



CHEMICAL COORDINATION AND INTEGRATION

Endocrine glands : Lack duct and are called ductless gland.

→ Secretion are called **Hormone**.

Hormones : Hormones are non-nutrient chemicals which act as intercellular messenger and are produce in trace amount.

* HUMAN ENDOCRINE SYSTEM

- ⊙ Endocrine glands located in different parts of body constitute Endocrine System.
- ⊙ Pituitary, Pineal, thyroid, adrenal, Pancreas, Parathyroid, thymus and gonads are Organised Endocrine bodies.
- ⊙ Some other organ eg: Liver, kidney and Heart also produce Hormone.

* HYPOTHALAMUS

- Basal part of diencephalon, forebrain.
- Regulate body function.
- Contain **Neurosecretory Cells** called nuclei which produce Hormone.

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Regulate the synthesis and secretion of pituitary hormone.

○ Hormone produce by Hypothalamus are of two types.

1. Releasing hormone: stimulate secretion of pituitary hormone

eg: **Gonadotropin releasing hormone [GnRH]**
stimulate pituitary to synthesise and secretion of gonadotropin.

2. ~~Somatostatin~~ Inhibiting Hormone: Inhibit secretion of pituitary hormone.

eg: **Somatostatin** from Hypothalamus inhibit release of growth hormone.

* PITUITARY GLAND

→ Located in bony cavity called **Sella turcica** attached to hypothalamus by a **stalk**.

→ Divide anatomically into **Adenohypophysis** and **Neurohypophysis**.

→ Adenohypophysis consist of two portion

(i) **pars distalis**: Commonly called **anterior pituitary**

→ Produce Growth Hormone [GH], Prolactin [PRL], Thyroid stimulating hormone [TSH], Luteinizing hormone [LH], Adrenocorticotropic hormone [ACTH] and FSH



(ii) Pars Intermedia secretes only one hormone called Melanocyte Stimulating hormone [MSH].

○ Neurohypophysis also known as posterior pituitary.

→ Store and release two hormone Oxytocin and Vasopressin.
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Synthesised by Hypothalamus.

○ Over-secretion of GH stimulate abnormal growth of body leading gigantism.

→ Low secretion of GH result in stunted growth result in dwarfism.

* Function OF Hormone.

[i] Prolactin: regulate growth of mammary gland and formation of milk in them.

[ii] T.S.H : stimulate synthesis and secretion of thyroid hormones.

[iii] ACTH: stimulates secretion and synthesis of steroid hormone Glucocorticoids from adrenal cortex.

[iv] LH : In male stimulates synthesis and secretion of hormone called **Androgen**.
 → In females induce Ovulation.

[v] FSH : FSH and androgen regulate spermatogenesis in male.
 → In female stimulates growth and development of Ovarian follicle.

[vi] MSH : Act on Melanocytes [melanin containing cells] and regulate pigmentation of skin.

[vii] Oxytocin : Act on smooth muscles and stimulate their contraction.

[viii] Vasopressin : act at kidney and stimulates reabsorption of water and electrolyte by distal tube.

It is also called **Anti-diuretic hormone** [ADH].

* PINEAL GLAND

→ Located at dorsal side of forebrain

→ secrete **Melatonin**.



- ⊙ Important for regulation of 24 hour rhythm
- ⊙ Help in maintaining body temperature, also influence metabolism and pigmentation.



Thyroid Gland

- Composed of two lobes - located on either side of trachea.
- interconnected with a connective tissue. Called **isthmus**.
- Composed of follicles and stromal tissue.

○ Follicular cells synthesise two hormones tetraiodothyronine or thyroxine [T_4] and triiodothyronine [T_3].

○ **Iodine** essential for normal rate of hormone synthesis.

→ Deficiency of iodine in our diet results in Hypothyroidism and enlargement of thyroid gland commonly called goitre.

→ Hypothyroidism during pregnancy causes defective development and maturation of growing baby leading to stunted growth, mental retardation, low intelligence, abnormal skin etc.

→ Women, Hypothyroidism causes menstrual cycle irregular.

○ **Hyperthyroidism**: Rate of synthesis and secretion of thyroid hormone increased to high.

* Function of Thyroid Hormones

- (i) Regulation of Metabolic rate.
- (ii) Support the process of RBCs formation.
- (iii) Control metabolism of Carbohydrates, protein and fats.
- (iv) Secrete protein hormone called **Thyrocalcitonin [TCT]** which regulate blood Calcium level.

* PARATHYROID GLAND

- four parathyroid gland are present on back side of thyroid gland, one pair each in two lobes of thyroid gland.
- Secrete a peptide hormone called **Parathyroid hormone [PTH]**
- Seccretion of PTH is regulated by Circulating level of Calcium ions.

* Function

- Act on bones and stimulate the process of bone resorption
- ~~Act on bone and stimulates the proce~~
- Increase Ca^{2+} level in blood, Hence it is a **Hypocalcemic** hormone.
- stimulate reabsorption of Ca^{2+} by renal tubules and increase Ca^{2+} absorption from digested food.



* THYMUS

- Lobular structure located on dorsal side of heart and aorta.
- Secrete peptide hormone called **Thymosins**.
- Thymosins play important role in differentiation of T-lymphocytes which provide cell-mediated immunity.
- also promote production of antibodies to provide Humoral immunity.

ADRENAL GLAND

- Our body has one pair, one at anterior part of each kidney.
- Composed of two type of tissues
 - (i) Centrally located Adrenal Medulla.
 - (ii) Outside lie Adrenal Cortex.

* Adrenal Medulla

- Secrete Adrenaline or Epinephrine and Noradrenaline or Norepinephrine.
- These are commonly called Catecholamines.
- Rapidly secreted in response to stress of any kind and during Emergency situation. and are called Emergency hormone or Hormones of Fight or Flight.

→ Increase alertness, pupillary dilation and piloerection [raising of hairs], sweating etc.

→ Catecholamines stimulate breakdown of glycogen result in increased concentration of glucose in blood.

* Adrenal Cortex :

→ Divide into three layers

i) Zona glomerulosa [inner layer]

ii) Zona fasciculata [middle layer]

iii) Zona reticularis [outer layer].

→ secretes many hormones, commonly called corticoids.

Glucocorticoids : Involved in carbohydrate metabolism

→ Cortisol is main glucocorticoid

Mineralocorticoids : Corticoids involved in regulation of water and electrolytes in our body.

→ Aldosterone is main mineralocorticoid.

* Function of Glucocorticoids:

- ① stimulate, gluconeogenesis, lipolysis and proteolysis.
- ② inhibit cellular uptake and utilization of amino acid.
- ③ Glucocorticoids, particularly Cortisol, produce anti-inflammatory reaction and suppress immune response.
- ④ stimulate RBC production.

* Function of Aldosterone

- ① act on renal tubules and stimulate the reabsorption of Na^+ and water and excretion of K^+ and phosphate ion.
- ② Maintain body fluid volume, electrolytes, osmotic pressure and blood pressure.

(*) Androgenic steroids secreted by adrenal cortex play role in growth of axial hair, pubic hair and facial hair.

PANCREAS

- Act as both exocrine and endocrine gland.
- Endocrine pancreas consist of 'Islets of Langerhans'

→ Two main type of cells in Islet of Langerhans are called.

- (i) α -Cells : secrete a hormone called glucagon
- (ii) β -Cells : secrete Insulin.

① Glucagon : → peptide hormone
→ Maintain Normal blood glucose level.

→ act on liver cells [hepatocytes] and stimulates glycogenolysis result in increased blood sugar [hyperglycemia]

→ Reduce cellular glucose uptake and utilization.

→ Glucagon is hyperglycemic hormone.

② Insulin : peptide hormone
→ Regulate glucose homeostasis.

→ Act on hepatocytes and adipocytes [cells of adipose tissue]

→ Enhance cellular glucose uptake and utilization

→ Rapid movement of glucose from blood to hepatocytes and adipocytes result in decreased blood glucose level. [Hypoglycemia]

→ stimulate conversion of glucose to glycogen [glycogenesis].

⊙ Diabetes Mellitus:

- Prolonged hyperglycemia lead to this disorder.
- Associated with loss of glucose through Urine. and formation of Harmful Compound known as ketone bodies.
- Treated with Insulin therapy.

TESTIS

- Present in Scrotal sac of Male.
- Composed of Seminiferous tubules and Interstitial tissue.
- Leydig cells / Interstitial Cell secretes group of Hormones called Androgen mainly Testosterone.

* Function of Androgen :

- Regulate development, maturation and function of Male accessory Sex Organ.
- Stimulate muscular growth, growth of facial and axillary hair.
- Stimulate process of spermatogenesis.
- act on Central Neural system and influence Male sexual behaviour.

OVARY

- Located in abdomen.
- produce two groups of hormone Estrogen and Progesterone.
- Estrogen is Synthesize and secreted by growing Ovarian follicle.
- After Ovulation Corpus luteum secrete Progesterone.

* Function of Estrogen :

- Stimulate growth and activities of secondary sex organ and development of female secondary sex character.

* function of Progesterone

- support pregnancy.
- Act on mammary glands and stimulate formation of alveoli and milk secretion.

HORMONES OF HEART, KIDNEY AND GASTROINTESTINAL TRACT

① Atrial wall of our heart secretes peptide hormone called Atrial natriuretic factor (ANF) which decreases blood pressure, when blood pressure is increased.

② ANF cause dilation of blood vessels. This reduces blood pressure.

③ Juxtaglomerular cells of kidney produce peptide hormone called Erythropoietin which stimulate RBCs production.

④ Endocrine cells of Gastro-intestinal tract secrete four major peptide hormone.

1. Gastrin: act on gastric gland and stimulate the secretion of HCL and pepsinogen.

2. Secretin: Act on exocrine pancreas and stimulate secretion of water and bicarbonate ion.

3. Cholecystokinin: act on pancreas and gall bladder and stimulate secretion of enzyme and bile juice. respectively.

① Gastric Inhibitory peptide [GIP]
Inhibit inhibit gastric secretion and motility.

① Non-Endocrine tissue secrete hormones
Called growth factors.
↓
Essential for Normal growth of tissue
and their repairing / regeneration.

* MECHANISM OF HORMONE ACTION

① Hormones produce their effect on target tissue by binding to specific protein.
Called Hormone receptors.

① Membrane bound receptors: Present on Cell membrane of target Cell.

① Intracellular receptors: Present inside the target Cell.

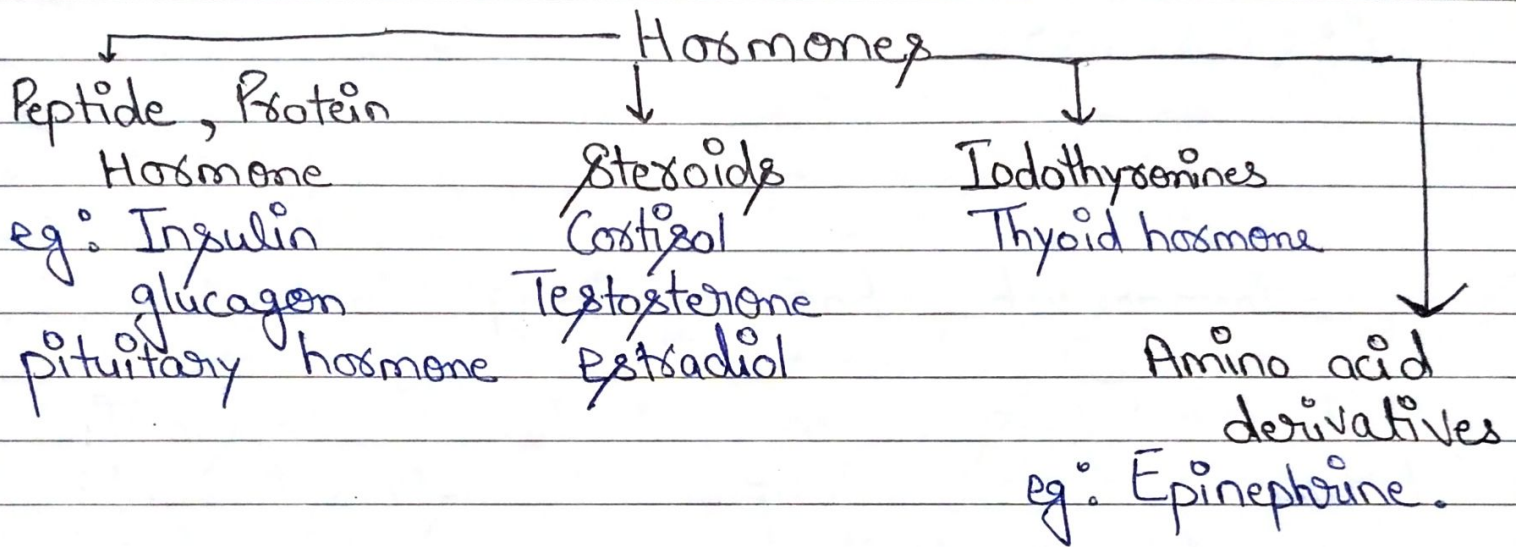
① Nuclear receptors: Present in Nucleus.

① Hormone Receptor Complex: Binding of ~~receptor~~ hormone to its receptors lead formation of Hormone Receptor Complex.

→ Receptor is specific.

⊙ Hormone Receptor Complex leads to certain biochemical changes in target tissue.

⊙ Target tissue Metabolism and physiological function are regulated by hormone.



⊙ Hormone which interact with membrane-bound receptors do not enter target cell but generate second messenger [Cyclic AMP, IP_3 , Ca^{++} etc]. which in turn regulate cellular metabolism.

⊙ Hormone which interact with intracellular receptors [eg: steroid hormone] regulate gene expression or chromosome function by interaction of hormone-receptor complex with genome.