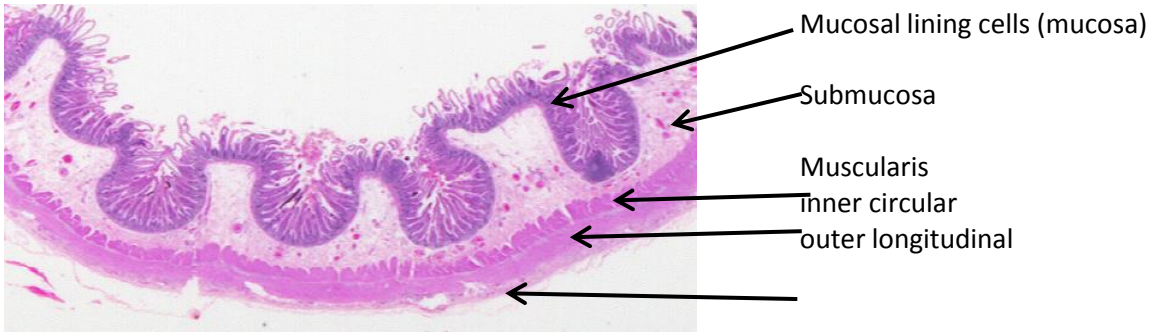
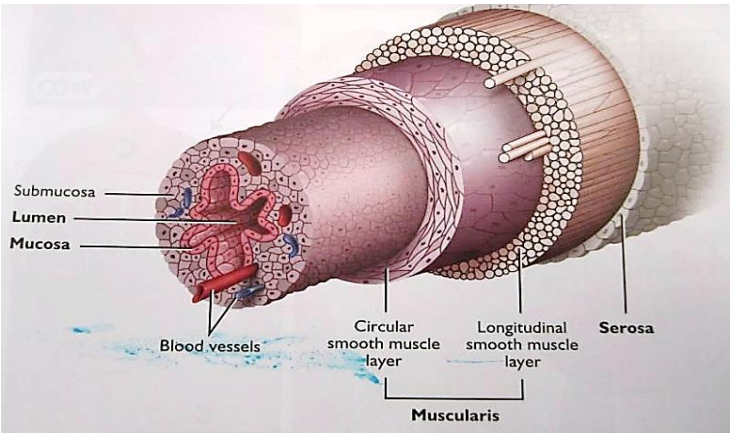
BIOS 2015 ... CHAPTER 17- Digestive System Disorders

Page	Note
	Roles of Gastrointestinal (GI) System:
	1. Digest food to a point that nutrients can be absorbed.
	2. To absorb nutrients.
	3. To participate in fluid balance, absorbing water from ingested fluids and solids.
	Nutrients are absorbed by active transport.
	Water is absorbed by osmosis.
	Pathway of Digestion:
	Digestion starts in mouth:
	' teeth break up food.
	- salivary amylase digests sugar.
	Digestion continues in stomach:
	- stomah churns or mixes food till it becomes a liquid called "Chyme"
	- the digestion process uses acid and enzymes that digest proteins, examples: Pepsin and Trypsin
	Chyme is released into the small intestine (duodenum), this triggers several events:
	- cholecystikinin and secretin are hormones released by the intestinal cells that cause the gallbladder to contract and the pancrease to release pancreatic fluid.
	- the bile from the gallbladder contains detergents that break up fat. The bile also contains toxins and waste that the liver has filtered from the blood and put in the bile for elimination in the feces.
	- the pancreatic fluid contains an enzyme, lipase, that beaks up fat, but it also is rich in bicarbonate that neutralizes the stomach acid and leaves the fluid basic or alkaline (this is why diarrhea loses base and cana result in metabolic acidosis).
	After the duodenum, fluid passes into the jejunum and ileum (parts of the small intestine) where nutrients are absorbed by active transport.
	Food then goes into the colon where water is absorbed and a solid stool is formed.
	Anatomy of the gut:
	

	The mucosa is different in the esophagus, stomach, small intestine and large intestine, but all have the same basic architecture of mucosa, submucosa, muscularis, and serosa.
	The muscularis also varies by region.
	Upper esophagus - striated muscle
	Lower esophagus- smooth muscle
	Stomach - 3 layers of smooth muscle (less well layered than ntesine)
	Small and large intestine - 2 layers of smooth muscle (inner circular, outer longitudineal)
	 Circular muscle cells wrap around the long axis of the intestine (like your fingers wrap around a dringing glass). Longitudinal muscle cells run perendicular to circular cells and run down the long axis of theintestine (like verical stripes down a pair of pants).
	Role of Liver:
	- filters blood draining from the intestines into the hepatic portal vein.
	- removes toxins, drugs, and waste and puts them in the bile for excretion in the feces.
	- makes bile for digestion of fat.
	- stores carbohydrates as glycogen
	- processes carbohydrate, protein and fat.
	- produces plasma proteins and cloting factors.
	- role in red blood cell beakdown by conjugating (adding sugar molecules to) bilirubin.
	Neural Controls:
	Autonomic nervous system (sympathetic and parasmpathetic) act in an opposite fashion to how they affect the heart because of you are in a fight or flight mode, you do not want blood diverted to the intestines for digestion.
	Sympathetic: speeds up heart but slows down gut.
	Parasympathetic (vagus nerve): slows down heart but speeds up gut.

Hormonal Control:

Hormone	Source	Stimulus	Effects
Gastrin	Gastric cells	Food in the stomach Protein, caffeine, or high pH of chyme	Increases gastric secretions and motility and promotes gastric emptying
Cholecystokinin	Intestinal mucosal cells	Protein and fat in the duodenum	Inhibits gastric secretions and motility; stimulates pancreatic enzyme secretion; stimulates gallbladder contractions and release of bile
Secretin	Intestinal mucosal cells	Acidic chyme in the duodenum	Stimulates bile and pancreatic secretions with high bicarbonate content
Neural Controls	**Source**	**Stimulus**	**Effects**
Parasympathetic nervous system	Vagus nerve	Taste food	Increases secretions and peristalsis
Sympathetic nervous system	SNS	Stress	Decreases secretions and peristalsis Stimulates vasoconstriction in the mucosa

Note: that cholecystikinin and secretin not only affect the gall bladder and pancreas but also signal the stomach to slow down so that the latest delivery from the stomach to the duodenum can be processed.

Vitamins:

Fat Soluble: A,D,E,K (these are stored in fat, so overconsumption can lead to toxicity).

Water Soluble: B and C (these are readily lost in the urine, B vitamins known for turning the urine bright yellow).

GI Symptoms:

Vague GI symptoms like anorexia, nausea and vomiting can be triggered by a wide variety of conditions:

Systemic infection
Emotional responses
Motion sickness
Pressure in the brain
Overindulgence of food, drugs
Pain

Vomiting center in brain (medulla) coordinates a number of events that must be orchestrated to achieve vomiting - sending food backwards in the GI tract.

Different color and texture in vomit may give information:

- blood in the stomac is digested by acid and forms "Coffee ground emesis"
- Bile reflusx into the stomach can cause green or yellow stained vomit.
- Dark brown vomit suggests origin from the small intestines.

Repeated vomiting may be a sign of an intestinal obstruction.

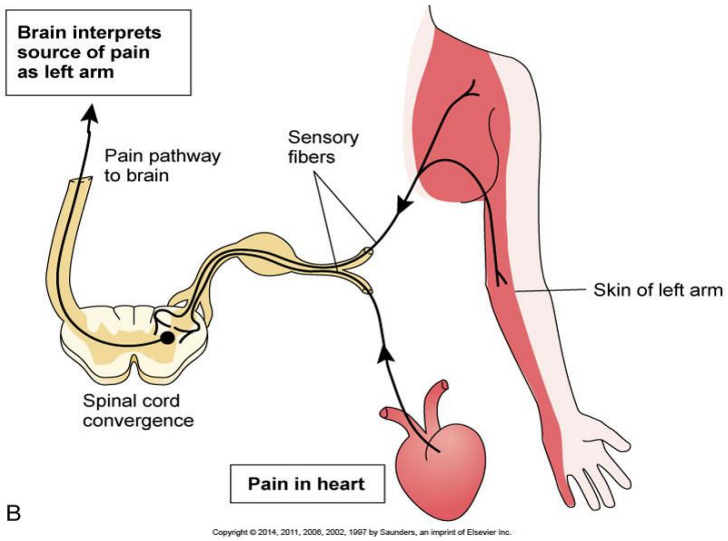
	Diarrhea:
	Large-volume diarrhea (secretory or osmotic) - Watery stool resulting from increased secretions into intestine from the plasma - Often related to infection - Limited reabsorption because of reversal of normal carriers for sodium and/or glucose **Small-volume diarrhea** - Often caused by inflammatory bowel disease - Stool may contain blood, mucus, pus - May be accompanied by abdominal cramps and tenesmus
	Steatrrhea: Fatty diarrhea, bulky greasy loose stool with fould odor (and floats). Seen in malabsoprtion in Celiac disease and Cystic fibosis.
	Blood in Stool:
	Blood may occur in normal stools with diarrhea, constipation, tumors, or an inflammatory condition. **Frank blood** - Red blood—usually from lesions in rectum or anal canal **Occult blood** - Small hidden amounts, detectable with stool test - May be caused by small bleeding ulcers **Melena** - Dark-colored, tarry stool - May result from significant bleeding in upper digestive tract
	Motility and stool consistency:
	It takes time for water to be absorbed from material in the colon to form a desireable consistency to stool.
	If peristalsis is too rapid, not enough water is absorbed and the stool is loose.
	If peristalsis is too slow, too much fluid is absorbed and the stool is hard (constipation).
	Fluid and Elecrolytes:
	Vomiting looses acid >>> metabolic alkalosis.
	Diarrhea looses base (bicarbonate) >>> metabolic acidosis.
	PAIN:
	Visceral Pain (often has vague associations).
	Burning, epigastric: stomach or duodenal ulcer.
	Dull aching in right upper quadrant: stretching of liver capsule.
	Diffuse craming pain: Distension of intestines, gas is a typical cause.
	Somatic Pain (more focused and localized).
	- local inflammaion may involve peritoneum.
	- pereitoneal inflammation may show "rebound tenderness" - push in on abdomen and rapidly release, causes a sharp pain. Commonl seen in appendicitis.
	Acute Appendicitis:
	Generalized abdominal pain followed by localization with point tenderness in right lower quadrant with associated rebound tenderness.

Referred Pain:

- Pain is perceived at a site different from origin.
- Results when visceral and somatic nerves converge at one spinal cord level

Source of visceral pain is perceived as the same as that of the somatic nerve (see diagram below).

- May assist or delay diagnosis, depending on problem



Classic Example of Referred Pain:
Left Arm Pain when having a heart attack.

Visceral nerve impulses from the heart activate sensory nerves from the arm and make the brain think there is arm pain and that is what you feel.

Classic Pain Asociations to Remember:

1. Pain in left arm and shoulder. Cardiac pain (heart attack).
2. Pain in right lower quadrant of abdomen: Appendix (acute appendicitis).
3. Pain in right upper quadrant of abdomen: Gall Bladder (cholecystitis).
4. Epigastric pain: Duodenum (acute ulcer), Pancreas (acute pancreatits).
5. Pain in left lower quadrant of abdomen: Sigmoid colon (diverticulitis).
6. Back pain: Kidneys (kidney stones).

Drugs used in Digestive Disorders:

Antacids and Proton pump inhibitors (PPI):
- To relieve gastric pain.
- Reduce gastric secretion (PPI).

Antiemetics (Anti + Emesis, Emesis is vomiting):
- To relieve vomiting (often by dulling nausea)

Laxatives or enemas:
- Treatment of acute constipation

Antidiarrheals:
- Reduction of peristalsis
- Relieve cramps

Disorders of Oral Cavity

Cleft lip and palate:

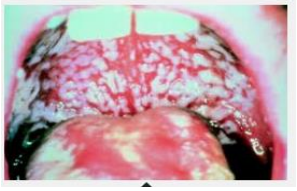
Baby with cleft lip

Congenital abnormalities
Cleft lip and cleft palate
Feeding problems of the infant
High risk of aspirating fluid into respiratory passages
Speech development impaired
Surgical repair done as soon as possible
Therapy with speech-language pathologist and orthodontist

Aphthous ulcers:

Inner lip, small painful, self limited,
possibly Strep. sanguis

Oral Candidiasis (Thrush):



Patchy white plaqus in mouth and on tongue.
Grows from local flora.
Opportunistic infection.
Seen with certain antibiotics, chemotherapy and

Oral Hepes (HSV type I):

Herpes simplex virus type 1 (HSV-1)
Transmitted by kissing or close contact
Virus remains dormant in sensory ganglion
Activated by stress, trauma, other infection
Formation of blister, ulcers, clear fluid release—
contains virus; can be autoinoculated to other areas
Lesions heal spontaneously in 7 to 10 days.
Acute stage may be alleviated by antiviral medication.
May spread to eyes: Conjunctivitis and keratitis

Syphilis (caused by spirochete Treponema pallidum):

May cause oral lesions
Highly contagious during first and second stages
Primary stage
Chancre, a painless ulcer on tongue, lip, palate
Heals spontaneously (1 or 2 weeks)
Secondary stage
Red macules or papules on palate—highly infectious
Heals spontaneously
Both stages treated with long-acting penicillin

Dental Caries (Cavities in teeth):

Bacteria break down sugar to acid, and acid dissolves mineral in tooth enamel.

Gingivitis - inflammation of the gums

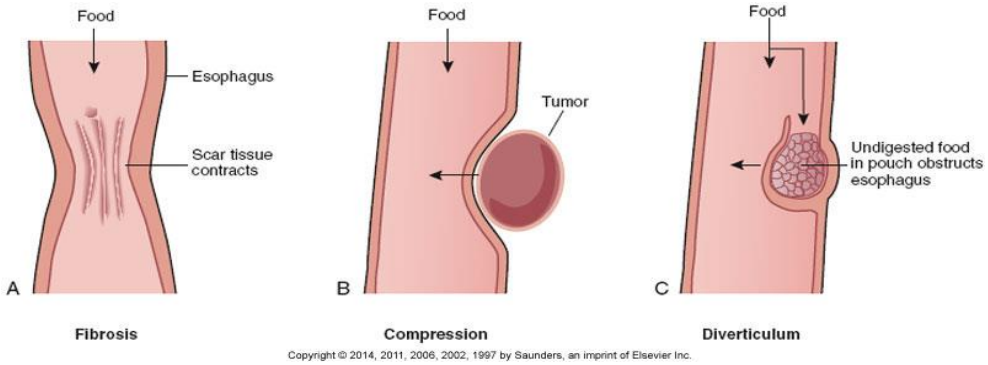
Periodontitis - inflammation of deeper tooth structures around roots.

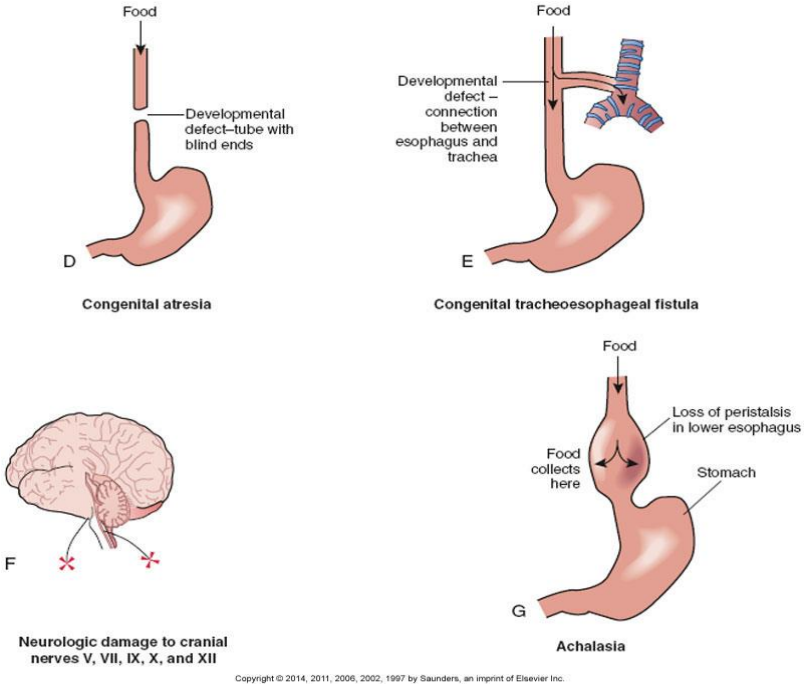
Hyperkeratosis - Leukoplakia:

Whitish plaque or epidermal thickening of mucosa
Occurs on buccal mucosa, palate, lower lip
May be related to smoking or chronic irritation
Lesions require monitoring.
Epithelial dysplasia beneath plaque may develop into

Sialadenitis - inflammation of salivary glands.

Dysphagia - difficult swallowing, various causes.

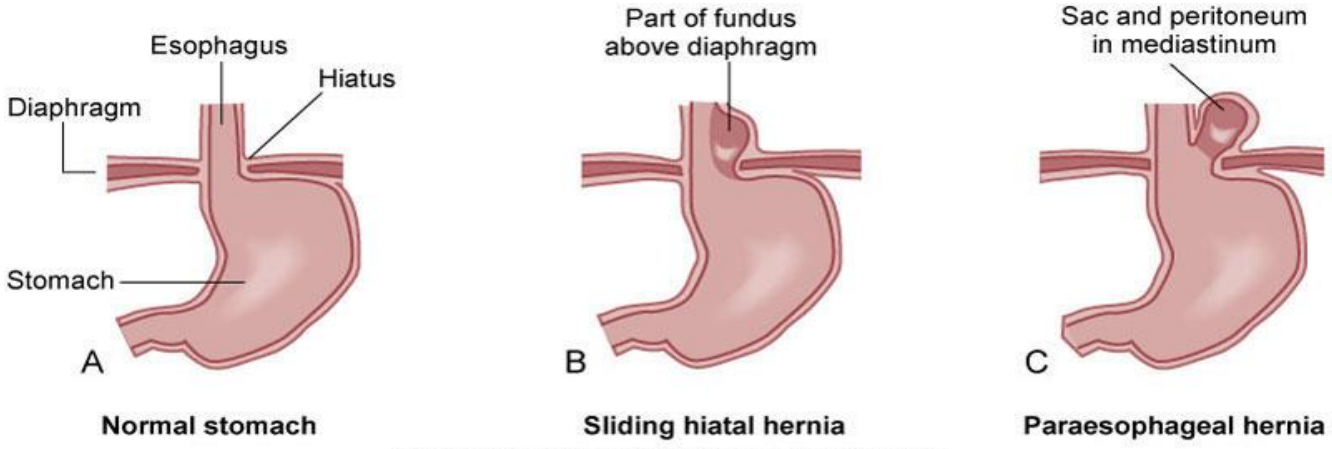




Esophageal Cancer:

Associated with chronic irritation because of:
Chronic esophagitis
Achalasia
Hiatal hernia
Alcohol abuse, smoking

Hiatal Hernia (Part of the stomach protrudes into the thoracic cavity):



Gastroesophageal Reflux Disease:

- Periodic reflux of gastric contents into distal esophagus causes erosion and inflammation

	Acute Gastritis (many causes):
	Infection by microorganisms Allergies to foods Spicy or irritating foods **Excessive alcohol intake** **Ingestion of aspirin or other NSAIDs** Ingestion of corrosive or toxic substances Radiation or chemotherapy
	Chronic Gastritis:
	Characterized by atrophy of stomach mucosa Loss of secretory glands **Reduced production of intrinsic factor** **Helicobacter pylori infection is often present.** Signs may be vague. Mild epigastric discomfort, anorexia, intolerance for certain foods **Increased risk of peptic ulcers and gastric carcinoma** **Certain autoimmune disorders are associated with one type of chronic gastric atrophy.**
	Escherichia coli Infection
	Although E. coli is usually harmless as a resident in the human intestine, infective strains can cause significant problems. **Infective strains** Enterotoxigenic E. coli Enteroinvasive E. coli Enteropathogenic E. coli Enteroaggregative E. coli Enterohemorrhagic E. coli
	Peptic Ulcer: Gastric and Duodenal Ulcers
	Most caused by H. pylori infection Usually occur in the proximal duodenum (duodenal ulcers) Also found in the antrum of the stomach (gastric ulcers) Development begins with breakdown of mucosal barrier Decreased mucosal defense More common in gastric ulcer development **Increased acid secretion predominant factor in duodenal ulcers**

Damage to mucosal barrier predisposes to development of ulcers and is associated with:

1. **Inadequate blood supply**
   - Caused by **vasoconstriction** (e.g., by **stress, smoking, shock**, circulatory impairment in older adults, scar tissue, anemia)
   - Interferes with rapid regeneration of epithelium
2. Excessive glucocorticoid secretion or medication
3. **Ulcerogenic substances** break down mucous layer.
   - **Aspirin, NSAIDs, alcohol**
4. Atrophy of gastric mucosa
   - Chronic gastritis

Increased acid pepsin secretions

- Increased gastrin secretion
- Increased vagal stimulation

Complications of peptic ulcer

Hemorrhage

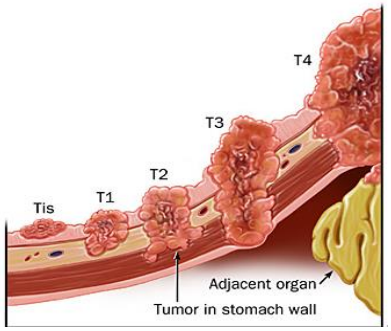
Perforation

- Ulcer erodes completely through the wall.
- Chyme can enter the peritoneal cavity.
- Results in chemical peritonitis

Obstruction

- May result later because of the formation of scar tissue

Gastric Carcinoma:



Diet seems to be a key factor, particularly **smoked foods, nitrites, and nitrates.**

Early carcinoma

- Confined to mucosa and submucosa

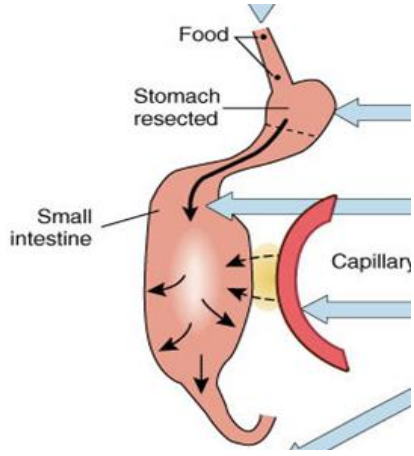
Later stages

- Infiltrates the muscularis

Asymptomatic in the early stages

- prognosis is poor on diagnosis
- survival rate less than 20%

Dumping:



Control of gastric emptying is lost, and gastric contents are "dumped" into the duodenum without complete digestion.

May follow gastric resection

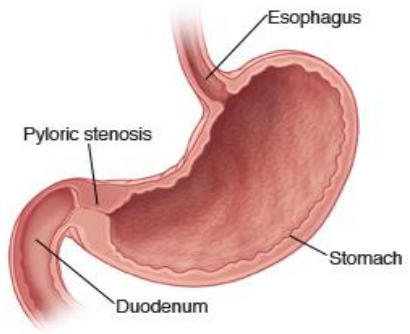
Effects:

Hyperosmolar chyme draws fluid from vascular compartment into intestine causing intestinal distention and **decreased blood pressure**.

High glucose in chyme leads to insulin release and subsequent **hypoglycemia.**

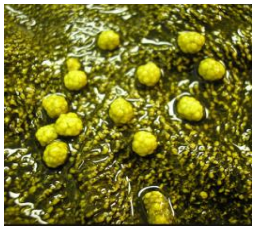
Give frequent small meals—high in protein, low in simple carbohydrates

Pyloric Senosis:

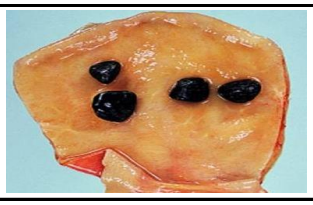


Narrowing and obstruction of pyloric sphincter
May be developmental anomaly
Signs appear within several weeks after birth.
- Projectile vomiting immediately after feeding
- Firm mass can be palpated at pylorus.
- Infant fails to gain weight, dehydration, persistent hunger
Surgery required to relieve the obstruction.

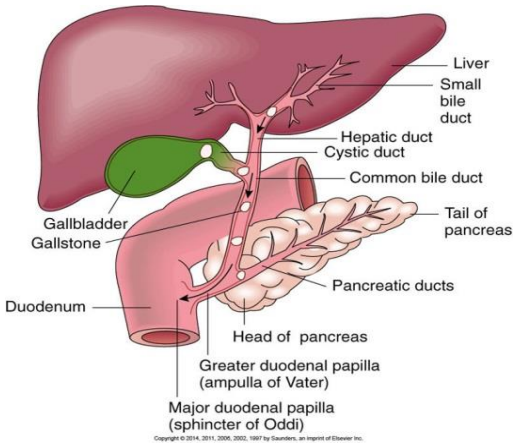
Gallstones:



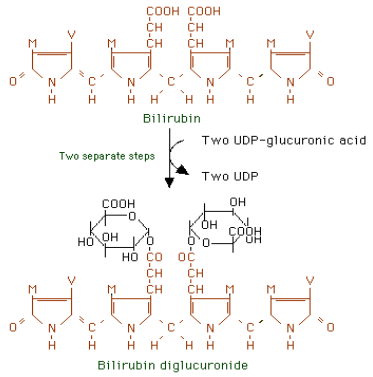
YELLOW - Cholesterol stones
Women (2 x men)
High cholesterol in bile (cholesterol stones)
High cholesterol intake
Obesity, Multiparity.



BLACK - Bilirubinate stones
Associated with hemolytic anemia.



Cholelithiasis
- Formation of gallstones
- Solid material (calculi) that form in bile
Choledocholithiasis
- Obstruction of the biliary tract by gallstones
Cholecystitis
- Inflammation of gallbladder and cystic duct
Cholangitis
- Inflammation usually related to infection of bile ducts



Uncongugated (indirect) bilirubin is processed in the liver to make Conjugated (direct) bilirubin.

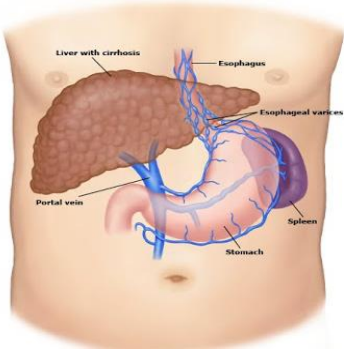
Total bilirubin = direct + indirect bilirubin.

Indirect bilirubin is calculated from measurements of total and direct bilirubin.

	Jaundice:
	Prehepatic jaundice - Result of **excessive destruction of red blood cells** - Characteristic of hemolytic anemias or transfusion reactions **- Rise in indirect bilirubin.** **Intrahepatic jaundice** - Occurs with **disease or damage to hepatocytes** - Hepatitis or cirrhosis **- Rise in direct and/or indirect bilirubin.** **Posthepatic jaundice** - Caused by **obstruction of bile flow** into gallbladder or duodenum **- Tumor, cholelithiasis**
	Hepatitis:
	Alcoholic (steatohepaitis, hepatitis with fatty change). Viral hepatitis Types A, B, C, D, E Chemical or drug toxicity Idiopathic (cause unknown).
	Hepatitis A (HAV) Small RNA virus **Infectious hepatitis**, transmitted by **fecal-oral route** Acute but self-limiting infection, **No carrier or chronic state.** Vaccine available. **Hepatitis B (HBV)** Partially double-stranded DNA virus Transmitted by **IV Rx abuse and sexual intercourse.** Usually **self limiting, sometimes chronic, can have a carrier state.** **Some develop cirrhosis and liver cancer.** **Vaccine available.** **Hepatitis C (HCV)** Single-stranded RNA virus Most common type transmitted **by blood transfusion** **Chronic disease common, can have a carrier sta**te. **Increases risk of hepatocellular carcinoma** **Treated with interferon injections**

	Toxic or Nonviral Hepatitis
	Variety of hepatotoxins can cause inflammation and necrosis of the liver. Drugs include: **Acetaminophen,** halothane, phenothiazines, tetracycline Chemicals include: Carbon tetrachloride (not used currently), toluene, ethanol Direct effect of toxins **May result from sudden exposure to large amounts or from lower dose and long-term exposure**
	Cirrhosis
	Progressive destruction and scarring of the liver Causes 1. **Alcoholic liver disease** **2. Biliary cirrhosis** - Associated with immune disorders, obstructed ducts. **3. Post-inflammatory or post-necrotic cirrhosis** - Linked with **chronic hepatitis** or long-term exposure to toxic materials **4. Metabolic** - Usually caused by genetic metabolic storage disorders
	Initial stage—fatty liver - Enlargement of the liver - Asymptomatic and reversible with reduced alcohol intake **Second stage—alcoholic hepatitis** - Inflammation and cell necrosis - **Fibrous tissue formation—irreversible change** **Third stage—end-stage cirrhosis** - Fibrotic tissue replaces normal tissue. - Little normal function remains.
	Functional Losses with Cirrhosis:
	1. Decreased removal and conjugation of bilirubin **2. Decreased production of bile** 3. Impaired digestion and absorption of nutrients 4. **Decreased production of blood-clotting factors** 5. **Impaired glucose and glycogen metabolism** 6. Impaired conversion of ammonia to urea **High blood ammonia is an ominous sign of serious liver failure.**

Sequelae with Cirrhosis



Develop esophageal varices
- Hemorrhage

Develop ascites, fluid in the peritoneal cavity
- Causes abdominal distention and pressure

Bruising from decreased clotting factors.

Hepatocellular carcinoma
Most common primary tumor of liver
More common in cirrhotic livers
Initial signs are mild and general.
Diagnosis usually occurs with advanced stages
Chemotherapy, possible lobectomy or radiofrequency ablation (RFA) procedure

Acute Pancreatitis

Inflammation of the pancreas
- Results in **enzymatic autodigestion of the tissue**
May be acute or chronic
- Acute leads to tissue destruction, **peritonitis, and possibly sepsis.**
- Chronic leads to scarring of pancreas.
Causes
- Gallstones
- Alcohol abuse

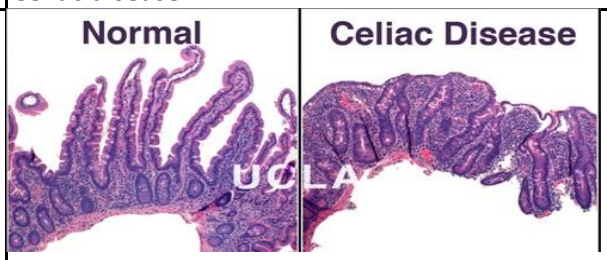
Diagnostic Tests: Elevated serum amylase and hyperlipidemia.

Pancreatic Cancer:

Risk factors: Smoking, heavy alcohol use, chronic pancreatitis.
Adenocarcinoma—most common form., Arises from the epithelial cells in the ducts
Weight loss and jaundice early manifestations
Frequently asymptomatic until well advanced
Metastases occur early.
Mortality is close to 95%. (sometimes patient's do better if the cancer is in the head of the pancreas and it causes early symptoms, namely, obstruction of the bile ducts leading to obstructive jaundice)

LOWER GI TRACT

Celiac disease



Malabsorption syndrome
Primarily a childhood disorder
- May occur in adults in middle age

Appears to have genetic link
Defect in intestinal enzyme
- **Prevents further digestion of gliadin (breakdown product of gluten)**
- Toxic effect on intestinal villi—atrophy of villi
- Malabsorption and malnutrition result.

Chronic Inflammatory Bowel Disease

Chrohn's Disease and Ulcerative Colitis.

Chron's is in the terminal ileum and spotty in colon; has transmural inflammation with fissures, and granulomas.
Ulcerative colitis involves much of the colon (confluent) ; as mucosal inflammation and no granulomas.

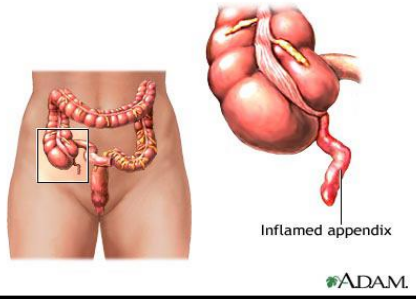
Treatment:

Anti-inflammatory medications, Antimicrobials, **Cytotoxic agents in serious cases.**
Surgical resection
In Chron's Disease segments that cause obstruction are resected.
In Ulcerative colitis a colectomy is done for intractable inflammation or if dysplasia is detected (dysplasia is widespread and heralds cancer).

Irritable Bowel Syndrome (IBS):

Vague intestinal unrest with a wide variety of symptoms and causes.

Acute Appendicitis:



Obstruction of the appendiceal lumen
- By a fecalith or foreign material
Appendiceal wall becomes inflamed.
- Purulent exudate fills lumen.
- Appendix is swollen.

Ischemia and necrosis of the wall

Acute appendicitis presents as nausea, vomiting and generalized abdominal pain progressing to point tenderness in right lower quadrant with rebound tenderness.

Diverticular Disease:

Diverticulum:
- Outpouching (herniation) of the mucosa through the muscular layer of the colon

Diverticulosis:
- Asymptomatic diverticular disease

Diverticulitis:
- Inflammation of the diverticula

Colon Cancer:

Forms over time progressing through benign polyps before becoming cancer.

Risk factors
- Familial multiple polyposis
- Long-term ulcerative colitis
- Genetic factors
- Environmental factors
- Diet low in fiber

Because blood flow from the colon drains into the liver, the liver is a common site of metastasis.

Peritonitis: Inflammation of the peritoneal membranes

Chemical peritonitis may result from:
Enzymes released with pancreatitis
Urine leaking form a ruptured bladder
Chyme spilled from a perforated ulcer
Bile escaping from the ruptured gallbladder
Blood
Any other foreign material in the cavity

Infections cause peritonitis:

- ruptured intestine or ruptured appendix spill bacteria into peritoneal space.

- sometimes bacterial leak into peritoneal space after **abdominal surgery.**

- Pelvic Inflamatory Disease is a portal to develop peritonitis.

THE END