

Gastric secretions

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Stomach

Functions of the stomach

- ▶ Storage of food.
- ▶ Mixing food with the gastric juice (**Isotonic acidic chyme**)
- ▶ Slow evacuation of **chyme into the duodenum** which is optimal for intestinal digestion & absorption
- ▶ Partial digestion of proteins and fats.
- ▶ Sterilization of ingested food by high acidity.
- ▶ Secretion of HCl, enzymes,....
- ▶ Help defecation by gastro-colic reflex.

Gastric secretion

► Gastric secretion

It is **2.5 – 3 L/day** of acidic juice (pH may reach 1)

It is secreted from the **gastric glands**

► Gastric glands

- Simple tubular glands open at the mucosal surface at the gastric pits.
- In these glands, many types of cells are present:
 - 1) Mucous neck cells (Goblet) → Mucus.
 - 2) Chief cells → Pepsinogen & enzymes.
 - 3) Oxyntic (parietal) cells → HCL & intrinsic factor (essential for life for absorption of vit.B12).
 - 4) G. cells → Gastrin H.
 - 5) D. cells → Somatostatin.
 - 6) Entero-chromaffin like cells → histamine
- The pyloric canal and cardiac region contain goblet cells only.
- The body & fundus contain all types of cells except **G. cells.**
- The antrum of pyloric area contains **1, 2, 4& 5 types of cells.**

HCL secretion:

- ▶ **HCl** is secreted by **the oxyntic (parietal) cells**.
- ▶ Concentration of **H⁺ ions** in gastric juice is **one million times** the conc. in plasma. So, **H⁺ ions** is secreted against a very high gradient.

▶ ***Mechanism of HCl secretion:***

1. In parietal cell CO₂ (from metabolism) → CO₂ + H₂O → H₂CO₃ under effect of Carbonic anhydrase enzyme.

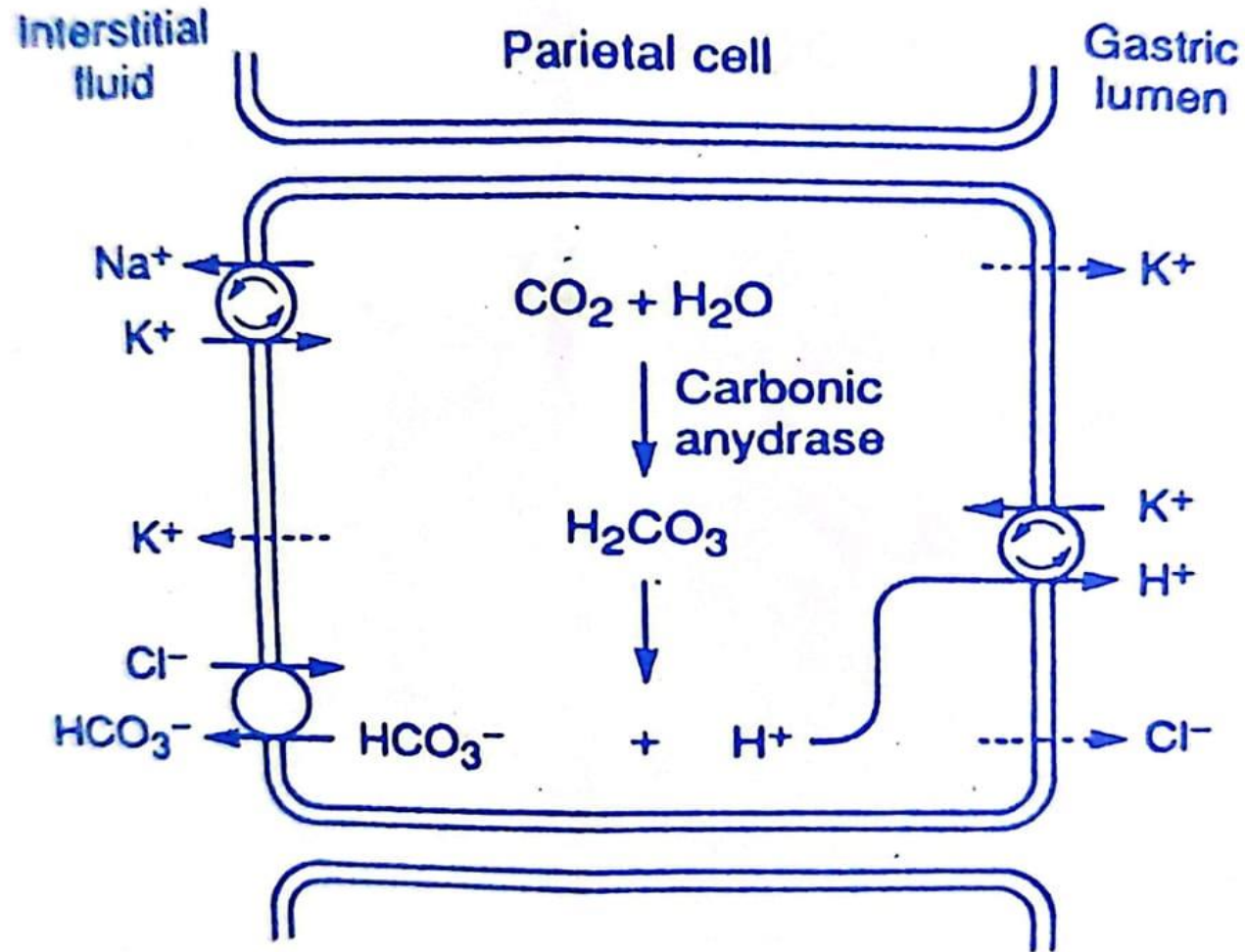
2. H₂CO₃ → **H⁺** + **HCO₃⁻**

3. The **bicarbonate diffuse to blood** in exchange with **CL⁻** (antiport)

4. The **H⁺** is secreted in lumen in exchange with **K⁺** by **H⁺ - K⁺ pump**

5. **CL⁻** Diffuse into the lumen to unite with **H⁺** → HCl

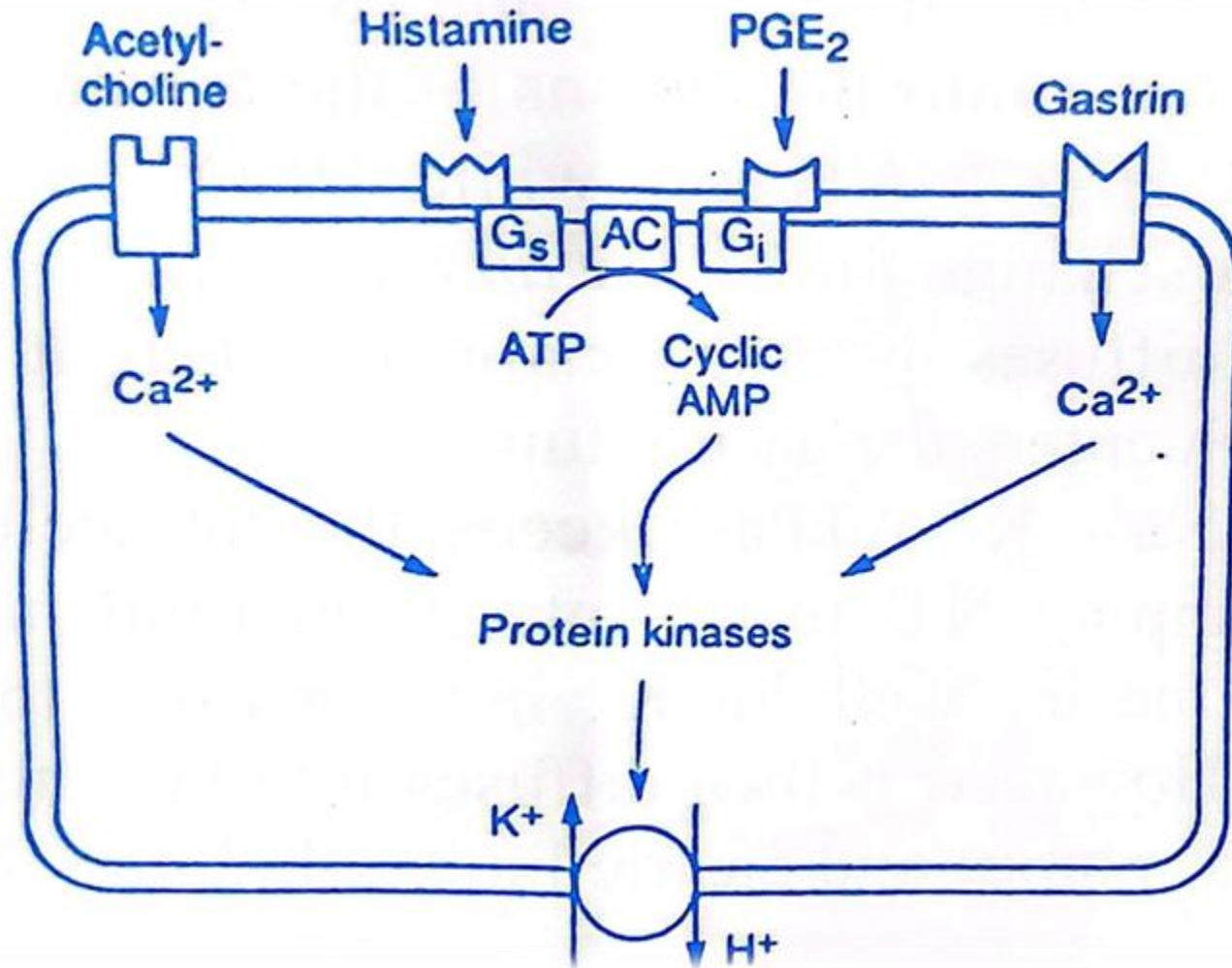
6. Diffusion of **HCO₃⁻** to blood → **NaHCO₃** → post prandial alkaline tide (↑ pH in blood and urine after gastric secretion).



Mechanism of HCL formation in the parietal cells

Factors affecting HCL secretion (Receptors on parietal cells)

- ▶ Histamine → ↑ **HCl** secretion via stimulation of **H2 receptors** by ↑ cAMP (these receptors are blocked by cimetidine).
- ▶ Acetyl choline → ↑ **HCl** secretion via muscarinic receptors (**M3**) by ↑ intra-cellular Ca^{+2} & this effect is blocked by atropine.
- ▶ Gastrin → ↑ **HCl** secretion via special gastrin receptors by ↑ intra-cellular Ca^{+2} .
- ▶ Prostaglandin E2 causes **decrease HCl** secretion via ↓ cAMP (used in treatment of peptic ulcer)



Regulation of HCL secretion

Functions of HCL

- ▶ Sterilization : by acidity (So, in infants less HCL secretion → more gastroenteritis .
- ▶ Digestion of protein by activation of **pepsinogen** → pepsin & give optimum pH of its effect (hydrolysis of protein)
- ▶ HCL enters the duodenum → ↑ **secretin** hormone → ↑ bile and pancreatic secretion.
- ▶ Produces curdling of milk.
- ▶ Initiate **entero-gastric inhibitory reflex** → ↓ gastric secretion and evacuation.
- ▶ ↑ absorption of iron (by converting ferric state into ferrous)

Secretion of enzymes

A- pepsinogens : (I & II)

- Secreted by chief (peptic) cells.
- Inactive pepsinogen \xrightarrow{HCL} active pepsin.
- Of optimum pH 1.6 – 3.2.
- Digest proteins \rightarrow proteases & polypeptides.
- Pepsinogen I is large amount, secreted by the chief cells and its secretion is linked with HCL secretion.
- Pepsinogen II is less amount, secreted by mucosal cells and not linked with HCL secretion.

B- Gelatinase : which liquefies gelatin.

C- Gastric lipase: act on short chain fat. Its optimum pH = 3.

Secretion of intrinsic factor

It is a glycoprotein secreted from oxyntic cells with HCL.

It is essential for vit. B12 absorption **in ileum**.

In gastritis → **pernicious anemia** (↓ B12 anemia).

Secretion of Mucus

There are **two types** of mucus

1. Soluble thin mucus:

Secreted by **mucus neck cells** by vagal stimulation as muco-proteins to lubricate gastric chyme.

2. Insoluble thick mucus:

Secreted by **the surface epithelium**

Viscid alkaline mucus layer to protect gastric wall from digestion & acidity.

N.B: the gastric mucosal barrier is protected by:

- 1) The insoluble thick alkaline (1 mm layer).
- 2) The mucosal cells are **impermeable** to H^+ which is pumped to the lumen .
- 3) Prostaglandins stimulate the previous two factors and **antagonist HCL secretion**
- 4) The tight junction between mucosal cells to prevent passing HCL in between cells.

N.B: Duodenum is protected by mucosal barrier + pancreatic alkaline secretion.

Secretion of gastrin hormone

It is a polypeptide of 3 types according to number of amino acids G34, G17 (most important) and G14.

It is secreted from:

G-cells: in **pyloric antrum**, flask - shaped cells

Action of gastrin

- **Stomach:** ↑ growth & secretion & motility.
- **Pancreas:** ↑ exocrine and endocrine secretion.
- **Sphincters:** - Lower esoph. → Contraction.
- Ileocecal → Relaxation.

Control of gastric secretion

- **Nervous and hormonal**

Three phases

- A- Cephalic phase: (25 %)**

- It is a nervous phase activated by conditioned and unconditioned reflexes:

- In the conditioned reflex:** Psychic stimulation of cerebral cortex will stimulate the vagal nuclei.

- In the unconditioned reflex:** Direct contact of food stimulate taste buds which give afferent to the vagal nuclei ,then the vagal nuclei stimulate gastric secretion by:

- 1.Direct stimulation of gastric glands (**ACh**) 2.Release of gastrin hormone

This is proved by :

- **Sham feeding:**

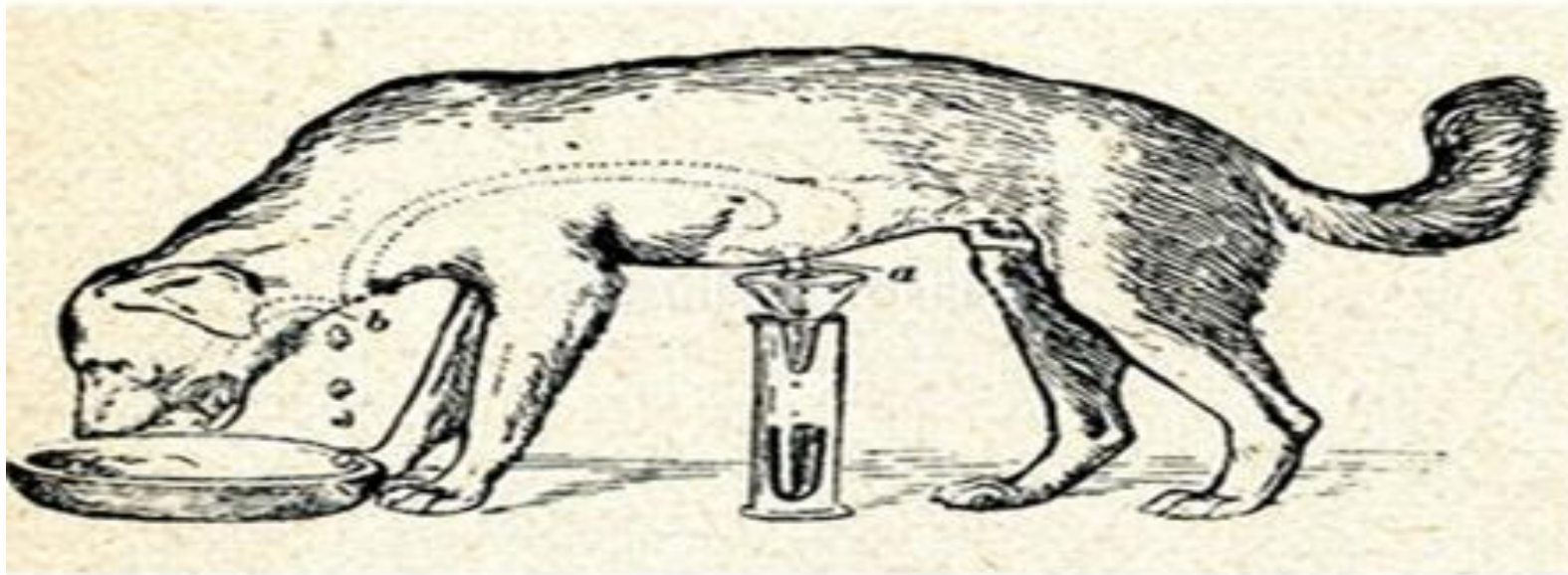
The esophagus is made to open in neck, so the food swallowed will pass to outside through this fistula & part of the stomach is made into a pouch to outside.

The blood & nerve supply is kept intact.

- **Denervated pouch:**

The nerve supply to the pouch is cut but the blood supply is intact.

Sham feeding increases gastric secretion but not in **Denervated pouch**. So, secretion depends on **intact vagal nerve**.



Sham feeding

B- Gastric phase : (70 %)

The presence of food in the stomach → increase gastric secretion by **mechanical**, **chemical** and **neural stimuli** as the following:

- **Gastrin secretion**: by direct stimuli as polypeptides, alcohol and caffeine or via local and vago-vagal reflex
- **Local nerve plexus**: by distension or polypeptides → stimulate Meissner's plexus → ↑ secretion.
- **Vago-vagal long reflex**: food in stomach → afferent vagus to vagal nuclei & efferent vagal → increase in gastric secretion so inhibited by **atropine**.

C-Intestinal phase:

The presence of food in the **duodenum**, inhibit the gastric secretion: as the following:

In the duodenum: presence of acid, fats or hyperosmotic solution in the duodenum will inhibit the gastric secretion via:

1- Nervous mechanism (Entero-gastric reflex)

- It is stimulated by presence of acid, fats or hyperosmotic solution in the duodenum or distention of the duodenum will **inhibit the gastric secretion**.
- The reflex is conducted in the many ways:
directly through the enteric nervous system & through signals to autonomic centers to activate sympathetic fibers (splanchnic nerves)
- **The response and the importance:**
 1. Inhibition of gastric secretion and motility
 2. Protection of duodenum from over distention by increase in the tone of pyloric sphincter → delay the emptying.
 3. Protection of duodenum from hyperacidity (till neutralized by alkaline duodenal secretion).
 4. Insure protein digestion.

2- Hormonal mechanism (Enterogastrone hormone)

- It is stimulated by the presence of fats and fatty acids → the release of many hormones from the duodenum [cholecystokinin (CCK), secretin, gastric inhibitory peptide (GIP)] → hormonal feed-back inhibition of gastric secretion and motility for complete digestion of fat.

N.B. :Gastric-inhibitory peptide (GIP):

is a duodenal hormone secreted in response to presence of glucose and fat in the duodenum and causes inhibition of gastric function and stimulate the insulin hormone release from pancreas.

A vibrant sunset scene with a bright sun partially obscured by dark, silhouetted mountains. The sky is a mix of deep reds, oranges, and purples, with scattered clouds catching the low light. The sun's reflection is visible on the dark water in the foreground. Overlaid on this scene is the text 'THank you' in a bold, blue, sans-serif font with a white outline. The 'T' is significantly larger than the other letters, and the 'H' is also large, making the word 'THank' stand out. The 'you' is in a smaller, regular weight of the same font.

THank you