Gastrointestinal (GI) Hormones

Kaleb Martin Archer, MD
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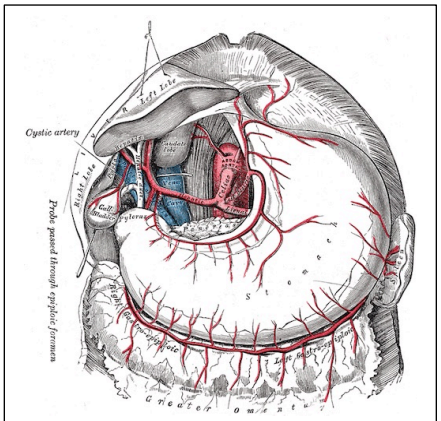
Hormones of the Stomach

Gastrin MN



Stomach [1]

- Functions:
  - Stimulates Stomach Parietal Cells to **Secrete HCl**
    - Primarily Done by Stimulating Enterochromaffin-Like (ECL) Cells to Release Histamine [2]
    - Also Has Some Direct Stimulation
  - Stimulates Stomach Chief Cells to Secrete Pepsinogen
  - Trophic Effects on Enterochromaffin-Like (ECL) Cells and Parietal Cells – Can Cause Mucosal Hyperplasia [3]
- Produced by **G Cells** of the Stomach [4]
- Stimulated By:
  - **Amino Acids** in the Stomach from Protein Digestion – Most Potent Stimulator
    - Phenylalanine and Tryptophan are the Strongest [5]
  - Alkaline Environment
  - Acetylcholine from Vagal Stimulation
  - Gastric Distention
  - Bombesin (Gastrin-Releasing Peptide)
- Inhibited By:
  - HCl in the Stomach – Negative Feedback
  - Somatostatin
- Multiple Forms: G34 (Big Gastrin), G17 (Little Gastrin), etc

Somatostatin (SS) MN

- Functions:
  - Inhibits Stomach Parietal Cells to Decrease HCl Secretion [6]
  - Inhibits Gastric Emptying
  - Inhibits Pancreatic Secretion (Insulin, Glucagon, and Pancreatic Enzymes)
  - Inhibits Bile Secretion [7]
  - Inhibits Growth Hormone, Thyroid Stimulating Hormone, and Procalcitonin in the Hypothalamus
  - Inhibits Intestinal Transport of Nutrients
  - Inhibits Splanchnic Blood Flow [8]
- Produced by **Delta (D) Cells** of the Stomach, Duodenum, and Pancreas [9]
- Stimulated By:
  - Acid in the Duodenum [9]
- Inhibited By:
  - Acetylcholine from Vagal Stimulation [9]
- Two Forms: SS-14 and SS-28
- Octreotide is a Somatostatin Analog Used for Various Treatments [10]

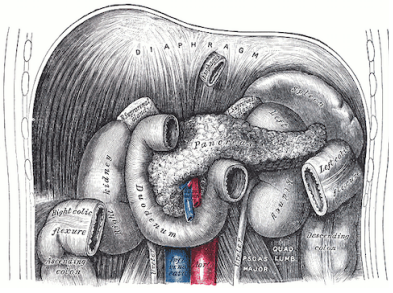
Ghrelin MN

- Function:
  - Stimulates Hunger – Primary Function
  - Increases Gastric Emptying and Acid Secretion [9]
  - May Raise Blood Glucose [11]
- Produced by Enterochromaffin Cells of the Stomach & Duodenum
- Levels are Highest Before Meals
- Levels are Significantly Decreased After Gastric Bypass – Enhances Weight Loss [12]

Hormones of the Small Intestine

Cholecystokinin (CCK) MN

- Functions:
  - Stimulates Gallbladder Contraction [13]
  - Stimulates Sphincter of Oddi Relaxation [14]
  - Stimulates Acinar Cells of the Pancreas to Secrete Digestive Enzymes [15]
  - Suppresses Hunger [16]
- Produced by **I Cells** of the Duodenum [17]



Duodenum [1]

- Stimulated By:
  - **Amino Acids and Fatty Acids** in the Duodenum – Strongest Stimulator [17]
  - Acetylcholine from Vagal Stimulation [17]
  - CCK-Releasing Peptide (Monitor Peptide) [18]
- Inhibited By:
  - Somatostatin – By Inhibition of CCK-Releasing Peptide [19]

Secretin MN

- Functions:
  - Stimulates **Bicarbonate Secretion** in the Pancreas – Primary Action [20]
  - Stimulates Bile Secretion [20]
  - Inhibits Gastrin Secretion [21]
  - Inhibits Stomach Parietal Cells to Decrease HCl Secretion [21]
  - Inhibits Gastric Motility [21]
- Produced by **S Cells** of the Duodenum [22]
- Stimulated By:
  - Acid in the Duodenum – Primary Stimulator [20]
  - Fatty Acids in the Duodenum [23]
  - Bile Salts in the Duodenum [23]

Motilin MN

- Primary Function: Stimulates Peristalsis and Gut Motility [21]
  - By Stimulating the Migrating Myoelectric Complex (MMC)
  - Initiated in the Stomach Antrum and Propagates Distally [21]
  - Secretion Peaks Every 100 Minutes Between Meals to Control Inter-Digestive Phase III Contractions [24]
  - "Housekeeper of the Gut" by Clearing Out and Making Ready for the Next Meal
- Produced by Mo Cells of the Duodenum and Jejunum [25]
- Stimulated By: [26]
  - Bile
  - Free Fatty Acids
  - Duodenal Acid
  - *Overall Stimulation is Poorly Understood
- Erythromycin (Antibiotic) Stimulates Motilin and is Often Used to Stimulate GI Motility [27]

Incretins (GIP and GLP-1)

- Definition: Hormones That Augment Insulin to Decrease Blood Glucose Levels
- *Gastric Inhibitory Peptide (GIP)*
  - Also Known As: Glucose-Dependent Insulinotropic Polypeptide
  - Functions:
    - Stimulates Insulin Secretion – Primary Function [28]
    - Weak Gastric Acid Inhibitor – Traditional Effect the Peptide Was Named For [29]
  - Produced by K Cells of Duodenum [30]
  - Stimulated by Glucose in the Duodenum

- *Glucagon-Like Peptide-1 (GLP-1)*
  - Primary Function: Stimulates Insulin Secretion [31]
  - Produced by L Cells of the Ileum and Colon [32]
    - Some in the Duodenum and Jejunum as Well
  - Stimulation Not Inhibited by Type 2 Diabetes [33]

Additional Hormones

- *Glucagon-Like Peptide-2 (GLP-2)*
  - Functions: [34]
    - Enhancement and Growth of Intestine
    - Stimulates Gastric Acid Secretion
  - Produced by L Cells of the Ileum and Colon (Co-Secreted with GLP-1) [34]
  - Analogs Used to Treat Short Bowel Syndrome [35]
- *Vasoactive Intestinal Polypeptide (VIP)*
  - Functions: [36]
    - Stimulates Intestinal Secretion and Absorption
    - Stimulates Bile Secretion
    - Stimulates Vasodilation
    - Relaxes Smooth Muscle (Lower Esophageal Sphincter and Colon)
  - Primarily Secreted by Neurons [37]
- *Peptide YY (Peptide Tyrosine Tyrosine)*
  - Functions:
    - Inhibits Gastric Emptying and Intestinal Motility [38]
    - Inhibits Pancreatic Secretion [39]
    - Inhibits Gallbladder Contraction [40]
    - Stimulates Water and Electrolyte Absorption in the Colon
    - Inhibits Appetite [41]
  - Produced by L Cells of the Ileum and Colon [42]
  - Stimulated by Protein and Fat [43]
- *Bombesin*
  - Functions:
    - Stimulates Gastrin Release and Gastroprotection [44]
    - Stimulates Cholecystokinin (CCK) Release [45]
    - Negative Feedback to Stop Eating Behavior – Second Only to CCK [46,47]
  - Produced Throughout the GI Tract and Brain

Hormones of the Pancreas

Hormones of the Pancreas

- *See Pancreas Physiology

Mnemonics

Hormone Secreting Cells

- G-G: G Cells Secrete Gastrin
- D (Double-SS): D Cells Secrete Somatostatin
- S (Single-S): S Cells Secrete Secretin
- I-CCK ("Icky"): I Cells Secrete CCK

Gastric Hormone Functions

- *Gastrin*: "Gastrin-Gastric"
    - Gastrin Stimulates Gastric Specific Functions
- *Somatostatin*: S-STATIN – STASIS
    - "Stasis" Inhibits All Other Functions
    - Known as "The Great Inhibitor"
- *Ghrelin*: "Ghrelin Growls"
    - Ghrelin Stimulates Hunger

Small Intestine Hormone Functions

- *Cholecystokinin*: *Chole*, "Bile"; *Cysto*, "Sac"; *Kinin*, "Move"
    - Greek Origin Equates to Gallbladder Contraction
- *Secretin*: Secretin-Secretes
    - Stimulates Bile and Pancreatic Bicarbonate Secretion
- *Motilin*: Motilin-Motility
    - Stimulates Motility

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