PITUITARY HORMONES: An Overview

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What are the major sections in the Pituitary Gland?

- Pituitary Gland contain two major sections:
  - **Anterior Pituitary** (Adeno-hypophysis):
    - Glandular Anterior Lobe
  - **Posterior Pituitary** (Neuro-hypophysis):
    - Neuronal Posterior Lobe
- Different mechanisms regulate the hormones produced from each section;

How is the Pituitary function regulated?

- Hypothalamus regulates Pituitary Function;
  - Hypothalamus is connected to Anterior Pituitary via Hypothalamic-Hypophysial Portal System (HHPS):
    - HHPS are capillaries that carries blood from Hypothalamus to Anterior Pituitary and back to Hypothalamus;
- **Releasing Hormones** produced in the **Ventral Hypothalamic Neurons** are carried via the Hypothalamic Portal System into the **Anterior Pituitary** where they stimulate or inhibit the production of **Anterior Pituitary hormones**;

- Hypothalamus is connected to the Posterior Pituitary via the Hypothalamic Tract;
- **Para-ventricular and Supra-optic nuclei** of the Hypothalamus secrete hormones into the **Posterior Pituitary** for storage and release in the blood;

What are the Anterior Pituitary Hormones?

- Hormones released by Anterior Pituitary;
- There are **Six Anterior Pituitary Hormones:**
  - Thyroid Stimulating Hormone (**TSH** or Thyrotropin),
  - Follicle Stimulating Hormone (**FSH,** Gonadotrophin),
  - Luteinizing Hormone (**LH**, Gonadotrophin),
  - AdrenoCorticoTropic Hormone (**ACTH** or Corticotrophin)
  - Growth Hormone (**GH**)
  - Prolactin (**PRL**)

What are the primary targets of Anterior Pituitary Hormones?

- **TSH**: Target is **Thyroid Gland**;
- **FSH**:
  - Targets in females: **Follicles in the Ovaries**,
  - Targets in males: **Testes**,
- **LH:**
  - Targets in females: **Follicles**,
  - Targets in males: **Testes**,
- **ACTH**: Targets in **Adrenal Cortex**,
- **GH**: Targets in **most tissues** in the body;
- **PRL**: Targets in **Mammary glands**;

What are the major functions of Anterior Pituitary Hormones?

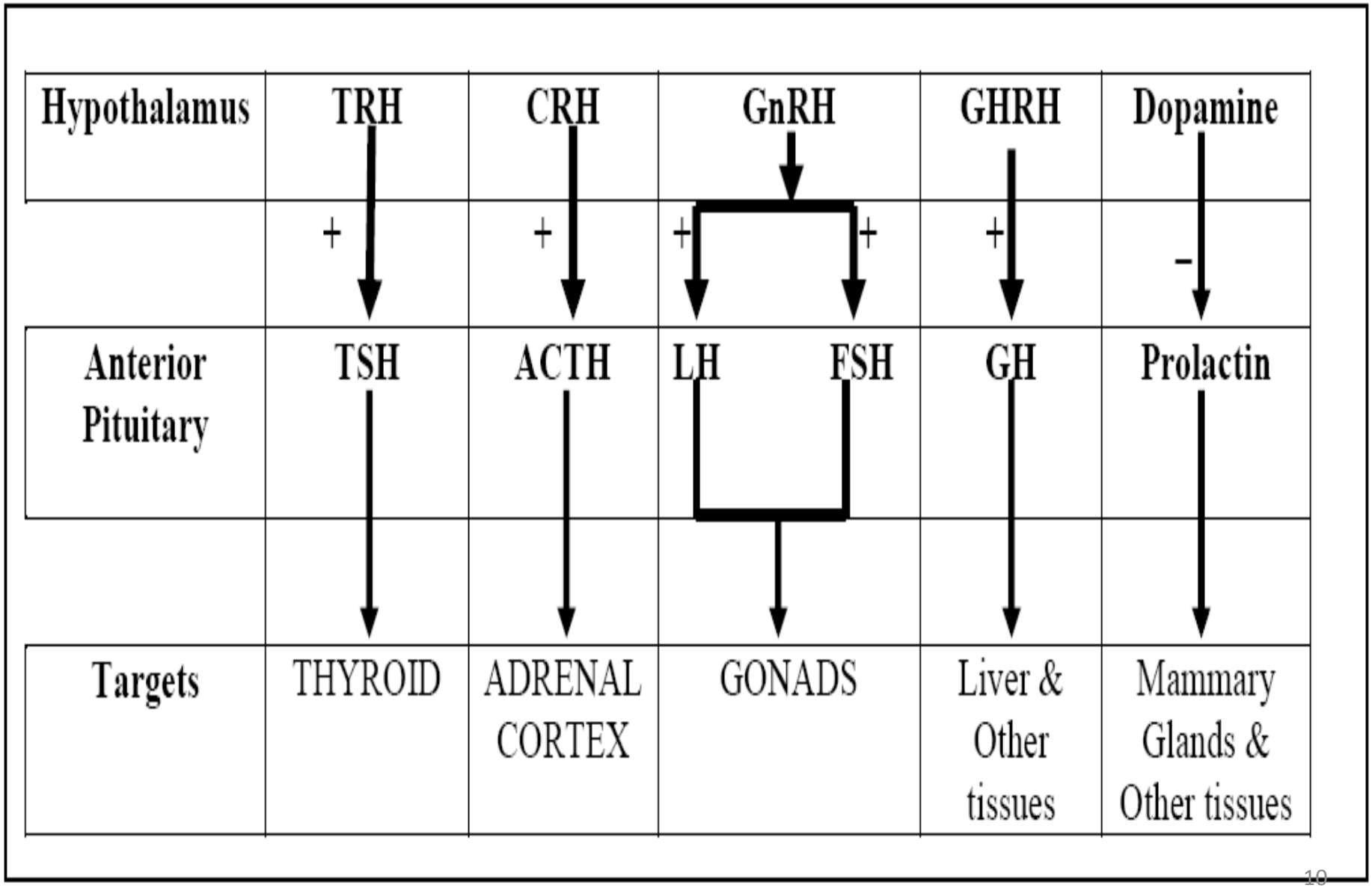
- **Major functions:**
- **TSH**: Stimulates secretion of Thyroid Hormones;
- **LH**:
  - **In Females**: Triggers Ovulation, increases secretion of Estrogen, Progesterone;
  - **In Males**: Stimulates production of Testosterone;
- **FSH**:
  - **In Females**: Stimulates growth and maturation of Follicle (Oocyte);
  - **In Males**: Stimulates Sperm production and maturation;
- **ACTH**: Causes the secretion of Glucocorticoid;

- **GH**:
  - Stimulates metabolism and growth of body tissues,
  - Stimulates Protein synthesis and Lipolysis,
  - Stimulates production of Insulin-like Growth Factor (IGF) in Liver,
  - **Diabetogenic action**: decreases glucose uptake in cells, thus resulting in increase blood glucose level;
- **PRL**:
  - Stimulates development of mammary glands,
  - Stimulates Lactation in females;
  - Inhibits ovulation by blocking Gonadotrophin Releasing Hormone (GnRH),
  - Function is males not well defined;

How are the Anterior Pituitary Hormones regulated?

- Anterior Pituitary hormones are regulated by **Hypothalamic Factors** (**Releasing Hormones**) from the Ventral Hypothalamus;
- **Fig. 1**: **Hypothalamic-Anterior Pituitary -Axis**:
  - Diagrammatic representation of Hypothalamic Factors (Releasing Hormones) and corresponding hormones produced in the Anterior Pituitary;

Fig. 1: Hypothalamic-Anterior Pituitary Axis:



What are the Hypothalamic Factors (Releasing Hormones)?

- Hypothalamic factors or releasing hormones are:
  - Thyrotropin Releasing Hormone (**TRH**);
  - Gonadotrophin Releasing Hormone (**GnRH**);
  - Growth Hormone Releasing Hormone (**GHRH**);
  - Corticotrophin Releasing Hormone (**CRH**);
  - Dopamine (**DA**) or Prolactin Inhibitory Factor (**PIF**);
  - Somatostatin (**SS**);

What are the functions of the Hypothalamic Factors (Releasing Hormones)?

- With the exception of Prolactin, the hypothalamic factors enhances secretion of Pituitary Hormones;
- Specific functions are as follows:
  - **TRH**: Induces secretion of **TSH** and **Prolactin**;
  - **GnRH**: Induces secretion of **LH** and **FSH**;
  - **GHRH**: Induces secretion of **GH**;
    - **Gherelin**: Peptide hormone released from epithelial cells lining the fundus of the stomach acts on the Anterior Pituitary to **enhance** secretion of **GH**;

- **CRH**: Induces production of Proopiomelanocortin (POMC),
  - POMC is then hydrolyzed to ACTH, gamma-MSH and beta-Lipotrophins,
- **Dopamine** or **Prolactin** Inhibitory Factor (PIF):
  - Inhibits release of Prolactin;
- **Somatostatin** (**SS**): Inhibits release of **GH**, **TSH;**

What are the major classes of Anterior Pituitary Hormones and how are they related?

- **Three** major classes (categories) of Anterior Pituitary Hormones:
- **Glycoprotein Hormones**:
  - They contain alpha-subunits and beta-subunits,
  - Alpha-subunits are similar,
  - Beta-subunits have hormonal activity;
- **Growth Hormone –Related Hormones (GHRH)**:
  - GH is a polypeptide,
  - GH is homologous with Prolactin and Human Placental Lactogen
- **Corticotrophin-related Hormones**:
  - They are components of Proopiomelanocortin (POMC);

What hormones are in the Glycoprotein class?

- Hormones in the Glycoprotein class are:
  - **LH,**
  - **FSH,**
  - **TSH,**
  - Human Chorionic Gonadotrophin (**h CG**) – from Placenta;

What are the hormones in the GHRH class?

- Hormones in the GHRH class include:
  - **GH,**
  - **Prolactin (PRL),**
  - **Human Placental Lactogen (HPL) – from Placenta**
  - **Insulin-like Growth Factor (IGF) – from Liver;**

What are the hormones in the CRH class?

- Hormones in the CRH class are:
  - **ACTH,**
  - **MSH,**
  - **Endorphins,**
  - **Enkephalins,**
  - **Lipotrophins;**

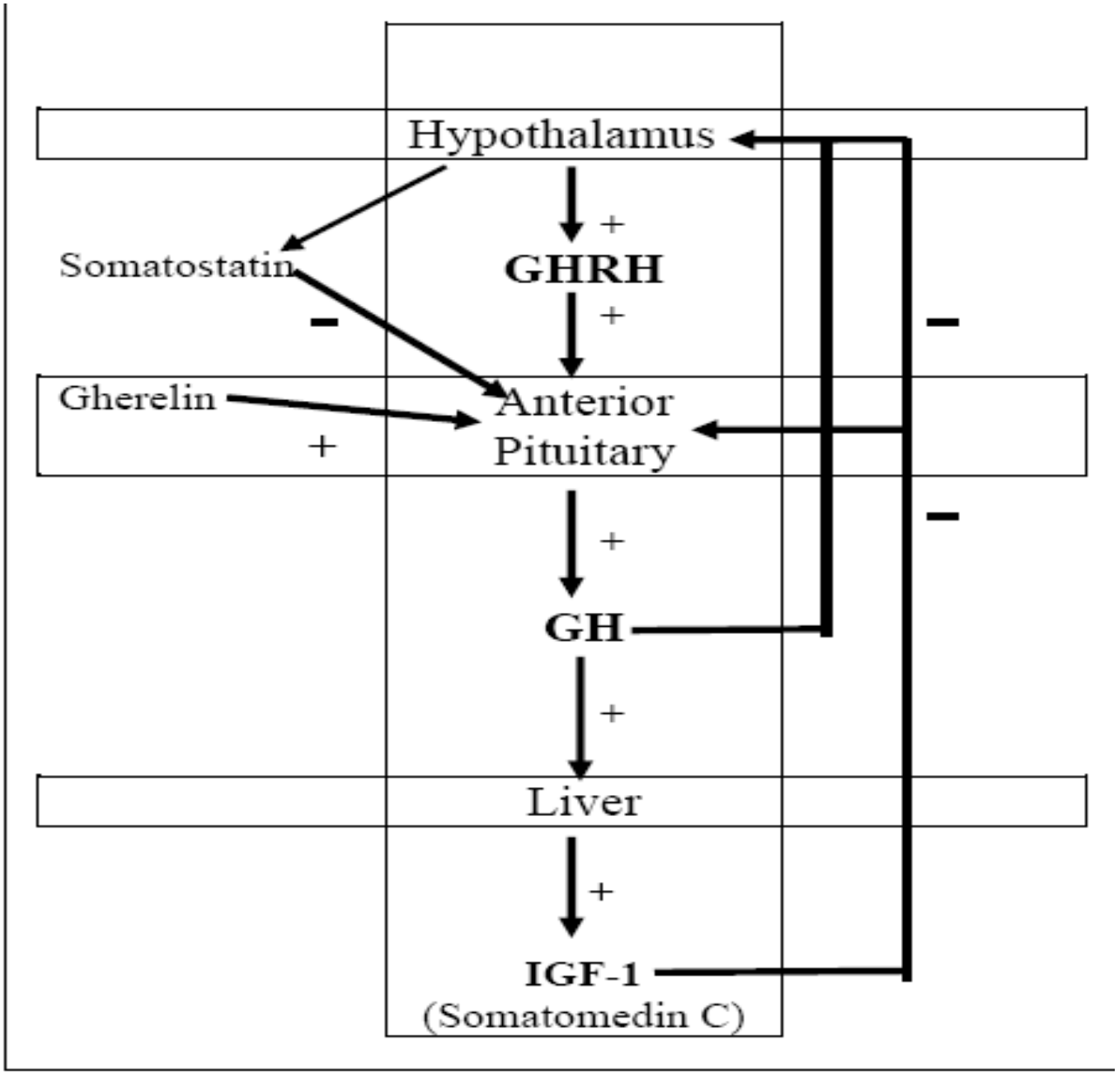
What factors affect secretion of Growth Hormone?

- Secretion of GH can be **enhanced** by:
  - **GHRH,**
  - **Somatostatin;**
  - **Sleep, Stress, Exercise,**
  - **Starvation,**
  - **Hypoglycemia;**
- Secretion of GH can be **suppressed** by:
  - **GH (Negative Feedback control)**
  - **IGF**
  - **Obesity,**
  - **Hyperglycemia;**

What mechanism regulates secretion of Growth Hormone?

- GH is regulated by Negative Feedback Mechanism
- **Fig 2**:
  - Diagrammatic representation of Negative Feedback mechanism for regulation of GH secretion;
  - **Hypothalamus – Anterior Pituitary – Axis** for GH
  - **Role of Gherelin** and **Somatostatin** are indicated in the diagram;

Fig. 2: Hypothalamus – Anterior Pituitary – Axis for GH



Briefly explain the regulation of GH secretion (Fig. 2)

- Hypothalamus secretes GHRH,
- GHRH acts on Anterior Pituitary to produce GH,
- GH acts on Liver to produce Somatomedins peptides;
  - Insulin-like Growth Factor-1 (IGF-1) called Somatomedin C is the major factor produced;
  - Gherelin, from stomach also stimulates GH secretion;
- High levels of IGF-1 and GH stimulate production of Somatostatin in the Hypothalamus,
- Somatostatin inhibits the secretion of GH;
- High plasma levels of IGF-1 exert Negative Feedback on Anterior Pituitary to modify action of GHRH and to inhibit secretion of GH;

What factors that affect secretion of Prolactin?

- Secretion of Prolactin can be **enhanced** by:
  - **TRH,**
  - **Dopamine Antagonists,**
  - **Breast-feeding,**
  - **Pregnancy,**
  - **Stress,**
- Secretion of Prolactin can be **suppressed** by:
  - **Dopamine (PIF),**
  - **Dopamine Agonists,**
  - **Prolactin (Negative Feedback control),**
  - **Somatostatin,**

What are the Posterior Pituitary Hormones?

- Posterior pituitary produces two polypeptide hormones;
  - **Arginine Vasopressin (AVP**)
    - Formally called Anti-Diuretic Hormone (ADH);
  - **Oxytocin**;

What are the functions of Posterior Pituitary Hormones?

- Functions of Posterior pituitary hormones:
- **Arginine Vasopressin (AVP)**:
  - Increases Aquaporins on distal tubules and collecting ducts in Kidneys;
    - Action causes Reabsorption of water via distal tubules and collecting ducts;
  - Causes constriction of Vascular Smooth Muscle;
- **Oxytocin**:
  - Induces contraction of Uterus;
  - Increases Milk production by inducing contraction of mammary glands;

What factors affect the secretion of Oxytocin?

- Oxytocin secretion is regulated by several factors:
  - Secretion is regulated via the Neuro-endocrine reflex arc initiated by suckling;
  - Dilation of the Cervix,
  - Breast-feeding,

What factors affect the secretion of Arginine Vasopressin?

- Factors that causes **increase secretion** of AVP:
  - Increased Plasma Osmolality (sensed by Hypothalamic Osmo-receptors),
  - Reduction in blood volume (sensed by Cardiac Baro-receptors),
  - Reduction in blood pressure,
  - Stress,
  - Hypoglycemia,
  - Nausea,
  - Pain,

- Factors that causes **decrease secretion** of AVP:
  - Decrease Plasma Osmolality,
  - Release of Atrial Natriuretic Peptide (ANP),
  - Alpha-Agonists,

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