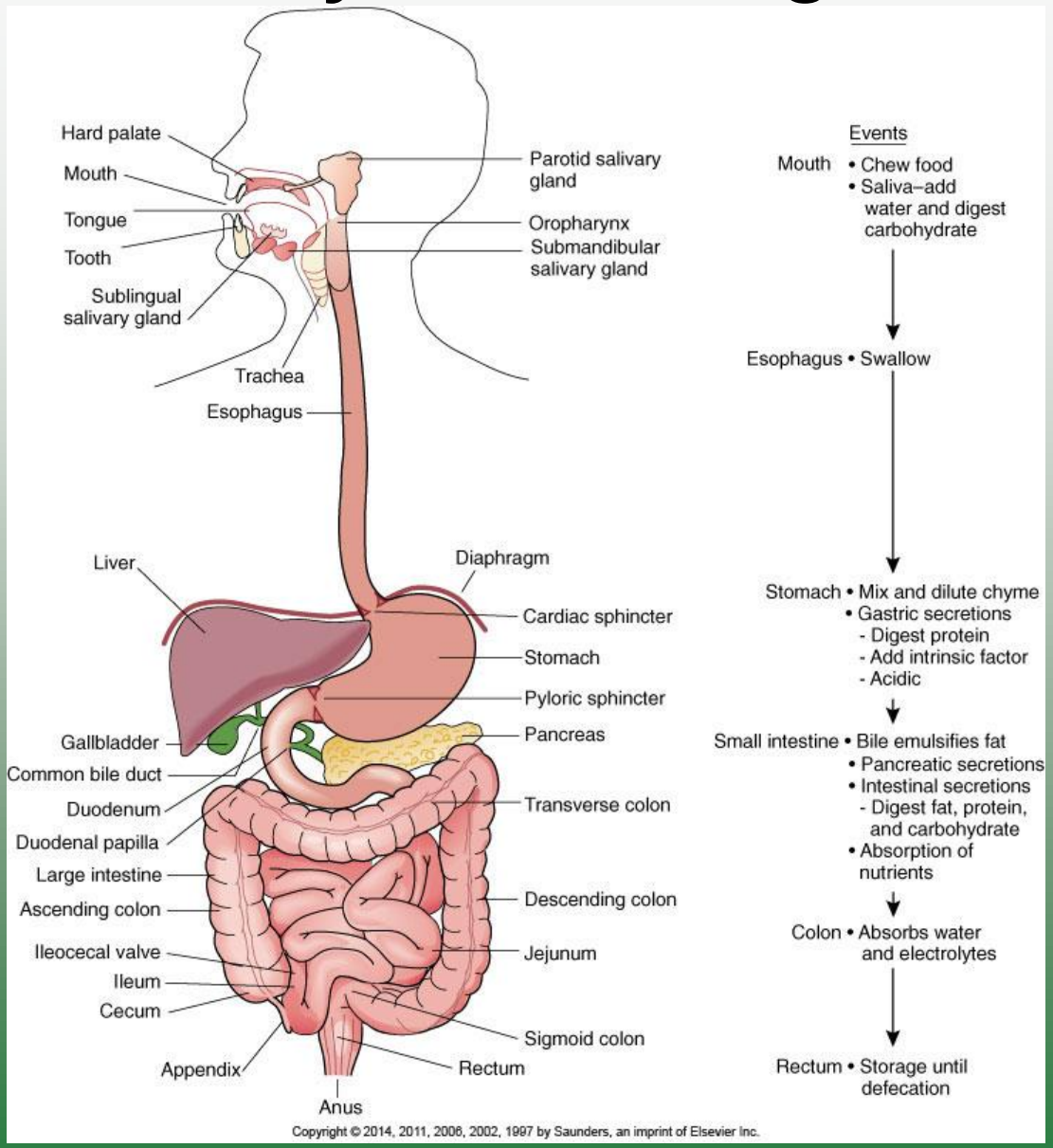
Chapter 17

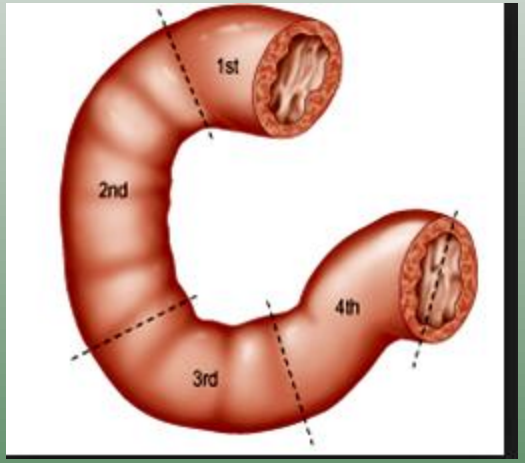
Digestive System Disorders

Digestive System

- Processes ingested food and fluids
  - Breaks them down into their units
  - Controlled by enzymes
- Absorbs necessary components
  - Membrane transport mechanisms
  - Mostly in small intestine

Anatomy of the Digestive System

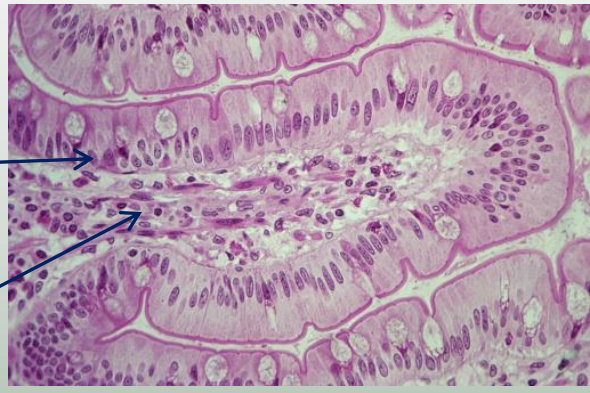




Parts of duodenum

Digestive System: Introduction

- Gut wall
  - Mucosa
    - Epithelium, including mucus-producing cells
  - Submucosa
    - Connective tissue—including blood vessels, nerves, lymphatics, secretory glands
  - Circular smooth muscle layer
  - Longitudinal smooth muscle layer
  - Serosa
    - Visceral peritoneum



Upper Gastrointestinal Tract

- Oral cavity
  - Initial phase of mechanical breakdown of food
    - Mastication by teeth
  - Initial chemical digestion
    - Salivary amylase—starts chemical breakdown of carbohydrates
  - Formation of bolus
- Pharynx
  - Swallowing (deglutition)
- Esophagus
  - Closed except during swallowing, skeletal muscle at superior end—followed by smooth muscle

Stomach

- Expansible muscular sac—acts as reservoir for food and fluid
- Three smooth muscle layers
- Constant mixing and churning of food
- Initial digestion of proteins
  - By pepsin
    - Formed by combination of pepsinogen and HCl
- Production of intrinsic factor
  - Essential for absorption of vitamin B_{12} in the ileum
- Formation of chyme
- Absorption of small and lipid-soluble molecules

Liver

- “Metabolic factory” of the body
- Receives blood from hepatic portal vein
  - Transport of nutrients from intestine to liver
- Hepatocytes store nutrients
  - Play role in carbohydrate, protein, fat metabolism
- Production of plasma proteins and clotting factors
- Breakdown of old and damaged erythrocytes
- Bile production

Pancreas

- Exocrine pancreas arranged in lobules
- Secretes digestive enzymes, electrolytes
  - Lipase
  - Trypsin
  - Chymotrypsin
  - Carboxypeptidase
  - Ribonuclease
  - Pancreatic amylase
  - Bicarbonate ions
- Pancreatic duct joins bile duct to enter duodenum

Lower Gastrointestinal Tract

- Small intestine
  - Duodenum, jejunum, ileum
  - Villi (folds of the mucosa) and microvilli (folds of cell membranes)
    - Increase surface area for absorption
  - Major site for absorption of nutrients
  - Lacteal—lymphatic vessel
  - Site of production of:
    - Mucus
    - Enterokinase, peptidases, nucleosidases, lipase, sucrase, maltase, lactase, cholecystokinin (hormone)

Lower Gastrointestinal Tract (Cont.)

- Large intestine
  - Resident normal flora
    - Breakdown of certain food materials
    - Vitamin K synthesis by bacteria
  - Fluid and electrolyte reabsorption
  - Formation of solid feces
    - Mass movements

Neural and Hormonal Controls

- **Autonomic** – opposite from heart because in flight or fight, digestion shuts down so blood can go to muscles.
- **Parasympathetic** nervous system (PNS)
  - Primarily through vagus nerve (cranial nerve [CN] X)
    - Increased motility
    - Increased secretions
- **Sympathetic** nervous system (SNS)
  - Stimulated by factors such as fear, anger
  - Inhibits gastrointestinal activity
  - Causes vasoconstriction
  - Reduced secretions and regeneration of epithelial cells

Major Controls in the Digestive Tract and Their Effects

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

Digestion and Absorption

- Carbohydrates
  - Digestion starts in mouth
  - Followed by digestion in the small intestine
- Proteins
  - Digestion starts in stomach, continues in small intestine
- Lipids
  - Emulsified by bile prior to chemical breakdown
  - Action of enzymes form monoglycerides and free fatty acids
  - Formation of chylomicrons

Digestion and Absorption (Cont.)

- Fat-soluble vitamins
  - Vitamins A, D, E, K
    - Absorbed with fats
- Water-soluble vitamins
  - Vitamins B and C—diffuse into blood
- Electrolytes
  - Absorbed by active transport or diffusion
- Drugs are primarily absorbed in the intestine.
  - Various transport mechanisms
  - Some (e.g., aspirin) absorbed in the stomach

Digestion and Absorption (Cont.)

- Water
  - Absorbed primarily by osmosis
  - About 700 mL of water is secreted into the digestive tract each day.
  - About 2300 mL is ingested in food and fluids
  - Only 50 to 200 mL leaves the body in feces.
  - Severe vomiting or diarrhea will interrupt this recycling mechanism.
    - Affects fluid and electrolyte balance of body

Common Manifestations of Digestive System Disorders

Anorexia, Nausea, Vomiting

- May be signs of digestive disorder or other condition elsewhere in the body
  - Systemic infection
  - Uremia
  - Emotional responses
  - Motion sickness
  - Pressure in the brain
  - Overindulgence of food, drugs
  - Pain

- Vomiting (emesis)
  - Vomiting center located in the medulla
    - Coordinates activities involved in vomiting
    - Protects airway during vomiting
  - Forceful expulsion of chyme from stomach
    - Sometimes includes bile from intestine
    -
- Bulimia—eating disorder
  - Damage to structures of the GI tract caused by recurrent vomiting
    - Oral mucosa
    - Teeth
    - Esophagus

Vomiting Reflex Activities

- Deep inspiration
- Closing the glottis, raising the soft palate
- Ceasing respiration
  - Minimizes risk of aspiration of vomitus into lungs
- Relaxing the gastroesophageal sphincter
- Contracting the abdominal muscles
  - Forces gastric contents upward
- Reversing peristaltic waves
  - Promotes expulsion of stomach contents

Characteristics of Vomitus

- Presence of blood—hematemesis
  - Coffee ground vomitus—brown granular material indicates action of HCl on hemoglobin
  - Hemorrhage—red blood may be in vomitus
- Yellow- or green-stained vomitus
  - Bile from the duodenum
- Deeper brown color
  - May indicate content from lower intestine
- Recurrent vomiting of undigested food
  - Problem with gastric emptying or infection

Diarrhea

- Excessive frequency of stools
  - Usually of loose or watery consistency
- May be acute or chronic
- Frequently with nausea and vomiting when infection or inflammation develops
- May be accompanied by cramping pain
- Prolonged diarrhea may lead to dehydration, electrolyte imbalance, acidosis, malnutrition

Common Types of 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

Common Types of Diarrhea

- Steatorrhea—“fatty diarrhea”
  - Frequent bulky, greasy, loose stools
  - Foul odor
  - Characteristic of malabsorption syndromes
    - Celiac disease, cystic fibrosis
  - Fat usually the first dietary component affected
    - Presence interferes with digestion of other nutrients.
  - Abdomen often distended

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

Gas

- From swallowed air, such as drinking from a straw
- Bacterial action on food
- Foods or alterations in motility
- Excessive gas causes:
  - Eructation
  - Borborygmus
  - Abdominal distention and pain
  - Flatus

Constipation

- Less frequent bowel movements than normal
- Small hard stools
- Acute or chronic problem
- May be caused by decreased peristalsis
  - Increased time for reabsorption of fluid
- Periods of constipation may alter with periods of diarrhea.
- Chronic constipation may cause hemorrhoids, anal fissures, or diverticulitis.

Causes of Constipation

- Weakness of smooth muscle because of age or illness
- Inadequate dietary fiber
- Inadequate fluid intake
- Failure to respond to defecation reflex
- Immobility
- Neurological disorders
- Drugs (i.e., opiates)
- Some antacids, iron medications
- Obstructions caused by tumors or strictures

Fluid and Electrolyte Imbalances

- Loss of fluid and electrolytes.

- Acid-base imbalances
  - Metabolic alkalosis
    - Results from loss of hydrochloric acid with vomiting
  - Metabolic acidosis
    - Severe vomiting causes a change to metabolic acidosis because of the loss of bicarbonate of duodenal secretions.
    - Diarrhea causes loss of bicarbonate.

Pain: Visceral Pain

- Burning sensation
  - Inflammation and ulceration in upper digestive tract
- Dull, aching pain
  - Typical result of stretching of liver capsule
- Cramping or diffuse pain
  - Inflammation, distention, stretching of intestines
- Colicky, often severe pain
  - Recurrent sooth muscle spasms or contraction
    - Response to severe inflammation or obstruction

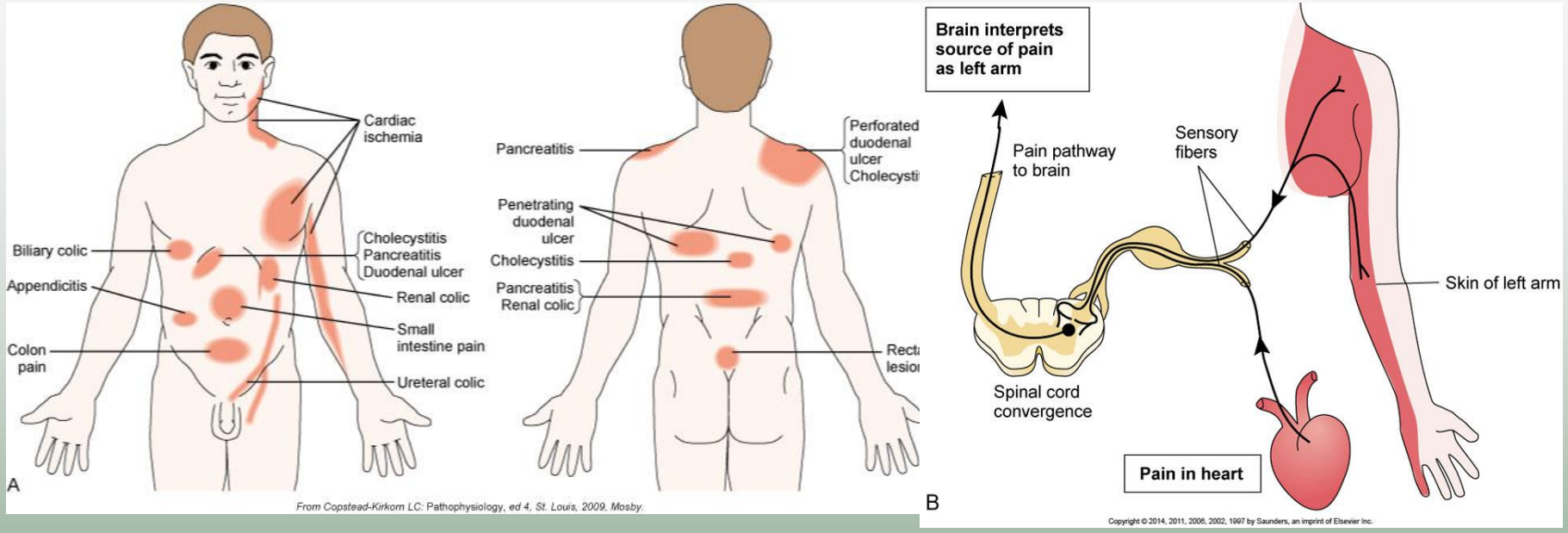
Pain: Somatic Pain

- Steady, intense, often well-localized abdominal pain
- Involvement or inflammation of parietal peritoneum
- Rebound tenderness—identified over area of inflammation when pressure is *released* (typical in acute appendiciitis

Pain: Referred Pain

- Common phenomenon
- 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.
- May assist or delay diagnosis, depending on problem

Pain: Referred Pain (Cont.)



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. Back pain: Kidneys (kidney stones).

Malnutrition

- Poor intake.
- Poor absorbption.
- Loss of nutrients.

Basic Diagnostic Tests

- Radiography
  - Contrast medium may be used.
- Ultrasound
  - May show unusual masses
- Computed tomography (CT)
- Magnetic resonance imaging (MRI)
- CT and MRI may use radioactive tracers.
  - Can be used for liver and pancreatic abnormalities

Basic Diagnostic Tests (Cont.)

- Fiberoptic endoscopy used in upper GI tract
  - Biopsy may be done during procedures.
- Sigmoidoscopy and colonoscopy
  - Biopsy and removal of polyps may be done
- Laboratory analysis of stool specimens
  - Check for infection, parasites and ova, bleeding, tumors, malabsorption
- Blood tests
  - Liver function, pancreatic function, cancer markers

Common Therapies and Prevention

- Dietary modifications
  - Example—gluten-free diet (celiac disease)
  - Reduced intake of alcohol and coffee
  - Increased fiber and fluid intake
- Stress reduction techniques
  - Stress impairs immune function and tissue healing.
- Drugs
  - Variety of medications are available.

Drugs Used in Digestive System Disorders

- Antacids and Proton pump inhibitors (PPI).
  - To relieve gastric pain.
  - Reduce gastric secretion (PPI).
- Antiemetics
  - To relieve vomiting
- Laxatives or enemas
  - Treatment of acute constipation
- Antidiarrheals
  - Reduction of peristalsis
  - Relieve cramps

Upper Gastrointestinal Tract Disorders

Disorders of the Oral Cavity

- 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


Baby with cleft lip

Disorders of the Oral Cavity

- Inflammatory lesions—aphthous ulcers
  - *Streptococcus sanguis* may be involved.
    - Part of the oral resident flora
  - Small painful lesions on:
    - Movable mucosa
    - Buccal mucosa
    - Floor of the mouth
    - Soft palate
    - Lateral borders of the tongue
  - Usually heal spontaneously

Disorders of the Oral Cavity: Infections

- Candidiasis
  - *Candida albicans*
  - Often part of the resident flora
    - Opportunistic organism
  - Oral candidiasis (thrush)
    - People receiving broad-spectrum antibiotics
    - During and after cancer therapy
    - Immunocompromised individuals or those with diabetes
  - May appear as red, swollen areas
  - May be irregular patches of a white curdlike material

Disorders of the Oral Cavity: Infections

- Herpes simplex type 1 infection
  - 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

Disorders of the Oral Cavity: Infections

- Syphilis
  - Caused by *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

Disorders of the Oral Cavity: Dental Problems

- Caries
  - *Streptococcus mutans*—initiating microbe
  - *Lactobacillus* follows in large numbers.
  - **Bacteria break down sugars and produce large quantities of lactic acid.**
  - **Lactic acid dissolves mineral in tooth enamel**
  - Tooth erosion and caries formation
  - Caries is promoted by frequent intake of sugars and acids.
  - Fluoride—anticaries treatment

Disorders of the Oral Cavity: Dental Problems (Cont.)

- Gingivitis
  - Changes in the gingivae may be a local or systemic problem.
  - Inflammation of the gingiva
    - Tissue becomes red, soft, swollen, bleeds easily
    - May be a result of accumulated plaque
  - Inadequate oral hygiene
  - Toothbrush trauma
    - Results from improper or excessive brushing
    - Creates extensive grooving on tooth surface
    - Increase plaque retention and damage to gingivae

Disorders of the Oral Cavity: Dental Problems

- Periodontal disease
  - Predisposing condition is gingivitis.
  - Involves tooth parts like roots deeper in gums and bone.
  - Treatment by a specialist – Periodontologist.

Disorders of the Oral Cavity: Dental Problems

- Hyperkeratosis
  - Leukoplakia (example)
  - 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 squamous cell carcinoma.

Cancer of the Oral Cavity

- Squamous cell carcinoma—common type
- Often develops in persons older than 40 years
  - Smokers, preexisting leukoplakia, alcohol abuse
  - Floor of the mouth, lateral borders of the tongue
  - Multiple lesions possible

Disorders of the Oral Cavity: Salivary Gland Disorders

- Sialadenitis
  - Inflammation of the salivary glands
  - May be infectious or noninfectious
  - Most commonly affected—parotid gland
- Mumps—infectious parotitis
  - Viral infection
  - Vaccine available
- Noninfectious parotitis
  - Often seen in older adults who lack adequate fluid intake and mouth care
- Most malignant tumor of salivary glands is mucoepidermoid carcinoma

Dysphagia

- Difficulty swallowing
- Causes
  - Neurological deficit
  - Muscular disorder
  - Mechanical obstruction

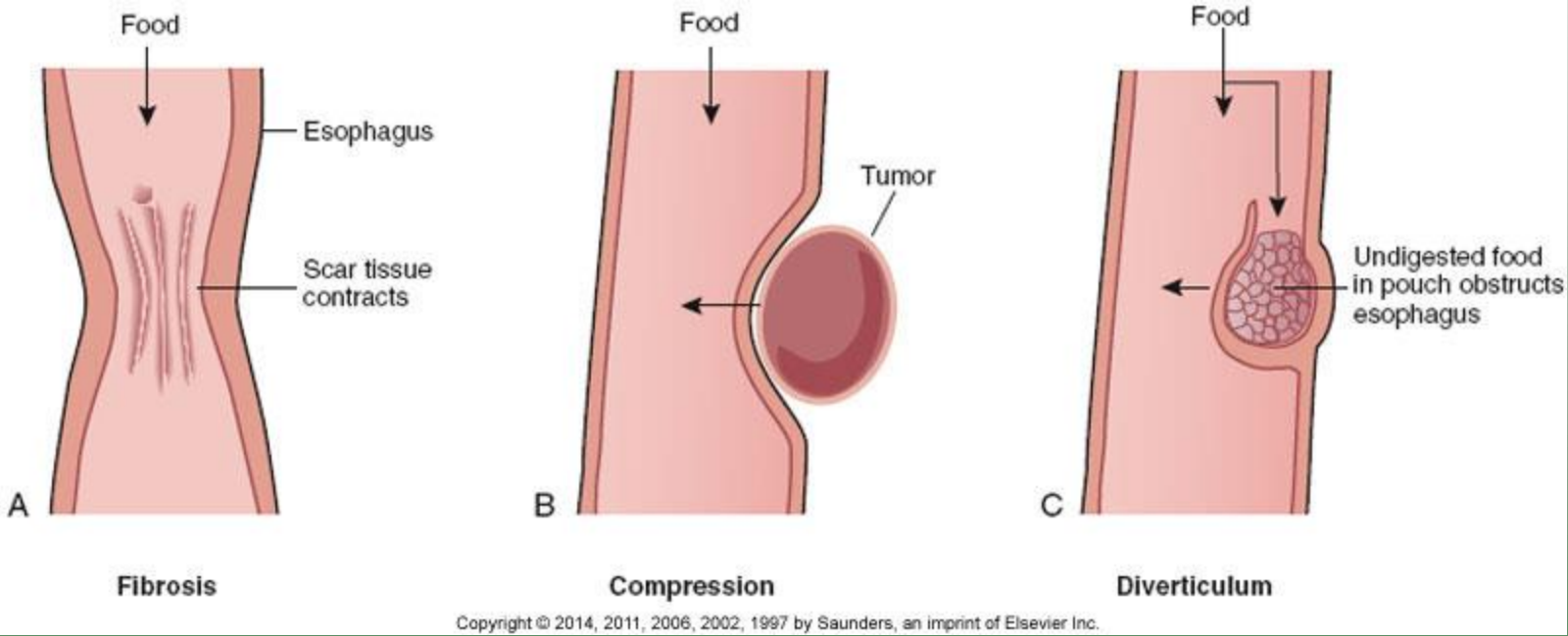
Dysphagia (Cont.)

- Mechanical obstruction
  - Congenital atresia
    - Developmental anomaly
    - Upper and lower esophageal segments are separated.
  - Stenosis
    - Narrowing of the esophagus
    - May be developmental or acquired
    - May be secondary to fibrosis, chronic inflammation, ulceration, radiation therapy
    - Stenosis or stricture may also result from scar tissue
    - May require treatment with repeated mechanical dilation

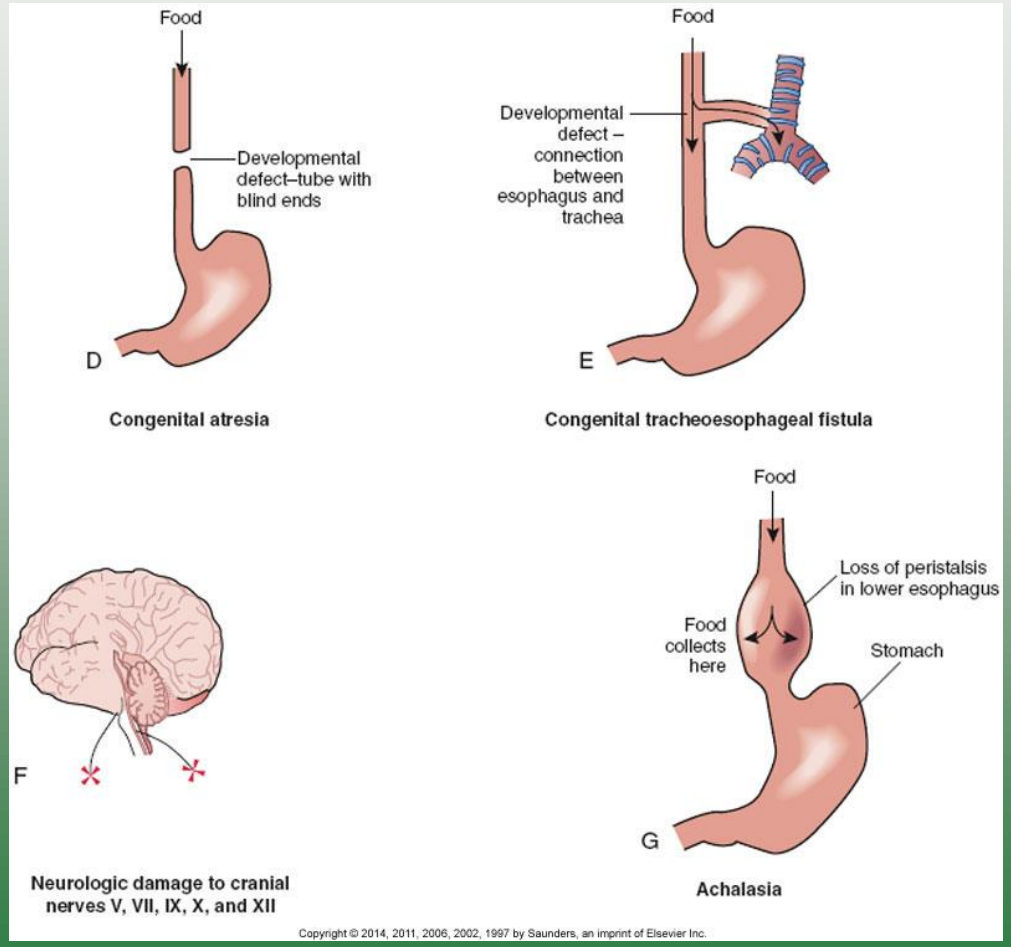
Dysphagia (Cont.)

- Mechanical obstruction (Cont.)
  - Esophageal diverticula
    - Outpouchings of the esophageal wall
    - Congenital or acquired following inflammation
    - Causes irritation, inflammation, scar tissue
    - Signs include dysphagia, foul breath, chronic cough, hoarseness
  - Tumors
    - May be internal or external

Causes of Dysphagia



Causes of Dysphagia (Cont.)



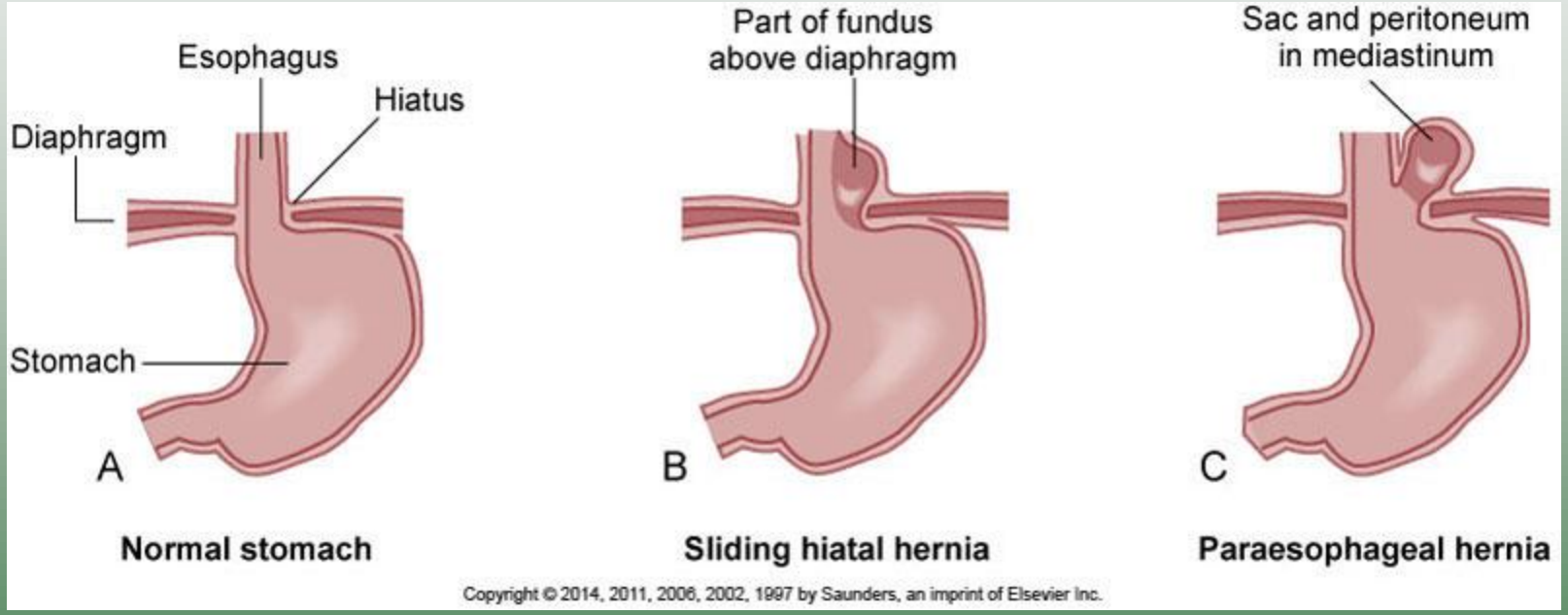
Esophageal Cancer

- Primarily squamous cell carcinoma
- Usually in distal esophagus
- Significant dysphagia in later stages
- Poor prognosis because of late manifestations
- 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.
- Sliding hernia
  - More common type
  - Portions of the stomach and gastroesophageal junction slide up above the diaphragm.
- Rolling or paraesophageal hernia
  - Part of the fundus of the stomach moves up through an enlarged or weak hiatus in the diaphragm and may become trapped.

Types of Hiatal Hernia



Hiatal Hernia (Cont.)

- Food may lodge in pouch of the hernia
  - Causes inflammation of the mucosa
  - Reflux of food up the esophagus
  - May cause chronic esophagitis
- Signs
  - Heartburn or pyrosis
  - Frequent belching
  - Increased discomfort when laying down
  - Substernal pain that may radiate to shoulder and jaw

Gastroesophageal Reflux Disease

- Periodic reflux of gastric contents into distal esophagus causes erosion and inflammation.
- Often seen in conjunction with hiatal hernia
- Severity depends on competence of the lower esophageal sphincter.
- Delayed gastric emptying may be a factor.
- Avoidance of:
  - Caffeine, fatty and spicy foods, alcohol, smoking, certain drugs
- Use of medication may reduce reflux and inflammation

Gastritis: Acute Gastritis

- Gastric mucosa is inflamed.
- May be ulcerated and bleeding
- May result from
  - 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

Gastritis: Acute Gastritis (Cont.)

- Basic signs of gastrointestinal irritation
  - Anorexia, nausea, vomiting may develop
  - Hematemesis caused by bleeding
  - Epigastric pain, cramps or general discomfort
  - With infection, diarrhea may develop.
- Acute gastritis is usually self-limiting.
  - Complete regeneration of gastric mucosa
  - Supportive treatment with prolonged vomiting
  - May require treatment with antimicrobial drugs

Gastritis: 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.

Gastritis: Gastroenteritis

- Inflammation of stomach and intestine
- Usually caused by infection
- May also be caused by allergic reactions to food or drugs
- Microbes can be transmitted by fecally contaminated food, soil, and/or water
  - Most infections are self-limiting.
  - Serious illness may result in compromised host or virulent organisms.
  - May cause epidemic outbreaks in refugee or disaster settings
  - Safe sanitation essential for prevention

Escherichia coli Infection

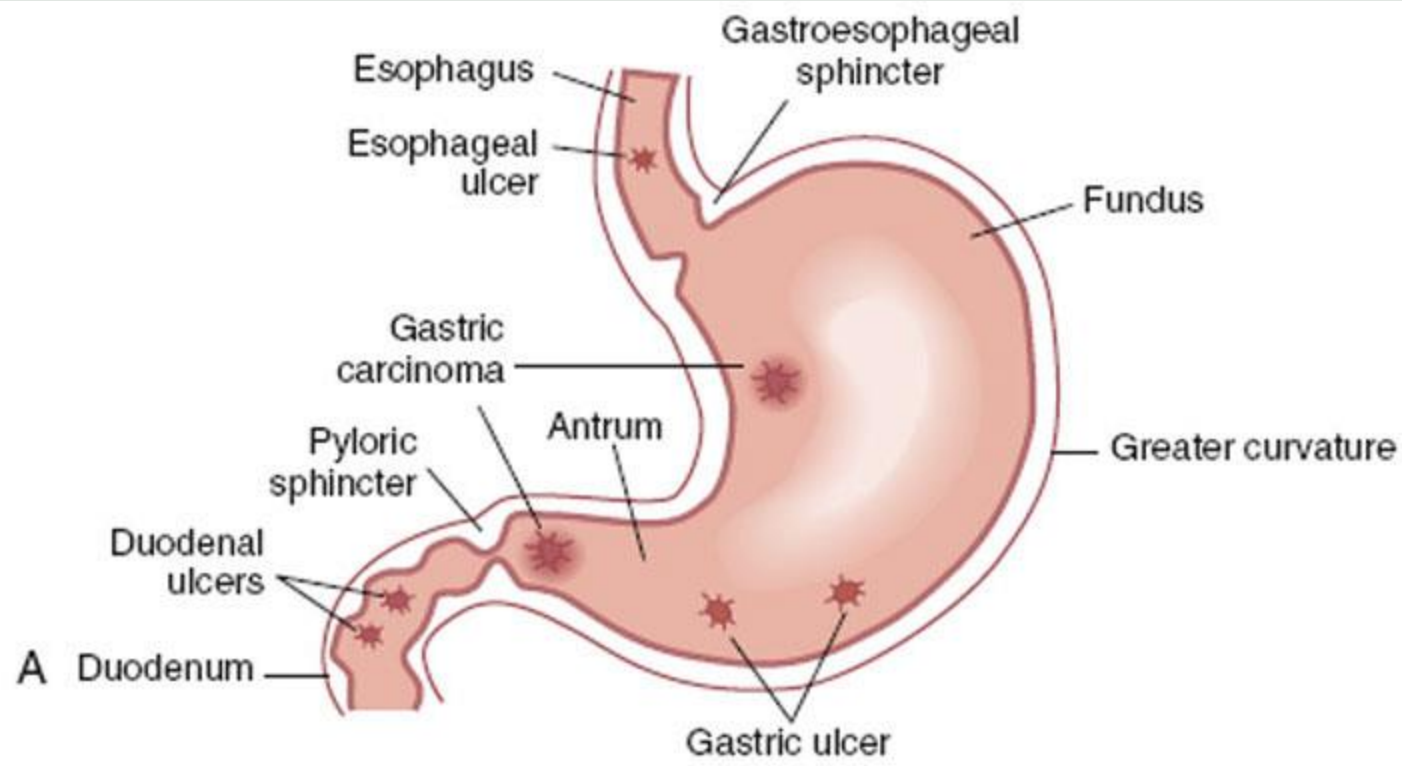
Although *E. coli* is usually harmless as a resident in the human intestine, infective strains can cause significant problems.

- 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

Peptic Ulcer: Common Locations



A. *Courtesy of RW Shaw, North York General Hospital, Toronto, Ontario, Canada.* From Cooke RA, Stewart B. *Colour Atlas of Anatomical Pathology,* ed 3, Sydney, 2004, Churchill Livingstone

Peptic Ulcer: Gastric and Duodenal Ulcers

- Damage to mucosal barrier predisposes to development of ulcers and is associated with:
  - 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
  - Excessive glucocorticoid secretion or medication
  - Ulcerogenic substances break down mucous layer.
    - **Aspirin, NSAIDs, alcohol**
  - Atrophy of gastric mucosa
    - Chronic gastritis

Peptic Ulcer: Gastric and Duodenal Ulcers

- **Increased acid pepsin secretions**
  - Increased gastrin secretion
  - Increased vagal stimulation
  - Increased sensitivity to vagal stimuli
  - Increased number of acid pepsin secretory cells in the stomach (genetic anomaly)
  - Increased stimulation of acid pepsin secretion
    - Alcohol, caffeine, certain foods
  - Interference with normal feedback mechanisms
  - Rapid gastric emptying

Peptic Ulcer: Gastric and Duodenal Ulcers (Cont.)

- Complications of peptic ulcer
  - Hemorrhage
    - Caused by erosion of blood vessels
    - Common complication
    - May be the first sign of a peptic ulcer
  - 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

Peptic Ulcer: Gastric and Duodenal Ulcers (Cont.)

- Signs and symptoms
  - Epigastric burning or localized pain, usually following stomach emptying
- Diagnostic tests
  - Fiberoptic endoscopy
  - Barium x-ray
  - Endoscopic biopsy
- Treatment
  - Combination of antimicrobial and proton pump inhibitor to eliminate *H. pylori*
  - Reduction of exacerbating factors

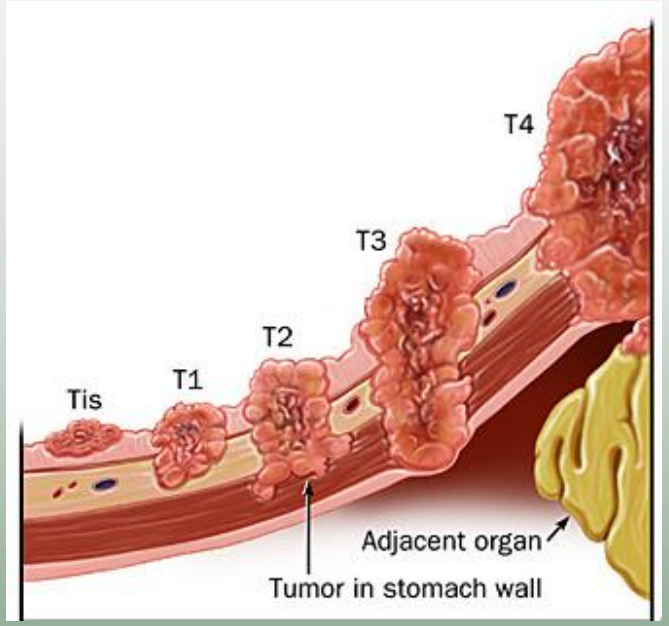
Stress Ulcers

- Associated with severe trauma or systemic problems
  - Burns, head injury
  - Hemorrhage or sepsis
- Rapid onset
  - Multiple ulcers (usually gastric) may form within hours of precipitating event
  - First indicator—hemorrhage and severe pain

END OF PART ONE – Part 2 pending editing

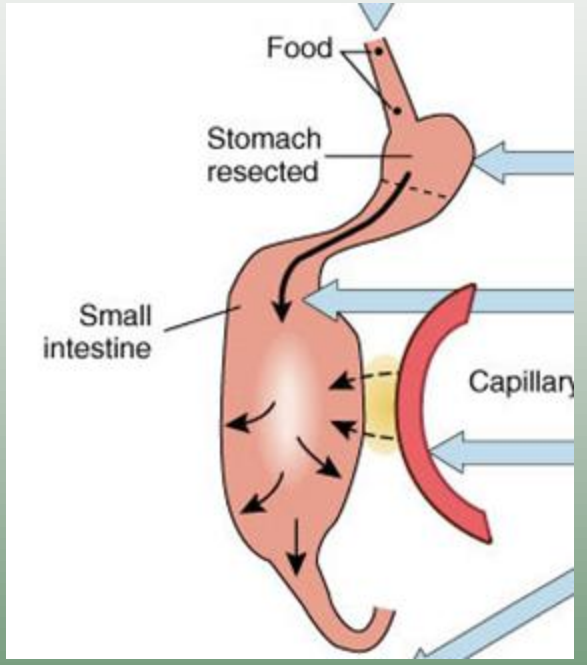
Gastric Cancer

- 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%



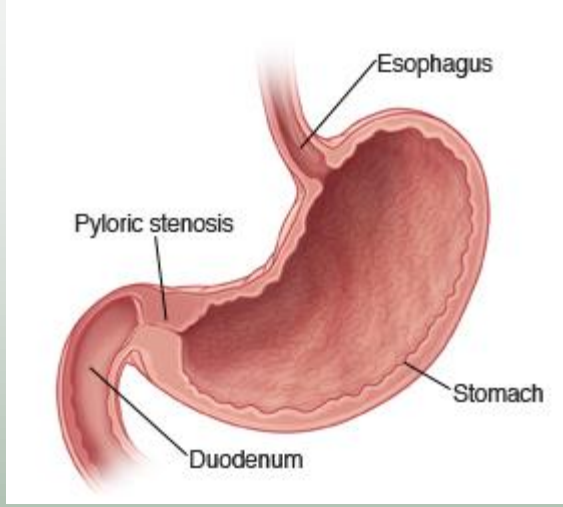
Dumping Syndrome

- 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 Stenosis

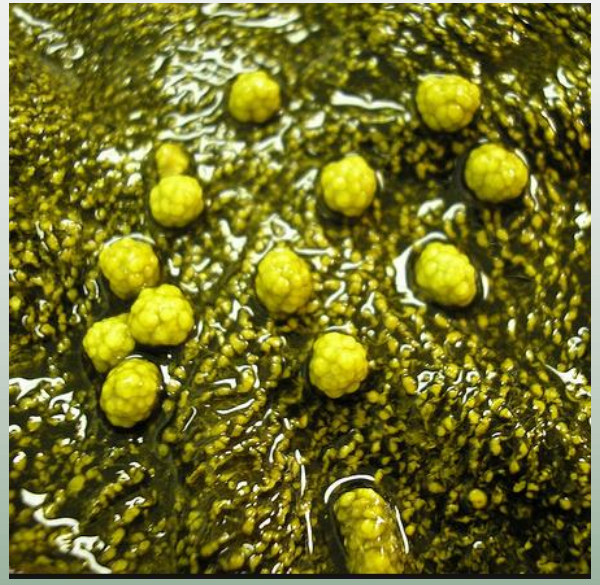
- Narrowing and obstruction of pyloric sphincter
- May be developmental anomaly
- Signs appear within several weeks after birth.
  - Projectile vomiting immediately after feeding
  - Firm mass can be palpated at pylorus.
  - Infant fails to gain weight, dehydration, persistent hunger
- Surgery required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

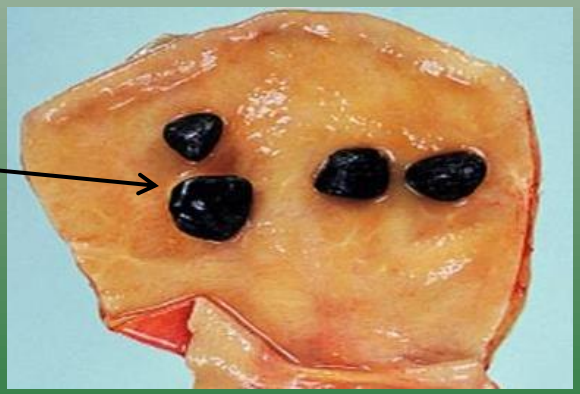


Disorders of the Liver and Pancreas

Gall Stones

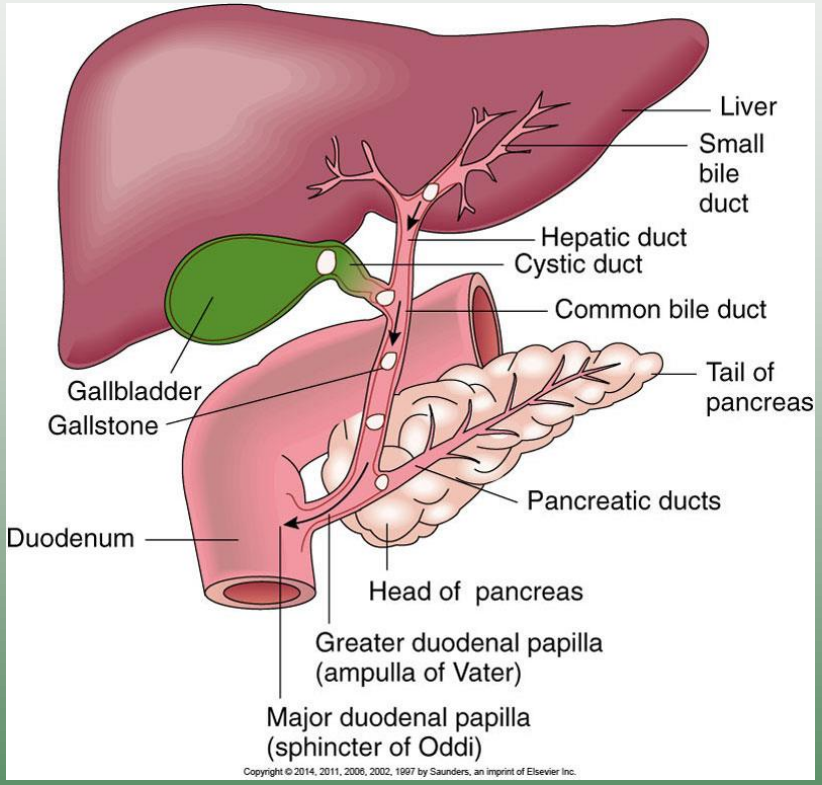
- Risk factors for gallstones
  - **Women** (2 x men)
  - **High cholesterol in bile (cholesterol stones)**
  - **High cholesterol intake**
  - **Obesity, Multiparity.**
  - Use of oral contraceptives or estrogen supplements
  - **Hemolytic anemia (bilirubin stones)**
  - Alcoholic cirrhosis
  - Biliary tract infection





Gallbladder Disorders

- 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

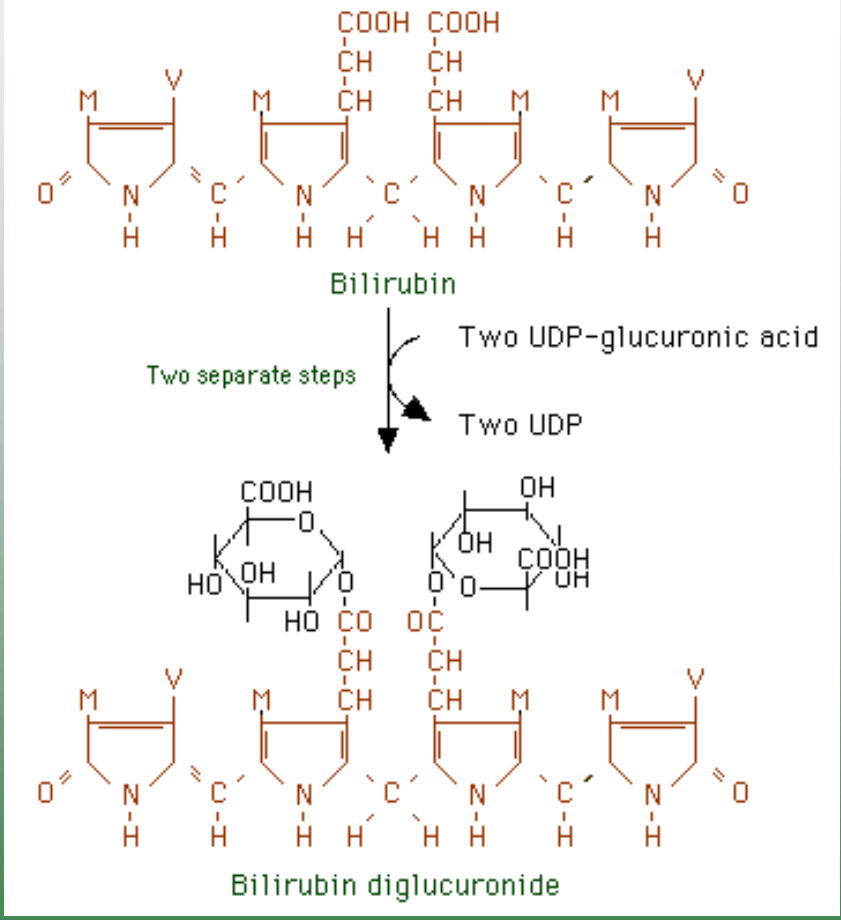


Gallbladder Disorders (Cont.)

- Obstruction of a duct by a large calculi
  - Nausea, vomiting, and sharp pain.
  - Jaundice may develop if duct blocked.
  - Surgical intervention may be necessary.
    - May be removed using laparoscopic surgery
    - Low-fat diet necessary following surgery

Bilirubin Measurement in Jaundice

- 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
    - **Rise in direct bilirubin.**

Hepatitis = Inflammation of the liver

- Alcoholic (steatohepaitis, hepatitis with fatty change).
- Viral hepatitis
  - Types A, B, C, D, E
- Chemical or drug toxicity
- Idiopathic (cause unknown).

Viral Hepatitis

- 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 state.
  - Increases risk of hepatocellular carcinoma
  - Treated with interferon injections

Viral Hepatitis: Signs and Symptoms

- Preicteric stage
  - Fatigue and malaise
  - Anorexia and nausea
  - General muscle aching
- **Icteric stage**
  - **Onset of jaundice**
  - **Stools light in color, urine becomes darker**
  - Liver tender and enlarged, mild aching pain
- Posticteric stage—recovery stage
  - Reductions in signs
  - Weakness persists for weeks

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
  - Alcoholic liver disease
  - Biliary cirrhosis
    - Associated with immune disorders, obstructed ducts.
  - Post-inflammatory or post-necrotic cirrhosis
    - Linked with chronic hepatitis or long-term exposure to toxic materials
  - Metabolic
    - Usually caused by genetic metabolic storage disorders

Cirrhosis: Alcoholic Liver Disease

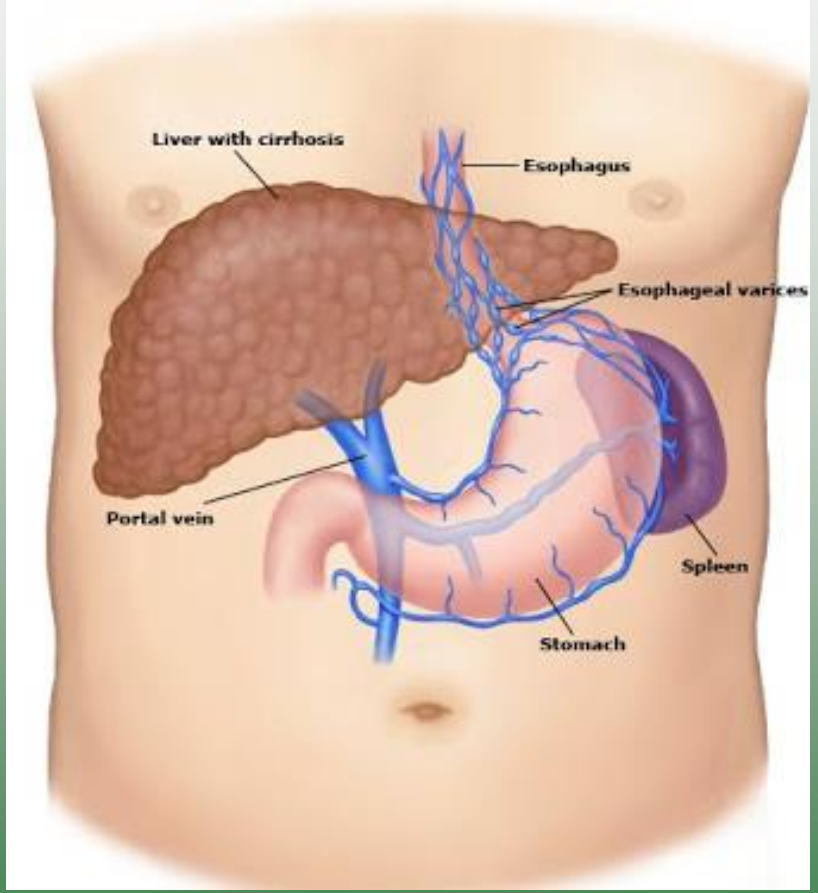
- **Initial stage—fatty liver**
  - Enlargement of the liver
  - Asymptomatic and **reversible** with reduced alcohol intake
- Second stage—alcoholic hepatitis
  - Inflammation and cell necrosis
  - Fibrous tissue formation—irreversible change
- Third stage—end-stage cirrhosis
  - Fibrotic tissue replaces normal tissue.
  - Little normal function remains.

Functional Losses with Cirrhosis

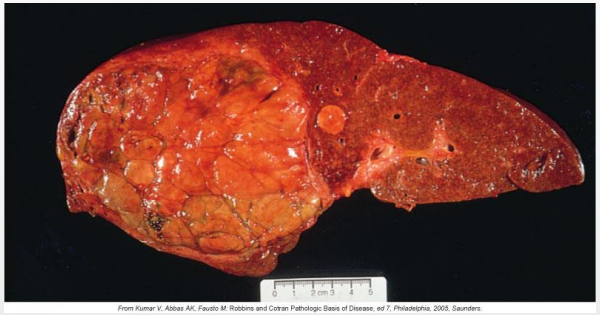
- Decreased removal and conjugation of bilirubin
- Decreased production of bile
- Impaired digestion and absorption of nutrients
- Decreased production of blood-clotting factors
- Impaired glucose and glycogen metabolism
- Impaired conversion of ammonia to urea
  - High blood ammonia is an ominous sign 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.



Liver Cancer



From Kumar V, Abbas AK, Fausto M: Robbins and Cotran Pathologic Basis of Disease, ed 7, Philadelphia, 2005, Saunders.

- 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

Acute Pancreatitis

- Diagnostic tests
  - Serum amylase levels—first rise, then fall after 48 hours
  - Hyperlipidemia.
  - Hypocalcemia
  - Leukocytosis
- Treatment
  - Oral intake is stopped.
  - Treatment of shock and electrolyte imbalances
  - Analgesics for pain relief

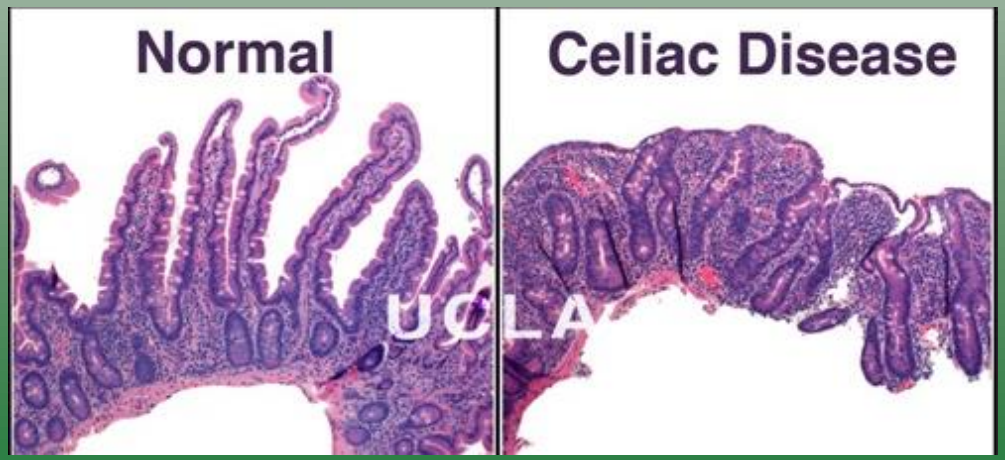
Pancreatic Cancer

- 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%.

Lower Gastrointestinal Tract Disorders

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

- Crohn's disease and ulcerative colitis are chronic inflammatory bowel diseases (IBDs).
- Causes unknown
- Genetic factor appears to be involved.
- Crohn's disease—often during adolescence
- Ulcerative colitis—second or third decade
- Many similarities between Crohn's disease and ulcerative colitis

Inflammatory Bowel Disease

Characteristic	Crohn's Disease	Ulcerative Colitis
Region affected	Terminal ileum, sometimes colon	Colon, rectum
Distribution of lesions	Transmural, all layers	Mucosa only
	Skip lesions	Continuous, diffuse
Characteristic stool	Loose, semi-formed	Frequent, watery, with blood and mucus
Granuloma	Common	No
Fistula, fissure, abscess	Common	No
Stricture, obstruction	Common	Rare
Malabsorption, malnutrition	Yes	Not common

Remember:

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 of IBD

- Anti-inflammatory medications
- Antimicrobials
- Cytotoxic agents in serious cases.
- Surgical resection
  - When Chron's segments cause obstruction.
  - Colectomy when Ulcerative colitis is intractable or if dysplasia is detected (dysplasia is widespread and heralds cancer).

Irritable Bowel Syndrome (IBS): Manifestations and Diagnosis

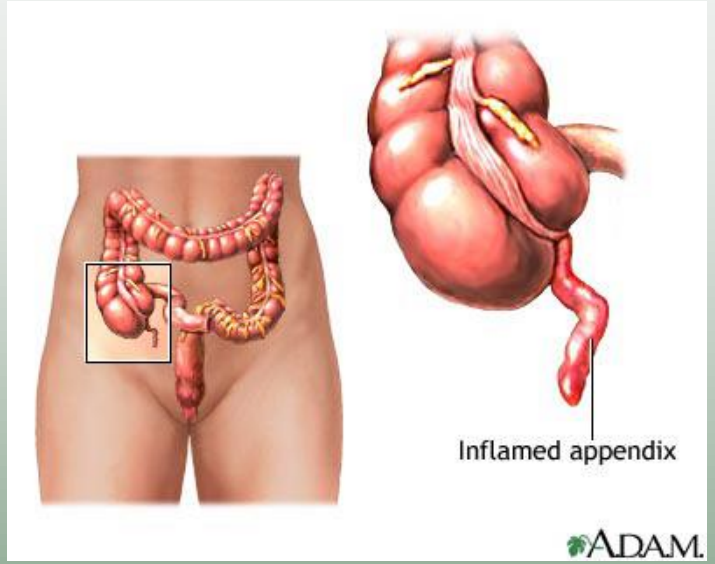
- Manifestations
  - Lower abdominal pain
  - Diarrhea
  - Constipation, alternating with diarrhea
  - Bloating, nausea
- Diagnosis
  - Based on signs and symptoms
  - Testing for food allergies
  - Testing for bacterial or parasitic infections
  - No single cure for IBS

Irritable Bowel Syndrome

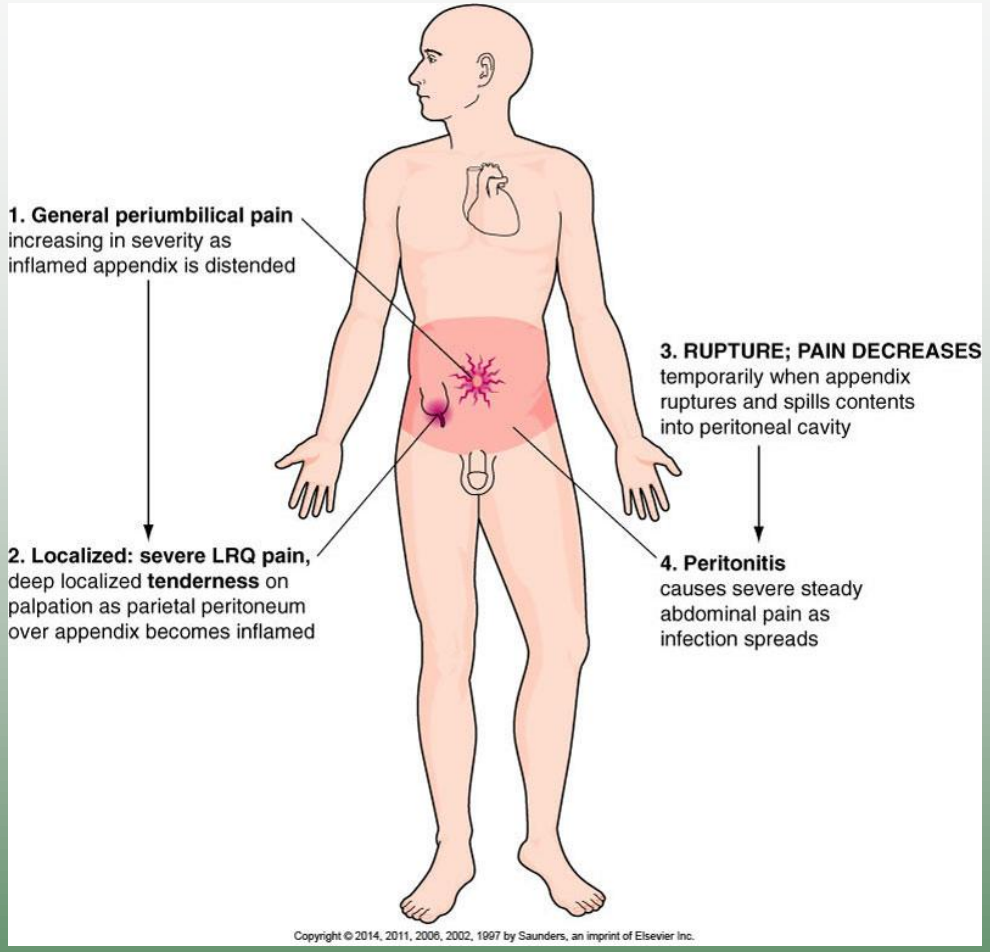
- Types
  - Abnormal gastrointestinal mobility and secretion
  - Visceral hypersensitivity
  - Postinfectious IBS
  - Overgrowth of flora
  - Food allergy or intolerance
  - Psychosocial factors

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
  - May result in perforation.



Typical Progression of Pain in Acute Appendicitis



Remember: Nausea, vomiting and generalized abdominal pain progressing to point tenderness in right lower quadrant with rebound tenderness.

Diverticular Disease

- Development of diverticula
- Diverticulum
  - Outpouching (herniation) of the mucosa through the muscular layer of the colon
- Diverticulosis
  - Asymptomatic diverticular disease
- Diverticulitis
  - Inflammation of the diverticula

Colorectal Cancer

- Most malignancies develop from adenomatous polyps.
- Early diagnosis is essential.
- Cancer occurs primarily in persons older than 50 years.
- Risk factors
  - Familial multiple polyposis
  - Long-term ulcerative colitis
  - Genetic factors
  - Environmental factors
    - Diet low in fiber

Colorectal Cancer (Cont.)

- Initial signs depend largely on the location of the growth.
- General signs
  - Change in bowel habits
    - Alternating diarrhea and constipation
  - Bleeding
  - Fatigue, weight loss, anemia
- Treatment
  - Surgical removal with radiation and/or chemotherapy

Intestinal Obstruction

- Lack of movement of intestinal contents through the intestine
  - More common in small intestine
- Mechanical obstructions
  - Result from tumors, adhesions, hernias, other tangible obstructions
- Functional or adynamic obstructions
  - Result from impairment of peristalsis
    - Spinal cord injury
    - Paralytic ileus caused by toxins or electrolyte imbalance

Intestinal Obstruction

- Gases, fluids and solids build up proximal to the obstruction.
- Can distend the intestine to the point of rupture.
- Small breaks in wall can lead to peritonitis.
- Stagnation can lead to bacterial overgrowth and sepsis (bacteria in blood stream).

- Treatment – to alleviate the obstruction. Often a medical emergency.

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

Peritonitis (Cont.)

- Bacterial peritonitis caused by:
  - Direct trauma affecting the intestine
  - Ruptured appendix
  - Intestinal obstruction and gangrene
- Any abdominal surgery
  - If foreign material is left or infection develops
- Pelvic inflammatory disease in women
  - When infection reaches the cavity through fallopian tubes

Peritonitis (Cont.)

- Signs and symptoms
  - Sudden, severe, generalized abdominal pain
  - Localized tenderness at site of underlying problem
  - Vomiting common, abdominal distention
  - Dehydration, hypovolemia, low blood pressure
  - Decreased blood pressure, tachycardia, fever, leukocytosis
- Treatment
  - Depends on primary cause
  - Surgery might be required.
  - Massive antimicrobial drugs—specific to causative organism

END OF PART TWO