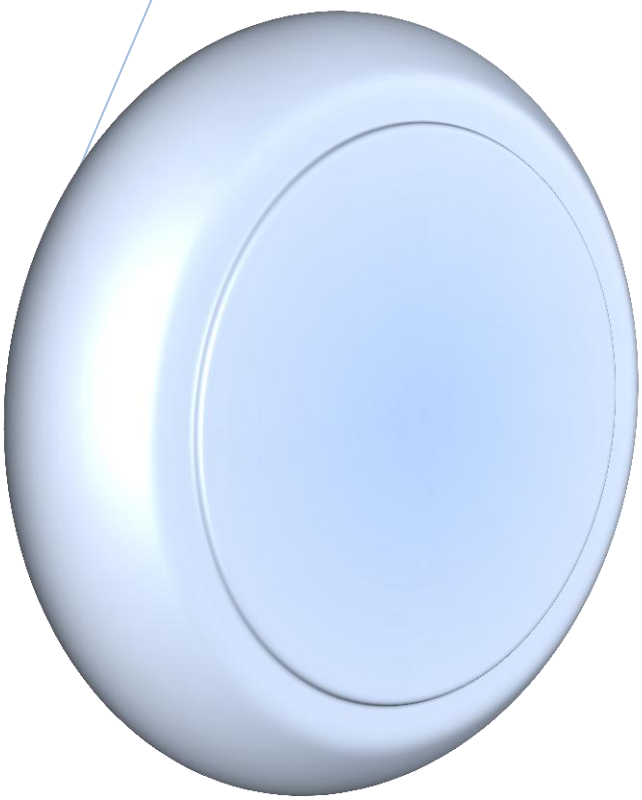


GIT for Mrcpch

Private notes

A trial of making a good source for Mrcpch studying

Dr.Mark
1/29/2012



Basic anatomy and physiology

Anatomy:

Oesophagus:

- Outer longitudinal and inner circular muscle layers with mysentric plexus in between
- Mucosa is lined by stratified squamous epithelium. Adult **length 25 cm**

Stomach:

- Lined by columnar epithelium.
- Chief cells produce pepsin, parietal cells produce gastric acid and intrinsic factor
- Secretions in adults are 3 L/day.
- Gastric acid secretion stimulated by :vagal +,gastrin, histamine via H2 receptors on parietal cells
- Gastric acid secretion inhibited by : sympathetic +,nausea , gastric acidity and S.I peptides
- Blood supply : from coeliac axis
- G cells in stomach secrete gastrin

Small intestine:

- Main function is absorption , mostly in the duodenum and jejunum apart from bilesalts and vit B12 which are absorbed in terminal ileum
- Blood supply from mid-duodenum onwards is the superior mesenteric artery
- Adult length 2-3 meters

Colon:

- Salt and water reabsorption is primarily function
- Blood supply from superior mesenteric artery until the distal transverse colon and then the inferior mesenteric artery after that
- Approximately 1 meter long in adults

Pancreas:

- Retroperitoneal, endocrine function (2% of tissue mass) and exocrine function (98%)
- Blood supply from celiac axis
- Secrete more than 1 L of pancreatic juice per day, which is bicarbonate rich and contain enzymes for absorption of CHO , fat and protein
- Fecal elastase is a commonly used screen for pancreatic function

Absorption of nutrients

- **Duodenum & proximal jejunum-→**Ca,Mg,P,iron,folic acid
- **Proximal 100-200 cm of S.I→**CHO,protein,water soluble vitamins
- **Throughout the S.I→**monoglycerides , FAs as miceller complexes, medium chain TG directly into PV
- **Distal ileum→** B12,bileacids
- **Colon →** water & electrolytes

Digestion:

CHO digestion	Protein digestion	Fat digestion
• Consumed as --- monosaccharides(glucose,fructose, galactose),disaccharides(lactose,sucrose,maltose,isomaltose) and the polysaccharides (dextrins,glycogen) • Salivary and pancreatic amylase breakdown starch into oligosaccharides and disaccharides. Pancreatic amylase aids CHO digestion but CHO digestion is not dependent upon it • Disaccharidases in the microvilli of S.I hydrolyse oligo and disaccharides into monosaccharides: o Maltose→glucose o Isomaltose→ glucose o Sucrose→glucose+fructose o Lactose→glucose+galactose • **Glucose and galactose** are then absorped by **active transport** mechanism and **fructose** by **facilitated diffusion** • Glucose absorption is dependent on sodium transporters.	• In the stomach gastric acid denatures protein and facilitates the conversion of pepsinogen into pepsin • Is S.I:enterokinase secreted from proximal duodenum→convert trypsinogen ito trypsin→activate pancreatic enzs(trypsin,chymotrypsin&elastase)→convert proteins into oligopeptides&AAs in duodenum→S.I absorb free AA&peptide by active transport→enter PV→liver	• Fat in duodenum→release pancreozymin,cholecystokinin→+ GB contraction • TG hydrolysed by pancreatic lipase→fatty acid + glycerol - *Free FAs+glycerol+monoglycerides*→emulsified by bile salts→micelles→absorbed along the brush border of mucosal cells - *Short chain FAs* enter the Portal circulation bound to albumin - *Longchain FAs:*resterified within the mucosal cells into TGs which combine with lesser amount of protein,phospholipids and cholesterol→chylomicrons→enter lymphatic system→via thoracic duct to blood stream

GIT polypeptide hormones

Hormone&location	Stimulus for release	Actions
Gastrin (G cells in gastric antrum)	1. AAs in antrum 2. Distension of antrum by food 3. Vagal +(- by ph<1.5)	+ gastric acid ,pepsin,internsic factor secretion + gastric empty + pancreatic bicarbonate secretion
Secretin "duodenum & jejunum"	Intraluminal acid(vagus has no direct action on secretin secretion)	+ pancreatic bicarbonate secretion - Gastric acid & pepsin secretion Delayed gastric emptying
Cholecystokinin&pancreozymin "duodenum & jejunum"	Intraluminal fat, AAs ,peptides and certain cations e.g. Ca , Mg	+ pancreatic enz &bicarbonate secretion - gastric emptying & motility of S.I + GB contraction & relaxation of sphincter of oddi
Gastric inhibitory peptide GIP "duodenum & jejunum"	Glucose , fat , AA	+ postprandial insulin secretions - gastric acid secretion & motility
Motilin "duodenum & jejunum"	Acid in small bowel	+ gastric and intestinal motility
Pancreatic polypeptide "pancreas"	Protein rich meal	Relax GB - pancreatic enz secretion
Vasoactive intestinal peptide	Neuronal +	- gastric emptying& pepsin secretion + pancreatic & intestinal secretion

NB: all – gastric acid except gastrin

Enterohepatic circulation:

- Liver produce bile →stored in Gb
- GB contraction(cholecystokinin&pancreozymin)→ bile released into duodenum(aid fat digestion)
- Bile is formed from cholesterol .(bile contain cholesterol, bile acid,phospholipid,bilepigments bilirubin and bliverdin) and protein
- 1ry bile acids are produced in the liver*(cholic acid,chenodeoxycholic acid*).2ry bile acid are formed of 1ry bile acid through conjugation with AAs by the action of intestinal bacteria(*deoxycholic acid ,lithocholic acid*)
- Both types of biles are deconjugated in the intestine→reabsorbed in the terminal ileum→transported back to the liver bounded to albumin for recirculation
- Fecal loss about 10-20% of pool per day
- There are about 6-8 cycles / day of EHC

Bile salts

Bile salts are steroids with detergent properties which are used to emulsify lipids in foodstuff passing through the intestine to enable fat digestion and absorption through the intestinal wall. They are secreted from the liver stored in the gall bladder and
passed through the bile duct into the intestine when food is passing through. Biosynthesis represents the major metabolic fate of cholesterol, accounting for more than half of the 800mg/day of cholesterol that the average adult uses up in metabolic
processes. By comparison, steroid hormone biosynthesis consumes only about 50 mg of cholesterol per day. Much more that 400mg of bile salts is required and secreted into the intestine per day, and this is achieved by re-cycling the bile salts
Most of the bile salts secreted into the upper region of the small intestine are absorbed along with the dietary lipids that they emulsified at the lower end of the small intestine. They are separated from the dietary lipid and returned to the liver for
re-use. Re-cycling thus enables 20-30g of bile salts to be secreted into the small intestine each day.
The most abundant of the bile salts in humans are cholate and deoxycholate, and they are normally conjugated with either glycine or taurine to give glycocholate or taurocholate respectively. The conjugation is important in identifying the bile salt for
re-cycling back to the liver.

Diagnostic investigations of GIT

Esophageal PH monitoring

- Assess the frequency & duration of oesophageal acid exposure and its relationship to symptoms
- Monitor intraoesophageal PH,usually over a period of 24hr
- Can be combined with HR & saturation monitoring in a young child to investigate whether the respiratory events are associated with GOR
- Save , invasive ,difficult in toddlers and uncooperative children
- Should be done only if the results will influence the management
- Transnasal of microelectrode contain PH sensor→lower oesophaeus & its position is confirmed radiologically
- Reflux index:
  - % of the study in which intra-oesophageal ph is <4
  - Estimates the total acid exposure time & is considered the most sensitive & specific measures
  - Normal reflux index : 12% in 1st year of life & up to 6% thereafter
  - Abnormal reflux index :in 95% of children with oesophagitis
- Not all children with significant GOR have oesophagitis
- Time taken for acid to be cleared from Oesophagus after a reflux can also be assessed by a PH study as a proxy for esophageal motility
- Scoring system for PH monitoring :
  - ✓ % of time PH < 4 (reflux index)[mild reflux 4-10,moderate 10-20,severe,20-30]
  - ✓ Number of episodes > 5 min
  - ✓ Duration of longest episode
  - ✓ Total number of reflux episodes

Limitation of the PH study:

a) Not diagnostic test for GOR as any cause of vomiting→abnormal study
b) –ve test not exclude GOR as only acid reflux only detected
c) Post prandial GOR is missed (overcome somewhat by dual probe technique)

Situation in which PH is most helpful:

a) Useful in determine whether symptoms (pain , crying and abnormal movement(sandifer) are associated with acid reflux
b) Useful in determine whether GOR could be contributing to airway complications
c) Assessing the adequacy of acid suppression in children who remain symptomatic despite being treated with PPI

Hydrogen breath test:

Principles: undigested / malabsorbed sugar when reach a part of GIT that has organisms within the lumen, mostly colon (small bowel in small bowel overgrowth) is then fermented by the organism→produce H2 which is excreted in breath

Procedures : the candidate sugar is taken as bolus dose after fasting→older children exhale in H2 monitor device and young children breath in face mask (reading at -30 , 0,every 30 min for 3 hr→breath H2 is plotted against time from CHO ingestion on graph

Result expression: normal small bowel transit time is considered to be about 2 hrs

- Increase in breath H2 at baseline or before 2 hr→small bowel fermentation overgrowth
- Increase after 2 hr →colonic fermentation due to sugar maldigestion/malabsorption

False +ve results	False -ve results
- Inadequate pretest fasting or recent smoking - Rapid delivery of the test sugar to the colon in pts with short bowel syndrome	- Recent use of antibiotics in pts with lung disorder - 1% of children are non H producers - Oral bacteria may lead to an early H peak(pretest mouth wash with antiseptic is advocated by some units)

NB : H2 peak occurring from bacterial overgrowth in distal S.I may be difficult to discriminate from the normal peak seen when the test sugar reach the colon

Celiac antibodies:

- **Serum IgA endomysial** & **tissue transglutaminase Ab** testing have the highest diagnostic accuracy
- IgA & IgG antigliadin antibody tests have lower diagnostic accuracy with frequent false +ve results & therefore no longer recommended for diagnostic evaluation or screening
- All are less accurate in children under 2 years of age
- Exclude IgA deficiency by measuring total IgA to avoid false –ve result as IgA deficiency is common in celiac pts.
- None of the serum Abs tests have 100% sensitivity & specificity and therefore small bowel biopsy is always needed for definite diagnosis I.e. when there is high degree of clinical suspicion→do small bowel biopsy even with –ve serological tests
- IgA endomysial Abs: difficult and done by indirect immunofluorescence
- Ant tissue transglutaminase : more easier , lower coast ,monitor response and adhere to a gluten free diet and done by ELISA

Tests for H. pylori:

A- Urea breath test: sensitivity 90%,specificity >95%

Principle: H.pylori has enzyme urease which converts urea to ammonia& bicarbonate and then CO2

Procedures: urea labeled with C13(nonradioactive) is administrated after fasting usually with fresh orange juice to delay gastric emptying. If H.Pylori present the urea hydrolyse C13 tagged co2→detect in breath samples→collected and analyzed by mass spectrometry

False –ve: test done within a month of antibiotic therapy or the child is taking H2 blocker or PPI prior to the test.so prior to the test NO ant secretory for 2 wks , no antibiotic for 4 wks

B- H.Pylori serology: using ELISA to detect IgG or IgA antibody (sensitivity 90-100%, specificity 76-96%)

- In UK prevalence of H.Pylori is low so –ve test exclude the infection but +ve test is more likely to be false +ve→ do secondary test as urea breath , stool Ag,endoscopy) to confirm initial result before initiating treatment
- *Sero conversion is slow so not useful for follow up*

C- Stool Ag:

- Has same limitation as urea breath test regarding false –ve after antibiotics, acid suppressing drugs
- Confirmation of eradication : urea breath test (of choice) , if not available stool Ag but less accurate

Pancreatic function testing:

- Tests can be either direct or indirect. Direct is a gold standard but is rarely performed as it is invasive and require intubation of the duodenum and duodenal secretion is aspirated after pancreatic stimulation by IV cholecystokinin and secretin or **Lundh test** meal(meal composed of standardized nutrients),it allow bicarbonate , amylase , trypsin and lipase assayed separately
- There are several indirect noninvasive test of pancreatic exocrine function are available, the most commonly used are fecal pancreatic elastase and fecal chymotrypsin measurements
  - **A. Fecal pancreatic elastase :**
    - Most widely used test ,high sensitivity in diagnosis of moderate to severe pancreatic insufficiency(after 2 wks of age)
    - Its value are independent of pancreatic enzymes replacement
  - **B. Fecal chymotrypsin :**
    - Levels are low only in advanced pancreatic insufficiency
    - Cannot be performed when the child taking pancreatic enzyme replacement

Pancreatic function can also be measured by breath tests. A labeled triglyceride, most commonly **14C-triolein**, is ingested and digested by pancreatic lipase in the duodenum, liberating 14CO2, which is detected in the expired air. Because of the radioactivity and long half-life of 14C, this test is not appropriate for use in children. Triolein labeled with 13C, a stable, nonradioactive isotope, is safe for pediatric use. It has not gained widespread acceptance because the test is relatively insensitive in detecting mild cases of pancreatic insufficiency and detection of 13CO2 requires a mass spectrophotometer that is not generally available.

Tests of fat malabsorption:

Quantitative estimation of stool fat:

- Gold standard for diagnosis of steatorrhea
- Most commonly used method of measurement of fat in stool is Titrimetric Van de Kamer method
- In adults : diet contain 100g fat for 3-5 day→ collect stool over 72-96 hr→pooled and refrigerated.in children collection period is 3 days
- Difficult in children to adhere strictly to such diet and steatorrhea is present when >7% of ingested fat is excreted(though infants under 6 month can excrete up to 15% of dietary fat due to physiological immaturity of the pancreatic and biliary secretions
- Rarely used in children

Quantitative estimation of stool fat:

- Fecal Sudan III staining /microscopy and fecal acid steatocrits are the most widely used tests
- Sudan III stain on a spot sample of stool can detect >90% of pts. with clinically significant steatorrhea
- The acid steatocrit is preformed rather like a hematocrit on a spot stool sample→gives the percentage of the stool that is composed of fat(sensitivity 100%,specificity 95% and positive predictive value of 90% as compared to the gold standard 72 hr fecal fat collection)

Other tests of GIT functions :

I. **Xylose tolerance test :**
   - Indirect method used to assess small bowel absorption
   - Xylose is a CHO a load(15mg/m2,max 25g) is ingested and a blood xylose level is taken after 1 hr, a level of < 25mg/dl is suggestive of CHO malabsorption
   - The test is neither sensitive nor specific
   - False +ve→ pernicious anemia , gut edema

II. **Fecal α-1 antitrypsin :**
   - Serum protein , not present in the diet
   - Same MW as albumin
   - Fecal levels reflect enteric protein loss e.g. protein losing Enteropathy

III. **Fecal calprotectin :**
   - Neutrophil protein (white cell protein)
   - Stable in feces
   - Found in adults and children to be a simple and noninvasive measure of bowel inflammation
   - Normal in diarrhea due to irritable bowel disease i.e. functional and elevated in inflammatory bowel disease, polyp , cancer colon also in infection

Common indications for GIT endoscopy and colonoscopy in children

	To diagnose microscopically and histologically	Therapeutic indications
Upper GI endoscopy	▪ Reflux esophagitis ▪ Esophageal and gastric varices ▪ Gastritis/GU ▪ Duodenitis/DU ▪ H.Pylori infection ▪ Crohn's disease of Upper GIT ▪ Enteropathies including celiac	▪ Dilatation of peptic stricture ▪ Sclerotherapy/banding of bleeding varices ▪ Bleeding control in bleeding GU/DU ▪ Insertion of feeding gastrostomy ▪ Passage of nasojejunal tube
Lower GI endoscopy	▪ Polyps ▪ Inflammatory bowel disease	Removal of polyp

Radiological contrast study of GIT

- Invasive and unpleaseant for children
- Assess for anatomical abnormalities causing symptoms

Table 39.1 Radiological contrast studies

Contrast study	Part of GI tract examined	Indications for use	Conditions identified
Videofluoroscopy	Oropharynx	Concerns regarding aspiration on swallowing Assessment of child's ability to swallow different consistencies of fluid/food safely	Bulbar palsy Pseudo-bulbar palsy
Barium swallow	Oesophagus	Dysphagia To investigate tracheo-oesophageal fistula	Oesophageal pouches/webs/ strictures/fistulae
Barium meal	Oesophagus, stomach and duodenum	Recurrent vomiting	Hiatus hernia Gastric outflow obstruction Malrotation (if duodenal–jejunal flexure to right of midline)
Barium meal and follow-through	Oesophagus, stomach, duodenum, jejunum and ileum	To identify presence of small bowel Crohn's disease Partial small bowel obstructive symptoms Note: images are not as good as with small-bowel contrast study	Small bowel Crohn's disease Small bowel strictures due to Crohn's disease or post-surgery
Small-bowel study (requires duodenal intubation)	Duodenum, jejunum and ileum	To identify small bowel Crohn's disease Partial small bowel obstructive symptoms	Small bowel Crohn's disease Small bowel strictures due to Crohn's disease or post-surgery
Contrast enema	Rectum and colon	To reduce intussusception (therapeutic) Very rarely used diagnostically in children	

Oesophageal foreign body

- If a foreign body is stuck in the Oesophagus it should be removed under direct vision.
- X-rays should be repeated just prior to the procedure to make sure that the foreign Body has not passed into the stomach or been vomited.
- Sharp objects, such as open safety pins, should be removed as an emergency, and disc batteries can cause corrosive injury to the Oesophagus within 4 hours, so the same applies to them.
- Asymptomatic coins can be observed for 24 hours, and watched expectantly.
- Hairballs are unlikely to stick in the Oesophagus.

Gastro esophageal reflux

- Retrograde movement of gastric content a cross the LES into the Oesophagus
- Occasional episodes of reflux are physiologic e.g. normal regurgitation phenomenon in infants
- Pathologic GERD : when the episodes are frequent or persist and thus produce esophagitis ,esophageal symptoms or in those who have respiratory sequelae
- TLESR is the primary mechanism allowing reflux to occur

Epidemiology and natural history:

- Evident in 1st few months of life(may be during 1st week of life)
- Peak at 4 month , resolve in up to 88% by 12m and nearly all by 24 month
- Histologic finding of oesophagitis persist in infant who have naturally resolving symptoms of refluxate
- GERD likely to has genetic predisposition :the following are identified:
  Family clustering of GERD - endoscopic oesophagitis - hiatal hernia - Barrett Oesophagus
- Complex inheritance : genetic + environmental factors

Clinical presentation of GERD:

Presentation	Infants	Children
Excessive regurgitation	○ Vomiting ○ Growth faltering	○ Vomiting ○ Growth faltering
Oesophagitis	○ Irritability with feedings ○ Feeding refusal ○ Arching ○ Hematemesis , anemia	○ Heartburn ○ Chest or abdominal pain ○ Dysphagia , odynophagia ○ Hematemesis , anemia ○ Sandifer's syndrome*
Respiratory disorders	○ Apnea/stridor ○ Aspiration pneumonia ○ Laryngospasm (malacia) ○ ALTE ○ Sudden unexpected death in infancy	○ Aspiration pneumonia ○ Bronchospasm (asthma) ○ Laryngospasm (aponea,strior) ○ Hoarseness

* Sandifer syndrome: gerd + neck contortions (arching, head turning)

NB: the following diseases have been associated with GERD: otitis media, sinusitis, lymphoid hyperplasia, hoarseness, vocal cord nodules and laryngeal edema

Differential diagnosis:

1. Infections e.g. urinary tract infection , gastroenteritis
2. Intestinal obstruction e.g. pyloric stenosis , intestinal atresia , malrotation
3. Food allergy and intolerance e.g. cow milk allergy , soy allergy , celiac disease
4. Metabolic disorders e.g. diabetes , IEM , adrenal insufficiency (shock+low K)
5. Psychological problems e.g. anxiety
6. Drug induced vomiting e.g. cytotoxic agents
7. Primary respiratory disease e.g. asthma , cystic fibrosis
   Posseting: small volume vomits that occur during or between feeding. Infant will be thriving and no cause of concern .treatment by reassurance

Differential diagnosis of reflux oesophagitis

- Cow milk allergic oesophagitis
- Candida oesophagitis
- Chemical oesophagitis from caustic ingestion
- Crohn's disease

Investigations of GERD: in Severe cases especially if there are symptoms or signs of oesophagitis

I. **Barium radiology** : not sensitive or specific but will pick up anatomical problems such as malrotation or stricture
II. **PH study** : gold standard for acid reflux but unless dual PH recording is performed (esophageal and gastric monitoring) will miss alkali reflux
III. **Nuclear medicine (milk scan)** : will assess acid or alkali reflux following a physiological meal, assess gastric emptying and it is possible to make a 24 hr film to look for evidence of aspiration (Tc 99m radioscintigraphy)
IV. **Upper GIT endoscopy with biopsy**
V. **multichannel intraluminal impedance (MII)** +/- manometry : diagnose GERD ,study oesophageal function

Question to ask	Test performed
Are there structural abnormalities in the upper GI	Barium meal
Is there a delay in gastric emptying	Radio nucleotide gastric empty study
Does aspiration occur	CXR,videofluoroscopy/barium swallow,bronchoscopy,radionucleotide "milk scan"
Is oesophagitis present	Endoscopy and biopsy
Are specific symptoms casually related to GOR	PH monitoring with event recording
Is a hiatus hernia present	Barium swallow , endoscopy
Is the quality of acid GOR abnormal	PH monitoring
Is there oesophageal motility disorder	Barium swallow , oesophageal manometry

Management of GERD:

Phase 1: basic/lifestyle treatments

Infants	Older children
Positioning : prone but not recommended (upright carried position) **Thickening feeds:** Reduce frequency of regurgitation **Antacids: e.g. gaviscon** may reduce possiting but no effect on significant GERD	**Avoid :** caffeine , chocolate , smoking and alcohol **Reduce weight** in obese **Antacid :** short term symptomatic relief

Phase 2: prokinetics

- only cisapride has good evidence that effective but not available (SE cardiac toxicity)
- domperidone , erythromycin and metoclopramide can be used

NB FDA announced a black box warning for metoclopramide, linking its chronic use (>3 mo) with tardive dyskinesia, the rarely reversible movement disorder

Phase 3: acid inhibition

- **H2 blockers e.g.** ranitidine ,cimetidine (block H2 receptor on parietal cells)
- **Proton pump inhibitors e.**g. omeprazole ,lansoprazole (block acid secretion bu irreversibly binding to and inhibiting the H-K ATPase pump on the luminal surface of parietal cell membrane)

Phase 4: surgery

- Failure if medical management over 3 months period
- High risk group include those with neurodisability or intractable respiratory symptoms exacerbated with GERD
- Ant reflux procedure e.g. Nissen fundoplication but only in life threatening reflux

Nb: consider trial of hypoallergenic formula during any phase

Specific management of clinical scenarios

I. An infant with uncomplicated GERD (happy puker):

- Diagnosed by history and examination , no investigation needed
- Just reassure , food thickening then revaluate if symptoms worsen or not improved by 18-24 m

II. An infant with recurrent vomiting and poor weight gain :

- Dietetic assessment→ poor weight gain despite adequate intake→ evaluate other causing of vomiting and weight loss other than GERD→investigate
    - CBC , electrolyte , LFTs,S.ammonia,glucose,urine analysis, urine ketones , reducing ketones, reducing substance in stools, review of newborn screening tests
    - Barium meal to exclude anatomical abnormalities
    - Upper endoscopy with biopsy may also required in selected cases
- If GERD continues to be suspected after the above evaluation→treatment option include :
    - Thickened formula , trial of hypo allergic formula,↑ caloric density of formula
    - Prokinetics therapy e.g. domperidone (no evidence but try it)
    - Implementing continuous nasogastric feeding

III. Infant with discomfort on feeding:

- If oesophagitis suspected →endoscopy with biopsy is the investigation of choice
- Therapeutic trial of acid suppression , food thickener or prokinetics drugs may be tried 1st

IV. A child or adolescent with recurrent vomiting or regurgitation

- Otherwise healthy children with recurrent vomiting or regurgitation after 2 year of age→ evaluate by barium meal and /or upper endoscopy with biopsy
- Treatment should be based upon findings

V. Child or adolescent with heart burn :

- Treated empirically with lifestyle changes + 4 weeks trial of H2 blocker or PPI
- Persistent or recurrent symptoms→ upper endoscopy with biopsy

VI. Apnea with ALTE:

- PH monitoring may be useful to link intraoesophageal acid with events
- These infants may be more likely to respond to anti reflux therapy when :
    - Vomiting or regurgitation occurs at the time of ALTE
    - Episodes occur while the infusion is awake
    - ALTE is characterized by obstructive apnea
- Maximize medical therapy with formula thickening , prokinetics , acid suppression
- Only minority require ant reflux surgery

VII. GERD in children with neurodisability :

- 1/3 of children with severe psychomotor retardation have significant GERD
- Exacerbated in many by the presence of large hiatal hernia and diffuse foregut dysmotility
- Growth faltering and dental erosions are a frequent problem

- All severe sequelae of GOR have a higher incidence in those children including recurrent aspiration pneumonia ,blood loss from oesophagitis , stricture formation etc.
- Oesophagitis can respond to H2 antagonist but most require maximal medical therapy with high dose PPIs
- Many of these children will not respond adequately to the medical therapy and will require fundoplication(have a high rate of perioperative , post-operative complications in this group)

Complication of GERD:

A. Oesophagitis :

- Manifested by : irritability, arching, and feeding aversion in infants; chest or epigastric pain in older children; and, rarely, as hematemesis, anemia, or Sandifer syndrome at any age
- Erosive esophagitis is found in approximately 12% of children with GERD symptoms and is more common in boys, older children, neurologically abnormal children, children with severe chronic respiratory disease, and in those with hiatal hernia
- Prolonged and severe oesophagitis → strictures (distal end) → dysphagia → repeated oesophageal dilatation and often fundoplication

B. Barrett Oesophagus:

- Long-standing esophagitis predisposes to metaplastic transformation of the normal esophageal squamous epithelium into intestinal columnar epithelium
- ↑ the risk of adenocarcinoma of the Oesophagus
- Rare in childhood
- Require aggressive medical treatment, regular endoscopic assessment
- The risk of malignancy is felt to relate to the extent of persistent exposure of distal Oesophagus to acid so surgery is often considered

C. Failure to thrive :

- Esophagitis and regurgitation may be severe enough to induce failure to thrive because of caloric deficits
- Enteral (nasogastric or nasojejunal, or percutaneous gastric or jejunal) or parenteral feedings are sometimes required to treat such deficits.

D. Others :

- Exacerbate lung problems such as asthma
- GERD may → episodes of aspiration (may be silent) → irreversible lung damage if recurrent



- ↑ risk of GERD in premature infants and in neurologically impaired and probably in severe chronic lung disease
- Vomiting of gerd may contain altered blood
- Gerd associations : CP,celiac,UTI,hiatus hernia, thoracic stomach,↑ ICP

Oesophageal disease note

The common symptoms and signs of oesophageal disease are cough or choking with swallowing, regurgitation or vomiting, dysphagia, complete inability to swallow, pain on swallowing (odynophagia), and hematemesis. Each can be attributed to one or more defects in the complex coordination of the swallowing sequence. Oesophagitis may cause the following symptoms:

EARLY: Salivation, refusal to drink, nausea, vomiting, epigastric pain, oral burns or ulcerations, fever, and leukocytosis that may clear in a few days, and rarely, oesophageal perforation.

LATE: Oesophageal strictures may develop over a few weeks and cause dysphagia and weight loss. ***Diffuse oesophageal spasm*** may be a cause of chest pain and dysphagia in adolescents. This primary motility disorder has characteristic oesophageal contractions noted on manometry simultaneously with midchest, retrosternal pain after swallowing liquids. Tensilon testing (edrophonium) may provoke pain.
Treatment is usually not needed, except in more severe cases, in which nitrates or calcium channel blocking agents have been successful.

Baclofen is a centrally acting ©-aminobutyric acid (GABA) agonist that has been shown to decrease reflux by decreasing TLESRs in healthy adults and in a small number of neurologically impaired children with GERD. New agents of great interest include peripherally acting GABA agonists devoid of central side effects, and metabotropic glutamate receptor 5 (mGluR5) antagonists that are reported to reduce TLESRs, but are as yet inadequately studied for this indication in children.

Hiatus hernia

This is herniation of the stomach though the oesophageal hiatus and may be of the sliding type(GE junction slides into the thorax) or para-oesophageal(a portion of the stomach herniates beside the GE junction)

Sliding hiatus hernia	Para esophageal hiatus hernia
• Common type • Associated with GERD	• Less common • No reflux occurs • Complication of Nissen fundoplication • May be congenital anomaly or associated with gastric volvulus • Upper abdominal pain and fullness after eating are a common symptom

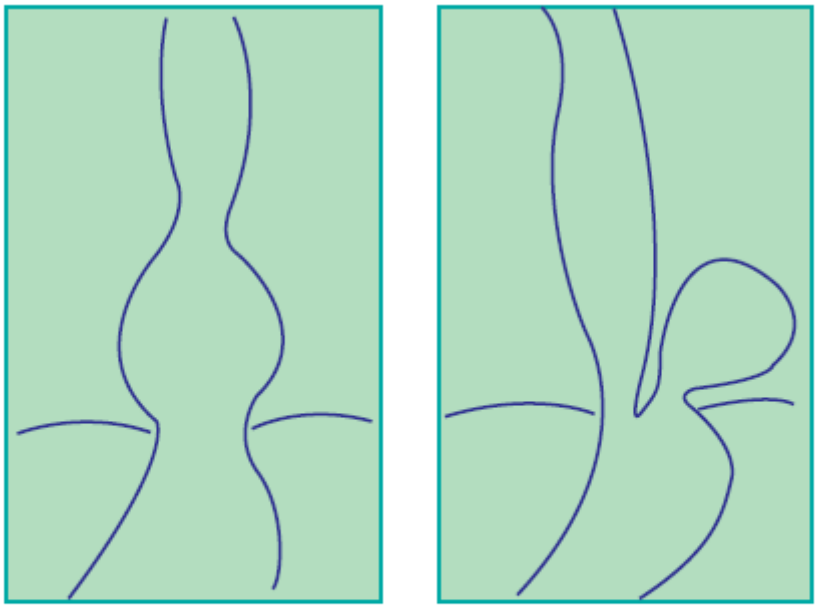


Figure 314-1 Types of esophageal hiatal hernia. *A*, Sliding hiatal hernia, the most common type. *B*, Paraesophageal hiatal hernia.

Peptic ulcer

Final common pathway for the development of ulcers is the action of acid and pepsin-laden contents of the stomach on the gastric and duodenal mucosa and the inability of mucosal defense mechanisms to allay those effects.

Types ant etiology of ulcer:

Primary peptic ulcer	Secondary peptic ulcer
▪ Chronic and often duodenal ▪ Often associated with H.Pylori	▪ Acute often gastric ▪ Often result from: o Stress :sepsis,shock,IC lesion(Cushing ulcer),severe burn o Drugs : aspirin ,NSAIDs o Zollinger-Ellison syndrome o short bowel syndrome o systemic mastocytosis

H.Pylori infection:

- account for 90% of duodenal ulcers in childhood
- can be asymptomatic or cause chronic gastritis or PU disease
- it is Gram –ve bacyerium S shaped rodes,infection usually acquired in childhood
- it is carcinogen
- no proven association between H.Pylori and recurrent abdominal pain
- transmission is faeco-oral and familial clustering is common
- Anemia, idiopathic thrombocytopenic purpura, short stature, and sudden infant death syndrome (SIDS) have also been reported as extra gastric manifestations of H. pylori infection

Clinical features:

1. intermittent abdominal pain, worse at night
2. nausea , vomiting, dyspepsia
3. iron deficiency anemia and GIT bleeding

NB: The classic symptom of peptic ulceration, epigastric pain alleviated by the ingestion of food, is present only in a minority of children.

Investigations:

- endoscopy with biopsy
- serology of H.Pylori “see investigation of GIT”

Management:

1. H2 antagonist or PPI e.g. omeprazole
2. Eradication of H.Pylori

MEDICATION	PEDIATRIC DOSE	HOW SUPPLIED
H_2 RECEPTOR ANTAGONISTS		
Cimetidine	20-40 mg/kg/day Divided 2 to 4 × a day	Syrup: 300 mg/mL Tablets: 200, 300, 400, 800 mg
Ranitidine	4-10 mg/kg/day Divided 2 or 3 × a day	Syrup: 75 mg/5 mL Tablets: 75, 150, 300 mg
Famotidine	1-2 mg/kg/day Divided twice a day	Syrup: 40 mg/5 mL Tablets: 20, 40 mg
Nizatidine	10 mg/kg/day Divided twice a day	
PROTON PUMP INHIBITORS		
Omeprazole	1.0-3.3 mg/kg/day<20 kg: 10 mg/day>20 kg: 20 mg/day Approved for use in those >2 yr old	Capsules: 10, 20, 40 mg
Lansoprazole	0.8-4 mg/kg/day<30 kg: 15 mg/day>30 kg: 30 mg/day Approved for use in those >1 yr old	Capsules: 15, 30 mg Powder packet: 15, 30 mg Solu-tab: 15, 30 mg
Rabeprazole	Adult dose: 20 mg/day	Tablet: 20 mg
Pantoprazole	Adult dose: 40 mg/day	Tablet: 40 mg
CYTOPROTECTIVE AGENTS		
Sucralfate	40-80 mg/kg/day	Suspension: 1,000 mg/5 mL Tablet: 1,000 mg

MEDICATIONS	DOSE	DURATION OF TREATMENT
Amoxicillin	50 mg/kg/day in 2 divided doses	14 days
Clarithromycin	15 mg/kg/day in 2 divided doses	14 days
Proton pump inhibitor	1 mg/kg/day in 2 divided doses	1 mo
or		
Amoxicillin	50 mg/kg/day in 2 divided doses	14 days
Metronidazole	20 mg/kg/day in 2 divided doses	14 days
Proton pump inhibitor	1 mg/kg/day in 2 divided doses	1 mo
or		
Clarithromycin	15 mg/kg/day in 2 divided doses	14 days
Metronidazole	20 mg/kg/day in 2 divided doses	14 days
Proton pump inhibitor	1 mg/kg/day in 2 divided doses	1 mo

Causes of antral gastritis and PU

1. H.Pylori infection
2. Anti-inflammatory drugs
3. Crohn's disease
4. Zollinger-Ellison syndrome
5. Autoimmune gastritis (adults)

Zollinger-Ellison syndrome:

- A rare syndrome characterized by refractory, severe peptic ulcer disease caused by gastric hyper secretion due to the autonomous secretion of gastrin by a neuroendocrine tumor, a gastrinoma.
- Clinical picture : picture of PU + diarrhea
- Diagnosis : recurrent , multiple or atypical ulcer location + ↑ fasting gastrin level
- Common in patients with multiple endocrine neoplasia (MEN1) and rare with neurofibromatosis and tuberous sclerosis.
- Treatment : PPI and H2 receptor antagonists(higher doses than PU)

Celiac disease

Etiology and epidemiology:

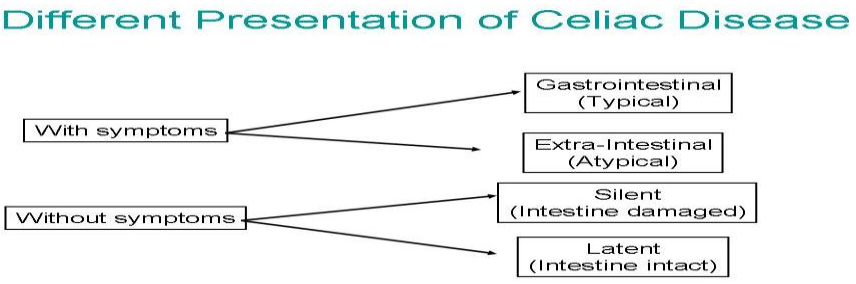
- Celiac disease is immune mediated disorder elicited by the ingestion of gluten in genetically susceptible person and characterized by chronic inflammation of small intestine
- Considered an autoimmune condition because of the presence of anti TGs Abs and association with other autoimmune disease (thyroid, liver, diabetes, adrenals)
- Celiac disease is triggered by ingestion of wheat gluten and related prolamines from rye and barely. Oats (safe but few pts. Have oats prolamine reactive mucosal T cells that can cause mucosal inflammation
- Prevalence rate in UK between 1:300 and 1:1000
- Environmental factors might affect the risk of developing celiac disease or the timing of its presentations:
    - Prolonged breast feeding → reduce the incidence of symptomatic disease
    - Timing of gluten introduction(less clear evidence):ingestion of ↑ amount in 1st year of life → ↑ incidence
    - Infectious agents: frequent Rota virus → ↑ incidence
    - In subset of person : contact with glidain at a time of ongoing intestinal inflammation → altered intestinal permeability and enhance Ag presentation → ↑ risk of developing the disease

NB : a dietary glidain is a fraction of the protein gluten

Genetics:

- HLA DQ2 , DQ8 (HLA B8 , HLA DR3 , HLA DR 7 ,DQW2)
- ↑ incidence in 1st degree relative 1:10
- Monozygotic twins incidence approximately 100%

Clinical presentations:



The Celiac Iceberg

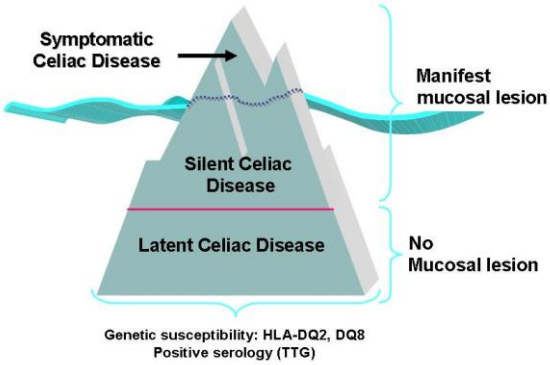


Table 330-6 CLINICAL SPECTRUM OF CELIAC DISEASE
SYMPTOMATIC
Frank malabsorption symptoms: chronic diarrhea, failure to thrive, weight loss
Extraintestinal manifestations: anemia, fatigue, hypertransaminasemia, neurologic disorders, short stature, dental enamel defects, arthralgia, aphthous stomatitis
SILENT
No apparent symptoms in spite of histologic evidence of villous atrophy
In most cases identified by serologic screening in at-risk groups (see Table 330-1)
LATENT
Subjects who have a normal histology, but at some other time, before or after, have shown a gluten-dependent enteropathy
POTENTIAL
Subjects with positive celiac disease serology but without evidence of altered jejunal histology
It might or might not be symptomatic

د مرفق يوسف
dr morkos yousef

Table 330-4 SOME CLINICAL MANIFESTATIONS OF CELIAC DISEASE IN CHILDREN AND ADOLESCENTS

SYSTEM	MANIFESTATION	(POSSIBLE) CAUSE
Gastrointestinal	Diarrhea Distended abdomen Vomiting Anorexia Weight loss Failure to thrive Aphthous stomatitis	Atrophy of the small bowel mucosa Malabsorption
Hematologic	Anemia	Iron malabsorption
Skeletal	Rickets Osteoporosis Enamel hypoplasia of the teeth	Calcium/vitamin D malabsorption
Muscular	Atrophy	Malnutrition
Neurologic	Peripheral neuropathy Epilepsy Irritability	Thiamine/vitamin B_{12} deficiency
Endocrinologic	Short stature Pubertas tarda Secondary hyperparathyroidism	Malnutrition Calcium/vitamin D malabsorption
Dermatologic	Dermatitis herpetiformis Alopecia areata Erythema nodosum	Autoimmunity
Respiratory	Idiopathic pulmonary hemosiderosis	

Table 330-5 RISK GROUPS FOR CELIAC DISEASE CASE-FINDING

1st-degree relatives
Dermatitis herpetiformis
Unexplained iron deficiency anaemia
Autoimmune thyroiditis
Type 1 diabetes
Unexplained infertility
Recurrent abortion
Dental enamel hypoplasia
Cryptic hypertransaminasemia
Autoimmune liver disease
Short stature
Delayed puberty
Down, Williams, and Turner syndromes
Irritable bowel syndrome
Unexplained osteoporosis
Sjögren syndrome
Epilepsy with occipital calcifications
Selective IgA deficiency
Addison disease

- The clinical features vary considerably :
    - **1st 2 year of life :**
    - Intestinal symptoms + muscle wasting , irritability
    - Occasionally there is constipation , rectal prolapse or intussusception
    - **Later presentation :**
    - Extra intestinal manifestations and associated disorders
    - Without any accompanying digestive symptoms affecting almost all organs
    - Most common extra intestinal manifestations → iron deficiency anemia unresponsive to iron therapy. Osteoporosis may be present (resolved by Gluten free diet with restoration of normal peak bone densitometry values, in contrast to adults)
    - Other extra intestinal manifestation :
        - Short stature, endocrinopathies, arthritis and arthralgia
        - Epilepsy with bilateral occipital calcifications
        - Peripheral neuropathy and cardiomyopathy
        - Chronic lung disease, Apthous stomatitis and alopecia
        - Dental enamel hypoplasia
        - Isolated hypertransaminasemia
    - Mechanism responsible for the severity and variety of clinical presentation remain obscure. Nutritional deficiencies or abnormal immune response have been advocated
- **Associations :**
    - Autoimmune diseases : sharing of the identical HLA
        - Autoimmune thyroiditis, Addison, sjogran syndrome
        - Autoimmune cholangitis, hepatitis, 1ry biliary cirrhosis
        - type I DM, IgA nephropathy, alopecia
        - Dilated cardiomyopathy
    - Syndromes : Down , Turner , William syndrome
    - Selective IgA deficiency
    - Dermatitis herpatiformis (all children with dermatitis herpatiformis have celiac disease)
        - ✓ Very itchy on extensor surfaces
        - ✓ Improves on gluten free diet
        - ✓ IgA Abs in normal and perilesional skin but not active lesions
        - ✓ Treatment with dapsone until diet effective
- Main cause of death in patient with celiac disease is NHL
- Adult patient can develop complications such as refractory celiac disease , ulcerative jejunoileitis or Enteropathy associated T cell lymphoma

Diagnosis:

I. **Celiac Abs testing :** see investigation of GIT
II. **Small bowel biopsy:** jejunal biopsy (endoscopic duodenal or jejunal)
    - ✓ Usually performed through a gastroscope(previously via Crosby capsule)
    - ✓ Celiac disease result in total villous atrophy with character tic features(see below);partial villous atrophy which is less common and has wide differential diagnosis (see below)

Characteristics features in biopsy:

- Total or Subtotal villous atrophy
- Crypt hypertrophy (elongation)
- Intra epithelial lymphocytosis
- A lamina properia plasma cell infiltrate

NB: all children should receive adequate gluten in diet at time of biopsy other wise False -ve

NB: total/subtotal villous atrophy can be seen also in tropical sprue , giardiasis

Differential diagnosis of partial villous atrophy	
A	○ Autoimmune entropathy ○ Acquired hpogammaglobulinaemia ○ Antineoplastic therapy
C	○ Celiac disease ○ Cow milk sensitive entropathy
G	○ Gastroenteritis with post gastroenteritis syndromes ○ Giardiasis ○ Gluten transient intolerance
S	○ Severe combined immunodeficiency (SCID) ○ Sprue tropical ○ Soy protein sensitive entropathy
P	○ Protein energy malnutrition

Mnemonic : Adult Cow Give Simply Protein

III. Gluten challenge : in children diagnosed under 2 year as transient gluten entropathy may occur under this age but celiac is diagnosed as a lifelong condition after 2 year of age

NB: Gluten challenge is not considered mandatory except in situations where there is doubt about the initial diagnosis, for example, when an initial biopsy was not performed or when the biopsy specimen
was inadequate or atypical of celiac disease.

IV. Other finding : anemia (dimorphic blood film. iron& folate def.) , hypoalbuminemia

The European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) current criteria, the 2 requirements mandatory for the diagnosis of celiac disease are the finding of villous atrophy with hyperplasia of the crypts and abnormal surface epithelium, while the patient is eating adequate amounts of gluten, and a full clinical remission after withdrawal of gluten from the diet

Treatment:

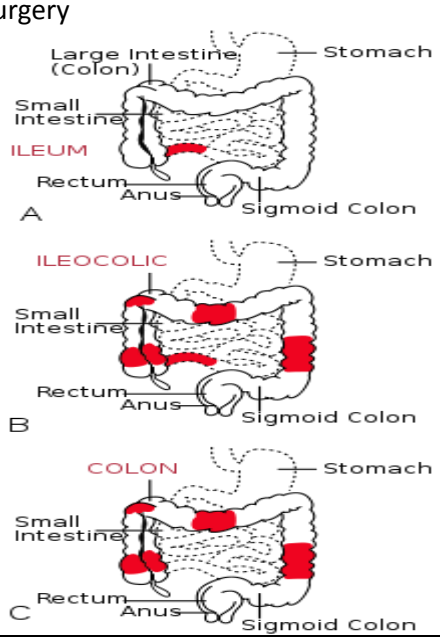
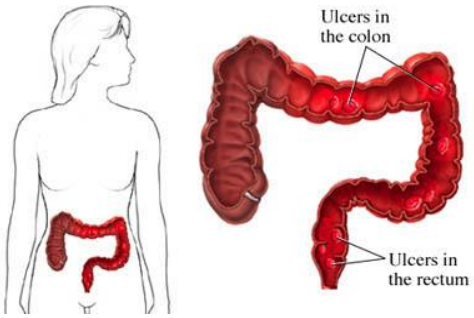
- Life time gluten free diet(reduce risk of complications such as intestinal lymphoma)
- Experienced dietician is needed to counsel the family

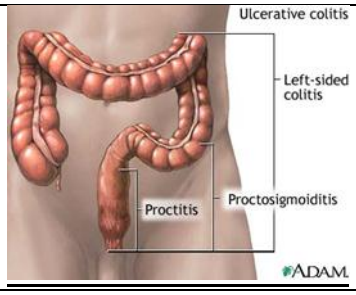
Inflammatory bowel diseas

	Crohn's disease	Ulcerative colitis
def	A disease of chronic inflammation of the bowel involving any part from the mouth to anus.the inflammation is transmural with skip lesions.	Disease of chronic inflammation of colon with ulceration
Site	Classically the terminal ileum and rectum is often spared (terminal ileum and proximal colon)	Classically involve the large bowel from rectum upward.(small bowel may be involved)
Incidence	- Male = female - 25% in childhood (2nd decade)	- Female > male slightly
Presentation	- Abdominal pain, diarrhea , weight loss - Growth failure and delayed pubery and sexual maturity(earliest of sign of growth failure is decreased height velocity)	- Colitis (diarrhea +blood) - Occult blood loss ,abdominal pain, cholangitis and increase inflammatory markers - Extra intestinal manifestations including growth failure, arthropathy ,erythema nodosum (unusual)
Clinical features: **A - GIT**	1- Abd.pain , diarrhea,anorexia,aphtous ulcers 2- Abd. Mass ,perianal lesions (tags , abscess , fistulae),stricture and fistulae common *Nb Cd can cause antral gastritis and PU*	1- Diarrhea with blood and mucus 2- Abdominal pain
B- Systemic	1- Fever , malaise , weight loss 2- Anemia and nutritional deficiencies 3- Growth retardation and amenorrhea(1ry or 2ry)	1- Anemia (iron loss) 2- Growth retardation (malabsorption)
C - extra intestinal	Risk of cancer increased Extra intestinal manifestation more common	Greatly increased
	Uveitis conjunctivitis fatty liver cholangocarcinoma Occur in both equally	
	Most commonly in Crohn's	Most commonly in UC
	Erythema nodosum Episcleritis Peripheral arthritis (nondestructive) Apthous ulcers Clubbing Renal stones (oxalate,uric acid) Gall stones NB: some manifestation as peripheral arthritis , erythema nodosum and anemia correlates with the activity of bowel disease	Pyoderma gangerosum Ankylosing spondylitis(HLAB27 pt) Sclerosing cholangitis Chronic active hepatitis cirrhosis
DD	1- GIT TB 2- Infectious enteropathies esp Yersinia ileitis 3- Small bowel lymphoma	1- Crohn's disease 2- Amoebic colitis 3- Bacillary dysentery

Investigations **Blood tests**	- anemia,often with a component of iron deficiency - ESR often elevated (may be normal) - Elevated platelets - Wbc normal or mildly elevated - The serum albumin level may be low, indicating small bowel inflammation or protein losing enteropathy - Fecal calprotectin elevated - ASCA Found in most CD patients and few UC patients - (anti-OmpC) and anti-flagellin (anti-CBir1) antibodies are associated with Crohn disease.	- anemia (either iron deficiency or anemia of chronic disease) or hypoalbuminemia - ***ESR and CRP often elevated, they may be normal even with fulminant colitis***. - Elevated WBC only in severe disease - Fecal calprotectin levels are usually elevated. - Atypical p-ANCA Found in most UC patients and few CD patients
Plain AXR	Partial small bowel obstruction , **thumb printing colon wall**	Dilated colon (toxic mega colon is colon width>2.5 vertebrae)
Barium meal and follow through **Upper endescopy and ileocolonscopy with biopsies** **Lesion histology**	Capsule endoscopy: Emerging role in diagnosis of small bowel CD, more sensitive than upper GI series with SBFT **Cobblestone appearance** (linear ulcers) , deep fissures , strictures and fistulae is common, discontinuous disease with **normal skip lesions** ***Non caseating granulomas***,transmural inflammation, patchy involvement	**Double contrast Barium(air) enema:** **Continuous pathology** "collar button ulcers" , "lead pipe"(smooth) colon, **backwash ileitis** , double contour **Ileo-colonoscopy with biopsy:**lesion histology Mucosal involvement , gland destruction , crypt abcesses , decreased goblet cells pesudopolyp , friability and ulcerations, ***No granuloma*** *NB:dilated rectum in severe cases*

Management options	**Polymeric elemental diets:** • Effective as initial therapy instead of steroids • Give exclusive polymeric enteral nutrition e.g. Modulin IBD for 8 wks orally or via NGT as tolerated • Ideal for children with growth failure **Antibiotics such as metronidazole** :1st line for perianal disease **Steroids :** • For acute exacerbation (no role for continuing steroid or maintainace) • Oral or IV HIGH DOSE for 3-4wks,then alternate days and reduce as able • Prednisolone , budesonide (special controlled ileal-release formulation of budesonide, a cst with local anti-inflammatory activity on the bowel mucosa and with high hepatic first-pass metabolism) **Aminosalicylates :** • Sulphasalazine* , mesalazine or olsalazine for colon disease • delayed release 5ASA(Asacol) for terminal small bowel disease • can be used for prevention of relapse **Immunomodulators :** • Azathioprine or 6 mercapturine in poor response to steroids or steroid dependant,reduce steroid requirements • Thiopurines (cause lymphoproliferative disorders and myelosuppression) • Methotrexate (improve height velocity) **Infliximab :** • Therapy with Abs directed against mediators of inflammation is used for patients with Crohn disease • chimeric monoclonal antibody to	**Aminosalicylates :** Oral e.g. sulphasalazine , mesalazine , olsalazine for mild colitis and prevention of relapse **Steroids :** Oral or IV at 1-2 mg/kg/day max 40 mg for cases unresponsive to Aminosalicylates **Immunomodulators and others** • Azathioprine , 6 mp • Cyclosporine (high SE profiles) • Tacrolimus , metronidazole • Used in steroid dependent or uncontrolled diseases **Infliximab :** monoclonal Abs to TNF alpha • effective in cases of fulminant colitis • effective for induction and maintenance therapy in adults with moderate to severe disease • SE : increase risk of infection as TB , malignancy (leukemia , lymphoma) **Surgery :** • TPN in preparation of surgery • Colectomy is performed for fulminant disease unresponsive to medical therapy Or pan colitis >10 years **Complications:** 1. Toxic megacolon 2. Fulminant colitis 3. Colon cancer (long term) so regular colonoscopy after 10 years active disease

	TNF-α, • effective for the induction and maintenance of • remission and mucosal healing in chronically active moderate to • severe Crohn disease, healing of perianal fistulas, and steroid sparing. • Rapid action and support growth • Side effects increased risk of infection (particularly tuberculosis) and malignancies (lymphoma, leukemia). **<u>Others :</u>** • Tacrolimus/pabecrolimus paste for perianal disease • TPN rarely necessary temporarily **<u>Surgery :</u>** • For special indications as recurrence risk is high • Resection of disease unresponsive to medical therapy (wide resection margin with right subtotal hemicolectomy) • Abscess, perforation , obstruction bleeding *NB: inflammatory markers almost universally raised in CD*	
Effect of smoking	Strongly associated with smoking Predict a worse course of the disease Increase risk of surgery and further surgery 	Associated with nonsmoker or ex-smoker Smoking protect against the disease 

*Sulphasalazine is dependent upon hydrolysis of the sulpha moiety of the drug from the amino-salicylic acid moiety by bacteria. Bacterial counts sufficient to achieve this are found in the large intestine in health, but not in the small bowel.

Differential diagnosis of colitis:

Infective colitis	Non infective colitis
• Salmonella , shigella , comylobacter pylori • E.choli 0157 (and other E.coli) • Clostridium difficile (pseudomem. Colitis) • Yersini , TB • CMV • Entamoeba histolytica	• Ulcerative colitis , Crohn's disease • Necrotizing enterocolitis • Microscopic colitis • Behcet disease • Food allergic colitis • Enterobious vermicularis

Pseudomembranous colitis:

Etiology: occur 2ry to infection with C.difficile producing toxins

- Spore forming Gram +ve obligate anaerobic bacillus(noninvasive)
- Part of normal flora of 3% of adult and much higher in neonate and infants
- The carrier are unaffected because their intestinal epithelium does not yet express the toxin receptors
- C.difficile produce 2 large MW toxins in the colon → pseudomembranous colitis
    - Toxin A : act primarily on the intestinal mucosa → diarrhea (thought to be the principle mediator of illness
    - Toxin B: In low doses ↑ vascular permeability and in high doses is lethal to experimental animals
- Predisposing factors :
    - Antibiotics , chemotherapeutic agents and antiviral drugs
    - Dietary changes , uremia and anesthesia
    - Hirsch sprung disease

Clinical manifestation: wide range of severity

1- Mild non bloody watery brown diarrhea with abdominal cramps
2- Severe hemorrhagic colitis with protein losing Enteropathy, hypoalbuminemia, shock, fever , leukocytosis , abdominal tenderness, distension ,toxic megacolon (cecal),perforation, peritonitis, sepsis and death

Diagnosis:

1- Detection of fecal toxin B (cytotoxic) in a symptomatic pts.
2- Sigmoidoscopy → pseudomembrane (not essential for diagnosis + risk of perforation)

Lesion appear grey with exudate that are poorly adherent and surrounded by an edematous and erythematous inflammatory response

Treatment:

1- Stop non vital antibiotics + fluid and electrolyte replacement
2- Drugs : metronidazole , vancomysin (in severe cases)
3- Other drugs in adults :e.g. nitazoxanide , fidaxamicin

NB : relapse rate 15-20%

Behcet syndrome:

- Orogenital ulceration with/without
    - Non erosive arthritis
    - Thrombophlebitis
    - Vascular thrombosis
    - CNS abnormalities including meningoencephalitis
- Treatment : usually unsatisfactory
    - Local and /or systemic steroids may be used acutely
    - Azathioprine and thalidomide used in prophylaxis

Acute pancreatitis	Chronic pancreatitis
This involve inflammation of the pancreas with autodigestion,localized necrosis and haemorrhage.complications can be severe	
Causes : • Biliary sludging • Cong anomalies • Blunt abdominal trauma • Viral infections :mumps, measles , EBV, coxsakie • Drugs : TPN ,steroids , azathioprine , depakine (Na valproate) • Disease associated : HUS , Kawasaki , stem cell transplant , brain tumor ,IBM as isovaleric acidaemia, hypothermia	**Causes :** • Hereditary : AD.progressively more severe attacks • Cong pancreatic or biliary ductal anomalies : hyperlipidemia , CF,Wilson • Predisposing disorders : cystinuria , cystinosis , isovaleric acidaemia , alpha 1 antitrypsin , ascaris
Clinical features : ▪ Abdominal pain (epigastric ,radiating straight through to the back) ,N,V,fever ▪ Tender abdomen , guarding, absent or obstructed bowel sounds , abdominal mass ▪ **Acute haemorrhagic pancreatitis** : o Very unwell , shocked , jaundiced o **Cullen sign** :bluish periumblical region o **Grey turner** sign : bluish flanks o 50% mortality with DIC,renal failure , RDS,sepsis , GIT bleeding	**Clinical features:** ▪ Repeated attacks of acute pancreatitis ▪ Intractable pain **Complications :**due to repeated attack Pancreatic pseudo cysts Calcifications Pancreatic insufficiency Pancreatic pleural fistula (rare):pleural effusion with high amylase contents
Investigations : ➢ Serum amylase > 500IU/L in 1st 72hrs(and or serum lipase increase) ➢ Other bloods : leukocytosis , hyperglycemia,hypocalcemia , elevated liver enzymes , prolonged clotting ➢ CXR : Lt pleural effusion , atelectasis ➢ AXR:ileus , ascites ,pseudocyst ,pancreatic calcification(in recurrent disease) ➢ US/or CT : edematous pancreas , abscess , pseudocyst	**Investigations :** ➢ As for acute + ➢ Sweat test + genotype for hereditary pancreatitis ➢ Amino and organic acid screen ➢ Stool for ascaris ➢ ERCP or MRCP
Management :possible place for octreotide 1. Analgesia 2. Keep NBM with IV fluid and NGT suctioning until amylase normal 3. Treat shock if necessary. 4. Fluid and electrolyte balance with careful monitoring 5. Surgical drainage if access or pseudocyst	**Management :** Endoscopic treatment with sphincterotomy, pancreatic or biliary endoprostheses and stone extraction is possible as necessary NB: attacks may be prevented with antioxidant and pancreatic supplements

Congenital hypertrophic pyloric stenosis

Epidemiology:

- Incidence 1-3/1000 USA
- Male >female 4-6:1
- Parents with history of pyloric stenosis → ↑ risk in baby(especially maternal)
- ↑ incidence in infant with blood group B or O

Etiology and association:

1. Associated cong. Anomalies : TOF , hypoplasia or agenesis of inferior labial frenulum
2. Syndromes and diseases :
    - Eosinophilia gastroenteritis
    - Apert syndrome
    - Zellweger syndrome
    - Trisomy 18
    - Smith- lemli optiz syndrome
    - Cornelia de Lange syndrome
3. Use of erythromycin in neonate especially 1st 2 weeks
4. female infants of mothers treated with macrolide antibiotics during pregnancy and breastfeeding
5. Reduced nitric oxide might contribute to the pathogenesis of pyloric stenosis.

Clinical picture:

1. **Non bilious vomiting :**
    - +/- projectile initially but usually progressive , immediately after feed
    - Might follow each feed or it may be intermittent
    - Usually after 3 weeks of age but may begin in 1st wk of life and as late as the 5th mo
    - After vomiting, the infant is hungry and wants to feed again
2. **Hypochloraemic hypokalemic metabolic alkalosis** : due to fluid and electrolyte loss
3. **Hyperbilirubinemia** is the most common clinical association of pyloric stenosis
    - Mostly unconjugated resolve with surgical correction
    - If conjugated → investigate other causes
4. **Olive shaped mass :**
    - Site : best palpated from the lt side, located above and to the rt of the umbilicus in the mid-epigastrium beneath the liver's edge.
    - olive is easiest palpated after an episode of vomiting.
5. **Visible peristalsis after feeding**
6. **Other coexistent clinical diagnoses :** eosinophilic gastroenteritis, hiatal hernia, peptic ulcer, congenital nephrotic syndrome, congenital heart disease, and congenital hypothyroidism

Investigations:

I. **Radiological investigation:**
   A. U/S exam: confirm diagnosis. sensitivity approximately 95%
      - Pyloric thickness 3-4 mm
      - Overall pyloric length 15-19
      - Pyloric diameter 10-14 mm
   B. Contrast study :
      - **String sign** : elongated pyloric canal
      - Shoulder sign : a bulge of the pyloric muscle into the antrum
      - Double tract sign : parallel streaks of barium seen in the narrowed channel

II. **Blood electrolytes and PH** must be done to look for :
   1. Signs of dehydration
   2. Jaundice (5-10%)
   3. Hypochloraemic hypokalemic metabolic alkalosis (vomiting)

NB: serum K is usually maintained but total body K is depleted

Differential diagnosis:

A. small emaciated infants → visible peristalsis
B. GERD with or without hiatal hernia → radiological differentiation
C. Adrenal insufficiency → no metabolic acidosis,↑ S.K and urinary Na of adrenal insufficiency
D. IEM → recurrent emesis :
   - With alkalosis → urea cycle
   - With acidosis → organic academia
   - Lethargy , coma or seizures
E. Gastroenteritis → vomiting and diarrhea (pts with CHPS occasionally have diarrhea)
F. Pyloric membrane or duplication (rare)
G. Duodenal stenosis proximal to ampulla of vater → picture of pyloric stenosi (DD no pyloric mass + U.s differentiation)

Treatment:

I. Pre-operative : correct electrolyte , metabolic disturbance and dehydration
   - Initial bolus of normal saline followed by infusion of half-normal saline containing dextrose 5%
   - KCL is added to the solution after urine output is observed

II. Operative: when hydrated and alkalosis is corrected. **Pyloromyotomy** (Ramstedt's procedure)

Intussusceptions

- It is invagination of a dilated segment of bowel into an adjacent proximal segment.
- The blood supply to the intussuscepted bowel is compromised and will become necrotic if not reduced rapidly.
- Usually occurs proximally to the ileo-caecal valve

Epidemiology:

- Most common cause of intestinal obstruction between 3 m-6y
- Most commonly below 2 years (6-9 m)
- Male : female 3:1
- Rare in neonate and premature infants
- Reduce spontaneously in few cases

Etiology and association:

- 90 % idiopathic with seasonal peak incidence spring and autumn
- Correlation noted with prior or concurrent respiratory adenovirus (type c) infection
- Can complicate : O.M , G.E , Henoch-Schönlein purpura, upper respiratory tract infection
- ↑ risk after the previous Rota virus vaccine within 2 wks (not used now)
- N association between wild-type human rotavirus and intussusception
- Associations : intestinal polyp , HSP , Meckel diverticulum , lymphoma , cystic fibrosis , inflamed payer's patches
- Postoperative intussusception is ileoileal and usually within several days of an abdominal operation
- Intrauterine intussusception may be associated with the development of intestinal atresia

Site:

Most common ileocolic, less common ceco-colic, rarely ilel, very rare the appendix forms the apex of an intussusception

Clinical manifestations:

1. Episodic abdominal pain with screaming and pallor and infant draws their knees up with straining efforts. Often well in between attack.
2. If not reduced → infant become progressively weaker and lethargic → shock like state → weak thread pulse with shallow and grunting respiration. Pain manifested by moaning sounds
3. Vomiting more frequent in early phase → bile stained in late phase
4. Stool of normal appearance in 1st few hrs. of symptoms → fecal excretion small or not occur with little or no flatus
5. In 1st 12 hr. blood is passed but at times not for 1-2 days and infrequently not at all (60% pass currant jelly stool)

   Classical triad of pain , palpable sausage shaped abdominal mass and bloody or currant jelly stool occurs in < 15 %

6. Abdominal palpation :
   - Slightly tender sausage shaped mass. Sometimes ill-defined which might ↑ in size and firmness during a paroxysm of pain

- Site : Rt upper abdomen more often (long axis cephalocuadal),epigastrium (long axis transverse)
- 30% of pts. Don't have palpable mass

7. Rectal examination : presence of blood , mucous on rectal exam support the diagnosis
8. Abdominal distension and tenderness develop when I.O become more acute
9. Rare occasions :intestinal prolapse through anus

NB: Ileoileal intussusception have a less-typical clinical picture, the symptoms and signs being chiefly those of small I.O

Diagnosis:

I. U/S : sensitivity 88%. a tubular mass in longitudinal views and a doughnut or target appearance in transverse images
II. Plain AXR: density in the area of the intussusception.
III. Enema : Air (most common) ,hydrostatic (saline) and water soluble contrast (less often)

Differential diagnosis:

1. Gastroenteritis : change the nature of illness should alert the physician
2. Enterocolitis : pain is less severe , less regular and infant ill in between pains
3. Meckel diverticulum : bleeding is painless
4. HSP : joint symptoms +purpura + haematuria.do U/S

Treatment:

1. Initial fluid resuscitation as needed
2. Air or contrast anemia reduction under fluoroscopic or ultrasonic guidance (successful 75%).C.I in rectal bleeding or peritonism
3. Surgical reduction -/+ resection if enema contraindicated or unsuccessful

NB: reduction is an emergency procedure and should done immediately after diagnosis in preparation for surgery

NB: Recurrent intussusception is noted in 5-8% and is more common after hydrostatic than surgical reduction.

NB: red currant jelly stool is a late feature of the disease

Hirschsprung disease

Developmental disorder (neurocristopathy) of the enteric nervous system characterized by the absence of ganglion cells in the sub mucosal and mesenteric plexus. The aganglionic segment is limited to the rectosigmoid in 80% of pts.

Epidemiology:

- Incidence 1:5000.polygenic inheritance,3-5% recurrence
- RET oncogene
- Associations :
    - Down, Goldberg-Shprintzen
    - Smith-Lemli-Opitz, Shah-Waardenburg, cartilage-hair hypoplasia,
    - congenital hypoventilation (Ondine's curse) syndromes
    - Urogenital or cardiovascular abnormalities.
    - Association with microcephaly, mental retardation, abnormal facies, autism, cleft palate, hydrocephalus, and micrognathia.

Types:

I. Short aganglionic segment : common , male > female.(constipation may occur in loder children in milder form)
II. Long aganglionic segment : rare male=female

Etiology:

- Due to absence of parasympathetic ganglia in Auerbach's and Meissner's plexi.
- the unopposed sympathetic activity result in hypertonus of the affected segment of bowel.
- the disease occur from rectum upwards

Clinical manifestation:

A. Neonatal period :
    - Distended abdomen , failure of passage of meconium and /or bilious vomiting or aspirate with feeding intolerance
    - Hirschsprung colitis due to failure of passage of stools(Clostridium difficile, Staphylococcus aureus, anaerobes, coliforms)→ diarrhea ,abdominal tenderness , sepsis and signs of bowel obstruction
    - History of chronic constipation , FTT , hypoalbuminemia from protein entropathy(less common)
B. Older children : Chronic constipation and abdominal distension
    - Constipation start in infancy and poorly respond to medical management
    - tympanitic distended abdomen with fecal mass palpable in Lt lower abdomen
    - Rectal exam :
        - normally placed anus , easily allowed entry of finger, empty rectum but when finger is removed, there may be explosive discharge of foul smelling feces and gas
        - stool consist of small pellets , be ribbon like or have a fluid consistency (large stools in functional constipation)
    - Intermittent attack of functional constipation may be associated with pain and fever

- Urinary retention with enlarged balder or hydronephrosis can occur 2ry to urinary compression.

Differential diagnosis:

I. In neonate :
   - meconium plug syndrome
   - meconium ileus
   - intestinal atresia

II. older children :
   - functional constipation (see the table)
   - the **Currarino triad** : 1- Anorectal malformations (ectopic anus, anal stenosis, imperforate anus)
     2- Sacral bone anomalies (hypoplasia, poor segmentation)
     3- Presacral anomaly (anterior meningoceles, teratoma, cyst)

1 DISTINGUISHING FEATURES OF HIRSCHSPRUNG DISEASE AND FUNCTIONAL CONSTIPATION

VARIABLE	FUNCTIONAL	HIRSCHSPRUNG DISEASE
HISTORY		
Onset of constipation	After 2 yr of age	At birth
Encopresis	Common	Very rare
Failure to thrive	Uncommon	Possible
Enterocolitis	None	Possible
Forced bowel training	Usual	None
EXAMINATION		
Abdominal distention	Uncommon	Common
Poor weight gain	Rare	Common
Rectum	Filled with stool	Empty
Rectal Examination	Stool in rectum	Explosive passage of stool
Malnutrition	None	Possible
INVESTIGATIONS		
Anorectal manometry	Relaxation of internal anal sphincter	Failure of internal anal sphincter relaxation
Rectal biopsy	Normal	No ganglion cells, increased acetylcholinesterase staining
Barium enema	Massive amounts of stool, no transition zone	Transition zone, delayed evacuation (>24 hr)

Investigation:

A. **Rectal suction biopsy:** gold standard
   - mucosa + submucosa
   - no closer than 2 cm above the dentate line
   - stained with acetylcholinstrease → large No of hypertrophied nerve bundle that stain +ve for Acetylcholinstrease with an absence of ganglion cells

B. **Anorectal manometry :**
   - measure the pressure of internal anal sphincter while a balloon is distended in the rectum
   - normally : rectal distension → relaxation of internal anal sphincter
   - in Hirschsprung internal anal sphincter fail to relax

C. Unprepared barium enema :

- in infant above 1 month(below this age the proximal ganglionic segment might be not significantly dilated in the 1st few weeks of life)
- classic finding :presence of an abrupt narrow transition zone between the normal dilated proximal colon and a smaller caliber obstructed distal colon
- in absence of this finding :compare the diameter of rectum to that of sigmoid colon, because a rectal diameter that is the same as or smaller than the sigmoid colon suggests Hirschsprung disease

NB: Radiologic evaluation should be performed without preparation to prevent transient dilatation of the aganglionic segment

D. AXR : constipation

Treatment: surgical

I. Immediate definitive repair or a temporary neonatal colostomy with definitive repair at 3-6 months of age.definitve repair is with direct resection and anastomosis or an endorectal pull through

NB: decompressing colostomy is done if there is associated enterocolitis or other complications
Otherwise pull through procedure is of choice

Surgical options:

A. **Swenson**: excise aganglionic segment +anastomosis of normal proximal bowel to rectum 1-2 cm above the dentate line.
B. **Duhamel** : create a neorectum which has anterior aganglionic half with normal sensation and a posterior ganglionic half with normal propulsion
C. **Endorectal pull through bu Soave** :stripping the mucosa from the aganglionic rectum, bringing normally innervated colon through the residual muscular cuff thus bypassing the abnormal bowel from within

Advances in techniques have led to successful laparoscopic single-stage Endorectal pull-through procedures, which are the treatment of choice

II. Ultra short segment (internal sphincter achalasia)
- The aganglionic segment is limited to the internal sphincter
- Symptoms of those with chronic constipation
- Rectal suction biopsy with ganglionic cells + abnormal manometry result
- Treatment is controversial :inj. Botulism to relax anal sphincter +/- myomectomy

III. Long segment (entire colon +/- part of small bowel): ileoileal anastomosis sparing part of colon to facilitate water reabsorption and help stool become firm

Long term preoperative problems:

1. Constipation
2. Recurrent enterocolitis
3. Stricture , prolapse
4. Perianal abscess
5. Fecal soiling
6. Some children require myectomy or redo pull through procedure

Acute diarrhea

Causes:

I. **Gastroenteritis :**
- Viral e.g. rotavirus (common),echo , adenovirus and Norwalk virus
- Bacterial e.g. Campylobacter, shigella, salmonella, cholera ,E.coli
- Protozoal e.g. Giardia , Cryptosporidium
- Unknown causes in up to 50 %.even when fully investigated

II. **Conditions that can mimic gastroenteritis :**
- Systemic infections e.g. sepsis and meningitis
- Local infections e.g. Respiratory tract infection, otitis media, hepatitis A, urinary tract infection
- Surgical disorder e.g. Pyloric stenosis, intussusception, acute appendicitis, necrotizing enterocolitis, Hirschsprung disease
- Metabolic disorder e.g. Diabetic ketoacidosis
- Renal disorder e.g. Haemolytic uraemic syndrome
- Drug induced e.g.Antibiotic e.g. amoxicillin,laxative induced
- Others e.g. Coeliac disease, cow's milk protein intolerance, adrenal insufficiency

Gastroenteritis

- Refers to diarrhea, which is abnormally frequent and liquidity of fecal discharges.
- Diarrhea is caused by different infectious or inflammatory processes in the intestine that directly affect enterocyte secretory and absorptive functions (see the table 1)
- Some of these processes act by increasing cyclic adenosine monophosphate (AMP) levels (Vibrio cholerae, Escherichia coli heat-labile toxin, vasoactive intestinal peptide-producing tumors)
- Other processes (Shigella toxin, congenital chloridorrhea) cause secretory diarrhea by affecting ion channels or by unknown mechanisms
- Enteritis has many viral, bacterial, and parasitic causes (Table 2).

Viral gastroenteritis:

- Most common between 6 month – 2 year, after transplacental Ab is cleared and breast feeding has stopped and before acquisition of protective immunity
- The most common viral agent is the Rota virus
- Tend to cause outbreaks and epidemics in winter months
- Rotavirus invades the epithelium and damages villi of the upper small intestine and, in severe cases, involves the entire small bowel and colon.
- It begin with low grade fever for 1-2 days followed by the onset of vomiting and watery diarrhea
- Usually Vomiting may last 3 to 4 days, and diarrhea may last 7 to 10 days
- Other viral agents include echo and adenoviruses , which can produce similar picture but less common than Rota virus

Bacterial gastroenteritis:

- The picture is similar to viral cases but a history of overseas travel is important if present
- *Campylobacter, shigella* and *salmonella* are associated with blood stained stool and abdominal pain is a particular feature of campylobacter
- *E.coli* strain O157 may → Haemolytic uremic syndrome and acute renal failure
- *Shigella* and *salmonell*a → dysentery (blood , mucus in stool)+fever

Protozoal gastroenteritis:

- *Entamoeba histolytica* (amebiasis), *Giardia lamblia*, and *Cryptosporidium parvum* are important enteric parasites
- Amebiasis occurs in warmer climates, whereas giardiasis is common among infants in day care centers
- *E. histolytica* infects the colon; amebae may pass through the bowel wall and invade the liver, lung, and brain. Diarrhea is of acute onset, is bloody, and contains leukocytes.
- *G. lamblia* is transmitted through ingestion of cysts, either from contact with an infected individual or from food or freshwater or well water contaminated with infected feces. The organism adheres to the microvilli of the duodenal and jejunal epithelium.
- *Cryptosporidium* causes mild, watery diarrhea in immunocompetent persons that resolves without treatment. It produces severe, prolonged diarrhea in persons with acquired immunodeficiency syndrome (AIDS)

Put in your mind
Diarrhea can be caused by URTI , UTI , antibiotic induced as amoxicillin
Intussusception associated with blood stained diarrhea "red currant jelly" is a late feature of the disease

Assessment if the child with Gastroenteritis:

a. History regarding duration , frequency and type of the stool(soft , liquid ,blood stained)
b. Recent travel overseas is important part of the history
c. Examination of the abdomen for tenderness , mass and presence of bowel sounds
d. Check other systems as examination of ear , throat , chest and urine
e. Assessment of dehydration ,less than 5% dehydration can manged at home but 5-10% and certainly over 10% will require hospitalization
f. Inquire about other family member affected
g. Stool culture is needed when
    1. Blood stained diarrhea
    2. Diarrhea > 1 week
    3. History of overseas travel
    4. Ill child during epidemic

NB: for the cause 3 and 4 consider hospitalization

h. Usually the child is treated with ORS for 24 hr
i. Consider hospital opinion in case of vomiting i s associated with diarrhea , bloody stool

Table 2. Common Pathogenic Organisms Causing Diarrhea and Their Virulence Mechanisms

Organisms	Pathogenic Mechanism(s)
VIRUSES	
Rotaviruses	Damage to microvilli
Caliciviruses	Mucosal lesion
Astroviruses	Mucosal lesion
Enteric adenoviruses (serotypes 40 and 41)	Mucosal lesion
BACTERIA	
Campylobacter jejuni	Invasion, enterotoxin
Clostridium difficile	Cytotoxin, enterotoxin
Escherichia coli	
Enteropathogenic (EPEC)	Adherence, effacement
Enterotoxigenic (ETEC) (traveler's diarrhea)	Enterotoxins (heat-stable or heat-labile)
Enteroinvasive (EIEC)	Invasion of mucosa
Enterohemorrhagic (EHEC) (includes O157: H7 causing HUS)	Adherence, effacement, cytotoxin
Enteroaggregative (EAEC)	Adherence, mucosal damage
Salmonella	Invasion, enterotoxin
Shigella	Invasion, enterotoxin, cytotoxin
Vibrio cholerae	Enterotoxin
Vibrio parahaemolyticus	Invasion, cytotoxin
Yersinia enterocolitica	Invasion, enterotoxin
PARASITES	
Entamoeba histolytica	Invasion, enzyme and cytotoxin production; cyst resistant to physical destruction
Giardia lamblia	Adheres to mucosa; cyst resistant to physical destruction
Spore-forming intestinal protozoa	Adherence, inflammation
Cryptosporidium parvum	
Isospora belli	
Cyclospora cayetanensis	
Microsporidia (Enterocytozoon bieneusi, *Encephalitozoon intestinalis*)	

Table 1. Mechanisms of Diarrhea

Primary Mechanism	Defect	Stool Examination	Examples	Comments
Secretory	Decreased absorption, increased secretion: electrolyte transport	Watery, normal osmolality; osmoles = 2 × (Na^+ + K^+)	Cholera, toxigenic *Escherichia coli*; carcinoid, VIP, neuroblastoma, congenital chloride diarrhea, *Clostridium difficile*, cryptosporidiosis (in AIDS)	Persists during fasting; bile salt malabsorption also may increase intestinal water secretion; no stool leukocytes
Osmotic	Maldigestion, transport defects, ingestion of unabsorbable solute	Watery, acidic, + reducing substances; increased osmolality; osmoles > 2 × (Na^+ + K^+)	Lactase deficiency, glucose-galactose malabsorption, lactulose, laxative abuse	Stops with fasting, increased breath hydrogen with carbohydrate malabsorption, no stool leukocytes
Motility				
Increased motility	Decreased transit time	Loose to normal-appearing stool, stimulated by gastrocolic reflex	Irritable bowel syndrome, thyrotoxicosis, postvagotomy dumping syndrome	Infection also may contribute to increased motility
Decreased motility	Defect in neuromuscular unit(s); stasis (bacterial overgrowth)	Loose to normal-appearing stool	Pseudo-obstruction, blind loop	Possible bacterial overgrowth
Mucosal invasion	Inflammation, decreased mucosal surface area and/or colonic reabsorption, increased motility	Blood and increased WBCs in stool	Celiac disease, *Salmonella* infection, shigellosis, amebiasis, yersiniosis, *Campylobacter* infection, rotavirus enteritis	Dysentery (blood, mucus, and WBCs)

د مرفت یوسف

dr mervat yousef

Table 39.6 Clinical features of pathogens

Pathogenesis	Predominant site of action	Infective agents	Clinical presentation
Direct cytopathic effect	Proximal small intestine	Rotavirus Adenovirus Calicivirus Norovirus (Norwalk-like virus) Enteropathogenic *E. coli* *Giardia*	Copious watery diarrhoea, vomiting, mild to severe dehydration; frequent lactose malabsorption; no blood in stools
Enterotoxigenicity	Small intestine	*Vibrio cholerae* Enterotoxigenic *E. coli* (ETEC) Entero-aggregative *E. coli* *Cryptosporidium*	Watery diarrhoea (can be copious in cholera or ETEC); no blood in stools
Invasiveness	Distal ileum and colon	*Salmonella* *Shigella* *Yersinia* *Campylobacter* Entero-invasive *E. coli* *Amoeba*	Dysentery: very frequent stools, cramps, pain, fever and often blood in stools. Variable dehydration. Course may be protracted
Cytotoxicity	Colon	*Clostridium difficile* Enterohaemorrhagic *E. coli* (EHEC) *Shigella*	Dysentery: abdominal cramps, fever, blood in stools. EHEC or *Shigella* may be followed by haemolytic–uraemic syndrome

Assessment of dehydration:

Infants are at particular risk of dehydration because of their:

1. greater surface area to weight ratio, leading to greater insensible water losses (300 ml/m2 per day, equivalent in infants to 15-17 ml/kg per day)
2. inability to gain access to fluids when thirsty
3. higher basal fluid requirements (100-120 ml/kg per day, i.e. 10-12% of body weight)
4. immature renal tubular reabsorption processes

Degree of dehydration: see the table 3

Table 3 Clinical assessment of dehydration

	Moderate dehydration	Severe dehydration
Body weight loss	5-10%	>10%
General appearance	Thirsty, drowsy	Drowsy, limp, cold, sweaty, cyanotic extremities
Respiration*	Deep, may be rapid	Deep and rapid
Eyes	Sunken	Grossly sunken
Tears	Reduced/absent	Absent
Mucous membranes	Dry	Very dry
Capillary refill time*	Prolonged (> 2 seconds)	Prolonged (>2 seconds)
Tissue turgor*	Retracts slowly	Retracts very slowly
Blood pressure	Normal or low	Low
Radial pulse	Rapid and weak	Rapid, thready, may be impalpable
Anterior fontanelle	Sunken	Very sunken
Urine output	Reduced	Marked oliguria

*Most helpful and reliable signs.

Useful signs include : reduced skin turgor ,dry oral mucosa , sunken eye and altered consciousness

- ✓ *Diarrhea 5-10% or more → hospital admission (IV fluid ,urea,electrolyte,culture)*
- ✓ *CRT< 2sec → severe dehydration is unlikely*
- ✓ *Less than 3% dehydration is clinically undetected*

Types of dehydration:

1. **Isonatraemic and hyponatraemic dehydration :**
   - In dehydration, there is a total body deficit of Na and water
   - In most instances, the losses of Na and water are proportional and plasma Na remains within the normal range (*isonatraemic dehydration*)
   - When Na losses exceed those of water, plasma sodium falls (*hyponatraemic dehydration*) → shift of water from extra- to intracellular compartments → ↑ intracellular volume → an increase in brain volume, sometimes → convulsions
   - Whereas the marked extracellular depletion → a greater degree of shock per unit of water loss. This form of dehydration is more common in poorly nourished infants in developing countries.
2. **Hypernatraemic dehydration:** least common
   - water loss exceeds the relative sodium loss and plasma Na conc. ↑
   - This usually results from high insensible water losses (high fever or hot, dry environment) or from profuse, low-Na diarrhea
   - Extracellular fluid become more hypertonic → water shift to extracellular space → less signs of dehydration (depression of the fontanelle, reduced tissue elasticity and sunken eyes are less obvious).usually irritable infant with doughy skin
   - This makes this form of dehydration more difficult to recognize clinically, particularly in an obese infant.
   - It is a particularly dangerous form of dehydration as water is drawn out of the brain and cerebral shrinkage within a rigid skull may lead to multiple, small cerebral haemorrhages and convulsions
   - Transient hyperglycemia occurs in some patients with Hypernatraemic dehydration(self-correcting and does not require insulin)

Management of gastroenteritis:

- The broad principles of management of acute gastroenteritis in children include oral rehydration therapy, enteral feeding and diet selection, zinc supplementation, and additional therapies such as probiotics.
- Majority of cases can be managed at home
- Presence of vomiting compound the problems but usually vomiting last 12-24 hr
- Fluid deficit varies from 50ml/kg (mild) in acute diarrhea up to >100ml/kg (severe)
- If possible measure the body weight and compare to the weight with the parent records in order to obtain an estimate if the volume of body water loss(1kg=1 L fluid)

Mild dehydration: ORS
Moderate dehydration: 6 hr trial ORS 100ml/kg (oral or NGT).IV if fail
Severe dehydration: IV fluid (resuscitate with saline, deficit and maintainace)

Hypernatremia dehydrations: slow correction over 48 hr

Composition (mmol/L) of oral rehydration solutions

	European solution	WHO/UNICEF
Sodium	60	90
Potassium	20	20
Chloride	50	80
Citrate	10	10
Glucose℞	75-110	110

Table 332-9 SUMMARY OF TREATMENT BASED ON DEGREE OF DEHYDRATION

DEGREE OF DEHYDRATION	REHYDRATION THERAPY	REPLACEMENT OF LOSSES	NUTRITION
Minimal or no dehydration	Not applicable	<10 kg body weight: 60-120 mL ORS for each diarrheal stool or vomiting episode>10 kg body weight: 120-240 mL ORS for each diarrheal stool or vomiting episode	Continue breast-feeding, or resume age-appropriate normal diet after initial hydration, including adequate caloric intake for maintenance*
Mild to moderate dehydration	ORS, 50-100 mL/kg body weight over 3-4 hr	Same	Same
Severe dehydration	Lactated Ringer solution or normal saline in 20 mL/kg body weight IV until perfusion and mental status improve; then administer 100 mL/kg body weight ORS over 4 hr or 5% dextrose ½ normal saline IV at twice maintenance fluid rates	Same; if unable to drink, administer through nasogastric tube or administer 5% dextrose in ¼ normal saline with 20 mEq/L potassium chloride IV	Same

Post-gastroenteritis syndrome:

- Infrequently, following an episode of gastroenteritis, the introduction of a normal diet results in a return of watery diarrhoea.
- Temporary lactose intolerance may have developed, which can be confirmed by the presence of non-absorbed sugar in the stools giving a positive Clinitest result.
- In such circumstances, a return to an oral rehydration solution for 24 hours, followed by a further introduction of a normal diet, is usually successful.
- Rarely, multiple dietary intolerances may result, such that specialist dietary management is required in the implementation of a diet which excludes cow's milk, disaccharides and gluten.
- In very severe cases, a period of parenteral nutrition is required to enable the injured small intestinal mucosa to recover sufficiently to absorb luminal nutrients.

Post-infective irritable bowel syndrome:

- Following an episode of gastroenteritis, particularly with a bacterial cause, a substantial proportion of children will develop symptoms of irritable bowel syndrome which may persist for some years.
- Characteristically, intermittent diarrhoea and abdominal pain (often relieved by defecation) occur, sometimes interspersed with constipation.
- In between episodes of pain and diarrhoea, affected children are symptom-free, have good general health and grow normally.
- The condition usually resolves spontaneously.
- No medication has been shown to be effective, except loperamide for diarrhoea.

Chronic diarrhea

- Chronic diarrhea refers to diarrhea that has persisted for more than 2-3 weeks.
- Children with chronic diarrhea and faltering growth need further assessment as the underlying cause may be malabsorption

Causes:

1. Toddler diarrhea
2. **Celiac disease**
3. **Food intolerance e.g** cow milk , lactose
4. **Cyctic fibrosis**
5. **Chronic infections** e.g. giardia , cryptosporidium
6. **Inflammatory bowel disease**
7. Irritable bowel disease
8. **Immunodeficiency** , overflow constipation, anxiety
9. CHO malabsorption e.g. sucrose isomaltose deficiency
10. Pancreatic dysfunction , protein loosing entropathy e.g. intestinal lymphangectasia
11. IEM e.g. cong. Chloride diarrhea
12. Congenital lactase deficiency
13. Hirschsprung disease

Investigations:

1. Stool: analysis, c &S , reducing substances , fats and electrolytes. Fecal elastase (pancreatic insufficiency)
2. Blood : FBC (immunodeficiency) , electrolytes , ESR,CRP , celiac screen (anti-endomysial IgA, tissue transglutaminase, total IgA)
3. AXR,CXR: obstruction , bronchiectasis
4. Sweat test : for cystic fibrosis
5. Trial off oral feed (secretory diarrhea will not stop , osmotic diarrhea will stop)
6. Endoscopy with small biopsy and duodenal juice culture (entropathy , infection)

Management:

1. Nutritional support while diagnosis is being arrived at
2. A hypoallergenic modular feed with supplementation e.g. Neocate can be tried first
3. If enteral feed fail → TPN
4. A trial of metronidazole for 5-7 day may be considered as giardia is only detected in stool specimens in 20% of cases
   NB: chronic constipation is a common cause presenting as apparent diarrhea which is in fact overflow soiling

Toddler's diarrhea:

- Chronic diarrhea up to 4-5 years of age with loose stools at frequency of 3-6/d
- Normal growth and no abnormality on examination
- Cause may be due to decrease gut transit time-→colonic bacterial degredation of partially digested foods and subsequent release of secretagogues
- Treatment : reassurance + dietary change (↑ fat , ↓ fiber,↓ juice) to increase gut transit time
- Usually resolves spontaneously by 3 years age

Carbohydrate malabsorption and intolerance:

Disorders of disaccharide absorption	Disorders of monosaccharide absorption
Primary : • Congenital alactasia • Congenital lactose intolerance • Sucrose – isomaltose deficiency	Primary : • Glucose – galactose malabsorption
Secondary (acquired) • Post enteritis (Rota virus),neonatal surgery, malnutrition • Late onset lactose intolerance	Secondary (acquired) • Post enteritis ,neonatal surgery, malnutrition

Lactose intolerance:

- CHO intolerance is usually lactose intolerance and is usually acquired and transient
- The deficient enzyme is the brush border enzyme lactase which hydrolyses lactose into glucose and galactose
- The intolerance will present with characterstic loose explosive stools
- Diagnosis is made by looking for reducing substances in the stool following CHO ingestion
- Clinitest tablets (which detect reducing substance in the stool) are used as the standard test,the detection of> .5% is significant
- Formal confirmation of the specific offending CHO is through stool chromatography
- Treatment is with a lactose – free formula in infancy and a reduced lactose intake in later childhood

Post gastroenteritis CHO intolerance:

- Following GE , CHO intolerance can be either to disaccharide or monosaccharaides
- Usually in children who have been infected with rota virus
- Both types of intolerance are usually transient and both removal of the offending CHO
- Both mono- and disaccharide intolerance will result in tests for reducing substances in the stool being +ve

- *Lactase present in brush border of small bowel. Any mechanism causing damage to the mucosa and villi of the small bowel (entropathy) → 2ry lactase deficiency*
- *In all human the amount of lactase present per area of small bowel reduce towards the middle of 1st decade but in some ethnic groups it falls to a level where symptoms will occur when even a small amount of lactose is ingested. This is termed **cong. Hypolactasia** and is very common. Managed by reducing the ingestion of lactose to that which can be tolerated*

Glucose-galactose malabsorption:

- Rare AR inherited condition characterized by rapid onset watery diarrhea from birth
- Responds to withholding glucose (stopping feed) and relapse on reintroduction
- Reducing substance +ve
- Small bowel biopsy and disaccharide estimation will be normal
- Treatment is by fructose as the main CHO source (absorbed by different mechanism)

Sucrose – isomaltose deficiency:

- This is a defect in CHO digestion , with the enzyme required for hydrolysis of sucrose and alpha limit dextrins not present in the small intestine
- Symptoms of watery diarrhea and /or faltering growth develop after the introduction of sucrose or complex CHO into the diet (at weaning time)
- Reducing substance –ve (non reducing sugar)
- Symptoms can be very mild
- Diagnosis is by stool chromatography
- Treatment : removal of sucrose or complex CHO from the diet

Reducing sugars by clinistest (GLMF): glucose ,lactose , maltose , fructose)
False +ve → ascorbic acid , nalidixic acid
+ve clinistest + -ve clinistix → galactosemia

Protracted diarrhea /intractable diarrhea of infancy:

Diarrhea starts in infancy and is less common

- **Congenital microvillus atrophy :**
  - Intractable diarrhea which is present from birth
  - Pathology is ultra-structural abnormality at the microvillus surface
  - Long term nutritional support with TPN is required
- **Congenital chloride diarrhea :**
  - Intractable diarrhea which is present from birth
  - Pathology is ultra-structural abnormality at the microvillus surface
  - Long-term nutritional support with TPN is required

- **Congenital chloride diarrhea :**
  - AR, severe watery diarrhea from birth
  - Often past history of polyhydraminos
  - Serum Na & CL are ↓ with ↑ stool PH and stool chloride (alkali stool)
  - Treatment is with Na & CL supplements
  - Good prognosis if diagnosed early

- **Autoimmune entropathy :**
  - Protracted diarrhea presenting in infancy associated with circulating Abs against intestinal epithelial cells
  - Severe villous atrophy with an inflammatory infiltrate
  - Associated with other autoimmune conditions
  - Treatment with immunosuppression
- **Glucose – galactose malabsorption :** see before

Giardiasis:

- Protozoal parasite which is infective in the cyst form
- It also exists in the trophozite form and is found in contaminated food and water
- Clinical manifestations vary from asymptomatic, acute diarrheal disease , chronic diarrhea.
- Malabsorption of sugars, fats, and fat-soluble vitamins has been well documented and may be responsible for substantial weight loss.
- Giardiasis has been associated with growth stunting and repeated Giardia infections with a decrease in cognitive function in children in endemic areas.
- Partial villous atrophy is occasionally seen
- Diagnosis is by stool examination for cysts or examination of the duodenal aspirate at small bowel biopsy
- Treatment is with metronidazole and is often given blind is suspicious cases

Causes of steatorrhea:

I. **Exocrine pancreatic insufficiency**: Cystic fibrosis – schawachman diamond
II. **Lack of bile salts :**
- 1ry byler disease
- 2ry obstructive jaundice, ileal resection (impaired EHC), small bowel bacterial over growth

III. **Mucosal pathology:**
- Enteropathy (loss of surface area): celiac – cow milk protein intolerance-giardiasis – autoimmune Enteropathy, tropical sprue
- Co lipase deficiency

IV. **Failure of chylomicron formation :** Abetalipoproteinemia
V. **Damage to intestinal lymphatic** : intestinal lymphangectasia

Cystic fibrosis: see respiratory system for details

Gastrointestinal manifestations of cystic fibrosis

Pancreatic	▪ Insufficiency occurs in up to 90% ▪ Pancreatitis 25% of cases ▪ Abnormal glucose tolerance in up to 10% by the 2nd decade ▪ Diabetes mellitus
Intestinal	▪ Meconium ileus ▪ Atresia , rectal prolapse ▪ Distal obstruction syndrome ▪ Strictures , perhaps 2ry to high dose pancreatic supplementation
Hepatobiliary	▪ Cholestasis in infancy ▪ Fatty lifer ▪ Focal biliary fibrosis ▪ Multilobular cirrhosis
Abnormalities of the gallbladder	▪ Cholelithiasis ▪ Obstruction of the common bile duct

Cow's milk protein intolerance:

- Due to an intolerance to cow's milk protein,which is usually transient
- The symptoms may be confined to the GIT or there may be other manifestations of atopy :cow milk protein allergy
- There is a 30-35% cross sensitivity between cow's milk and soyprotein
- In children with GIT manifestations changes in the small intestinal mucosa may vary from normal to patchy to partial to subtotal villous atrophy

GIT manifestations	▪ Diarrhea , vomiting , FTT ▪ Acute colitis ▪ constipation
Non GIT manifestations	▪ migraine ▪ eczema , asthma and anaphylaxis

Cow's milk protein colitis:

- in children <2 year who present with bloody diarrhea
- often family history of atopy
- Sigmoidoscopy → colitic appearance.
- Biopsies → ↑ eosinophils in the lamina properia (eosinophilic colitis)

Investigations of cow's milk intolerance:

- ↑ eosinophils in the peripheral blood film
- IgE may be ↑ , may +ve RAST to cow's milk protein and +ve skin prick test
- However ,cow's milk protein intolerance is often present when all these tests are –ve so therapeutic trial is indicated when there is sufficient clinical suspicious

Treatment:

1. Cow's milk protein free diet using a casein hydrolysate as a milk substitute
2. The child should challenged at the age of 2 years (most children outgrown the condition by this age)
   NB : anaphylaxis is rare but the challenge should done in hospital

Bacterial overgrowth (small bowel):

- Repeated courses of antibiotics are a risk factor
- Stasis → bacterial proliferation with the emergence of resistant strains
- Malabsorption results with steatorrhea and fat soluble vitamins malabsorption
- Diagnosis (high index of suspicion)
  - Patients with risk factors e.g. previous GIT surgery , short bowel syndrome
  - Hydrogen breath testing may be useful
  - Radioisotope labeled breath testing my also have a role
  - Barium radiology if obstruction suspected
  - Duodenal juice culture at endoscopy if performed
- Treatment :
  - Management of the underlying cause
  - Metronidazole orally or IV (of choice)
  - Probiotics have been used

Short gut syndrome:

- Mainly seen in small number of surgically treated infants when large segment of S.I are resected (necrotizing enterocolitis or mid gut volvulus).may be seen in older children due to trauma , inflammatory bowel disease and vascular abnormalities
- These infants are dependent on parenteral nutrition following surgery and are prone to fluid and electrolyte disturbance , sepsis from central venous catheters and liver damage (PN cholestasis)
- They require 40-60 cm of non-dilated upper S.I preferably with an intact ileo-caecal valve and a colon to have enough bowel to sustain nutrition without PN in long term
- This length of bowel will not be sufficient initially as it needs to undergo adaptation to ↑ its surface area. This process can take up to 1 year

Intestinal lymphangectasia

Def: this is a group of disorders involving dilatation of the intestinal lymphatic with leakage of lymph into the intestine and peritoneal cavity(functional obstruction of lymph through the thoracic duct and into the inferior Vena Cava

Association: Noonan – Turner syndrome

Causes:

A. Congenital
B. Acquired :lymphatic obstruction from abdominal or thoracic surgery,malrotation , Rt Heart failure or constrictive pericarditis , post Fontan cardiac surgery

Clinical features:

1. Fat malabsorption with steatorrhea and features of Vit E defeiciency (Ataxia , peripheral neuropathy and retinitis pigmentosa)
2. Protein loosing enteropathy (odema , chylous , hypoalbuminemia and hypogamma aglobulinemia)

Diagnosis: small bowel biopsy (distended villi with dilated lacteals) – fecal α1 antitrypsin ↑ due to protein loosing

Treatment: ↑ MCT , ↓ LCT + high protein

Shwachman diamond syndrome

Pancreas

Pancreas Exocrine insufficiency with subsequent malabsorption

Blood

- Neutropenia : often cyclic progress to myeloid suppression can occur
- Neutrophil chemotactic defects
- Thrombocytopenia (70%) – anemia (50%)
- High HB F

Skeletal

- Metaphysical dystosis
- Short stature & faltering growth

Others

- Mild hepatic dysfunction
- Increase frequency of infections

Treatment

- Pancreatic enzymes replacement therapy and steroids or androgens
- Stem cell transplant & Gcsf have been used
- Average survival is 35 years

Abetalipoproteinemia

LIPOPROTEINS

Structure and function :

- Lipoproteins are globular, micelle-like particles consisting of a hydrophobic core of triacylglycerols and cholesterol esters surrounded by an amphipathic coat of protein, phospholipid and cholesterol
- . The apolipoproteins (apoproteins) on the surface of the lipoproteins help to solubilize the lipids and target the lipoproteins to the correct tissues.
- There are five different types of lipoprotein, classified according to their functional and physical properties: chylomicrons, very low density lipoproteins (VLDLs), intermediate density lipoproteins (IDLs), low density lipoproteins (LDLs), and high density lipoproteins (HDLs).
- The major function of lipoproteins is to transport triacylglycerols, cholesterol and phospholipids around the body.

Chylomicrons : largest of lipoprotein. Dietary lipoproteins

- Chylomicrons are synthesized in the intestine and transport dietary triacylglycerols to skeletal muscle and adipose tissue, and dietary cholesterol to the liver
- At these target tissues the triacylglycerols are hydrolyzed by lipoprotein lipase on the surface of the cells and the released fatty acids are taken up either for metabolism to generate energy or for storage.
- The resulting cholesterol-rich chylomicron remnants are transported in the blood to the liver where they are taken up by receptor mediated endocytosis

VLDLs, IDLs and LDLs :

- VLDLs are synthesized in the liver and transport triacylglycerols, cholesterol and phospholipids to other tissues, where lipoprotein lipase hydrolyzes the triacylglycerols and releases the fatty acids for uptake.
- The VLDL remnants are transformed first to IDLs and then to LDLs as all of their apoproteins other than apoB-100 are removed and their cholesterol esterified.
- The LDLs bind to the LDL receptor protein on the surface of target cells and are internalized by receptor-mediated endocytosis.
- The cholesterol, which is released from the lipoproteins by the action of lysosomal lipases, is either incorporated into the cell membrane or re-esterified for storage. High levels of intracellular cholesterol decrease the synthesis of the LDL receptor, reducing the rate of uptake of cholesterol, and inhibit HMG CoA reductase, preventing the cellular synthesis of cholesterol.

HDLs :

- HDLs are synthesized in the blood and extract cholesterol from cell membranes, converting it into cholesterol esters
- Some of the cholesterol esters are then transferred to VLDLs.
- About half of the VLDLs and all of the HDLs are taken up into the liver cells by receptor-mediated endocytosis and the cholesterol disposed of in the form of bile salts.

Atherosclerosis :

- Atherosclerosis is characterized by cholesterol-rich arterial thickenings (atheromas) that narrow the arteries and cause blood clots to form.
- If these blood clots block the coronary arteries supplying the heart, the result is a myocardial infarction, or heart attack.

Familial hypercholesterolemia:

- This is an inherited disorder in which individuals have a lack of functional LDL receptors preventing cholesterol from being taken up by the tissues.
- The resulting high blood cholesterol level leads to an ↑ in the formation of atheromas and can cause death from myocardial infarction during childhood.

Apolipoproteins :
Apo A-I and Apo A-II:major components of HDL
Apo B: structural protein for chylomicron remnants , VLDL,LDL
Apo C-I, Apo C-II and Apo C-III and Apo E-III:normally stored in HDL between meals but transfer to TG-rich lipoproteins after meals
Apo E-I,Apo E-II and Apo E-III and Apo E-IV:enter plasma with nascent HDL produced in liver. transfer with cholesterol ester from HDL to TG rich lipoprotein remnants
Concerning apolipoproteins:

- It is coded by different genes in the liver and gut.
- RNA splicing is responsible for the different liver and gut forms.
- Polymorphism increases coronary artery disease risk.

Abetalipoproteinemia:

• Failure of chylomicron formation with impaired absorption of long chain fats with fat retension in the enterocyte

• Malabsorption occur from birth

• Present in early infancy with faltering growth, abdominal distension and foul smelling bulky stools

• Symptoms of vit E deficiency develop later (Ataxia, peripheral neuropathy and retinitis pigmentosa)

• Diagnosis: low cholesterol, very low plasma TG, acanthocytes on exam of peripheral blood film, absence of beta lipoprotein in the plasma (Apo B)

• Treatment : substitute medium chain TG for long chain TG in diet(medium chain TG are absorbed via PV rather than thoracic duct + high dose of fat soluble vitamins. Most neurological abnormalities are reversible with high dose of vit E if given early

Constipation

- Defined as pain, difficulty or delay in defecation.
- Parents have very different ideas about what constitutes constipation and some normal children may only have their bowels open 2-3 times a week
- Breast fed babies may only have a bowel motion every 7-10 days and this can be quite normal for them

Causes:

I. **Infants :**
   - Inadequate fluid or food intake "common"
   - Hirschsprung's disease " rare"

II. **Toddlers and children :**
   - Secondary to minor illness "common"
   - Anal fissure "common"
   - Functional /psychological "common"
   - No obvious cause "common"
   - Anal stenosis , Hirschsprung
   - Hypothyroidism , hypercalcemia
   - Cystic fibrosis
   - Neurological problems / hypotonia : e.g. spina bifida , cerebral palsy

Factors that can trigger constipation:

- Intercurrent illness with poor fluid and food intake
- Perianal pathology such as anal fissure or streptococcal infection → stool withholding
- Difficult early toilet training → stool withholding

Common causes of constipations:

Inadequate fluids:

- Young children may become fluid depleted during a febrile illness, particularly if this associated with vomiting
- The constipation may resolve by the simple ↑ of fluids but may → later chronic constipation

Anal fissure:

- A small tear in the anal mucosa can → painful defecation associated with fresh rectal bleeding and may cause the child to suppress the desire to defecate to avoid the painful experience
- This itself may then cause development of chronic constipation.
- Anal fissure heals spontaneously
- Symptomatic treatment include faecal softeners and local anesthetic jelly

Functional constipation:

- This by far the most common cause of constipation seen by Gps and heath visitors
- There may be an obvious precipitating cause in the history such as an anal fissure or a febrile illness
- The stool become hard , pellet like and difficult to pass and because of pain the child is reluctant to attempt to pass them
- Fresh blood may be present on the surface of the stools.
- The rectum becomes distended and loaded with faeces
- Particularly common in children with disability/immobility

Some rare causes of constipation:

Hirschsprung disease: Mild form may occur with short segment, so consider Hirschsprung if constipation does not respond to normal measures (see before)

Anal stenosis: diagnosed by rectal exam. Respond to anal dilatation

Evaluation of a case with constipation

I. History :

Look for answer for the following questions:

1. Did the problem begin from birth? If not at what age?
2. Was there a delay in the passage of meconium at birth?
3. What does the carer/parents mean by constipation?
4. Does the child pass hard stools casing bleeding?
5. What does the child eat? Is the child thriving?
6. Is there a previous difficult toilet training experience?

II. Examination :

- Record the child growth , height and weight plotted on a centile chart
- Look for signs of anemia and palpate abdomen for masses
- Gentle but careful rectal examination can be helpful to confirm loaded rectum

III. Investigations :

- Not needed in the majority of cases
- Plain AXR : excess faeces in the colon help to confirm the diagnosis
- Thyroid function tests and serum Ca in rare cases

Management of constipation:

1. Explanation and reassurance
2. Dietary advice :appropriate diet if cereals , fruits and vegetables and adequate fluid intake
3. Drug treatment :
    - Softeners e.g. lactulose , paraffin oil(also act as mild stimulant and prevent water reabsorption by coating colonic pits)
    - Non absorbed laxative irrigative e.g. Movicol , non- absorbed polyethylene glycol solution with added electrolytes
    - Stimulant e.g. Senekot , Na picosulphate
    - Bulking agents e.g. fybogel –methylcellulose (bulk forming laxative)
4. Enema if necessary for disimpaction e.g. phosphate enema (can exacerbate stool withholding cycle)
5. Anal fissure : local anaesthetic cream and/or GTN ointment

Complication of long term constipation:

1. Acquired megacolon (↓ sensation of a full rectum)
2. Anal fissure
3. Overflow incontinence : prolonged constipation → overflow diarrhea due to liquid faeces escaping around a hard lump of faeces in the rectum (rectal faecolith)
4. Behavioural problems : fear of defecation , embarrassment of overflow

NB: constipation is a common in children with nocturnal and diurnal enuresis and treatment of the constipation frequently results in a significant improvement in the wetting

Faecal soiling:

It is involuntary soiling. Normal bowel control is achieved by around 2 years(girls are quicker than boys)

Soling by day : boys > girls (2:1). 1-2% 5-12 years old

Causes:

1. Faecal retention with overflow incontinence.this can happen in :
    - after an episode of diarrhea,then anal fissure → painful defecation and constipation
    - due to psychological stress coinciding with toilet training,result in refusal to sit on potty
    - due to other diseases e.g. Hirschsprung disease , hypothyroidism
    - if the rectum is chronically obstructed with feaces it may enelarge to form a megarectum → loss of sensation of fecal matter and diminished urgency to defecate
2. neurological damage: with failure to establish bowel control e.g. cerebral palsy, learning diffculity
3. stress : normal bowel control but soiling in resoinse to stress only

NB: important to exclude Hirschsprung disease , which is present from birth.if this is suspected → full investigation is necessary

Management:

- comprehensive history including GIT and social
- abdominal , rectal and neurological examination
- plain AXR: faecal retention
- empty bowel of impacted faeces : micro enemas ,manual disimpaction
- ↑ fibre diet and stool softeners (for painless stools)

Encopresis:

- Voluntary passage of faeces in an otherwise healthy child beyond the usual age for toilet training and it is usually due to non-organic causes.
- Treatment :

  Psychotherapy (child and family therapy) including a behavioral modification program (+ve reinforcement , defined periods of toilet training, remove fear of the toilet and remove control battle between parents and child

GIT bleeding

Clinical presentations:

- Hematemesis : fresh blood (upper GI), coffee ground (alter by gastric juice)
- Melena : partially digested blood
- Haemetochezia :frank blood per rectum (lower GI pathology)
- Massive bleeding with collapse
- Small bleeds with iron deficiency anemia

Causes:

Infant	Child	Adolescent
• Swallowed maternal blood • Hemorrhagic disease of the newborn • NEC • Cow's milk protein allergy • Anal fissure • Intussusception • Volvulus • Meckel diverticulum	• Colonic polyps (painless) • Anal fissure (pain+constipation) • Bacterial infections • Intussusception • Mallory wess tears • Haemolytic uremic syndrome • Henosh0schonlein purpura • Oesophageal varices • Meckel diverticulum • Oesophagitis • PU/gastritis • IBD • Av malformations ,haemangioma,telangiectasia • Sexual abuse	• Bacterial infection • IBD • Anal fissure • Colonic polyps • PU/gastritis • Malloery Weiss tear • Oesophageal varices • telangiectasia

Anal fissure:

- bright red blood on the outside of the stool, sometimes dripping into the toilet and on the toilet tissue
- usually there is a history of passage of large constipated stool and pain on defecation
- fissure is generally posterior and obvious on anal inspection
- treatment is usually by stool softening agents

Food allergy:

- bloody diarrhea can be the presenting feature of allergic enterocolitis
- most commonly due to cow's milk and /or soy protein
- the child is usually less than 3 months old and though the infant can have associated vomiting and become dehydrated, the bloody stools are often the isolated concern in otherwise well baby with normal weight gain
- the child should be given a hypoallergic formula , usually a hydrolysate

د مرفق يوسف
dr marwa yousef

Infectious enterocolitis:

- bloody stools can occur in infections due to *salmonella, shigella, campylobacter jejuni, Yersini enterocolitica,E.coli057* and *E.histolytica*
- pseudomembranous colitis due to *clostridium difficile* should be considered in any child having received broad spectrum antibiotics
- stool cultures and hot stools for ova , cysts and parasite examination (and Cl.difficile toxin ,if indicated) are mandatory in any child with bloody diarrhea

Meckel diverticulum: 2% of individual – 2 inch long – 2 feet from ileo-caecal valve

- It is an ileal remnant of the vitellointestinal duct which may contain ectopic gastric mucosa or pancreatic, colonic tissues (50%)
- Site : distal ileum on the anti-mesenteric border within 100 cm of the ileo-caecal valve and is around 5-6 cm long
- Mostly asymptomatic or may be present with intermittent painless blood per rectum
- Bleeding may be quite severe and require blood transfusion
- other presentation include intussusception (commoner in older male),perforation and peritonitis
- Technetium scan : is used to look for ectopic gastric mucosa (should be performed 4 weeks post bleed to avoid false -Ve as the gastric mucosa is often lacerated post hemorrhagic

Polyposis:

I. Juvenile colonic polyps :

- Occur in 3-4% of population in the colon only
- Symptos usually between 2-10 y (painless usually) bright red rectal bleeding , autolysis ,prolapse of polyp,anemia +/- abdominal pain
- Uncommon in children ?15 years
- They are usually benign hamartomas (unless they have an adenomatous element)
- Most polyps are solitary and located with 30 cm of anus
- Not pre malignant but multiple juvenile polyps can be pre malignant
- Diagnosis : rectal exam , colonoscopy with polyp removal , barium enema

II. Familial polyposis syndromes :

- **Familial adenomatous polyposis coli (FAP)**
  - AD, incidence 1:8000,premalignant condition
  - APC gene has been identified on the long arm of chromosome 5
  - Many different mutations may occur within this gene → FAP
  - Multiple adenomas on the distal bowel(100-1000),onset <10 years
  - Annual colonoscopy needed after age 10 years and pan colectomy after 10 y of disease(usually late teens or early 20s)
- Congenital hypertrophy of the retinal pigment epithelium (CHRPE)
  - Seen in association with APC gene mutations
  - CHARPE lesions are an early clinical marker for familial polyposis coli and may be used in risk assessment

TURCOT syndrome: APC gene defects, 1ry medulloblastoma, multiple colorectal polyposis

Gardner syndrome:

- APC gene defect
- Multiple colorectal polyps
- Soft tissue and bone tumors (esp. mandible)
- Extra colonic cancers
- Prophylactic colectomy at the end of 2nd decade

Peutz – Jegher syndrome: AD, 50% new mutations

- Mucosal pigmentation (freckles) of lips and gums (oral hyperpigmentation 1st to be appear)
- Stomach and small bowel hamartomas
- Malignant tumors (not of GIT) develop in 50% of patients

Hemorrhoids:

- Rare in infant and children and if present usually due to portal hypertension
- Occur in constipated adolescents causing bleeding during defecation with blood on the surface of the stool or the toilet paper or driping in toilet bowel
- The child may describe something coming out from their anus during defecation and the pain is typically aching in nature rather than sharp as described with anal fissure

Acute abdominal pain

Causes:

Surgical intra-abdominal	Medical	Extra - abdominal
• Acute appendicitis • Intestinal obstruction • Intussusception • Inguinal hernia • Peritonitis • Meckel's diverticulum • Pancreatitis • Mesenteric adenitis • Trauma	• Gastroenteritis (viral or bacterial e.g. campylobacter) • Renal (UTI, renal stones , hydronephrosis) • Henoch – schonlein purpura • DKA • Sickle cell anemia • Hepatitis • Irritable bowel syndrome • Recurrent abdominal pain • Gynecological causes (dysmenorrhea, pelvic inflammatory disease,haematocolops) • Constipation • Psychological • Lead poisoning • Porphyria	• Lower lobar pneumonia • URTI • Testicular torsion • Referred pain from hip/spine • shingles

Evaluation of a case of acute abdominal pain :

History:

- the type of pain , its duration and uts position are very important features to ascertain from the history.(not possible in very young children)
- a significant feature associated with pain is intermittent bouts of screaming , particularly associated with pallor(important feature of intussusception)
- older children are more able to give a history and may relate a pain initially to the periumblical area, only later moving to the lower abdomen and the right iliac fossa(e.g. appendicitis)
- in general the childrens are poor localizers and generally point to the whole of the abdomen when asked to describe where the pain is maximal
- a history of blood in the stool may occur in intussusception (red currnt jelly) but also associated with an acute GE (e.g. campylobacter infection , with abdominal pain and blood as strong features)
- other features such as a skin rash or arthralgia should be inquired for in relation to Henoch-schonlein purpura

Examination:

- on physical examination the position of the child is important, the child who lies still and is not keen to move may well have peritonism
- localized tenderness is an important sign as is tachycardia and /or fever
- examination of the throat or neck for signs of URTI may be relevant (mesenteric adenitis)
- signs of peritonism namely guarding and rigidity will require surgical follow up and admission of the child to hospital
- rectal examination is an area of debate, in acute appendicitis it may be helpful in making a diagnosis of pelvic appendix but it should not be a routine investigation

Some causes of acute abdominal pain:

Infantile colic:

- commonly occur around the age of 3 months in full term infants
- the incidence is equal for bottle fed and breastfed babies
- parents are aware of the infant having paroxysmal episodes of crying, often later in the day
- during the episodes the infants draw up their legs, exhibiting fisting and sometimes are puce in the face
- Sometimes the problem is relieved by the passage of flatus or faeces.
- Possible theories as to causation suggest that certain infants are susceptible to colic and it may be associated with hunger, aerophagy and abdominal distension and overfeeding
- Differential diagnosis include : intussusception , a strangulated inguinal hernia and also minor infections such as otitis media or UTI which can present in a similar way
- The management consists of a full history and examination of the child to exclude any obvious case and then strong reassurance to the parents that there is no abnormality and that problem will resolve
- Additional sucrose has been suggested as a treatment
- Exclusion of cow's milk from the mother diet can improve the condition in some cases
- It is known that prolonged colic can be one of the precipitating factors in non-accidental injury

NB: mother on diet free from cow milk should receive additional Ca , Vit A and D

Acute appendicitis:

- Most common cause of acute abdominal pain that is seen by GP (3:1000)
- May occur in very young infants up to teenagers and beyond
- Classical presentation is of initially mild periumblical abdominal pain, often associated with a mild fever, one or two episodes of diarrhea and then movement of the pain to the right iliac fossa, the pain causes the child to lie still, since movement will aggravate it.
- Clinical signs will include localized tenderness in the right iliac fossa, guarding and rebound tenderness. Should perforation have occurred and peritonitis ensured, a rigid board like abdomen may be found

- The child requires to be referred to hospital as soon as possible
- Diagnosis is usually clinical though an elevated neutrophil WBC and CRP may be helpful in supporting the diagnosis
- Treatment is appendectomy

Mesenteric adenitis:

- Children often present to their GP following a recent history of URTI with abdominal pain sometimes localized to the the right iliac fossa
- On examination there may be a signs of residual infection in the throat or ears, possibly with cervical lymphadenopathy
- Abdominal examination is entirely normal
- It is though that the condition is caused by acute enlargement of the abdominal lymph nodes that → the pain
- Management is expectant and the condition resolves spontaneously

Don't forget to consider DKA , lower lobe pneumonia , Henoch-Schonlein purpura ,UTI And gynecological causes as dysmenorrhea

Volvulus:

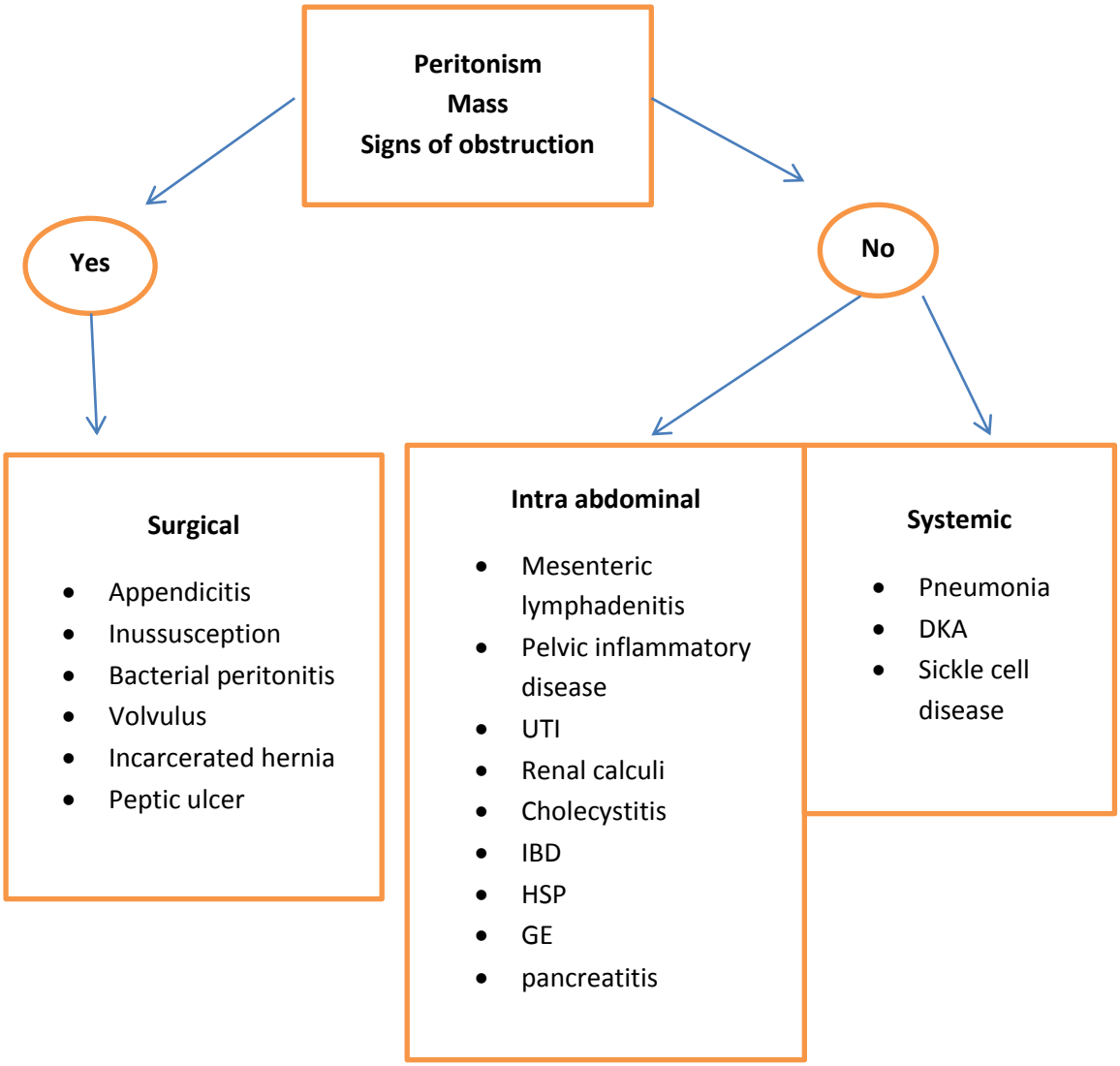
- Volvulus or twisting occurs when a long mobile loop of bowel revolves around its own mesentery
- Volvulus of midgut from malrotation is most common during infancy but may occur at anytime in childhood
- It may be intermittent or may cause ischaemia and infarction of gut
- The symptoms are abdominal pain and bilious vomiting and there may be associated fullness/abdominal distension
- A plain AXR → double bubble appearance due to air proximal to the obstruction,though there is usually a small amount of distal air
- The diagnosis is confirmed with an upper GIT contrast study which will demonstrate the lig. Of Treitz to be abnormally placed (should lie to the Lt of the midline and above the duodenal bulb)
- Treatment is surgical

Investigation:

At primary care level: FBC for leukocytosis, ESR and urine culture to exclude a UTI

Hospital:

- FBC, urea and electrolytes, LFTs and S.amylase.
- urine analysis for blood, protein and glucose, and culture
- radiological : AXR , CXR and U/S , and CT abdomen



Chronic abdominal pain

Causes and characteristics of chronic abdominal pain

Table 298-13 CHRONIC ABDOMINAL PAIN IN CHILDREN

DISORDER	CHARACTERISTICS	KEY EVALUATIONS
NONORGANIC		
Functional abdominal pain	Nonspecific pain, often periumbilical	Hx and PE; tests as indicated
Irritable bowel syndrome	Intermittent cramps,diarrhea, and constipation	Hx and PE
Non-ulcer dyspepsia	Peptic ulcer–like symptoms without abnormalities on evaluation of the upper GI tract	Hx; esophagogastroduodenoscopy
GASTROINTESTINAL TRACT		
Chronic constipation	Hx of stool retention, evidence of constipation on examination	Hx and PE; plain x-ray of abdomen
Lactose intolerance	Symptoms may be associated with lactose ingestion; bloating, gas, cramps, and diarrhea	Trial of lactose-free diet; lactose breath hydrogen test
Parasite infection (especially *Giardia*)	Bloating, gas, cramps, and diarrhea	Stool evaluation for O&P; specific immunoassays for *Giardia*
Excess fructose or sorbitol ingestion	Nonspecific abdominal pain, bloating, gas, and diarrhea	Large intake of apples, fruit juice, or candy or chewing gum sweetened with sorbitol
Crohn disease	See Chapter 328	
Peptic ulcer	Burning or gnawing epigastric pain; worse on awakening or before meals; relieved with antacids	Esophagogastroduodenoscopy or upper GI contrast x-rays
Esophagitis	Epigastric pain with substernal burning	Esophagogastroduodenoscopy
Meckel's diverticulum	Periumbilical or lower abdominal pain; may have blood in stool	Meckel scan or enteroclysis
Recurrent intussusception	Paroxysmal severe cramping abdominal pain; blood may be present in stool with episode	Identify intussusception during episode or lead point in intestine between episodes with contrast studies of GI tract
Internal, inguinal, or abdominal wall hernia	Dull abdomen or abdominal wall pain	PE, CT of abdominal wall
Chronic appendicitis or appendiceal mucocele	Recurrent RLQ pain; often incorrectly diagnosed, may be rare cause of abdominal pain	Barium enema, CT
GALLBLADDER AND PANCREAS		
Cholelithiasis	RUQ pain, might worsen with meals	Ultrasound of gallbladder
Choledochal cyst	RUQ pain, mass ± elevated bilirubin	Ultrasound or CT of RUQ
Recurrent pancreatitis	Persistent boring pain, might radiate to back, vomiting	Serum amylase and lipase ± serum trypsinogen; ultrasound or CT of pancreas
GENITOURINARY TRACT		
Urinary tract infection	Dull suprapubic pain, flank pain	Urinalysis and urine culture; renal scan
Hydronephrosis	Unilateral abdominal or flank pain	Ultrasound of kidneys
Urolithiasis	Progressive, severe pain; flank to inguinal region to testicle	Urinalysis, ultrasound, IVP, CT
Other genitourinary disorders	Suprapubic or lower abdominal pain; genitourinary symptoms	Ultrasound of kidneys and pelvis; gynecologic evaluation
MISCELLANEOUS CAUSES		
Abdominal migraine	See text; nausea, family Hx migraine	Hx
Abdominal epilepsy	Might have seizure prodrome	EEG (can require >1 study, including sleep-deprived EEG)
Gilbert syndrome	Mild abdominal pain (causal or coincidental?); slightly elevated unconjugated bilirubin	Serum bilirubin
Familial Mediterranean fever	Paroxysmal episodes of fever, severe abdominal pain, and tenderness with other evidence of polyserositis	Hx and PE during an episode, DNA diagnosis
Sickle cell crisis	Anemia	Hematologic evaluation
Lead poisoning	Vague abdominal pain ± constipation	Serum lead level
Henoch-Schönlein purpura	Recurrent, severe crampy abdominal pain, occult blood in stool, characteristic rash, arthritis	Hx, PE, urinalysis
Angioneurotic edema	Swelling of face or airway, crampy pain	Hx, PE, upper GI contrast x-rays, serum C1 esterase inhibitor
Acute intermittent porphyria	Severe pain precipitated by drugs, fasting, or infections	Spot urine for porphyrins

Table 298-14 DISTINGUISHING FEATURES OF ACUTE GASTROINTESTINAL TRACT PAIN IN CHILDREN

DISEASE	ONSET	LOCATION	REFERRAL	QUALITY	COMMENTS
Pancreatitis	Acute	Epigastric, left upper quadrant	Back	Constant, sharp, boring	Nausea, emesis, tenderness
Intestinal obstruction	Acute or gradual	Periumbilical-lower abdomen	Back	Alternating cramping (colic) and painless periods	Distention, obstipation, emesis, increased bowel sounds
Appendicitis	Acute	Periumbilical, then localized to lower right quadrant; generalized with peritonitis	Back or pelvis if retrocecal	Sharp, steady	Anorexia, nausea, emesis, local tenderness, fever with peritonitis
Intussusception	Acute	Periumbilical-lower abdomen	None	Cramping, with painless periods	Hematochezia, knees in pulled-up position
Urolithiasis	Acute, sudden	Back (unilateral)	Groin	Sharp, intermittent, cramping	Hematuria
Urinary tract infection	Acute	Back	Bladder	Dull to sharp	Fever, costo-vertebral angle tenderness, dysuria, urinary frequency

Functional abdominal pain (non organic):

- Recurrent abdominal pain (RAP) in children was defined as at least 3 episodes of pain over at least 3 mo. that interfered with function
- In many situations the term recurrent abdominal pain was used synonymously with functional abdominal pain
- Other Terms such as chronic abdominal pain, nonorganic abdominal pain, and psychogenic abdominal pain that were used for describing abdominal pain in children led to clinical confusion.

American Academy of Pediatrics Subcommittee on Chronic Abdominal Pain and the North American Society for Pediatric Gastroenterology Hepatology and Nutrition Committee on Abdominal Pain suggested that RAP no longer be used.
The recommended clinical definitions for long-lasting intermittent or constant abdominal pain by the same committees are outlined in the table below

DISORDER	DEFINITION
Chronic abdominal pain	Long-lasting intermittent or constant abdominal pain that is functional or organic (disease based)
Functional abdominal pain	Abdominal pain without demonstrable evidence of pathologic condition, such as anatomic metabolic, infectious, inflammatory or neoplastic disorder. Functional abdominal pain can manifest with symptoms typical of functional dyspepsia, irritable bowel syndrome, abdominal migraine or functional abdominal pain syndrome.
Functional dyspepsia	Functional abdominal pain or discomfort in the upper abdomen
Irritable bowel syndrome	Functional abdominal pain associated with alteration in bowel movements
Abdominal migraine	Functional abdominal pain with features of migraine (paroxysmal abdominal pain associated with anorexia, nausea, vomiting or pallor as well as maternal history of migraine headaches)
Functional abdominal pain syndrome	Functional abdominal pain without the characteristics of dyspepsia, irritable bowel syndrome, or abdominal migraine.

Table 334-2 CHILDHOOD FUNCTIONAL GI DISORDERS: CHILD/ ADOLESCENT (CATEGORY H)

H1. Vomiting and aerophagia
- H1a. Adolescent rumination syndrome
- H1b. Cyclic vomiting syndrome
- H1c. Aerophgia

H2. Abdominal pain—related FGIDs
- H2a. Functional dyspepsia
- H2b. Irritable bowel syndrome
- H2c. Abdominal migraine
- H2d. Childhood functional abdominal pain
  - H2d1. Childhood functional abdominal pain syndrome

H3. Constipation and incontinence
- H3a. Functional constipation
- H3b. Nonr-Retentive fecal incontinence

Table 334-3 ROME III CRITERIA FOR CHILDHOOD FUNCTIONAL ABDOMINAL PAIN H2D AND CHILDHOOD FUNCTIONAL ABDOMINAL PAIN SYNDROME H2D1

H2d. CHILDHOOD FUNCTIONAL ABDOMINAL PAIN
Diagnostic criteria* must include **all** of the following: • Episodic or continuous abdominal pain • Insufficient criteria for other FGIDs • No evidence of an inflammatory, anatomic, metabolic or neoplastic process that explains the subject's symptoms
H2d1. CHILDHOOD FUNCTIONAL ABDOMINAL PAIN SYNDROME
Diagnostic criteria* must satisfy criteria for childhood functional abdominal pain and have at least 25% of the time **one or more** of the following: • Some loss of daily function • Additional somatic symptoms such as headache, limb pain, or difficulty sleeping.

Table 334-4 ALARM *SYMPTOMS* USUALLY NEEDING FURTHER INVESTIGATIONS

Pain that wakes up the child from sleep
Persistent right upper or right lower quadrant pain
Significant vomiting (bilious vomiting, protracted vomiting, cyclical vomiting or worrisome pattern to the physician)
Unexplained fever
Genitourinary tract symptoms
Dysphagia
Chronic severe diarrhea or nocturnal diarrhea
Gastrointestinal blood loss
Involuntary weight loss
Deceleration of linear growth
Delayed puberty
Family history of inflammatory bowel disease, celiac disease, and peptic ulcer disease

Table 334-5 ALARM *SIGNS* USUALLY NEEDING FURTHER INVESTIGATIONS
Localized tenderness in the right upper quadrant
Localized tenderness in the right lower quadrant
Localized fullness or mass
Hepatomegaly
Splenomegaly
Jaundice
Costovertebral angle tenderness
Arthritis
Spinal tenderness
Perianal disease
Abnormal or unexplained physical findings

- Children with functional pain do not have higher levels of conduct disorder or oppositional behavior compared to the controls but they can be more prone to emotional symptoms or psychiatric disorders later in life.
- Parents of patients with functional abdominal pain have more symptoms of somatization, anxiety, and depression.
- Both the family and the affected child when an adult have a higher incidence of irritable bowel syndrome (IBS).
- Laboratory studies may be unnecessary if the history and physical examination lead to a diagnosis of functional abdominal pain. Nonetheless, medical tests can reassure the patient and family, and at times the physician, if there is significant functional disability and poor quality of life.
    - Basic screening blood tests : CBC,ESR,CRP,basic chemistry panel, celiac panel, stool analysis and culture ,urine analysis and culture
    - Radiological : U/S abdomen , pelvic U/S in lower abdominal pain
    - H. pylori infection does not seem to be associated with chronic abdominal pain, but in patients with symptoms suggesting gastritis or ulcer, an H. pylori test (fecal H. pylori antigen) may be performed
    - Breath hydrogen testing is done for ruling out lactose or sucrose malabsorption
    - Esophagogastroduodenoscopy is indicated with symptoms suggesting persistent upper GI pathology
    - In the absence of this suspicion, esophagogastroduodenoscopy is unlikely to identify an abnormality and is usually not necessary.

د مرفت یوسف

dr mordor yousef

Treatment of functional abdominal pain:

Primary care pediatrician can diagnose functional abdominal pain in most children 4-18 year with chronic abdominal pain if there is no alarming symptoms and signs , normal physical examination and –ve stool occult blood test

I. Reassurance and education of the child and family with explanation in simple language that the pain is real but there is no underlying serious condition
II. return to the previous activity if stopped because of pain
III. cognitive Behavioural therapy is helpful in short term management of pain and functional disability
IV. Biofeedback, guided imagery, and relaxation techniques have been useful in some children with functional pain.
V. Drug therapy (not shown consistent benefits)
    - acid suppressants for dyspepsia symptoms
    - Antispasmodics and low-dose amitriptyline.
    - For chronic abdominal pain with IBS symptoms, antidiarrheal and nonstimulating laxatives are used. Peppermint oil for 2 wk improves IBS symptoms in children.

Irritable Bowel Syndrome

- IBS is most in adolescents and young adults and
- is characterized as a chronic functional bowel disorder associated with abdominal pain or discomfort and altered bowel function.
- There are multiple diagnostic criteria with varying durations of symptoms ranging from ≥3 mo to >2 yr.
- Abdominal pain is episodic, cramping, or aching, usually in the lower abdomen, and often relieved by defecation.
- There may be abdominal discomfort, bloating, and flatulence.
- Diarrhea and constipation alone or in an alternating pattern must be present.
- The diarrhea is often watery and frequent and is associated with pain, the passage of mucus per rectum, and a feeling of incomplete emptying. The constipation is associated with a decreased stooling frequency and the passage of hard stools.
- Symptoms may be traced back to childhood or following an episode of presumed bacterial or viral gastroenteritis.
- It is important to rule out organic causes of abdominal pain and altered
- bowel patterns, especially celiac disease, even in the absence of the classic features of this disease.
- Management focuses on the dominant symptoms.
- Pain has been managed with cognitive-behavioral therapy, pain clinic referrals, peppermint, antispasmodic agents, and tricyclic antidepressant agents (amitriptyline).
- Diarrhea has been managed with loperamide, oral nonabsorbable antibiotics, and 5-HT3 antagonists(alosetron).
- Constipation is managed with fiber (psyllium), increased fluid intake, lactulose, 5-HT4 agonists (tegaserod), and selective C2 chloride channel–activating agents.
- In all medication trials, there is often a high response to placebo.

Vomiting

- **Vomiting** is a coordinated, sequential series of events that leads to forceful oral emptying of gastric contents.
- Vomiting should be distinguished from **regurgitation** of stomach contents, also known as gastroesophageal reflux (GER), chalasia, or *spitting up*. Although the end result of vomiting and regurgitation is similar, they have completely different characteristics.
- Vomiting is usually preceded by nausea, followed by forceful gagging and retching.
- Regurgitation, on the other hand, is effortless and not preceded by nausea

Causes:

I. **Newborn and infants :**
   - Common causes :
     - Possetting
     - GERD
     - GE
     - Overfeeding
     - Cow's milk protein intolerance, but not lactose intolerance
   - Less common causes:
     - Pyloric stenosis
     - Intussusception
     - Occult infection e.g. UTI
     - Raised intracranial pressure

II. **Young children :**
   - Common causes :
     - GE
     - Systemic infection
   - Less common causes : toxic ingestion

III. **Adolescent :**
   - Common causes :
     - GE
     - Systemic infection
   - Less common causes:
     - Migraine
     - Pregnancy
     - Bulimia
     - Raised intracranial pressure

Differential Diagnosis

- In neonates with true vomiting, congenital obstructive lesions should be considered.
- Allergic reactions to formula also are common in the first 2 months of life.
- Infantile GER ("spitting up") occurs in most infants and can be large in volume, but is effortless and these infants do not appear ill.
- Pyloric stenosis occurs in the first month of life and is characterized by steadily worsening, forceful vomiting which occurs immediately after feedings.
- Prior to vomiting a distended stomach, often with visible peristaltic waves is often seen. Pyloric stenosis is more common in male infants, and there may be a positive family history.
- Other obstructive lesions, such as intestinal duplication cysts, atresias, webs, and midgut malrotation must be ruled out.

- Metabolic disorders (organic acidemias, galactosemia, urea cycle defects, etc.) can cause vomiting in infants.
- In older children with acute vomiting, viral illnesses are common.
- Other infections, especially streptococcal pharyngitis, urinary tract infections, and otitis media, commonly result in vomiting. When vomiting is chronic, central nervous system (CNS) causes (increased intracranial pressure, migraine) must be considered.
- When abdominal pain or bilious emesis accompanies vomiting, evaluation for bowel obstruction, peptic disorders, and appendicitis must be immediately initiated

Distinguishing Features

- Physicians caring for children see hundreds of patients with viral gastroenteritis for every one with a less common diagnosis.
- It is important to be alert for unusual features that suggest another diagnosis (see Table below).
- Viral gastroenteritis usually is not associated with severe abdominal pain or headache and does not recur at frequent intervals

Assessment

- Physical examination should include assessment of the child's hydration status, including examination of capillary refill, moistness of mucous membranes, and skin turgor.
- The chest should be auscultated for evidence of pulmonary involvement.
- The abdomen must be examined carefully for distention, organomegaly, bowel sounds, tenderness, and guarding.
- A rectal examination and testing stool for occult blood should be performed

Laboratory evaluation

- Laboratory evaluation of vomiting should include serum electrolytes, tests of renal function, complete blood count, amylase, lipase, and liver function tests.
- Additional testing may be required immediately when history and examination suggest a specific etiology.
- Ultrasound is useful to look for pyloric stenosis, gallstones, renal stones, hydronephrosis, biliary obstruction, pancreatitis, appendicitis, malrotation, intussusception, and other anatomic abnormalities.
- CT may be indicated to rule out appendicitis or to observe structures that cannot be visualized well by ultrasound.
- Barium studies can show obstructive or inflammatory lesions of the gut and can be therapeutic, as in the use of contrast enemas for intussusception

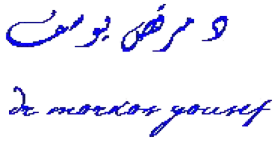
Treatment

- Treatment of vomiting needs to address the consequences and causes of the vomiting. Dehydration must be treated with fluid resuscitation.
- This can be accomplished in most cases with oral fluid-electrolyte solutions, but IV fluids are commonly required.
- Electrolyte imbalances should be corrected by appropriate choice of fluids. Underlying causes should be treated when possible.
- The use of antiemetic medications is controversial.
- These drugs should not be prescribed until the etiology of the vomiting is known and then only for severe symptoms. Phenothiazines, such as prochlorperazine, may be useful for reducing symptoms in food poisoning and motion sickness.
- Their side effect profile must be considered carefully, and the dose prescribed should be conservative.
- Anticholinergics, such as scopolamine, and antihistamines, such as dimenhydrinate, are useful for the prophylaxis and treatment of motion sickness.

- Drugs that block serotonin 5-HT3 receptors, such as ondansetron and granisetron, are used for viral gastroenteritis, and can improve tolerance of oral rehydration therapy. They are clearly helpful for chemotherapy-induced vomiting, often combined with dexamethasone.
- No antiemetic should be used in patients with surgical emergencies or when a specific treatment of the underlying condition is possible.
- Correction of dehydration, ketosis, and acidosis by oral or intravenous rehydration is helpful to reduce vomiting in most patients with viral gastroenteritis.

Drugs used to control emesis and their mechanism of action

Drug group	Indication	Mechanism
Antihistamines	Motion sickness and mild chemotherapy induced vomiting	• Labyrinthine suppression via anticholinergic effect. • H1 receptor antagonism in vomiting centre
Substitute benzamides e.g. metoclopramide	Chemotherapy,gastroparesis	D2 receptor blockade at CTZ.in high dose has 5HT3 activity in the gut
5 HT3 receptor antagonists e.g. ondansetron	Chemotherapy Post-operative N & V	5 HT3 receptor blockade most important in Gut,but possibly some effect in CTZ and vomiting centre
Benzodiazepines e.g. lorazepam	Chemotherapy	Central GABA inhibition,producing sedation and anxiolysis
Phenothiazides	Rarely used in children because of extrapyramidal side effects	D2 receptor blockade at CTZ
Butyrophenones e.g. domperidone	Chemotherapy , gastroparesis,GERD	D2 receptor blockade at the enteric nervous system



Differential Diagnosis of Vomiting by Historical Features

Potential Diagnosis	Historical Clues
Viral gastroenteritis	Fever, diarrhea, sudden onset, absence of pain
Gastroesophageal reflux	Effortless, not preceded by nausea, chronic
Hepatitis	Jaundice, history of exposure
Extragastrointestinal infections	
Otitis media	Fever, ear pain
Urinary tract infection	Dysuria, unusual urine odor, frequency, incontinence
Pneumonia	Cough, fever, chest discomfort
Allergic	
Milk or soy protein intolerance (infants)	Associated with particular formula or food, blood in stools
Other food allergy (older children)	
Peptic ulcer or gastritis	Epigastric pain, blood or coffee-ground material in emesis, pain relieved by acid blockade
Appendicitis	Fever, abdominal pain migrating to the right lower quadrant, tenderness
Anatomic obstruction	
Intestinal atresia	Neonate, usually bilious, polyhydramnios
Midgut malrotation	Pain, bilious vomiting, gastrointestinal bleeding, shock
Intussusception	Colicky pain, lethargy, vomiting, currant jelly stools, mass occasionally
Duplication cysts	Colic, mass
Pyloric stenosis	Nonbilious vomiting, postprandial, <4 mo old, hunger
Bacterial gastroenteritis	Fever, often with bloody diarrhea
Central nervous system	
Hydrocephalus	Large head, altered mental status
Meningitis	Fever, stiff neck
Migraine syndrome	Attacks scattered in time, relieved by sleep; headache
Cyclic vomiting syndrome	Similar to migraine, usually no headache
Brain tumor	Morning vomiting, accelerating over time, headache, diplopia
Motion sickness	Associated with travel in vehicle
Labyrinthitis	Vertigo
Metabolic disease	Presentation early in life, worsens when catabolic or with exposure to substrate
Pregnancy	Morning, sexually active, cessation of menses
Drug reaction or side effect	Associated with increased dose or new medication
Cancer chemotherapy	Temporally related to administration of chemotherapeutic drugs

Carcinoid tumors

en

Endocrine tumors include
APUDomas :these hormone secreting tumors arise from APUD cells(neural crest cell derivitaves of the gastroenteropathic endocrine system).they are :

- Carcinoid
- VIPomas,gastrinoma,somatostatinoma
- Mastocytoma
- Medullary carcinoma thyroid

Neurogenic tumors : ganglioneuroma , phaeochromocytoma
APUD= amine precursor uptake decarboxylation

- Carcinoid tumors are tumors of the intestine arise in the appendix in children
- They are bengin or low grade malignancy and when symptomatic present as appendicitis
- Tumors elsewhere in the GIT are likely to metastasize
- They produce the carcinoid syndrome,the result of serotonin(5-HT) and other hormone production, when metastatic

Carcinoid syndrome

Clinical features:

1. All have liver metastasis
2. Intestinal hypermobility with watery diarrhea and abdominal pain
3. Bluish red facial flushing with telangiectasia
4. Bronchoconstriction
5. Tricuspid incompetence or pulmonary stenosis

Diagnosis:

- Urine 5HIAA ↑ (serotonin metabolite)
- Plasma serotonin
- Bradykinin,histamine,tachykinins and /or prostaglandins ↑

Treatment:

- Resection of primary tumor if possible
- Octreotide (somatostatin analogue) inhibits release of gut hormones