

UNIVERSITY OF PNG
SCHOOL OF MEDICINE AND HEALTH SCIENCES,
DIVISION OF BASIC MEDICAL SCIENCES,
DISCIPLINE OF BIOCHEMISTRY AND MOLECULAR BIOLOGY
PBL SEMINAR
PITUITARY HORMONES: An Overview

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 the Pituitary Function;
 - Hypothalamus is connected to the Anterior Pituitary via the 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 the Anterior Pituitary
- There are six Anterior Pituitary Hormones
 - Thyroid Stimulating Hormone (TSH or Thyrotropin)
 - Follicle Stimulating Hormone (FSH, a Gonadotrophin)
 - Luteinizing Hormone (LH, a Gonadotrophin)
 - Adrenocorticotrophic Hormone (ACTH, or Corticotrophin)
 - Growth Hormone (GH)
 - Prolactin (PRL)

What are the primary targets of the Anterior Pituitary Hormones?

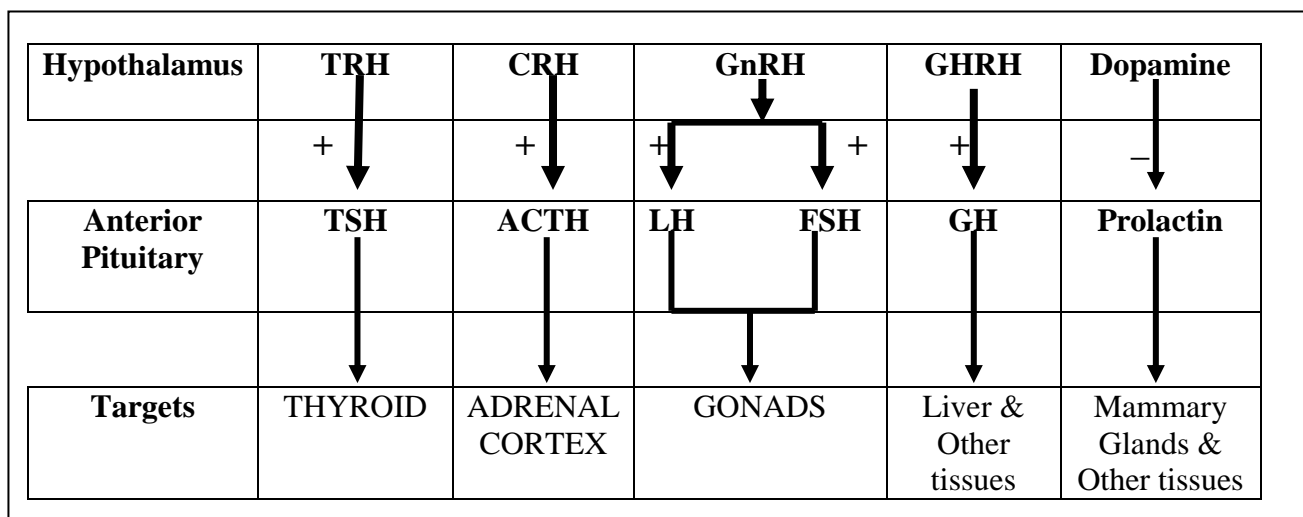
- TSH:
 - Target is Thyroid Gland
- FSH:
 - Targets in females: Follicles in the Ovaries;
 - Targets in males: Testes;
- LH:
 - Targets in females: Follicles;
 - Targets in males: Testes
- ACTH:
 - Targets: Adrenal Cortex
- GH:
 - Targets: Most tissues in the body;
- Prolactin (PRL):
 - Targets: Mammary glands;

What are the major functions of the Anterior Pituitary Hormones?

- TSH:
 - Function: Stimulates secretion of Thyroid Hormones;
- LH:
 - Functions in females: Triggers Ovulation, increases secretion of Estrogen, Progesterone;
 - Function in males: Stimulates production of Testosterone;
- FSH:
 - Functions in females: Stimulates growth and maturation of Follicle (Oocyte);
 - Functions in males: Stimulates Sperm production and maturation;
- ACTH:
 - Function: Causes the secretion of Glucocorticoid;
- GH:
 - Functions:
 - 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;
- Prolactin (PRL):
 - Functions:
 - Stimulates development of mammary glands
 - Stimulates Lactation in females;
 - Inhibits ovulation by blocking Gonadotrophin Releasing Hormone (GnRH)
 - Function in 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 the corresponding hormones produced in the Anterior Pituitary



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 the secretion of Pituitary Hormones;
- Specific functions are as follows:
 - TRH: Induces the secretion of TSH and Prolactin;
 - GnRH: Induces the secretion of LH and FSH;
 - GHRH: Induces the 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 the production of Proopiomelanocortin (POMC),
 - POMC is then hydrolysed 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?

- There are three major classes (categories) of Anterior Pituitary Hormone:
 - 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?

- There are Four Hormones in the Glycoprotein class
 - 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;

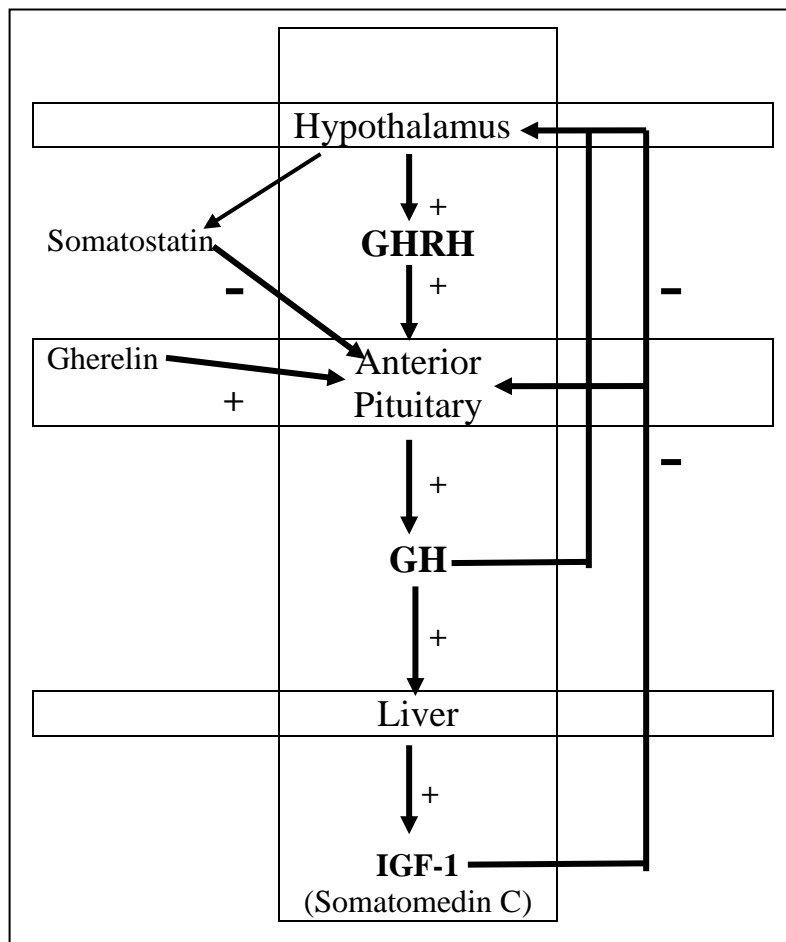
What are the factors that affect secretion of Growth Hormone?

- Secretion of GH can be enhanced by:
 - GHRH, Somatostatin;
 - Sleep, Stress, Exercise, Starvation, Hypoglycemia;
- Secretion of GH can be suppressed by:
 - GH and IGF-1 (Negative Feedback control)
 - Obesity;
 - Hyperglycemia;

What feedback mechanism regulates secretion of Growth Hormone?

Fig 2:

Diagrammatic representation of Feedback mechanism for regulation of GH secretion (Hypothalamus – Anterior Pituitary – Axis for GH)



Feedback mechanism that regulates secretion of GH (Fig. 2)

- Hypothalamus secretes GHRH,
- GHRH acts on the Anterior Pituitary to stimulate release of GH,
- GH acts on the Liver to produce group of peptides called Somatomedins,
 - Insulin-like Growth Factor-1 (IGF-1) also called Somatomedin C is the major factor produced;
- Gherelin, a peptide produced in the stomach also stimulates secretion of GH;
- 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 the Anterior Pituitary to modify the action of GHRH and to inhibit secretion of GH;

What are the factors that can 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 the Posterior Pituitary Hormones?

- Functions of the Posterior pituitary hormones are as follows:
- **Arginine Vasopressin (AVP):**
 - Increases Aquaporins on the distal tubules and collecting ducts;
 - 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 can affect the secretion of Oxytocin?

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

What are the factors that 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,