University of Mosul
Lecture No.:
College of Veterinary Medicine
Date:
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Website:

Lecture title: **Digestive system**

Lecturer Affiliation:

Department of Physiology, Biochemistry and Pharmacology, College of Veterinary Medicine, University of Mosul, Mosul, Iraq

Summary:

Swallowing (Deglutition)

Deglutition, it is a highly complex reflex that delivers ingesta or fluids from mouth to the stomach through pharynx and esophagus.

- ✓ The Pharynx, it is a common passage for food and air, lined by mucous membrane and surrounded by muscles.

- ✓ In general, swallowing can be divided into 3 stages: -
  (1) ***Voluntary stage***, which initiates the swallowing process in the mouth
  (2) ***Pharyngeal stage***, which is involuntary and constitutes passage of food through the pharynx into the esophagus
  (3) ***Esophageal stage***, another involuntary phase that transports food from the pharynx to the stomach.

Voluntary Stage of Swallowing

1- In the voluntary phase of deglutition, the ingested feed materials are converted into bolus
2- Initiate stretch reflex
3- Grinding (mastication) ⟹ large particles to small particles
4- Increase salivation and with the tongue pushed back the bolus into the pharynx.

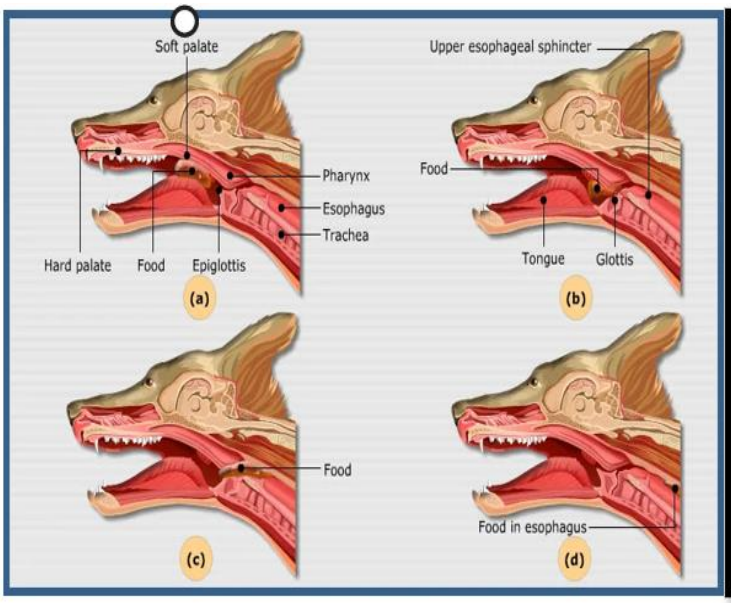
Pharyngeal Stage of Swallowing

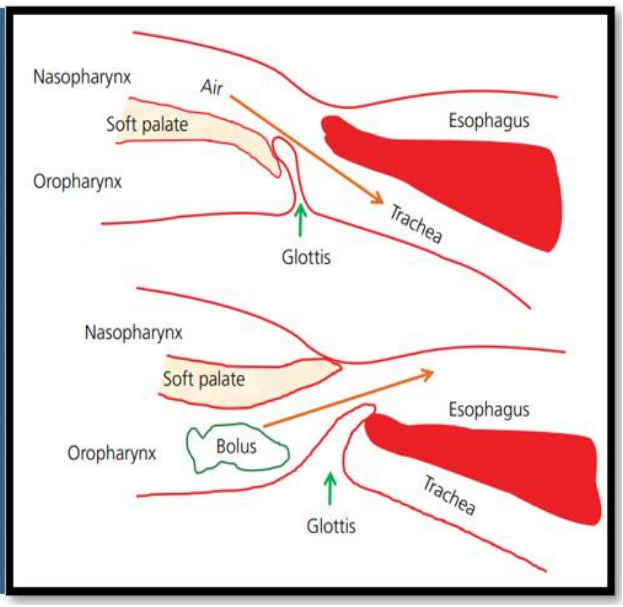
1- As the bolus of food enters to pharynx, it stimulates the receptor in wall of pharynx and reflexes occur.
2- Respiration is inhibited.

3- larynx is closed and pulled upward and forward (the base of the tongue folds the epiglottis to close the opening of larynx).
4- Contraction of the pharyngeal muscles force the bolus into the esophagus.

Esophageal Stage of Swallowing

1- The esophagus functions primarily to conduct food rapidly from the pharynx to the stomach.
2- contact of the bolus with esophagus creates a primary peristaltic wave that sweeps the bolus to the stomach.
3- Stretch esophageal wall led to Contraction (longitudinal m.) and relaxation (circular m.) by secondary peristaltic waves to carried the food to the stomach.
4- Finally, contraction lower esophageal sphincter then relaxes cardiac sphincter to allow bolus enter to stomach.





Motility of the Esophagus

✓ Define peristalsis: the involuntary contraction and relaxation of the alimentary tract muscles, creating wave-like movements that push the contents of the entire canal forward.
✓ The esophagus normally exhibits two types of peristaltic movements**:**

1. **Primary peristalsis**

2. If the primary peristaltic wave fails to move bolus into the stomach, the **Secondary peristaltic** waves result from distention of the esophagus itself cause empty the esophageal contents into the stomach

Mechanism of action:

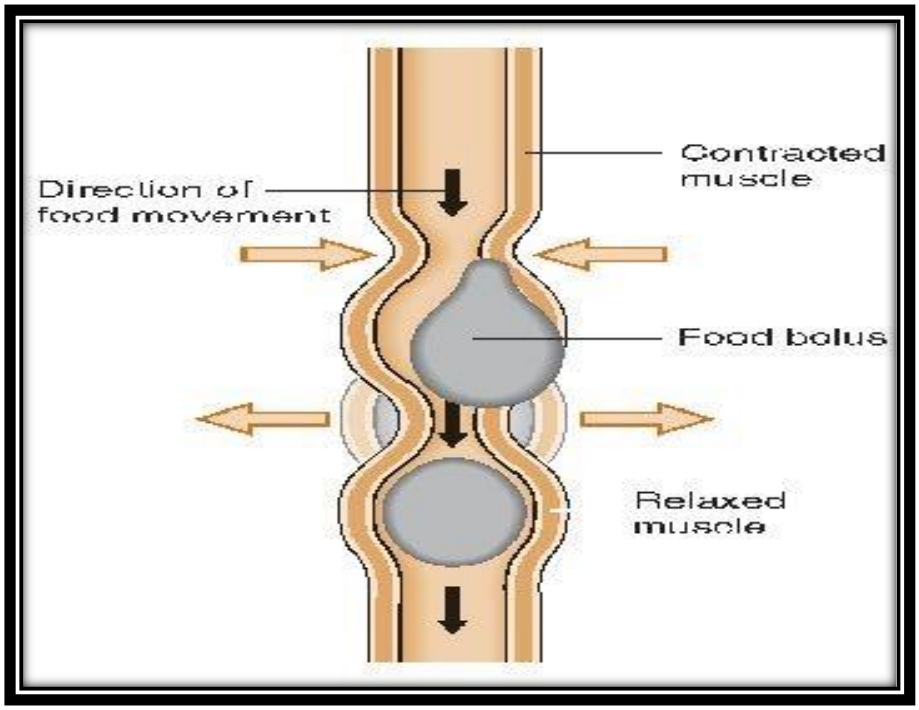
The stretch reflex begins when bolus in the esophagus that led to

⇩

stimulation the myenteric plexus that innervate circular and longitudinal muscles

⇩

at a site of contraction, circular m. stimulated but longitudinal m. relaxed while, at a site of distention circular m. relaxed but longitudinal m. is stimulated



Stomach (simple stomach)

- ✓ The stomach lies between the esophagus and duodenum at the left side of the abdominal cavity. Stomach stores food which is then mixed with acid, mucus, and pepsin; then released at a controlled steady rate into the duodenum.
- ✓ **Anatomically**, the stomach is usually divided into **two** major parts: (1) the body and (2) the antrum

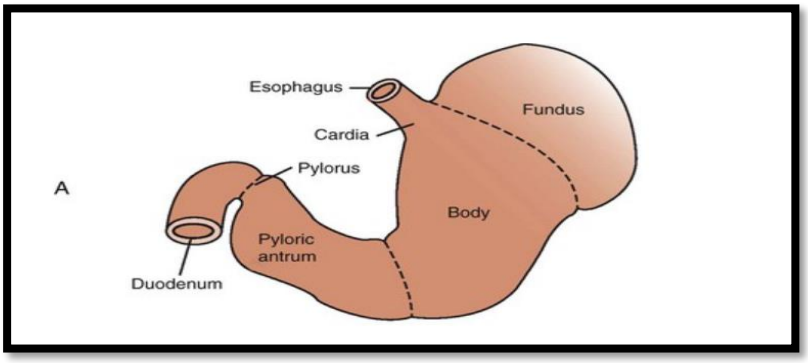
- ✓ The stomach can be divided **physiologically** into **four** distinct functional compartments based on the distribution of gastric mucosa however, not all species have all four compartments

1. **Esophageal stomach**: The portion of stomach that lies just below the esophagus. This portion of stomach is **non-glandular** in nature as no mucus, acid, or proteolytic enzymes are produced from this area. The horse has a rather large esophageal stomach compartment, but it is very smaller than the dog, pig, and cow.

2. **Cardia stomach**: It is situated just below the esophageal stomach. It is considered a **glandular stomach** that produces thick mucus and buffer. The mucous and buffer protect the epithelium from corrosive actions of gastric acid the proteolytic enzymes. The portion of cardia is very large in pigs, very small in dogs. Cardia is almost absent in horse and cow.

3. **Fundic stomach**: This portion is the largest compartment for storage of the food, and **all** the animals have fundic stomach. It is **glandular** in nature and cells produce acid, proteolytic enzymes, hormones, and mucus.

4. **Pyloric stomach**: It is the terminal portion of the stomach joined with duodenum and guarded by pyloric sphincter. Pyloric stomach is **glandular**. These glands produce only mucus and buffer without acid or proteolytic enzymes. The G cells present at the pyloric region produce the hormone gastrin in response to gastric distension or in increased stomach pH. All mammals have a pyloric stomach for mixing and empty of the food



Functions of the Stomach

(1) Storage of large quantities of food until the food can be processed in the stomach, duodenum, and lower intestinal tract.

(2) Mixing of this food with gastric secretions until it forms a semifluid mixture called **chyme**

(3) Slow emptying of the chyme from the stomach into the small intestine at a rate suitable for proper digestion and absorption by the small intestine.

Gastric mucosa and secretion

The fundic stomach contains **gastric pits** lined with mucus secreting cells at the luminal surface. The mucous protects the gastric mucosa from acid and proteolytic enzymes by forming a gel, The cells have rapid regenerating property to mature within 2–3 days, there are different types of cells in the gastric pits: -

1. Chief cells (peptic cells or zymogenic cells):

- Chief cells in fundus of the stomach. They secret **pepsinogen** converted to its active from pepsin by the hydrochloric acid.
- Chief cells also produce **rennin**, a proteolytic enzyme required to curdle milk. Renin is important in neonates to digest milk proteins.

2.Parietal cells (Oxyntic cells):

- These cells produce gastric **HCl** that facilitates hydrolytic breakdown of proteins
- and also kills many of the bacteria ingested through food.
- parietal cells also produce a protein known as **intrinsic factor** that helps in absorption of Vit-B12.

3. Enterochromaffin (Enteroendocrine cells): (ECL) cells

- In gastric mucosa, these cells are found among the parietal and chief cells. They are the predominant neuroendocrine cells of GI tract and produce **serotonin** which controls gastric acid and proteolytic enzyme secretion.

4.Mast cells:

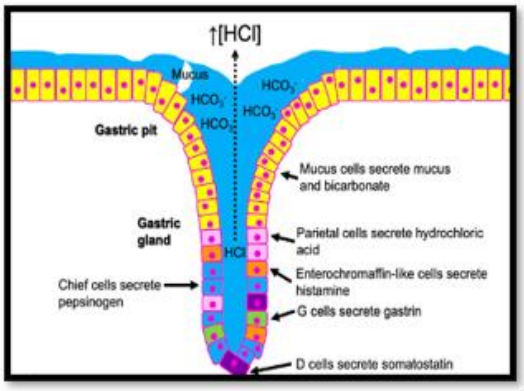
- Mast cells released inflammatory mediators like histamine, prostaglandin D, and other pro-inflammatory cytokines.

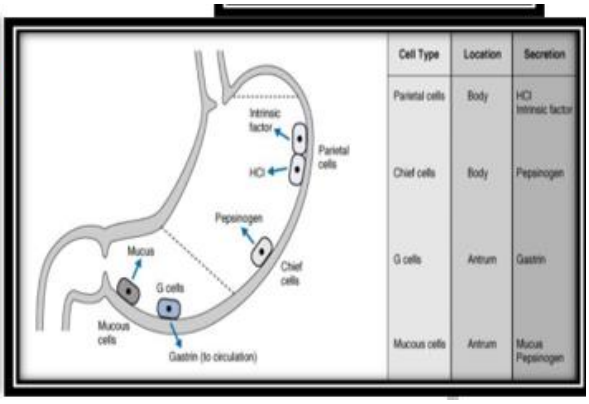
5.Delta cells (δ-cells or D cells):

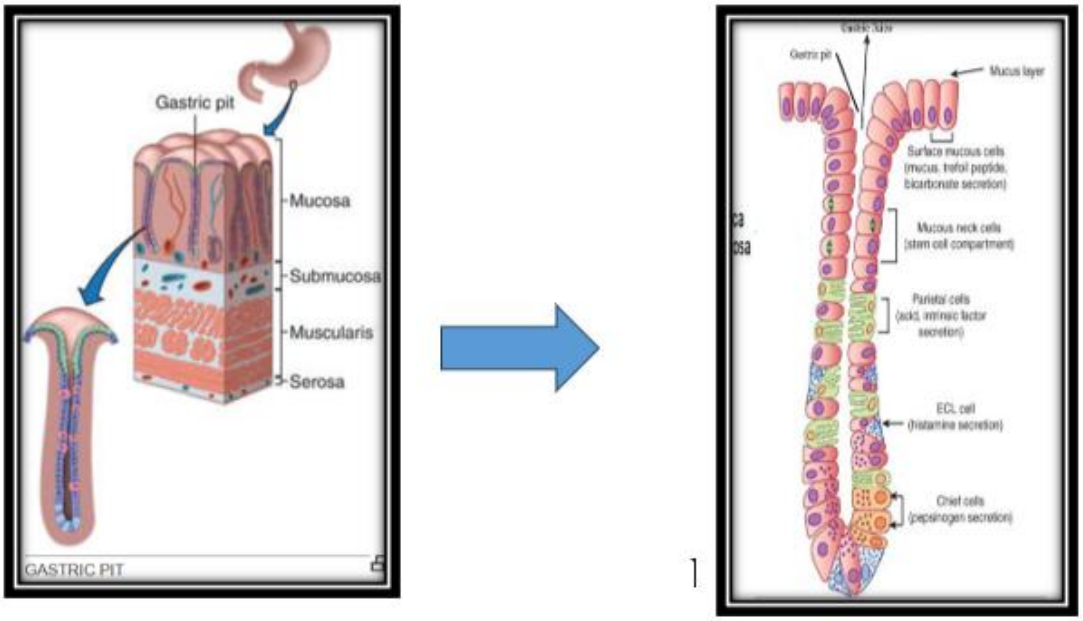
- These are **Somatostatin** producing cells of the stomach, intestine, and pancreatic islets. Somatostatin inhibits gastrin release.

6. Gastrin cells (G cells):

- G cells secret **Gastrin** in response to peptides and amino acids.







Control of Gastric Secretion

Cephalic Phase:

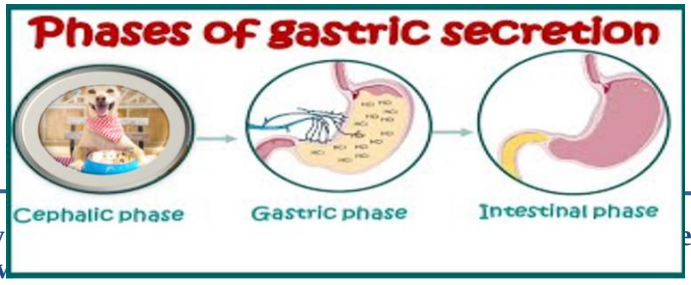
It is stimulated by sight, smell, taste, thought and swallowing of food. The cephalic phase is entirely. The response is mediated by the vagus nerve that stimulate gastric acid secretion. The cephalic phase of gastric secretion is absent in ruminants.

Gastric Phase:

It begins with the presence of food in the stomach (due to gastric distension). Stimulate stretch reflex by vagus nerve to stimulate G cells for gastrin release. Gastrin in turn stimulates acid secretion.

Intestinal phase:

It starts after the food leaves the stomach and enters into the duodenum (gastric empty) It is mediated by **motilin** that responsible for push **chyme** to duodenum, then cholecystokinin (CCK), **secretin** and **gastrin** will respond to released.



Motility of stomach

- ✓ When food enters the stomach, the cardiac sphincter (junction of the esophagus and the stomach) is relaxed.
- ✓ the waves of **weak peristaltic contraction** occur
- ✓ As the constrictor waves become more intense, providing **powerful peristaltic waves** move toward the pyloric region at rate of 3-4 times/minute, to help mixing and push of the content.
- ✓ Yet the pylorus sphincter (junction of the stomach and the duodenum) is relax enough expelled into the duodenum with each peristaltic wave.
- ✓ **Parasympathetic** stimulation, in general, increases overall degree of activity of the gastrointestinal tract.
- ✓ Normal function of the gastrointestinal tract is not very dependent on **sympathetic** stimulation, but strong sympathetic stimulation decreased motility causing constipation.