Functions of the Digestive System

CHAPTER 14
p. 423-433

Major Functions of the GI Tract

1. Digestion
2. Absorption

Six Processes of the GI Tract

1. Ingestion
2. Propulsion
3. Mechanical digestion
4. Chemical digestion
5. Absorption
6. Defecation

1. Ingestion

• intake of food

2. Propulsion

a. Peristalsis - alternating contracting & relaxation; involuntary
b. Segmentation - movement of food back & forth across an organ mixing with digestive juices
3. Mechanical Digestion

- breaking food into smaller fragments
  - Mastication in mouth
  - Churning in stomach
  - Segmentation in small intestine
    - All prepare food for degradation by enzymes

4. Chemical Digestion

- breakdown large molecules into their building blocks; occurs in mouth, stomach & small intestine
- These are hydrolysis reactions (water is added to a bond to be broken)
- The three digestible chemical units are:
  - Carbohydrates
  - Proteins
  - Lipids

a. Carbohydrates

- Building block: monosaccharides
  - Glucose, fructose and galactose
- Disaccharides
  - Sucrose (table sugar) glucose + fructose
  - Lactose (milk sugar) glucose + galactose
  - Maltose (malt sugar) glucose + glucose
- Polysaccharides
  - Starch: many glucose units
- Indigestible polysaccharides
  - Ex: cellulose: provides fiber (bulk)

b. Proteins

- Building block: amino acids
- Intermediate products are polypeptides and peptides

c. Lipids

- Building Blocks: fatty acids and glycerol

5. Absorption

- Transport of nutrients from the lumen into the blood or lymph
- Enter cells by active or passive transport
- Small intestine is where most absorption occurs
6. Defecation

- Elimination of waste in a solid form (feces)
- Occurs via anus

Digestive Activities: Mouth, pharynx, esophagus

- Ingestion and breakdown
- Mouth
  - Physical breakdown by chewing
  - Chemical breakdown of starch into maltose by salivary amylase
- Pharynx and esophagus only transport food-no digestive function

Swallowing and Peristalsis

- Deglutition (swallowing)-two phases:
  - Buccal phase- bolus of food enters pharynx
  - Pharyngeal-esophageal phase: transports food through – controlled by parasympathetic (involuntary) nerves
- Tongue blocks off mouth and uvula blocks nasal passages, larynx rises and epiglottis blocks off respiratory (trachea)
- At the end of the esophagus food presses against the cardioesophageal sphincter and food enters the stomach

Digestive Activities: Stomach

- Gastric juice secreted
- Gastrin is produced when food enters and pH falls
- Gastrin causes glands to produce pepsinogens, mucous and HCl
- Mucous protects from acid (ulcers can occur)
- Acid environment activates pepsinogen to pepsin (enzyme that digests protein)
- Rennin is produced and breaks down milk protein (in infants)
Propulsion
- Peristaltic waves move toward the pylorus
- Pyloric sphincter lets 3ml or less of chyme into small intestine
- Duodenum is stretched and the enterogastric reflex inhibits emptying of the stomach
- 4-6 hrs to empty a meal

Heartburn
- Cardioesophageal sphincter fails to close
- Gastric juice backs up into esophagus
- Can lead to inflammation or ulceration of the esophagus
- Common cause is hiatal hernia (stomach protrudes above the diaphragm)

Vomiting
- Local irritation activates the emetic center of brain
- Can also be activated by disturbance in the inner ear (equilibrium)
- Reverse peristalsis

Digestive Activities: Small Intestine
- 3-6 hour journey completes digestion and nearly all absorption
- Microvilli contain brush border enzymes
- Protective mucous is secreted
- Pancreatic juice is ducted in from the pancreas (vagus nerve and hormones)
- Mucosal cells secrete hormones to stimulate pancreas and liver

Chemical Influences
- Carbohydrates – sugars & starches
  - Salivary amylase – mouth
  - Pancreatic amylase – produced by pancreas & sent to duodenum
  - Brush border enzymes – dextrinase, glucoamylase
  - Lactase (lactose), maltase (maltose), sucrase (sucrose)
- Produced & act in small intestine
• Proteins
  – Begins in stomach with pepsin & rennin (more abundant in children)
  – Pancreas – trypsin, chymotrypsin, carboxypeptidase
  – Brush border – aminopeptidase, carboxypeptidase & dipeptidase

• Fats
  – Bile emulsifies fats
  – Pancreatic lipases sent to small intestine to complete fat digestion

• Nucleic Acids
  – Pancreas produces nucleases to breakdown nucleic acids (DNA, RNA)

<table>
<thead>
<tr>
<th>HORMONE</th>
<th>SOURCE</th>
<th>STIMULUS</th>
<th>ACTION</th>
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</thead>
<tbody>
<tr>
<td>GASTRIN</td>
<td>Stomach</td>
<td>Food in stomach</td>
<td>• release of gastric juice&lt;br&gt;• Mobilization of small intestine&lt;br&gt;• Relaxation of ileocecal valve</td>
</tr>
<tr>
<td>HISTAMINE</td>
<td>Stomach</td>
<td>Food in stomach</td>
<td>• activates panethelial cells</td>
</tr>
<tr>
<td>SOMATOSTATIN</td>
<td>stomach</td>
<td>Food in stomach</td>
<td>• inhibits secretion of gastric &amp; pancreatic juices&lt;br&gt;• Inhibits emptying of stomach &amp; gall bladder</td>
</tr>
</tbody>
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| SECRETIN                 | duodenum   | Chyme from stomach| Release of pancreatic juices & bile                         |
| CHOLECYSTOKININ (CCK)   | duodenum   | Chyme from stomach| • Release of pancreatic juices & bile<br>• Relaxes duodenal papillae |
| GASTRIC INHIBITORY PEPTIDE (GIP) | duodenum   | Chyme from stomach| • Inhibits secretion of gastric juices                      |

At the end of the ileum water, undigested material and bacteria enters the large intestine through the ileocecal valve
Peristalsis moves food through the small intestine
Segmentation also plays a role
Digestive Activities: Large Intestine

- 12-14 hour journey
- Bacteria in colon metabolize waste and produce gases (methane and hydrogen sulfide)
- Some bacteria make vitamin K and B vitamins
- Vitamins, water and some ions absorbed here
- Feces is delivered to rectum

Peristalsis and mass movements occur in the large intestine

Mass movements are strong waves that move over colon 3-4 times daily
Bulk (fiber) keeps stool soft and increases the strength of contractions
When feces enter the rectum defecation reflex is initiated

Defecation

- Walls of sigmoid colon and rectum contract and anal sphincter relaxes
- Brain can control the external sphincter and rectal walls relax
- With the next mass movement defecation reflex is initiated again

Diarrhea

- Any condition (bacteria) that rushes food through the large intestine before water is absorbed
- Can cause dehydration and electrolyte imbalance if prolonged

Constipation

- Food remains in the large intestine too long and too much water is absorbed
- Makes the stool hard and difficult to pass
- Results from lack of fiber, poor bowel habits and laxative abuse