Gastric and Intestinal Secretion

Khushal Khan
KMU-IPMS

Gastric Secretion

- Stomach secretes:
  - **Water**
  - **Electrolytes**
  - **Hydrochloric acid**
  - **Glycoproteins (mucin, intrinsic factor, enzymes)**

- Gastric motility and secretion regulated by:
  - **Neural mechanisms**
  - **Humoral mechanisms**

Gastric Glands

1. **Oxyntic (acid-forming) glands:**
   - Located in body and fundus (proximal stomach)

Cell types:

- Mucous neck cells: **secrete mucus**
- Peptic (chief) cells: **secrete pepsinogen (inactive)**
- Parietal (oxyntic) cells: **secrete HCl & intrinsic factor**
- Enterochromaffin-like (ECL) cells: **secrete histamine**

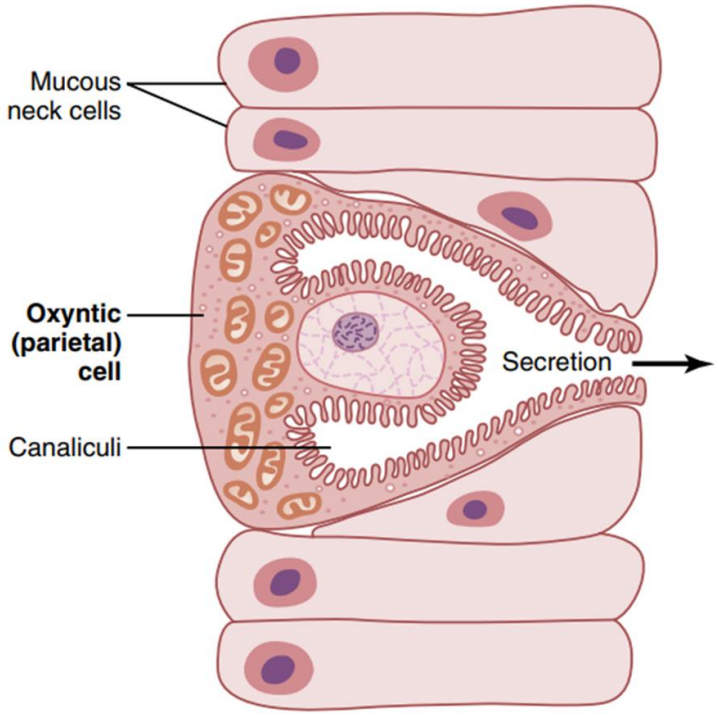
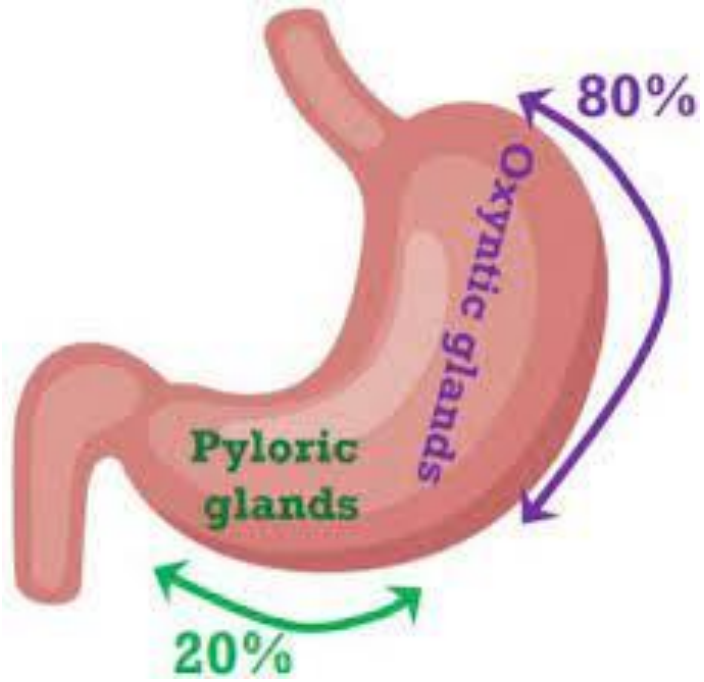
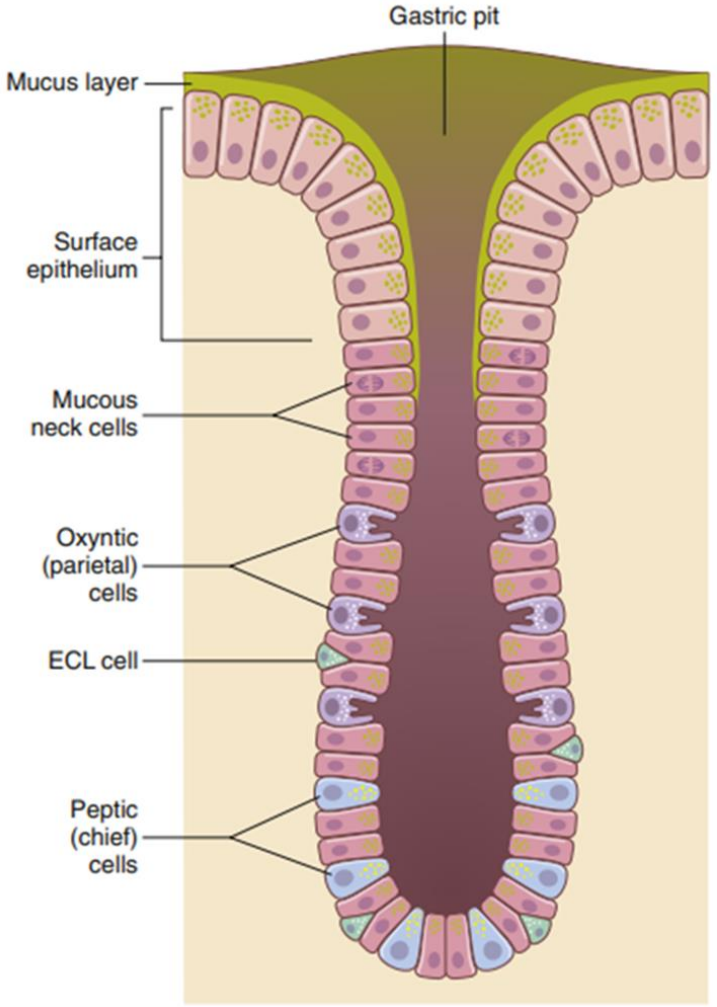


Figure 65-5. Schematic anatomy of the canaliculi in a parietal (oxyntic) cell.

Gastric Glands

2. **Pyloric glands:**
   - Located in antrum (distal stomach)
   - Secrete mainly **mucus, some pepsinogen, and hormone gastrin**





Types of Cells in the Stomach

- There are various types of cells in the stomach. They are:
- In the Lumen – **Columnar epithelium –** surface mucous cells produce mucous (viscous, 1mm thick layer)
- In the Gastric Glands:
    i. **Mucous neck cells** - secrete **mucus**
    ii. **Peptic (chief) cells -** secrete **pepsinogen (inactive)**
    iii. **Parietal (oxyntic) cells** - secrete **hydrochloric acid** & **intrinsic factor**
    iv. **Enteroendocrine cells** – (entero-digestive system, endocrine-hormone secretion)
        - **G Cells –** secrete hormone, **Gastrin**
        - **ECL Cells (Enterochromaffin-like cells) –** secrete **Histamine**
        - **D Cells -** secrete hormone, **Somatostatin**

- **Gastric acid is secreted by parietal cells.**
  - Concentrated hydrochloric acid **(155 mEq/L)**
  - Potassium chloride **(15 mEq/L)**
  - Small amounts of sodium chloride.

- **Hydrochloric acid is as necessary as pepsin for protein digestion in the stomach.**
  - Hydrochloric acid crucial for protein digestion, working alongside pepsin.
  - Pepsinogens become active pepsin upon contact with HCl, aiding in protein breakdown.

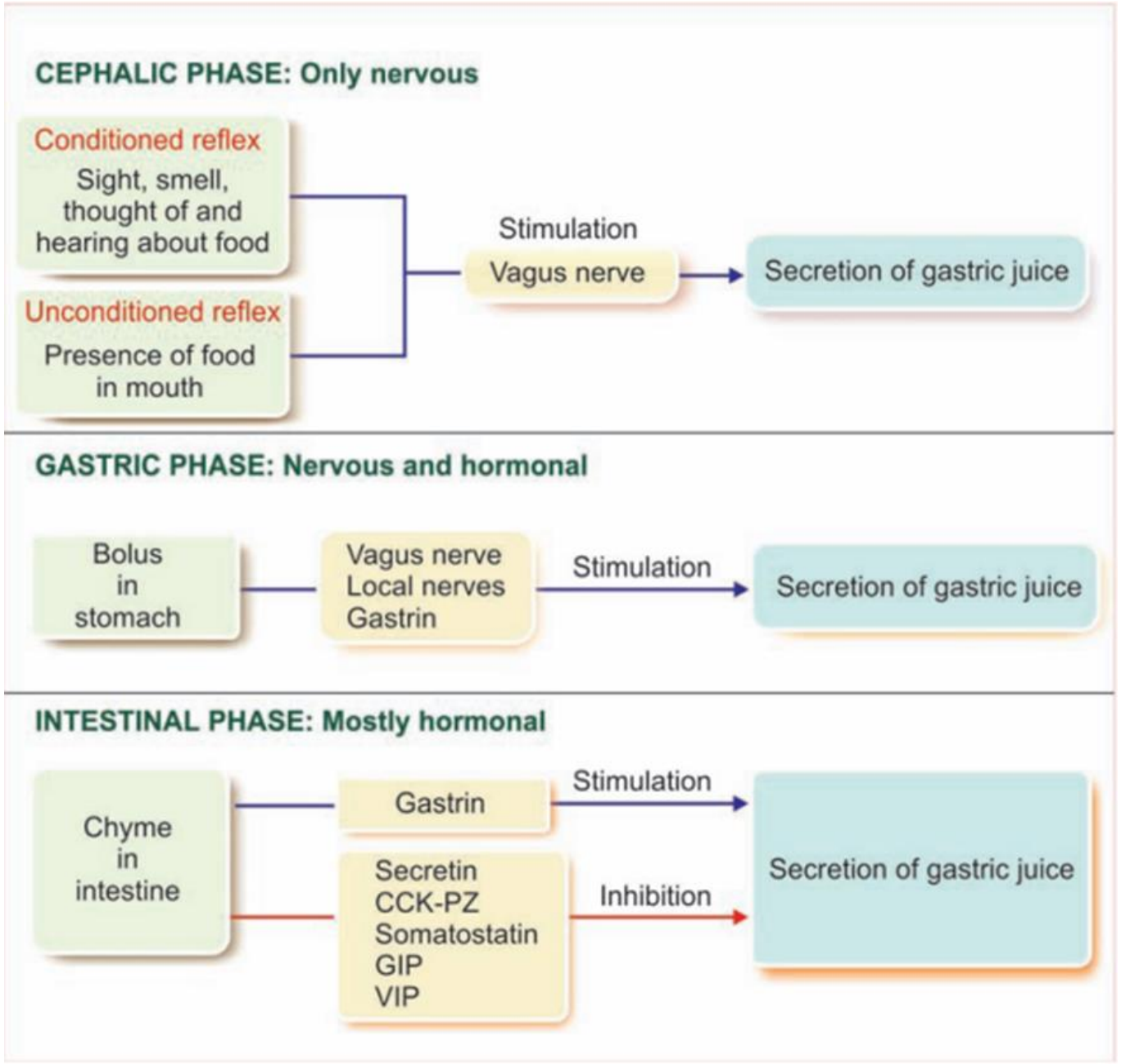
- **Parietal cells also secrete “intrinsic factor.”**
  - Intrinsic factor is essential for **absorption of vitamin B12 in the ileum.**
  - Destruction of **acid-producing cells (e.g., chronic gastritis)** leads to:
    - Achlorhydria.
    - Potential pernicious anemia due to impaired red blood cell maturation.

Phases of Gastric Secretion

1. **Cephalic Phase** (accounts for 30% of the response to a meal)
   - It is initiated by the anticipation of eating, odour and taste of food.
   - It is mediated entirely by the vagus nerve.

2. **Gastric Phase** (accounts for 60% of the acid response to a meal)
   - It is initiated by **distention of the stomach** - nervous stimulation of gastric secretion.
   - Additionally - **partial digestion products of proteins** - cause gastrin to be released.
   - The **gastrin** then causes **secretion of a highly acidic gastric juice.**

3. **Intestinal phase** (10% of the response)
   - It is initiated by nervous stimuli associated with **distention of the small intestine**.
   - The **presence of digestion products of proteins in the small intestine** also stimulate gastric secretion via a humoral mechanism.


CEPHALIC PHASE: Only nervous
Conditioned reflex
Sight, smell, thought of and hearing about food
Unconditioned reflex
Presence of food in mouth
Stimulation
Vagus nerve
Secretion of gastric juice
GASTRIC PHASE: Nervous and hormonal
Bolus in stomach
Vagus nerve
Local nerves
Gastrin
Stimulation
Secretion of gastric juice
INTESTINAL PHASE: Mostly hormonal
Chyme in intestine
Gastrin
Stimulation
Secretin
CCK-PZ
Somatostatin
GIP
VIP
Inhibition
Secretion of gastric juice

Regulation

Stimulants of Gastric Secretions:

- **Acetylcholine:** Stimulates secretion of **pepsinogen, hydrochloric acid, and mucus.**
- **Gastrin and Histamine:** Stimulate **acid secretion by parietal cells.**

Inhibition of Gastric Secretion:

- **Excess Acid:** Gastric secretion inhibited when stomach **pH falls below 3.0.**

Gastrin secretion is decreased for two reasons:

1. The high acidity – stimulates release of **somatostatin** from delta cells
   - Which in turn depresses gastrin secretion by the **G-cells**

2. The acid causes an **inhibitory nervous reflex that inhibits gastric secretion.**
   - This mechanism protects the stomach.

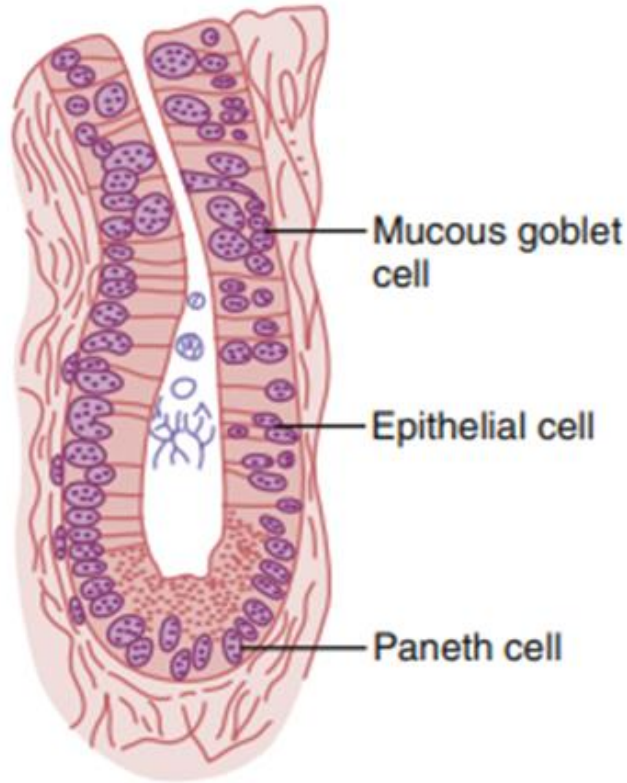
Inhibition by Chyme in Small Intestine:

1. **Enterogastric Reflex:**
   - Initiated by distention of small bowel, presence of acid, protein breakdown products, or mucosal irritation.
   - Inhibits stomach secretion through enteric, sympathetic, and vagus nerves.

2. **Hormonal Regulation:**
   - Chyme presence in **upper small intestine** triggers release of intestinal hormones.
   - **Secretin and gastric inhibitory peptide** crucial for inhibiting gastric secretion.

Secretions of Small Intestine

- The intestinal secretions are formed by the **enterocytes of the crypts.**
- **Rate: about 1800 ml/day.**
- **pH: slightly alkaline pH - 7.5 to 8.0**
- The secretions are also rapidly reabsorbed by the villi.



Stimuli:

- **Tactile or irritative stimuli** from the chyme in the intestines

Function:

- This fluid provides a **watery medium for absorption of substances** from chyme when it comes in contact with the villi.

Composition:

- Intestinal secretion consists of;
- **Peptidases** – proteins ⟶ amino acids
- **Sucrase, Maltase, Isomaltase**, and **Lactase** – disaccharides → monosaccharides
- **Intestinal lipase** - neutral fats → glycerol and fatty acids

- Small intestine consists of the following glands;
  - **Brunner's Glands**
  - **Crypts of Lieberkühn**

Brunner’s Glands

- Located in the wall of the duodenum **- between the pylorus of the papilla of Vater**

- These glands secrete large amounts of **alkaline mucus.**

Stimuli:

- Tactile or irritating stimuli on the duodenal mucosa
- Vagal stimulation, which causes increased Brunner gland secretion
- Gastrointestinal hormones, especially secretin

Function:

- **Protection** – mucous protect the duodenal wall from digestion by the highly acidic gastric juice
- **Neutralization of Gastric acid** – mucous contains $HCO3^-$, along with pancreatic and bile

Crypts of Lieberkühn

- Tubular glands formed from the mucosa of the small intestine, situated b/w the bases of the villi.
- Located across the entire surface of the small intestine, interspersed between intestinal villi.

Secretion: Cells within these glands produce intestinal juice.

Cell Composition:

1. **Goblet Cells:** Secrete **mucus,** providing lubrication and protection to intestinal surfaces.
2. **Enterocytes:** Secrete significant amounts of **water and electrolytes.**

Secretions of Large Intestine

Structure:

- Contains numerous crypts of Lieberkühn.
- Lacks villi, distinguishing it from the small intestine.
- Contain **Mucous Cells:** Secrete mucus rich in bicarbonate (HCO3-), devoid of digestive enzymes.

Stimuli:

- Direct tactile stimulation of epithelial cells lining the large intestine.
- Local nervous reflexes to mucous cells in the crypts of Lieberkühn.
- Stimulation of pelvic nerves from the spinal cord.

Function: Protection

- Mucus shields the large intestine wall from abrasion.
- Acts as an adherent medium for fecal matter.
- Protects the intestinal wall from bacterial activity.
- Forms a barrier against acid attack on the intestinal wall.

Thank You