Digestive System Chapter 22

Digestive System

= Gastrointestinal (GI) tract or _____plus accessory organs

Module 22.1: Overview of the Digestive System

INTRODUCTION

Digestive system

- breaks down food into nutrients that can be absorbed by bloodstream and delivered to body cells in useable form
- = GI tract or alimentary canal and _____
- Alimentary canal
 - continuous tube consisting of _____(mouth), pharynx,

esophagus, stomach, small intestine, and _____

- Accessory organs
 - located around alimentary canal and assist in digestion in someway
 - include teeth, tongue, salivary glands, liver, _____

BASIC DIGESTIVE FUNCTIONS AND PROCESSES

Functions:

- 1. _____, break it down into its component nutrients to be used by body cells
- 2. _____, and acid-base homeostasis
- 3. Ingest vitamins and minerals, produce hormones, excrete wastes
- Main processes include:
 - 1. Ingestion bring food and water into month
 - 2. Secretion -mucus, enzymes, acid, and hormones
 - 3. _____ via peristalsis
 - 4. Digestion mechanical and chemical
 - 5. ______ through wall of alimentary canal into blood or lymph

6. **Defecation** – eliminate waste products

REGULATION OF MOTILITY BY NERVOUS AND ENDOCRINE SYSTEMS

Motility - key process in every region of alimentary canal

- Oral cavity, pharynx, superior esophagus, and last
 portion of L.I. -
- Remainder of alimentary canal _____

Types: mixing & churning, propulsion

Regulation:

1. Nervous ANS: SNS inhibits

PSN stimulates

2. Endocrine hormones – stimulate or inhibit

HISTOLOGY OF THE ALIMENTARY CANAL

- _____ = concentric layers of tissue surround a space
- 4 main layers:
 - 1. _____- epithelium
 - 2. Submucosa CT
 - 3. **Muscularis externa** smooth muscle
 - 4. Serosa (or_____) CT & epithelium
- Mucosa:
 - a. epithelium _____ or stratified squamous goblet cells → mucus
 - b. lamina propria CT
 - c. muscularis mucosae SMC

- dense irregular CT, with blood vessels and submucosal glands

submucosal plexus (Meissner's plexus)
 regulate secretions

- Muscularis externa
 - inner circular SMC

- outer longitudinal SMC

____(Auerbach's plexus)

regulate motility

- Serosa = ____
 - within peritoneal cavity
 - simple squam. epithelium & loose CT

or

- Adventitia
 - outside peritoneal cavity
 - dense irregular CT

ORGANIZATION OF ABDOMINOPELVIC ORGANS

- Peritoneal membranes:
 - Outer parietal peritoneum
 - < peritoneal cavity- serous fluid>
 - Inner visceral peritoneum (serosa)
- Mesenteries
 - Folds of visceral peritoneum between loops of intestines
 - "fatty apron" : hangs from base of stomach
 - Lesser Omentum : lesser curvature of stomach to liver



Peritonitis

Peritonitis = inflammation of peritoneum

• Results when blood or contents of an abdominal organ leak into peritoneal cavity; usually due to *trauma*; often involves a bacterial infection

•

• Treatment for peritonitis may involve

Module 22.2: THE ORAL CAVITY, PHARYNX, AND ESOPHAGUS

INTRODUCTION

Oral cavity (mouth)

-

- posterior to teeth and bounded by cheeks
- lined with stratified squamous nonkeratinized epithelial.
- beginning of alimentary canal
- accessory organs: ______
- forms = saliva and chewed food

STRUCTURE OF ORAL CAVITY

- Cheeks:
- Lips:
 - orbicularis oris muscle and covered with ______
 - labial frenulum
- Vestibule space between lips, cheeks and gums
- Gums _____
- Palate:

hard palate (ant. 2/3) = _____

soft palate (post. 1/3) = skeletal muscle

_____ – prevents food from entering nasal cavity

TEETH AND MASTICATION

Teeth

- organs of mechanical digestion
- Mastication to increase surface area of food
- Teeth located in bony sockets called alveoli maxilla and mandible
- Dentition Formula: 3 2 1 4 1 2 3
 - 3 tricuspids (molars)
 - 2 bicuspids (premolars)
 - 1 cuspids (canines)
 - 4 incisors

- Secondary dentition (32 permanent teeth)
- Tooth structure
- _____ above gum line
 - Enamel hard mineralized substances
 - Dentin
 - _____ below gum line
 - Pulp blood vessels, nerves

TONGUE

Tongue

- skeletal muscle covered w/ stratified squamous epithlial
- lingual frenulum _____
- Papillae:
 - 1. _____
 - 2. fungiform
 - 3. circumvallate
 - 4. foliate papillae
- All papillae <u>except</u> filiform contain sensory receptors called **taste buds**

SALIVARY GLANDS

Salivary glands -> saliva contains water, enzymes, mucus, and other solutes

1. _____ (25-30% of saliva)

\rightarrow parotid duct

- located over masseter muscle

2. _____ (65-70%)

ightarrow submandibular ducts

- located along mandible

3._____(5%)

ightarrow sublingual ducts

- situated inferior to tongue

Saliva

- -____, initiates CHO digestion
- Lysozyme an enzyme that kills bacteria
- IgA antibody that destroys pathogens
- Bicarbonate to neutralize acid
 - Parotid glands \rightarrow water and enzymes
 - Submandibular glands \rightarrow secrete enzymes, mucus
 - Sublingual glands \rightarrow secretes mainly mucus, some enzymes.

• Functions of Saliva:

Moistening, lubricating, and cleansing oral mucosa

- Lysozyme and IgA deter growth of bacteria
- digestion by moistening and mixing ingested food into a bolus so it can be swallowed
- _____ digestion by salivary amylase
- ______ in water of saliva to stimulate taste receptors on tongue

PHARYNX

Common passageway for 2 systems:

- extends from internal nares \rightarrow _____

Pharynx (throat)

- nasopharynx
- oropharynx
- laryngopharynx

Function of pharynx

_____ - bolus passes into esophagus

 Pharynx is surrounded by three pairs of skeletal muscles: upper, middle, and lower pharyngeal constrictor muscles

TONSILS

Tonsils - defend body from pathogens that have entered nasal or oral cavities

- 1. _____ tonsils
 - posterior oral cavity on either side of tongue
- 2. _____ tonsils
- located under base of tongue
- 3. _____ tonsils
 - located on posterior wall of nasopharynx

ESOPHAGUS

- Esophagus
 - muscular tube about 25 cm (10 in.) long
 - posterior to trachea
 - transports bolus from pharynx to stomach
 - mucosa: lined with _____
 - muscularis: superior 1/3 skeletal middle 1/3 skeletal & SMC inferior 1/3 _____

Upper esophageal sphincter

- junction of pharynx and esophagus
- modified sphincter

Gastroesophageal sphincter (aka_____LES or cardiac sphincter)

- regulates passage of bolus into stomach; also prevents reflux

_____ - opening in diaphragm

- Primary functions of esophagus are ______
- During swallowing, skeletal muscle and smooth muscle of muscularis undergo
- Thick esophageal epithelium protects esophagus from *abrasion* by food, also
 <u>prevents</u> *absorption*

SWALLOWING OR DEGLUTITION

Swallowing or ____

- specialized type of propulsion that pushes bolus of food from oral cavity through pharynx and esophagus to stomach
 - 1. Voluntary phase tongue pushes bolus posteriorly toward oropharynx
 - 2. _____ bolus enters oropharynx
 - soft palate and epiglottis seal off nasopharynx and larynx
 - swallowing reflex initiated by medulla
 - all structures (uvula, larynx) move up and epiglottis depresses
 - 3. _____ peristaltic waves move bolus down esophagus to stomach

Module 22.3: THE STOMACH

GROSS ANATOMY OF STOMACH

Anatomy

greater curvature - convex left side

lesser curvature - concave right side

5 regions:

Cardia - receives bolus when LES relaxes

Fundus – upper left domed-shaped

_____ – largest section

Pyloric antrum - inferior portion

_____ – connects with duodenum via pyloric sphincter

Rugae = _____

- same four tissue layers as rest of alimentary canal with modifications:

	- Muscularis externa: additional inner layer of oblique smooth muscle
С	hyme –
•	Mucosa-indentations to form
	Goblet cells
	Gastric glands, found at base of gastric pits
	 contain both endocrine cells that secrete hormones and acidic,
	enzyme-containing fluid called gastric juice
	4 main cells types:
	1 cells \rightarrow hormones
	G cells secrete hormone gastrin stimulates secretions

2. _____ pepsinogen

- precursor to enzyme **pepsin** which begins protein dig.

- hydrochloric acid (HCI) 3. _____
 - → intrinsic factor (req. for absorption of vitamin____)
- 4. Mucous neck cells secrete acidic mucus

FUNCTIONS OF STOMACH

HISTOLOGYOFSTOMACH

Stomach

Gastric secretions:

HCI

<u>Mucus</u>

Necessary to convert pepsinogen to pepsin from goblet cells & mucus glands

<u>Pepsinogen</u>

Intrinsic factor

from parietal cells

inactive form of pepsin

req. for Vit. B12 absorption

<u>Pepsin</u>

protein splitting enz. ٠

Regulation of Gastric Secretions:

- 1. (30 40%)
 - triggered by sight, smell, taste, or thought of food
 - PSN (Vagus n.) triggers gastric juice secretion
- 2.____(50 60%)

triggered by food in stomach

- gastrin released
- gastric juice secreted

3.____(~5%)

- triggered by food moving into S.I.
- intestinal gastrin released \rightarrow secretion of gastric juice



- Gasuoesophageal sphincter normally closed except during swallowing: When this mechanism fails, acid from stomach regurgitates into esophagus
- If chronic, it is called gastroesophageal reflux disease, or GERD, and may lead to ٠ pain, difficulty swallowing, vocal cord damage, respiratory problems, and even esophageal cancer
- Multiple factors contribute
- Helicobacter pylori
- Treatment

Enterogastric reflex

- as chyme enters duodenum, declining pH (more acidic) and presence of lipids trigger enterogastric reflex
- \rightarrow decreases vagal activity and reduces acid secretion \rightarrow _____

Emptying function

- Liquids move rapidly
- Solids must be converted to a *nearly liquid* state before entering S.I.
- → delays gastric emptying
- Duodenum needs to process incoming chyme



Vomiting

- Occasionally stomach contents move *backward*, an unpleasant process known as vomiting (emesis)
- Involves a complex motor response during which SMC of stomach and SI *relaxes* while abdominal skeletal muscles and diaphragm *contract* to increase intraabdominal pressure
- In addition, upper and lower esophageal sphincters *relax*, soft palate *closes off* nasopharynx, and larynx *elevates* so that epiglottis covers glottis
- Can be a response of variety of stimuli:
- Stimuli activate sensory components of Vagus nerve
- Drugs that treat vomiting are known as ______

Module 22.4: THE SMALL INTESTINES

INTRODUCTION

Small intestine (small bowel)

- 6 meters long (~20 feet)
- secretion, digestion, absorption, and propulsion

3 regions:

1. Duodenum

- ~25 cm, retroperitoneal, "C" shaped
- Major duodenal papilla ______
- Duodenal (Brunner's) glands →

2. Jejunum

- middle segment
- ~ 2.5 meters (7.5 feet) in length

3. lleum

- final segment, is also intraperitoneal
- ~ 3.6 meters (10.8 feet) in length

STRUCTURE AND FUNCTIONS OF SMALL INTESTINE

Increased surface area for absorption ~400 to 600x:

1. Circular folds or _____

- mucosa and submucosa of S.I.

- _____ to give **enterocytes** (S.I. cells)

more time to absorb nutrients

2. Villi

layer of enterocytes surrounding blood capillaries and lymphatic vessel

(_____)

3. Microvilli _____

- Modification of plasma membrane of enterocytes

MOTILITY OF SMALL INTESTINE

• Types of movement:

Peristalsis

Segmentation



Appendicitis

- Small size of appendix and fact that it is blind-ended cause it to occasionally become blocked, generally by fecal matter
- Bacteria within feces *multiply* in appendix and cause infection; results in *inflammation*, a condition known as appendicitis
- Signs and symptoms
- Requires <u>immediate</u> treatment
- Can lead to _____

Module 22.5: THE LARGE INTESTINE

INTRODUCTION

Large intestine (large bowel)

- ~1.5 meters (5 feet) long
- receives material from S. I. not digested or absorbed
- _____ (mucus), propulsion, defecation
 - _____ and electrolytes
- bacteria mfr. Vitamins

GROSS ANATOMY OF LARGE INTESTINE		
L. I. = Cecum, Colon (ascending, transverse, descending, sigmoid), rectuCecum	m, anus	
 vermiform appendix contains <i>lymphatic nodules</i> – <i>right side</i> 		
 – left side Sigmoid colon 		
Rectum Rectal valves - horizontal folds to hold feces in Anal canal		
External anal sphincter –		
HISTOLOGY OF LARGE INTESTINE		
Histological features: - Mucosaand its cells lack - Many goblet cells -> protective and lubricating mucus - Taeniae coli = - Haustra = pockets or saccules - Epiploic appendages =		
BACTERIA IN LARGE INTESTINE		
Normal flora (gut flora) ~ 500 different bacterial species that have symbiotic () relationship	
- Produce Vit. K ()		
- Metabolize undigested materials		
- Deter growth of pathogens		
- Stimulate immune system		

MOTILITY OF LARGE INTESTINE AND DEFECATION

• Diarrhea

- _____, not have enough time to absorb water → produces watery feces

Constipation

- motility_____, too much water absorption and fecal material becomes hard

PANCREAS, LIVER, AND GALL BLADDER

INTRODUCTION

- Pancreas, liver, and gallbladder
 - accessory organs

_____secrete a product into a duct to outside of body

PANCREAS

Pancreas – both endocrine and exocrine functions

- Hormones (pancreatic islets: beta & alpha cells)
 - insulin (_____)
 - glucagon (_____)
- Pancreatic juice (exocrine) *enzymes* secreted by ______
- Pancreas
 - left upper quadrant of abdomen
 - 3 regions: _____
 - Pancreatic duct & accessary duct
- Pancreatic juice
 - Bicarbonate ions

- Pancreatic amylase
- Pancreatic lipase
- Trypsin, chymotrypsin, carboxypeptidase
- Nucleases

Hormonal stimulation of Pancreas & other target tissues

- Cholecystokinin (CCK) (duodenum)
 - Inhibits gastric glands
 - Stim. G.B. to release bile
- Secretin (duodenum)
 - Increases bile production in Liver
- GIP –

LIVER AND GALLBLADDER

Liver

- covered by thin CT capsule
- 4 lobes: **right, left,** _____
- falciform ligament separates right and left lobes
- round ligament: remnant of umbilical vein
- Liver lobule
- basic unit of liver
- composed cords of **hepatocytes** arranged around a central vein \rightarrow
 - hepatic v. \rightarrow IVC
- hepatic sinusoids drain _____

Functions of liver

- Hepatocytes → _____
 - Nutrient metabolism
 - Detoxification detoxifies substances produced by body, and substances that we eat or drink

<u>directly</u> excretes bilirubin in bile, antibiotics and other substances liver processes

Gallbladder

- small sac on posterior liver
- CCK triggers contraction of SMC causing release bile into
- Cystic duct joins with common hepatic duct \rightarrow _____
- -> hepatopancreatic ampulla through hepatopancreatic (h-p) sphincter
- CCK causes_____of G.B. – Relaxation of h-p sphincter
- Secretin stimulates bile production

Module 22.7: NUTRIENT DIGESTION AND ABSORPTION

DIGESTIONANDABSORPTIONOFCARBOHYDRATES

Salivary amylase (salivary glands)

- inactivated in stomach due to low pH

Pancreatic amylase (exocrine pancreas)

- picks up CHO digestion in duodenum Lactase, maltase, sucrase (brush border enz. S.I.)

> Lactose \rightarrow G +galactose Maltose \rightarrow G + G Sucrose \rightarrow G + fructose



Lactose Intolerance

- Many adults lack enzyme lactase and as a result <u>cannot</u> digest milk sugar lactose
- Most people produce lactase as infants, but production of enzyme declines as we age

- <u>Without</u> lactase, disaccharides such as lactose cannot be absorbed into enterocytes of small intestine
- Lactose intolerance can be managed by *avoiding* lactose-containing foods orby taking **lactase supplements**

DIGESTION AND ABSORPTION OF PROTEINS

Proteins →amino acids

Pepsin (stomach)

- Chief cells of gastric glands
- Pepsinogen \rightarrow pepsin (req. pH 2)

_____ (activated by brush border enz.)

- from trypsinogen (pancreas)

_____ (pancreas)

Carboxypeptidase (pancreas)

DIGESTION AND ABSORPTION OF LIPIDS

Triglycerides \rightarrow _____

Bile salts cause emulsification of lipids

Gastric lipase (stomach)

Pancreatic lipase (pancreas)

_____ (protein-coated lipid pkg.) absorbed into lacteal ightarrow

lymphatic circulation \rightarrow thoracic duct \rightarrow Lt. Subclavian vein (blood circulation)

DIGESTION AND ABSORPTION OF NUCLEIC ACIDS

Nucleic acids (DNA, RNA) \rightarrow nucleotides

_____ (pancreas)

ABSORPTION OF WATER, ELECTROLYTES, AND VITAMINS

- > 9 L. H₂O _____
 - ~2 L. of water are *ingested*
 - ~7 L. secreted into alimentary canal

Of the 9 liters, _____are absorbed into enterocytes of **S.I.**

 Most of remaining water is absorbed into enterocytes of *L.I.*, leaving only about 0.1 liter of water to be excreted in feces

REVIEW OF HORMONES

<u>Source</u>

Function

Target Tissue

Gastrin –

CCK –

Secretin -