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**Study Guide**

The Digestive System

**Chapter 16**

**Based on the text book By Lauralee Sherwood**

**Human Physiology: From Cells To Systems**

**(7th edition)**

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**Department Of Physiology**

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**Part-I**

**Gastrointestinal Motility**

**Background**

1. Refresh your knowledge about smooth muscle, its contraction and its control **(Revisit Chapter 8, Muscle Physiology-page 289-299).**
2. Clarify the concept that multiunit smooth muscle is neurogenic while single-unit smooth muscle is myogenic (self-excitable).
3. Learn Regulation of Digestive system **(Read from pages 593-595, chapter 16, The Digestive system)**

Digestive activities are controlled by:

1. The autonomous smooth muscle function (slow-wave potentials)
2. The enteric nervous system (also called intrinsic nerves of GIT)
3. The autonomic nervous system (also called extrinsic nerves to GIT)
4. Gastrointestinal Hormones
5. Specifically clarify your concept about slow wave potentials

Slow Wave Potentials (Basal Electrical Rhythm)

Like self excitable cardiac cells, some specialized smooth muscle cells have pace maker activity. These small oscillatory cycles between depolarizations and repolarizations **[See diagram 8-31 and read page 295 from Chapter-8 (Muscle Physiology) & then read from Page 593 (Digestive system)]**

1. Read about modification of smooth muscle activity by the autonomic nervous system. **(Chapter 8, Muscle Physiology-page 289-299)**
2. Read other factors influencing smooth muscle activity including muscle stretch, certain hormones, local metabolites and certain drugs. **(Chapter 8, Muscle Physiology-page 289-299)**
3. The smooth muscle of digestive system is also influenced by the enteric nervous sytem, which is a specialized network of nerve fibers built into the wall of the digestive tract. The enteric nervous system can act independently of the rest of the nervous system but is also influenced by autonomic fibers that terminate on enteric neurons **(Page 134 & Page 595)**.
4. There are three types of receptors in the digestive tract wall. These receptors respond to local changes in the digestive tract. Receptor activation alters digestive activity through neural reflexes and hormonal pathways. These receptors are:
   1. **Chemoreceptors:** sensitive to chemical changes within lumen of GIT
   2. **Mechanoreceptors:** sensitive to stretch or tension within the wall of GIT
   3. **Osmoreceptors:** sensitive to the osmolarity of the luminal contents.

**Mouth:**

**Food** enters the digestive system through the mouth, where it is chewed and mixed with saliva and the **‘bolus’** of food is passed on. The teeth are responsible for chewing (mastication), a process in which the food is broken down into small pieces and mixed with saliva. **(Pages 596)**

**Pharynx & Esophagus:**

The tongue propels the bolus of food to the back of throat, which stimulates the process of **‘swallowing reflex’.**

The swallowing center in the medulla coordinates a complex group of activities that result in closure of the respiratory passages and propulsion of food through the pharynx and esophagus into the stomach. **(Pages 598-600 and Figures 16-5 and 16-6)**

**Stomach:**

Gastric motility includes filling, storage, mixing and emptying. Gastric filling is facilitated by vagally mediated ‘**receptive relaxation’** of the stomach. Gastric storage takes place in the body of the stomach, where peristaltic contractions of the thin muscle walls are two weak to mix the contents. Gastric mixing in the thick muscled antrum results from vigorous peristaltic contractions. **(Read Pages 600-601, Review figures 16-7 and 16-8)**

**Gastric emptying** is influenced by factors in both the stomach and duodenum.

1. Increased volume and fluidity of **‘chyme’** in the stomach promote emptying.
2. Fat, acid, hypertonicity and distension in the duodenum (the dominant factors controlling gastric emptying) delay gastric emptying until the duodenum is ready to process more chime. They do so by inhibiting stomach peristaltic activity via the **‘enterogastric reflex’** and the **‘enterogastrones’**, secretin, secretin and cholecystokinin (CCK), which are secreted by the duodenal mucosa.
3. Emotions can also influence gastric motility through autonomic nervous system.

**(Read Pages 600-601, Review Figures 16-8 and table 16-2)**

**Vomiting (emesis)**

Vomiting is the forceful expulsion of gastric contents out through the mouth. It is not due to reverse peristalsis. The vomiting reflex is coordinated in vomiting center that is located in the medulla. The force comes from diaphragm and abdominal muscles. Causes of vomiting range from simple stimulation of back of throat to complex ‘motion sickness’. **(Read Pages 604-605)**

**Small Intestine:**

**Segmentation,** the small intestine’s primary motility during digestion of a meal, thoroughly mixes the chime with digestive juices to facilitate digestion; it also exposes the products of digestion to the absorptive surfaces. **(Page 621-622, Review Figure 16-19).**

Between meals ‘the migrating motility complex’ sweeps the lumen clean, it is called ‘intestinal housekeeper’. **(Page 622)**

**Ileocaecal valve**

It is the junction between ileum (small intestine) and cecum large intestine. It is surrounded by thickened smooth muscle that forms a sphincter. It prevents the colonic contents, that are full of bacteria, from entering the nutrient-rich small intestines, where they would multiply uncontrollably. The only times when this sphincter slightly opens is when new meal enters stomach and gastrin hormone is released or when the pressure in ileum is increased. **(Page 622, Review Figure 16-20)**

**Large Intestine:**

The colon concentrates and stores undigested food residues (fiber; that is, plant cellulose) and bilirubin until they can be eliminated in feces **(Page 633-635, Review figure 16-28)**

**Haustral contractions** slowly shuffle the colonic contents back and forth to mix and facilitate absorption of most of the remaining fluid and electrolytes.

**Mass movements** several times a day, usually after meals, propel the feces long distances. Movement of feces into the rectum triggers the **‘defecation reflex’**. This reflex causes the internal anal sphincter to relax and the rectum and sigmoid colon to contract vigorously. If the external sphincter is relaxed defecation occurs. **(Page 635)**

**Vocabulary related to motility**

Reflex

Reflux

Regurgitation

Mixing

Emptying

Peristalsis

Segmentation

The migrating motility complex

Haustrations (Haustral contractions )

Mass movements

**Concepts to make**

* The apparatus for motility
* Types of smooth muscle in stomach
* Places in GIT that have skeletal (striated) muscles
* The controls of motility
* Gastric emptying
* How entry of new food effects emptying
* Peristalsis and Receptive relaxation
* Swallowing reflex and role of sphicters of esophagus
* Enterogastric reflex
* Defecation reflex
* Swallowing center
* Vomiting center

**Work Sheet-1**

1. **Name the four basic digestive processes and define them**

|  |  |  |
| --- | --- | --- |
| **No** | **Function** | **Definition** |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |

1. **What functions from the above list are performed by the parts of digestive system listed below.**

|  |  |  |
| --- | --- | --- |
| **No** | **Part of GIT** | **List of functions** |
|  | Mouth |  |
|  | Esophagus |  |
|  | Stomach |  |
|  | Small intestine |  |
|  | Large intestine |  |

1. **The following is list of the three major Gastrointestinal hormones, identify their effect only on motility**

|  |  |  |
| --- | --- | --- |
| No. | GIT Hormone | Effect on motility |
| 1 | Gastrin |  |
| 2 | Cholecystokinin |  |
| 3 | Secretin |  |

1. **Describe the specific types of motility in each component of the digestive tract. What factors control each type of motility.**

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Part of GIT** | **Specific type of motility** |  |
| 1 | Esophagus |  |  |
| 2 | Stomach |  |  |
| 3 | Small intestine |  |  |
| 4 | Large intestine |  |  |

**Short Essay Questions**

**1**

1. What is swallowing reflex?
2. How is this reflex coordinated?
3. Name the stages of this reflex and discuss events in each stage?

|  |
| --- |
| **a.** |
|  |
|  |
| **b.** |
|  |
|  |
|  |
| **c.** |
|  |
|  |
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**2**

1. **What is the importance of LES (lower esophageal sphincter)?**
2. **What factors control LES?**
3. **What clinical condition can occur if this sphincter does not function properly?**

|  |
| --- |
| **a.** |
|  |
|  |
| **b.** |
|  |
|  |
|  |
|  |
|  |
|  |
| **c.** |

**Practice MCQs (more than one answers can be true)**

**Gastroesophageal Reflux is prevented by:**

A. Lower esophageal sphincter. T F

B. Upper esophageal sphincter. T F

C. Peristalsis. T F

D. Deglutition reflex. T F

E. Intragastric pressure. T F

**Gastroesophageal Reflux is worsened by:**

A. Obesity. T F

B. Bending. T F

C. Smoking. T F

D. Muscle relaxing drugs. T F

E. Pregnancy. T F

**Most of the peristaltic activity of the stomach occur in:**

A. Proximal stomach. T F

B. Distal stomach. T F

C. Antrum. T F

D. Fundus. T F

E. All above. T F

**Part of the GIT that have oblique muscle layer is:**

A. Esophagus. T F

B. Stomach. T F

C. Deudenum. T F

D. Ileum. T F

E. Colon. T F

**Mixing & propulsive movements occur together in:**

A. Esophagus. T F

B. Stomach. T F

C. Deudenum. T F

D. Ileum. T F

E. Colon. T F

**Factors that enhance gastric emptying are:**

A. Stomach distension. T F

B. Deuodenal distension. T F

C.Gastrin. T F

D. CCK. T F

E.GIP. T F

**Storage of food in stomach is:**

A. Done in distal stomach. T F

B. Facilitated by vagovagal reflex. T F

C. Can make the stomach to accept large amount of food. T F

D. Requires receptive contraction of proximal stomach. T F

E. Requires actively contracting stomach. T F