

Chemical Coordination and Integration

Endocrine Glands and Hormones..

- Neural system and endocrine system jointly coordinate and regulate psychological functions in body.
- Endocrine glands are ductless, their secretions are called hormones.
- Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts.

Human Endocrine System

- Endocrine system is chemical coordination system in body, consists of endocrine glands, their hormones and their modes of action.
- Human endocrine system consists of foll.^g glands → Hypothalamus, pituitary, pineal, thyroid, parathyroid, thymus, adrenal, pancreas and gonads.

HORMONES	FUNCTIONS	DISORDERS
Pituitary gland (Hormones of Pars distalis)		
Somatotropin (STH) or Growth Hormone (GH)	promotes growth by stimulating protein synthesis and tissue building.	Hypersecretion — Gigantism and acromegaly. Hyposecretion — Dwarfism.
Prolactin (PRL)	Regulates growth of mammary glands and formation of milk.	
Thyroid stimulating hormone (TSH)	Stimulates secretion of thyroid hormones from thyroid gland.	
Adrenocorticophic hormone (ACTH)	Stimulates synthesis and secretion of steroid hormone called glucocorticoid from adrenal cortex.	
Luteinizing (LH) hormone	Stimulates the synthesis and secretion of androgen from testis. Induces ovulation and maintains the corpus luteum.	
Follicle stimulating hormone (FSH)	Regulate spermatogenesis. Stimulates the growth and development of ovarian follicles.	

Pituitary gland (Hormones of Pars intermedia)

Melanocyte stimulating hormone (MSH)	Acts on melanocytes to regulate pigmentation of skin.	Hypersecretion - Hyper-pigmentation
Pituitary Gland (Hormones of neurohypophysis)		
Oxytocin.	Contracts the smooth muscles. Stimulates contraction of uterus at time of child birth, and milk ejection from mammary gland.	
Vasopressin or ADH.	Stimulates reabsorption of water and electrolytes by DCT of kidney.	Hyposecretion → Diabetes insipidus.

Hormones of pineal Gland..

Serotonin	Helps in vasoconstriction of blood vessels.	
Melatonin.	Regulates diurnal (24-hr) rhythm of body. Influences metabolism, pigmentation and menstrual cycle, influences our defense capability.	

Hormones Of Thyroid gland.

Thyroxin or tetraiodothyroxine (T ₄) and triiodothyroxine (T ₃)	Control metabolism of carbohydrates, protein and fats, regulation of basic metabolic rate (BMR), support RBC formation, maintenance of water and electrolyte balance.	Hyposecretion - cretinism in children, myxedema in adults. Hypersecretion - goiter, Graves disease.
Thyrocalcitonin (CTCT)	It regulates (lowers) blood calcium levels.	

Hormones of adrenal Gland.

Glucocorticoid (mainly cortisol)	Stimulate gluconeogenesis, lipolysis and proteolysis. Inhibit cellular uptake and utilization of amino acids. Maintain cardiovascular system and kidney functions. Stimulates RBC production. Produces anti-inflammatory reactions and suppress immune response.	Hyposecretion - Addison's disease. Hypersecretion - Cushing's syndrome, Adrenal Virilism, Gynaecomastia.
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Mineralocorticoids (mainly aldosterone)	Regulate the water (body fluid volume), electrolytic balance, osmotic pressure and blood pressure. Aldosterone stimulates the reabsorption of Na^+ and water from renal tubules and excretion of K^+ and PO_4^{3-} ions.	
Androgenic corticoids.	Role in growth of axial hair, pubic hair and facial hair during puberty.	
Adrenaline (epinephrine) and noradrenaline (norepinephrine)	Secreted in response to any stress emergency situation, so called emergency hormones (hormones of fight or flight) Increase alertness, pupillary dilation, piloerection (rising of hairs), sweating, heartbeat, heart contraction and rate of respiration. Stimulate breakdown of glycogen, lipids and proteins.	Hyposecretion — Low blood pressure and slow working of heart and lungs. Hypersecretion — Rise in blood pressure, rapid heart rate and breathing.

Hormones Of Pancreas.

Insulin (from β -cells)	Regulate glucose homeostasis. Stimulate glycogenesis.	Hyposecretion - Diabetes mellitus. Hypersecretion - Insulin shock.
Glucagon (from α -cells)	Increases blood sugar by stimulating glycogenolysis. Stimulate gluconeogenesis (hyperglycemic hormone).	Hyposecretion - Hypoglycemia

Hormones Of testis.

Testosterone / Leydig Cells.	Stimulates development of male Secondary sex characteristics and Sperm production.	Hyposecretion - poor development of sexual characters leading to feminism.
Inhibin	Inhibits FSH release from pituitary.	

Hormones Of Ovary..

Estrogen.	Stimulate development and maintenance of female Secondary sex characteristics. Stimulates maturation of Ova.	Hyposecretion — Failure Of development of secondary sex characters.
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Progesterone	Stimulates uterus for pregnancy and formation of placenta. Stimulates mammary glands.	Hyposecretion - Abortion
Hormones Of Heart, Kidney and Gastrointestinal Tract.		
Heart	Atrial natriuretic factor (ANF)	Reduces blood volume, blood pressure and Na^+ concentration.
Kidney	Erythropoietin	Stimulates erythropoiesis.
	Renin and Calcitriol	Stimulates release of aldosterone. Aids in absorption of Ca^{+2} .
Gastrointestinal Tract	Gastrin.	Acts on gastric glands and stimulates secretion of HCl and pepsinogen.
	Secretin	Acts on exocrine pancreas and stimulates secretion of water and bicarbonate ions.
	Cholecystokinin (CCK)	Acts on both, pancreas and gall bladder and stimulates secretion of pancreatic enzymes and bile juice.
	Gastric Inhibitory peptide (GIP)	Inhibits gastric secretion.

Parathyroid Gland

- parathyroid glands are present on backside of thyroid gland, one pair each in 2 lobes of thyroid gland.
- They secrete parathyroid hormone (PTH) - a peptide hormone.

Functions of parathyroid hormone

- Rise Ca^{+2} levels in blood (hypercalcaemic hormone).
- Stimulates bone resorption (demineralization).
- Stimulates reabsorption of Ca^{+2} by renal tubules and increase Ca^{+2} absorption from digested food.
- along with TCT, help in calcium balance in body.

Thymus..

- Located on dorsal side of heart and aorta.
- Secreates thymosin (peptide hormones)
- Thymus is degenerated in old individuals. So, production of thymosin decreases. As result, immune response of old person becomes weak.

Functions Of Thymosin

- Differentiation of T-lymphocytes, which provide cell-mediated immunity.
- promote production of antibodies for Humoral Immunity.

Mechanism Of Hormone Action...

Based on chemical nature, hormones of various types: →

peptide, polypeptide, protein hormones	eg- Insulin, Glucagon, pituitary hormones, hypothalamic hormones....
Steroids.	eg- cortisol, testosterone, estradiol and progesterone.
Iodothyronines	eg- thyroid hormones.
Amino-acid derivatives.	eg- Adrenaline, Nor-adrenaline

a) Located on membrane of target cell →

→ These are membrane bound receptors.

→ Form hormone receptor complex

↓
Leads to biochemical changes in tissue.

↓
Release of secondary messengers like (Cyclic amp., IP_3 , Ca^{++} ...) which regulate cellular metabolism.

b) Located inside target cell →

→ These are intracellular receptors

→ Hormones (steroid hormones, iodothyronines etc) interact with them and cause physiological and development effects of regulating gene expression.

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