Chapter 23: The Digestive System

I. OVERVIEW

Consists of alimentary canal and accessory organs. GIT (gastrointestinal tract) and teeth, tongue, gallbladder, salivary glands, liver and pancreas.

(A) Digestive Processes

Ingestion; propulsion (swallowing and peristalsis); mechanical digestion-chewing, churning, segmentation; chemical digestion- requires enzymes; absorption- into blood or lymph; defecation.

(B) Basic Concepts

GIT (gastrointestinal tract) lumen “outside of body”- a tube within a tube. Processes triggered by mechanical and chemical stimuli. Intrinsic and extrinsic controls; short vs. long (involve CNS) reflexes. Many hormones.

(C) Relationships between Organs

Most contained within peritoneum. Visceral and parietal layers with fluid between. Its mesentaries attach organs to body wall, hold vessels and fat too. A few structures retroperitoneal. Inflammation = peritonitis.

Blood via splanchnic circulation.

GIT wall layers: mucosa; submucosa; muscularis; serosa = visceral peritoneum. Internal and external NS- linked to the ANS.

II. FUNCTIONAL ANATOMY

(A) Mouth and Associated Organs


-3- Salivary glands - intrinsic and extrinsic: parotids (infected by mumps); submandibular; sublingual. Mucous and serous secretions. 

Saliva: mostly water, electrolytes, amylase and lipase, mucin, lysozyme, IgA, urea, uric acid. Antimicrobial. 1000-1500 ml/ day. Parasympathetic stimulation.


(B) Pharynx
Food moves into oro- and laryngopharynx.

(C) Esophagus
Approximately 25cm long. Heartburn = GERD (gastro-esophageal reflux disease). Common with hiatal hernia (stomach above diaphragm). Linked to cancer.

(D) Digestion through the Esophagus
Mastication (chewing); deglutition (swallowing)- buccal phase voluntary; peristalsis.

(E) Stomach
Bolus becomes chyme.

-1- Gross anatomy: 6-10" long, holds ~4L. Lined with rugae.
Cardiac, fundic, body and pyloric regions, with sphincter. 
Greater and lesser curvatures. 
Its mesentaries = lesser & greater omentum.

-2- Microscopic anatomy: additional oblique muscular layer. 
Lining of mucous cells with gastric pits, lead into glands.

Glands contain mucous cells, 
parietal (HCl, intrinsic factor for B12 absorption) cells, 
chief cells (pepsinogen) and 
enteroendocrine (hormones & paracrines) cells.

Wall protected by mucosal barrier: bicarbonate; tight junctions; quick replacement by stem cells.

Peptic (gastric in stomach) ulcers linked to H. pylori.

-3- Digestive processes: mechanical and chemical digestion. 
HCl & pepsin, rennin in infants. Some lingual lipase action. 
Absorption of alcohol, aspirin…..

Regulation: cephalic → gastric → intestinal phases.
Alkaline tide as Cl- switched with HCO3-.
Stomach usually empties within four hours. 
Carbohydrates faster, fats slower. 
Emetic center in medulla induces reverse peristalsis.

(F) Small Intestine & Associates

-1- Small Intestine: Between pyloric sphincter and ileocecal valve. 2-4m long.

Duodenum; jejunum; ileum. 
Lined with plicae circularis, villi, microvilli = brush border, with enzymes. 
Enhances surface area. 
Goblet cells, 

intestinal crypts (of Lieberkuhn)- produces intestinal juice, enteroendocrine cells, T Cells and Paneth cells (immunological). 

Peyer’s Patches = lymphoid follicles. Duodenal (Brunner’s) Glands- alkaline mucous.
-2- Liver & Gallbladder:
Liver with many functions, produces bile for digestion.
Largest gland.
Traditionally, lobes separated by surface features.
Its common bile duct merges with gallbladder cystic duct, converge into bile duct.

Hexagonal lobules with plates of hepatocytes.
Central vein, portal triads peripherally-
each with a hepatic artery, hepatic portal vein branch and bile duct.
Liver sinusoids between plates.
Kupffer cells (macrophages) along walls.

Hepatocytes produce bile and process nutrients.
Store glycogen, fat metabolism, store vitamins, produce plasma proteins, detoxify.
Bile travels through canaliculi, opposite direction from blood.

Six versions of hepatitis, all viral. Some chronic.
May lead to cirrhosis, also linked to alcohol abuse.
Liver becomes fatty and fibrous.

Bile- alkaline with bile salts and pigments, cholesterol, triglycerides & phospholipids.
Emulsification done by bile salts and phospholipids.
Bile salts recycled by enterohepatic circulation.
Main pigment is bilirubin.

Gallbladder stores and concentrates bile.
Crystallized cholesterol produces gallstones = biliary calculi.

-3- Pancreas: juice into pancreatic duct, fuses with bile duct, leads to duodenum.
Acinar cells produce enzymes.
Juice with water, enzymes, electrolytes (mostly HCO3).
Inactive proteases, amylase, lipases, nuclease.

CCK from small intestine increases bile and pancreatic secretion.
3-6 hours in small intestine.
Segmentation increases contact between contents and secretions.

(G) Large Intestine: 7cm diameter, 1.5m long.
Ribbon-like teniae coli;
haustra (pouches);
epiploic appendages (fat).
Cecum with vermiform appendix → ascending, transverse, descending, sigmoid colon → rectum → anus.

Bacterial flora ferments undigested carbohydrates, produces acid and gas, vitamins.

12-24 hours in large intestine.
Water and electrolyte reabsorption.
Mass movements → elimination of feces.

Diverticulitis = inflammation of pouches.
Irritable Bowel Syndrome – stress related.
External anal sphincter voluntary. Enhanced with valsalva maneuver.

Diarrhea, constipation = alterations in timing, effects amount of reabsorption.

**III. PHYSIOLOGY OF DIGESTION & ABSORPTION**

**(A) Chemical Digestion**

Involves hydrolysis.
Production of monosaccharides via amylases and other enzymes.
Lactose intolerance due to ineffective lactase.
Most polysaccharides, except for starch and some glycogen, undigestible.

Proteins → amino acids with pepsin, rennin (infants), trypsin, chymotrypsin, peptidases.

Most fats are triglycerides, digested with lipases.
Coated with bile salts for emulsification, → fatty acids and monoglycerides.

Nuclease for DNA and RNA.

**(B) Absorption**

Most from small intestine.
Active transport (most), some facilitated diffusion, cotransport.
Absorption of whole proteins via endocytosis, associated with food allergies.
Fats accumulate as micelles → chylomicrons in intestinal cells → lipoproteins in blood.

Gluten malabsorption causes celiac disease.