

EFFECTS OF HORMONES IN PHYSIOLOGICAL MECHANISMS

by

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OUTLINE

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- Hormones of the pituitary
- Thyroid and parathyroid hormones
- The adrenal gland
- Hormones of the pancreas
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- Hormones of the liver
- Hormones of the skin

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INTRODUCTION

•Hormones are blood bound substances involved in regulating a variety of processes

•The endocrine system form an important communication system that serves to regulate, integrate and coordinate variety of different physiological processes namely:

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❖The digestion, utilisation and storage of nutrients

❖Growth and development

❖Ion and water balance

❖Reproductive functions

There are two major classes of hormones:
Proteins, peptides, amino acids and steroids

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HORMONES REGULATION

The regulations of hormones circulating in the blood are tightly controlled by 3 homeostatic mechanisms.

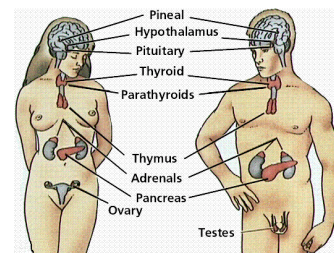
-When 1 hormone stimulates the production of a second, the second suppresses the productions of the first e.g. FSH/oestrogen

-Antagonistic pair of hormones e.g. insulin and glucagon

-Hormones secretion is increased (or decreased) by the same substance whose level is decreased by the hormones e.g. calcium and parathyroid hormone

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Locations of Endocrine glands in the body



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HORMONES OF THE PITUITARY

-The pituitary gland is a pea sized structure located at the base of the brain.

-In humans, it consists of two lobes: The anterior lobe and the posterior lobe

A. THE ANTERIOR LOBE

-It contains 6 types of secretory cells all but one of which are specialised to secrete only one of the anterior lobe hormones.

-All of them secrete their hormones in response to hormones reaching them from the hypothalamus of the brain

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a. THYROID STIMULATING HORMONES(TSH)

-This is a glycoprotein consisting of a beta chain of 112 amino acids(aa) and alpha chain of 89 aa

-The alpha chain here is similar to that found in FSH and LH as well as Chorionic gonadotrophine.

-It is stimulated by Thyrotropin stimulating hormones and inhibited by the arrival of somatostatin from the hypothalamus.

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FUNCTIONS OF TSH

-TSH stimulates the thyroid gland to secrete thyroxine

-It does this by binding to transmembrane G protein coupled receptor (GPCR) on the surface of the cells of the thyroid gland

-Development of antibodies against TSH receptor leads to hyperthyroidism.

-This condition is also called **Thyrotoxicosis or graves disease**

-Deficiency of TSH causes Hypothyroidism.

-Some people can inherit mutant SH receptors which results in Hypothyroidism and by so doing causes **Osteoporosis**.

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b. FOLLICLE STIMULATING HORMONES (FSH)

-It is a heterodimeric glycoprotein consisting of the same alpha chain as in TSH and a beta chain of 150aa

-The synthesis and release of FSH is triggered by the arrival of Gonadotropin releasing hormones (GnRH) from the hypothalamus.

-The effect of FSH depends on sex

i. FSH in females

In sexually matured females, FSH (assisted by LH) act on the follicle to stimulate it to release oestrogen

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ii. FSH in males

-In sexually matured males, FSH act on spermatogonia stimulating (with the aid of testosterone) the production of sperm

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c. LUTEINIZING HORMONE (LH)

-It has most properties of FSH but differ in the way it function from FSH in both males and females

i. LH in females

-it stimulates the follicle to secrete oestrogen in the first half of the menstrual cycle

-Increase in LH triggers the completion of meiosis I of the egg and its release in the middle of the cycle

-It also stimulates the now empty follicle to develop into corpus luteum which secretes progesterone during the later half of the menstrual cycle

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d. GROWTH HORMONES (GH)

- It is a protein of 191 aa
- A GH secreting cell is stimulated to synthesise and release GH by the arrival of growth hormones releasing factor (GHRF) from the hypothalamus
- GH promotes body growth by binding to receptors on the surface of liver cells
- This stimulates them to release insulin like growth factor 1(IGF-I; also known as somatomedin).
- IGF-I acts directly on the end of the long bone promoting their growth

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EFFECT OF GH

- In childhood, hyposecretion of GH produces a stunted-but
- normal well-proportioned-growth of midget.
- Hypersecretion leads to gigantism.
- In adults, a hyper secretion of GH leads to acromegally

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e. ADRENOCORTICOTROPIC HORMONE (ACTH)

- ACTH is a peptide of 39 aa. It is cut from a large precursor proopiomelanocortin (POMC)
- ACTH act on the cells of the adrenal cortex, stimulating them to produce glucocorticoids like cortisol, mineralocorticoids like aldosterone, androgens (male sex hormones like testosterone)
- In the foetus, ACTH stimulates the adrenal cortex to synthesise a precursor of oestrogen called Dehydroepiandrosterone sulphate(DHEA-S) which help prepare the mother for giving birth

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- The production of ACTH depends on the intermittent arrival of corticotropine releasing hormone(CRH) from the hypothalamus

- f. ALPHA MELANOCYTE STIMULATING HORMONE (Alpha MSH)

- Alpha MSH is also a cleavage product of POMC. In fact alpha MSH is identical to the first 13 aa at the terminal of ACTH

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B. THE POSTERIOR LOBE

- The posterior lobe of the pituitary releases two hormones both synthesised in the hypothalamus into the circulation.

a.ANTIDIURETIC HORMONE (ADH)

- ADH is a peptide of 9 aa
- It acts on the collecting ducts of the kidney to facilitate the reabsorption of water into the blood by so doing reducing the volume of urine formed thus it named ADH
- A deficiency of ADH or inheritance of mutant gene for its receptors(V2) lead to excessive loss of urine, a condition known as **diabetes insipidus**

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b. OXYTOCIN

- Oxytocin is peptide of 9 aa
- It acts on certain smooth muscles stimulating contraction of the uterus at the time of birth
- It stimulates the release of milk when the baby begins to suckle
- It acts on the nucleus accumbens and amygdala in the brain where it enhances bonding between males and females after they have mated; Bonding between a mother and her new born; increase the level of ones trust in other people

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THYROID AND PARATHYROID

A. THYROID GLAND

- The thyroid gland is a double lobe structure located in the neck. Embedded in its rear surface are the four parathyroid glands
- It synthesise and secretes thyroxine (T_4) and calcitonin
- T_4 is a derivative of the aa tyrosine with 4 atoms of iodine
- The active form is triiodothyronin (T_3) formed when 1 atom of iodine is removed from thyroxine

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DISEASE OF THE THYROID

i. Hypothyroid diseases

- Cretinism
- Myxedema
- Goitre

ii. Hyperthyroid diseases

- Graves disease is an example of autoimmune disease. High levels of thyroid hormones suppress the production of TSH through the negative feedback mechanism mentioned. The resulting low level of TSH causes an increase in the number of bone reabsorbing osteoclasts resulting in osteoporosis

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cretinism



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Myxedema in Adult



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GOITRE



Encarta Encyclopedia, AFIP/Science Source/Photo Researchers, Inc.

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Calcitonin

- It is a polypeptide of 32 aa
- It controls the level of calcium ions in blood

B. PARATHYROID GLAND

- They are 4 tiny structures embedded in the rear surface of the thyroid gland. They secrete parathyroid hormones (PTH) a polypeptide of 84 aa
- It increase calcium ion concentration in blood
- 2 classes of inherited disorder involving mutant gene encoding the calcium ion receptor occur:

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- Loss of function
- Gain o function

Hyperparathyroidism

- It leads to the brittling and braking of bones

Hypoparathyroidism

- Damage of parathyroid during neck surgery
- Inherited mutation in the PTH gene

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ADRENAL GLAND

- The adrenal glands are two small structures situated unto of each kidney. Both in anatomy and in function, they consist of two distinct region:

An outer layer, the **adrenal cortex** which surrounds the **adrenal medulla**

Adrenal Cortex

- The adrenal cortex secretes a variety of steroid hormones. These fall in 3 classes:

- Glucocorticoids e.g. cortisol
- Mineralocorticoids e.g. aldosteron

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- Androgens e.g. testosterone

Hyposecretions of adrenal cortex

- Addison Disease

Hypersecretion of glucocorticoids

- Cushing's syndrome

ii. Adrenal medulla

- it consists of masses of neurones that are part of the sympathetic branch of the autonomic nervous system

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- Their neurones releases their neurotransmitter into blood
- The two main hormones involved are adrenaline and noradrenaline which is triggered by nervous stimulation in response to physical and mental stress
- The hormones bind to adrenergic receptors transmembrane protein in the plasma membrane of many cell types.
- Some effects are: increase in the rate and strength of heart beat resulting in increase blood pressure, rise in the blood sugar level, increase metabolic rate, bronchial dilation, pupil dilation, hair stand on each (Goose flesh in humans)

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Hormones of Pancrease

- Islet of langerhans contains four types of cells, namely:
 - Beta cells secreting insulin and amylin
 - Alpha cells which secrete glucagon
 - Delta cells secreting somatostatin and
 - Gamma cells secreting polypeptide.

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Diabetes Mellitus

There three categories of diabetes mellitus, namely:

- Insulin-dependent diabetes mellitus (IDDM) type 1
- Non-insulin dependent diabetes mellitus (NIDDM) type 2
- Inherited form of the diabetes.

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Diabetes mellitus



Hormones of the Gut

- The gut is very rich in hormones and the following main hormones will be looked into
- Gastrin (14 amino acids)
- Somatostatin (secreted by cells in the gastric gland)
- Secretin (27 amino acids)
- Cholecystokinin (CCK) with 8 amino acids
- Ghrelin (28 amino acids)
- Obestatin (23 amino acids)

Hormones of the gut continue

- Neuropeptide γ (NPY) containing 32 amino acids, functioning in increasing storage of ingested food as fat and also block the transmission of pain signal to the brain.
- Peptide YY₃₋₃₆ containing 34 amino acids and acts in reverse action with NPY.

Hormones of the liver

The three important hormones secreted by the liver are:

- Insulin-like growth factor 1 made up of 70 amino acids.
- Angiotensin
- Thrombopoietin (TPO) made up of 332 amino acids.

Hormones of the skin

- Dihydrocholesterol is triggered in response to ultra-violet ray, converting it to calciferol (vitamine D)
- Calciferol then travel to the liver via the blood where it is converted into 25 (OH) vitamine D where it is further converted into calcitriol (1-25 [OH]₂ vitamine D) in the kidney.

Hormones of the heart

In response to a rise in blood pressure, the heart responds to two peptides;

- A-type natriuretic peptide (ANP) with 28 amino acid
- B-type natriuretic peptide (BNP) with 29 amino acid.

THANKS FOR YOUR
PATIENCE AND KIND
ATTENTION****

